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"Gyantse" to "Hallel", by Various**

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THE ENCYCLOPÆDIA BRITANNICA
A DICTIONARY OF ARTS, SCIENCES, LITERATURE AND
GENERAL INFORMATION
ELEVENTH EDITION

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HAGENAU	HALL, ROBERT
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HAGENBECK, CARL	HALL, WILLIAM EDWARD
HAGERSTOWN	HALL (spa of Austria)
HAG-FISH	HALL (town of Germany)
HAGGADA	HALL (of a mansion)
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GYANTSE, one of the large towns of Tibet. It lies S.E. of Shigatse, 130 m. from the Indian frontier and 145 m. from Lhasa. Its central position at the junction of the roads from India and Bhutan with those from Ladakh and Central Asia leading to Lhasa makes it a considerable distributing trade centre. Its market is the third largest in Tibet, coming after Lhasa and Shigatse, and is especially celebrated for its woollen cloth and carpet manufactures. Here caravans come from Ladakh, Nepal and upper Tibet, bringing gold, borax, salt, wool, musk and furs, to exchange for tea, tobacco, sugar, cotton goods, broadcloth and hardware. The town is compactly built of stone houses, with wooden balconies facing the main street, whence narrow lanes strike off into uninviting slums, and contains a fort and monastery. In the British expedition of 1904 Gyantse formed the first objective of the advance, and the force was besieged here in the mission post of Changlo for some time. The Tibetans made a night attack on the post, and were beaten off with some difficulty, but subsequently the British attacked and stormed the fort or jong. Under the treaty of 1904 a British trade agent is stationed at Gyantse.

GYGES, founder of the third or Mermnad dynasty of Lydian kings, he reigned 687-652 B.C. according to H. Geizer, 690-657 B.C. according to H. Winckler. The chronology of the Lydian kings given by Herodotus has been shown by the Assyrian inscriptions to be about twenty years in excess. Gyges was the son of Dascylus, who, when recalled from banishment in Cappadocia by the Lydian king Sadyattes—called Candaules “the Dog-strangler” (a title of the Lydian Hermes) by the Greeks—sent his son back to Lydia instead of himself. Gyges soon became a favourite of Sadyattes and was despatched by him to fetch Tundo, the daughter of Arnossus of Mysia, whom the Lydian king wished to make his queen. On the way Gyges fell in love with Tundo, who complained to Sadyattes of his conduct. Forewarned that the king intended to punish him with death, Gyges assassinated Sadyattes in the night and seized the throne with the help of Arselis of Mylasa, the captain of the Carian bodyguard, whom he had won over to his cause. Civil war ensued, which was finally ended by an appeal to the oracle of Delphi and the confirmation of the right of Gyges to the crown by the Delphian god. Further to secure his title he married Tundo. Many legends were told among the Greeks about his rise to power. That found in Herodotus, which may be traced to the poet Archilochus of Paros, described how “Candaules” insisted upon showing Gyges his wife when unrobed, which so enraged her that she gave Gyges the choice of murdering her husband and making himself king, or of being put to death himself. Plato made Gyges a shepherd, who discovered a magic ring by means of which he murdered his master and won the affection of his wife (Hdt. i. 8-14; Plato, *Rep.* 359; Justin i. 7; Cicero, *De off.* iii. 9). Once established on the throne Gyges devoted himself to consolidating his kingdom and making it a military power. The Troad was conquered, Colophon captured from the Greeks, Smyrna besieged and alliances entered into with Ephesus and Miletus. The Cimmerii, who had ravaged Asia Minor, were beaten back, and an embassy was sent to Assur-bani-pal at Nineveh (about 650 B.C.) in the hope of obtaining his help against the barbarians. The Assyrians, however, were otherwise engaged, and Gyges turned to Egypt, sending his faithful Carian troops along with Ionian mercenaries to assist Psammetichus in shaking off the Assyrian yoke (660 B.C.). A few years later he fell in battle against the Cimmerii under Dugdammē (called Lygdamis by Strabo i. 3. 21), who took the lower town of Sardis. Gyges was succeeded by his son Ardys.

See Nicolaus Damascenus, quoting from the Lydian historian Xanthus, in C. Müller, *Fragmenta historicorum Graecorum*, iii.; R. Schubert, *Geschichte der Könige von Lydien* (1884); M. G. Radet, *La Lydie et le monde grec au temps de Mermnades* (1892-1893); H. Gelzer, “Das Zeitalter des Gyges” (*Rhein. Mus.*, 1875); H. Winckler, *Altorientalische Forschungen*, i. (1893); Macan’s edition of Herodotus.

(A. H. S.)

GYLIPPUS, a Spartan general of the 5th century B.C.; he was the son of Cleandridas, who had been expelled from Sparta for accepting Athenian bribes (446 B.C.) and had settled at Thurii. His mother was probably a helot, for Gylippus is said to have been, like Lysander and Callicratidas, a *mothax* (see [HELOT](#)). When Alcibiades urged the Spartans to send a general to lead the Syracusan resistance against the Athenian expedition, Gylippus was appointed, and his arrival was undoubtedly the turning point of the struggle (414-413). Though at first his long hair, his threadbare cloak and his staff furnished the subject of many a jest, and his harsh and overbearing manner caused grave discontent, yet the rapidity and decisiveness of his movements, won the sympathy and respect of the Syracusans. Diodorus (xiii. 28-32), probably following Timaeus, represents him as inducing the Syracusans to pass sentence of death on the captive Athenian generals, but we need have no hesitation in accepting the statement of Philistus (Plutarch, *Nicias*, 28), a Syracusan who himself took part in the defence, and Thucydides (vii. 86), that he tried, though without success, to save their lives, wishing to take them to Sparta as a signal proof of his success. Gylippus fell, as his father had done, through avarice; entrusted by Lysander with an immense sum which he was to deliver to the ephors at Sparta, he could not resist the temptation to enrich himself and, on the discovery of his guilt, went into exile.

Thucydides vi. 93. 104, vii.; Plutarch, *Nicias*, 19, 21, 27, 28, *Lysander*, 16, 17; Diodorus xiii. 7, 8, 28-32; Polyaeus i. 39. 42. See [SYRACUSE](#) (for the siege operations), commentaries on Thucydides and the Greek histories.

GYLLEMBOURG-EHRENSVÄRD, THOMASINE CHRISTINE, Baroness (1773-1856), Danish author, was born on the 9th of November 1773, at Copenhagen. Her maiden name was Buntzen.

Her great beauty early attracted notice, and before she was seventeen she married the famous writer Peter Andreas Heiberg. To him she bore in the following year a son, afterwards illustrious as the poet and critic Johan Ludvig Heiberg. In 1800 her husband was exiled, and she obtained a divorce, marrying in December 1801 the Swedish Baron K. F. Ehrensvärd, himself a political fugitive. Her second husband, who presently adopted the name of Gyllembourg, died in 1815. In 1822 she followed her son to Kiel, where he was appointed professor, and in 1825 she returned with him to Copenhagen. In 1827 she first appeared as an author by publishing her romance of *The Polonius Family* in her son's newspaper *Flyvende Post*. In 1828 the same journal contained *The Magic Ring*, which was immediately followed by *En Hverdags historie (An Everyday Story)*. The success of this anonymous work was so great that the author adopted until the end of her career the name of "The Author of *An Everyday Story*." In 1833-1834 she published three volumes of *Old and New Novels*. *New Stories* followed in 1835 and 1836. In 1839 appeared two novels, *Montanus the Younger* and *Ricida*; in 1840, *One in All*; in 1841, *Near and Far*; in 1843, *A Correspondence*; in 1844, *The Cross Ways*; in 1845, *Two Generations*. From 1849 to 1851 the Baroness Ehrensvärd-Gyllembourg was engaged in bringing out a library edition of her collected works in twelve volumes. On the 2nd of July 1856 she died in her son's house at Copenhagen. Not until then did the secret of her authorship transpire; for throughout her life she had preserved the closest reticence on the subject even with her nearest friends. The style of Madame Ehrensvärd-Gyllembourg is clear and sparkling; for English readers no closer analogy can be found than between her and Mrs Gaskell, and *Cranford* might well have been written by the witty Danish authoress.

See J. L. Heiberg, *Peter Andreas Heiberg og Thomasine Gyllembourg* (Copenhagen, 1882), and L. Kornelius-Hybel, *Nogle Bemaerkninger om P. A. Heiberg og Fru Gyllembourg* (Copenhagen, 1883).

GYLLENSTJERNA, JOHAN, COUNT (1635-1680), Swedish statesman, completed his studies at Upsala and then visited most of the European states and laid the foundations of that deep insight into international politics which afterwards distinguished him. On his return home he met King Charles X. in the Danish islands and was in close attendance upon him till the monarch's death in 1660. He began his political career at the diet which assembled in the autumn of the same year. An aristocrat by birth and inclination, he was nevertheless a true patriot and demanded the greatest sacrifices from his own order in the national interests. He was therefore one of those who laboured most zealously for the recovery of the crown lands. In the Upper House he was the spokesman of the gentry against the magnates, whose inordinate privileges he would have curtailed or abolished. His adversaries vainly endeavoured to gain him by favour, for as court-marshal and senator he was still more hostile to the dominant patricians who followed the adventurous policy of Magnus de la Gardie. Thus he opposed the French alliance which de la Gardie carried through in 1672, and consistently advocated economy in domestic and neutrality in foreign affairs. On the outbreak of the war in 1675 he was the most loyal and energetic supporter of the young Charles XI., and finally his indispensable counsellor. Indeed, it may be said, that the political principles which he instilled into the youthful monarch were faithfully followed by Charles during the whole of his reign. In 1679 Gyllenstjerna was appointed the Swedish plenipotentiary at the peace congress of Lund. The alliance which he then concluded with Denmark bound the two northern realms together in a common foreign policy, and he sought besides to facilitate their harmonious co-operation by every means in his power. In 1680, after bringing home Charles XI.'s Danish bride from Copenhagen, he was appointed governor-general of Scania (Skåne), but expired a few weeks later.

See M. Höjer, *Öfversigt af Sveriges yttre politik under åren 1676-1680* (Upsala, 1875). (R. N. B.)

GYMKHANA, a display of miscellaneous sports, originally at the military stations of India. The word would seem to be a colloquial remodelling of the Hindustani *gend-khana*, ball-house or racquet-court, by substituting for *gend* the first syllable of the English word "gymnastics." The definition given in Yule's *Glossary* is as follows: "A place of public resort at a station, where the needful facilities for athletics and games ... are provided." The name of the place was afterwards applied to the games themselves, and the word is now used almost exclusively in this sense. According to Yule the first use of it that can be traced was, on the authority of Major John

Trotter, at Rurki in the year 1861, when a gymkhana was instituted there. Gymkhana sports were invented to relieve the monotony of Indian station life, and both officers and men from the ranks took part in them. The first meetings consisted of promiscuous horse and pony races at catch weights. To these were soon added a second variety, originally called the *pāgōl* (funny races), the one generally known outside India, which consisted of miscellaneous races and competitions of all kinds, some serious and some amusing, on horseback, on foot and on bicycles. Among these may be mentioned the usual military sports; such as tent-pegging, lemon-cutting and obstacle racing; rickshaw racing; tilting at the ring sack, pillion, hurdle, egg-and-spoon, blindfold, threading-the-needle and many other kinds of races depending upon the inventive powers of the committees in charge.

GYMNASTICS AND GYMNASIUM, terms signifying respectively a system of physical exercises practised either for recreation or for the purpose of promoting the health and development of the body, and the building where such exercises are carried on. The gymnasium of the Greeks was originally the school where competitors in the public games received their training, and was so named from the circumstance that these competitors exercised naked (γυμνός). The gymnasium was a public institution as distinguished from the palaestra, which was a private school where boys were trained in physical exercises, though the term palaestra is also often used for the part of a gymnasium specially devoted to wrestling and boxing. The athletic contests for which the gymnasium supplied the means of training and practice formed part of the social life of the Greeks from the earliest times. They were held in honour of heroes and gods; sometimes forming part of a periodic festival, sometimes of the funeral rites of a deceased chief. In course of time the Greeks grew more attached to such sports; their free active life, spent to a great extent in the open air, fostered the liking almost into a passion. The victor in any athletic contest, though he gained no money prize, was rewarded with the honour and respect of his fellow citizens; and a victory in the great religious festivals was counted an honour for the whole state. In these circumstances the training of competitors for the greater contests became a matter of public concern; and accordingly special buildings were provided by the state, and their management entrusted to public officials. The regulation of the gymnasium at Athens is attributed by Pausanias (i. 39. 3) to Theseus. Solon made several laws on the subject; but according to Galen it was reduced to a system in the time of Cleisthenes. Ten *gymnasiarchs*, one from each tribe, were appointed annually. These performed in rotation the duties of their office, which were to maintain and pay the persons who were training for public contests, to conduct the games at the great Athenian festivals, to exercise general supervision over the morals of the youths, and to adorn and keep up the gymnasium. This office was one of the ordinary λειτουργίαι (public services), and great expense was entailed on the holders. Under them were ten *sophronistae*, whose duty was to watch the conduct of the youths at all times, and especially to be present at all their games. The practical teaching and selecting of the suitable exercises for each youth were in the hands of the *paedotribae* and *gymnastae*, the latter of whom also superintended the effect on the constitution of the pupils, and prescribed for them when they were unwell. The *aleiptae* oiled and rubbed dust on the bodies of the youths, acted as surgeons, and administered the drugs prescribed. According to Galen there was also a teacher of the various games of ball. The gymnasia built to suit these various purposes were large buildings, which contained not merely places for each kind of exercise, but also a stadium, baths, covered porticos for practice in bad weather, and outer porticos where the philosophers and men of letters read public lectures and held disputations.

The gymnasium of the Greeks did not long remain an institution exclusively devoted to athletic exercises. It soon began to be applied to other uses even more important. The development arose naturally through the recognition by the Greeks of the important place in education occupied by physical culture, and of the relation between exercise and health. The gymnasium accordingly became connected with education on the one hand and with medicine on the other. Due training of the body and maintenance of the health and strength of children were the chief part of earlier Greek education. Except the time devoted to letters and music, the education of boys was conducted in the gymnasia, where provision was made, as already mentioned, for their moral as well as their physical training. As they grew older, conversation and social intercourse took the place of the more systematic discipline. Philosophers and sophists assembled to talk and to lecture in the gymnasia, which thus became places of general resort for the purpose of all less systematic intellectual pursuits, as well as for physical exercises. In Athens there were three great public gymnasia—Academy, Lyceum and Cynosarges—each of which was consecrated to a special deity with whose statue it was adorned; and each was rendered famous by association with a celebrated school of philosophy. Plato's teaching in the Academy has given immortality to that gymnasium; Aristotle conferred lustre on the Lyceum; and the Cynosarges was the resort of

the Cynics. Plato when treating of education devotes much consideration to gymnastics (see especially *Rep.* iii. and various parts of *Laws*); and according to Plato it was the sophist Prodicus who first pointed out the connexion between gymnastics and health. Having found such exercises beneficial to his own weak health, he formulated a method which was adopted generally, and which was improved by Hippocrates. Galen lays the greatest stress on the proper use of gymnastics, and throughout ancient medical writers we find that special exercises are prescribed as the cure for special diseases.

The Greek institution of the gymnasium never became popular with the Romans, who regarded the training of boys in gymnastics with contempt as conducive to idleness and immorality, and of little use from a military point of view; though at Sparta gymnastic training had been chiefly valued as encouraging warlike tastes and promoting the bodily strength needed for the use of weapons and the endurance of hardship. Among the Romans of the republic, the games in the Campus Martius, the duties of camp life, and the enforced marches and other hardships of actual warfare, served to take the place of the gymnastic exercises required by the Greeks. The first public gymnasium at Rome was built by Nero and another by Commodus. In the middle ages, though jousts and feats of horsemanship and field sports of various kinds were popular, the more systematic training of the body which the Greeks had associated with the gymnasium fell into neglect; while the therapeutic value of special exercises as understood by Hippocrates and Galen appears to have been lost sight of. Rousseau, in his *Émile*, was the first in modern times to call attention to the injurious consequences of such indifference, and he insisted on the importance of physical culture as an essential part of education. It was probably due in some measure to his influence that F. L. Jahn and his followers in Germany, encouraged by the Prussian minister Stein, established the *Turnplätze*, or gymnastic schools, which played an important part during the War of Liberation, and in the political agitations which followed the establishment of the German confederation by the Congress of Vienna. The educational reformers Pestalozzi and Froebel emphasized the need for systematic physical training in any complete scheme of education.

The later development of the classical gymnasium (when it had become the school of intellectual culture rather than of exclusively physical exercise), and not the original idea, has been perpetuated in the modern use of the word in Germany, where the name "gymnasium" is given to the highest grade of secondary school, and the association of the word with athleticism has been entirely abandoned. On the other hand, in England, France and elsewhere in Europe, as well as in America, the history of the word has been precisely the reverse; the connexion of the gymnasium with philosophy and mental culture has been dropped, and it indicates a building exclusively intended for the practice of physical exercises. But whereas the Greeks received training in the gymnasium for contests which are now designated as *athletic sports (q.v.)*, gymnastics in the modern sense is a term restricted to such exercises as are usually practised indoors, with or without the aid of mechanical appliances, as distinguished from sports or games practised in the open air.

It was not until near the end of the 19th century that gymnastics were recognized in England as anything more than a recreation; their value as a specifically therapeutic agent, or as an article in the curriculum of elementary schools, was not realized. More recently, however, educationists have urged with increasing insistence the need for systematic physical training, and their views received greater attention when evidence of deterioration in the physique of the people began to accumulate. During the first decade of the 20th century more than one commission reported to parliament in England in favour of more systematic and general physical training being encouraged or even made compulsory by public authority. Voluntary associations were formed for encouraging such training and providing facilities for it. Gymnastics had already for several years been an essential part of the training of army recruits with exceedingly beneficial results, and gymnasia had been established at Aldershot and other military centres. Physical exercises, although not compulsory, obtained a permanent place in the code for elementary schools in Great Britain; and much care has been taken to provide a syllabus of exercises adapted for the improvement of the physique of the children. These exercises are partly gymnastic and partly of the nature of drill; they do not in most cases require the use of appliances, and are on that account known as "free movements," which numbers of children go through together, accompanied whenever possible by music. On the other hand at the larger public schools and universities there are elaborate gymnasia equipped with a great variety of apparatus, the skilful use of which demands assiduous practice; and this is encouraged by annual contests between teams of gymnasts representing rival institutions.

The appliances vary to some extent in different gymnasia, some of the more complicated requiring a greater amount of space and involving a larger cost than is often practicable. But where these considerations are negligible, substantial uniformity is to be found in the equipment of gymnasia not designed for specifically medical purposes. The simplest, and in many respects the most generally useful, of all gymnastic apparatus is the dumb-bell. It was in use in England as early as the time of Elizabeth, and it has the advantage that it admits of being exactly proportioned to the individual strength

Gymnastic apparatus.

of each learner, and can be adjusted in weight as his strength increases. The exercises that may be performed with the dumb-bell, combined with a few simple drill-like movements, give employment to all parts of the body and to both sides equally. Dumb-bell exercises, therefore, when arranged judiciously and with knowledge, are admirably suited for developing the physique, and are extensively employed in schools both for boys and girls. The bar-bell is merely a two-handed dumb-bell, and its use is similar in principle. The Indian club is also in use in most gymnasia; but the risk of overstraining the body by its unskilful handling makes it less generally popular than the dumb-bell. All these appliances may be, and often are, used either in ordinary schoolrooms or elsewhere outside the gymnasium. The usual fixed sorts of apparatus, the presence of which (or of some of them) in a building may be said to constitute it a gymnasium, are the following: a leaping-rope; a leaping-pole; a vaulting-horse; a horizontal bar, so mounted between two upright posts that its height from the ground may be adjusted as desired; parallel bars, used for exercises to develop the muscles of the trunk and arms; the trapeze consisting of a horizontal bar suspended by ropes at a height of 4 to 5 ft. from the ground; the bridge ladder; the plank; the inclined plane; the mast; swinging rings; the prepared wall; the horizontal beam.

Before the end of the 19th century the therapeutic value of gymnastics was fully realized by the medical profession; and a number of medical or surgical gymnasia came into existence, provided with specially devised apparatus for the treatment of different physical defects or weaknesses. The exercises practised in them are arranged upon scientific principles based on anatomical and physiological knowledge; and these principles have spread thence to influence largely the practice of gymnastics in schools and in the army. A French medical writer enumerates seven distinct groups of maladies, each including a number of different complaints, for which gymnastic exercises are a recognized form of treatment; and there are many malformations of the human body, formerly believed to be incurable, which are capable of being greatly remedied if not entirely corrected by regular gymnastic exercises practised under medical direction.

The value of gymnastics both for curing defects, and still more for promoting health and the development of normal physique, is recognized even more clearly on the continent of Europe than in Great Britain. In Germany the government not only controls the practice of gymnastics but makes it compulsory for every child and adult to undergo a prescribed amount of such physical training. In France also, physical training by gymnastics is under state control; in Sweden, Denmark, Switzerland, Italy, Russia, systems more or less distinct enjoy a wide popularity; and in Finland gymnastics are practised on lines that exhibit national peculiarities. The Finns introduce an exceptional degree of variety into their exercises as well as into the appliances devised to assist them; women are scarcely less expert than men in the performance of them; and the enthusiasm with which the system is supported produces the most beneficial results in the physique of the people. International gymnastic contests have become a feature of the revived Olympic Games (see [ATHLETIC SPORTS](#)), and in those held at Athens in 1906 a team of Danish ladies took part in the competition and proved by their skilful performance that gymnastics may be practised with as much success by women as by men.

The chief work on the ancient gymnastics is Krause, *Gymnastik und Agonistik der Hellenen* (1841); of more recent works mention may be made of Jäger, *Gymnastik der Hellenen* (1881); L. Grasberger, *Erziehung und Unterricht im klassischen Altertum* (1881); J. P. Mahaffy, *Old Greek Education* (1883); A. S. Wilkins, *National Education in Greece* (1873); E. Paz, *Histoire de la gymnastique* (1886); Wickenhagen, *Antike und moderne Gymnastik* (1891); Becker-Göll, *Charicles* ii.; Brugsma, *Gymnasiorum apud Graecos descriptio* (1855); Petersen, *Das Gymnasium der Griechen* (1858). See also N. Laisné, *Gymnastique pratique* (Paris, 1879); Collineau, *La Gymnastique* (Paris, 1884); *L'Hygiène à l'école* (Paris, 1889); P. de Coubertin, *La Gymnastique utilitaire* (Paris, 1905); H. Nissen, *Rational Home Gymnastics* (Boston, 1903).

(R. J. M.)

GYMNOSOPHISTS (Lat. *gymnosophistae*, from Gr. γυμνός, σοφιστής, "naked philosophers"), the name given by the Greeks to certain ancient Hindu philosophers who pursued asceticism to the point of regarding food and clothing as detrimental to purity of thought. From the fact that they often lived as hermits in forests, the Greeks also called them *Hylobioi* (cf. the *Vāna-prasthās* in Sanskrit writings). Diogenes Laërtius (ix. 61 and 63) refers to them, and asserts that Pyrrho of Elis, the founder of pure scepticism, came under their influence, and on his return to Elis imitated their habits of life, to what extent does not appear. Strabo (xv. 711, 714) divides them into Brahmans and Sarmans (or Shamans). See [JAINS](#).

GYMNOSPERMS, in Botany. The Gymnosperms, with the Angiosperms, constitute the existing groups of seed-bearing plants or Phanerogams: the importance of the seed as a distinguishing feature in the plant kingdom may be emphasized by the use of the designation Spermophyta for these two groups, in contrast to the Pteridophyta and Bryophyta in which true seeds are unknown. Recent discoveries have, however, established the fact that there existed in the Palaeozoic era fern-like plants which produced true seeds of a highly specialized type; this group, for which Oliver and Scott proposed the term Pteridospermae in 1904, must also be included in the Spermophyta. Another instance of the production of seeds in an extinct plant which further reduces the importance of this character as a distinguishing feature is afforded by the Palaeozoic genus *Lepidocarpon* described by Scott in 1901; this lycopodiaceous type possessed an integumented megaspore, to which the designation seed may be legitimately applied (see [PALAEOBOTANY: Palaeozoic](#)).

As the name Gymnosperm (Gr. γυμνός, naked, σπέρμα, seed) implies, one characteristic of this group is the absence of an ovary or closed chamber containing the ovules. It was the English botanist Robert Brown who first recognized this important distinguishing feature in conifers and cycads in 1825; he established the gymnospermy of these seed-bearing classes as distinct from the angiospermy of the monocotyledons and dicotyledons. As Sachs says in his history of botany, "no more important discovery was ever made in the domain of comparative morphology and systematic botany." As Coulter and Chamberlain express it, "the habitats of the Gymnosperms today indicate that they either are not at home in the more genial conditions affected by Angiosperms, or have not been able to maintain themselves in competition with this group of plants."

These naked-seeded plants are of special interest on account of their great antiquity, which far exceeds that of the Angiosperms, and as comprising different types which carry us back to the Palaeozoic era and to the forests of the coal period. The best known and by far the largest division of the Gymnosperms is that of the cone-bearing trees (pines, firs, cedars, larches, &c.), which play a prominent part in the vegetation of the present day, especially in the higher latitudes of the northern hemisphere; certain members of this class are of considerable antiquity, but the conifers as a whole are still vigorous and show but little sign of decadence. The division known as the Cycadophyta is represented by a few living genera of limited geographical range and by a large number of extinct types which in the Mesozoic era (see [PALAEOBOTANY: Mesozoic](#)) played a conspicuous part in the vegetation of the world. Among existing Cycadophyta we find surviving types which, in their present isolation, their close resemblance to fossil forms, and in certain morphological features, constitute links with the past that not only connect the present with former periods in the earth's history, but serve as sign-posts pointing the way back along one of the many lines which evolution has followed.

It is needless to discuss at length the origin of the Gymnosperms. The two views which find most favour in regard to the Coniferales and Cycadophyta are: (1) that both have been derived from remote filicinean ancestors; (2) that the cycads are the descendants of a fern-like stock, while conifers have been evolved from lycopodiaceous ancestors. The line of descent of recent cycads is comparatively clear in so far as they have undoubted affinity with Palaeozoic plants which combined cycadean and filicinean features; but opinion is much more divided as to the nature of the phylum from which the conifers are derived. The Cordaitales (see [PALAEOBOTANY: Palaeozoic](#)) are represented by extinct forms only, which occupied a prominent position in the Palaeozoic period; these plants exhibit certain features in common with the living Araucarias, and others which invite a comparison with the maidenhair tree (*Ginkgo biloba*), the solitary survivor of another class of Gymnosperms, the Ginkgoales (see [PALAEOBOTANY: Mesozoic](#)). The Gnetales are a class apart, including three living genera, of which we know next to nothing as regards their past history or line of descent. Although there are several morphological features in the three genera of Gnetales which might seem to bring them into line with the Angiosperms, it is usual to regard these resemblances as parallel developments along distinct lines rather than to interpret them as evidence of direct relationship.

Gymnospermae.—Trees or shrubs; leaves vary considerably in size and form. Flowers unisexual, except in a few cases (Gnetales) without a perianth. Monoecious or dioecious. Ovules naked, rarely without carpellary leaves, usually borne on carpophylls, which assume various forms. The single megaspore enclosed in the nucellus is filled with tissue (prothallus) before fertilization, and contains two or more archegonia, consisting usually of a large egg-cell and a small neck, rarely of an egg-cell only and no neck (*Gnetum* and *Welwitschia*). Microspore spherical or oval, with or without a bladder-like extension of the exine, containing a prothallus of two or more cells, one of which produces two non-motile or motile male cells. Cotyledons two or several. Secondary xylem and phloem produced by a single cambium, or by successive cambial zones; no true vessels (except in the Gnetales) in the wood, and no companion-cells in the phloem.

- I. *Pteridospermae* (see [PALAEOBOTANY, PALAEOZOIC](#)).
- II. *Cycadophyta*.
 - A. Cycadales (recent and extinct).

- B. Bennettitales (see Palaeobotany: *Mesozoic*).
- III. *Cordaitales* (see PALAEOBOTANY: *Palaeozoic*).
- IV. *Ginkgoales* (recent and extinct).
- V. *Coniferales*.
 - A. Taxaceae.
 - B. Pinaceae.

There is no doubt that the result of recent research and of work now in progress will be to modify considerably the grouping of the conifers. The family *Araucariaceae*, represented by *Araucaria* and *Agathis*, should perhaps be separated as a special class and a rearrangement of other genera more in accord with a natural system of classification will soon be possible; but for the present its twofold subdivision may be retained.

- VI. *Gnetales*.
 - A. Ephedroideae.
 - B. Gnetoideae.
 - C. Welwitschioideae (Tumboideae).

CYCADOPHYTA.—A. *Cycadales*.—Stems tuberous or columnar, not infrequently branched, rarely epiphytic (Peruvian species of *Zamia*); fronds pinnate, bi-pinnate in the Australian genus *Bowenia*. Dioecious; flowers in the form of cones, except the female flowers of *Cycas*, which consist of a rosette of leaf-like carpels at the apex of the stem. Seeds albuminous, with one integument; the single embryo, usually bearing two partially fused cotyledons, is attached to a long tangled suspensor. Stems and roots increase in diameter by secondary thickening, the secondary wood being produced by one cambium or developed from successive cambium-rings.

The cycads constitute a homogeneous group of a few living members confined to tropical and sub-tropical regions. As a fairly typical and well-known example of the Cycadaceae, a species of the genus *Cycas* (e.g. *C. circinalis*, *C. revoluta*, &c.) is briefly described. The stout columnar stem may reach a height of 20 metres, and a diameter of half a metre; it remains either unbranched or divides near the summit into several short and thick branches, each branch terminating in a crown of long pinnate leaves. The surface of the stem is covered with rhomboidal areas, which represent the persistent bases of foliage- and scale-leaves. In some species of *Cycas* there is a well-defined alternation of transverse zones on the stem, consisting of larger areas representing foliage-leaf bases, and similar but smaller areas formed by the bases of scale-leaves (*F* and *S*, fig. 1). The scale-leaves clothing the terminal bud are linear-lanceolate in form, and of a brown or yellow colour; they are pushed aside as the stem-axis elongates and becomes shrivelled, finally falling off, leaving projecting bases which are eventually cut off at a still lower level. Similarly, the dead fronds fall off, leaving a ragged petiole, which is afterwards separated from the stem by an absciss-layer a short distance above the base. In some species of *Cycas* the leaf-bases do not persist as a permanent covering to the stem, but the surface is covered with a wrinkled bark, as in *Cycas siamensis*, which has a stem of unusual form (fig. 2). Small tuberous shoots, comparable on a large scale with the bulbils of *Lycopodium Selago*, are occasionally produced in the axils of some of the persistent leaf-bases; these are characteristic of sickly plants, and serve as a means of vegetative reproduction. In the genus *Cycas* the female flower is peculiar among cycads in consisting of a terminal crown of separate leaf-like carpels several inches in length; the apical portion of each carpellary leaf may be broadly triangular in form, and deeply dissected on the margins into narrow woolly appendages like rudimentary pinnae. From the lower part of a carpel are produced several laterally placed ovules, which become bright red or orange on ripening; the bright fleshy seeds, which in some species are as large as a goose's egg, and the tawny spreading carpels produce a pleasing combination of colour in the midst of the long dark-green fronds, which curve gracefully upwards and outwards from the summit of the columnar stem. In *Cycas* the stem apex, after producing a cluster of carpellary leaves, continues to elongate and produces more bud-

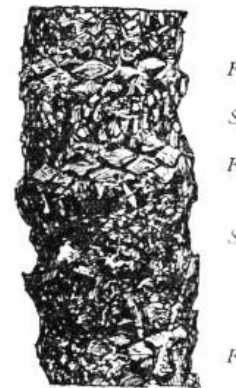


FIG. 1.—Stem of *Cycas*. *F*, foliage-leaf bases; *S*, scale-leaf bases.



FIG. 2.—*Cycas siamensis*.

scales, which are afterwards pushed aside as a fresh crown of fronds is developed. The young leaves of *Cycas* consist of a straight rachis bearing numerous linear pinnae, traversed by a single midrib; the pinnae are circinately coiled like the leaf of a fern (fig. 3). The male flower of *Cycas* conforms to the type of structure characteristic of the cycads, and consists of a long cone of numerous sporophylls bearing many oval pollen-sacs on their lower faces. The type described serves as a convenient representative of its class. There are eight other living genera, which may be classified as follows:—

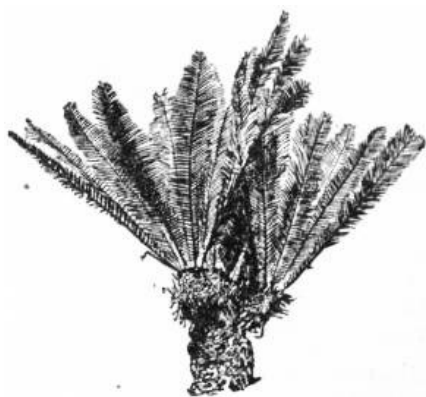


FIG. 3.—*Cycas*.
Young Frond.

Classification.—A. *Cycadeae.*—Characterized by (a) the alternation of scale- and foliage-leaves (fig. 1) on the branched or unbranched stem; (b) the growth of the main stem through the female flower; (c) the presence of a prominent single vein in the linear pinnae; (d) the structure of the female flower, which is peculiar in not having the form of a cone, but consists of numerous independent carpels, each of which bears two or more lateral ovules. Represented by a single genus, *Cycas*. (Tropical Asia, Australia, &c.).

B. *Zamieae.*—The stem does not grow through the female flower; both male and female flowers are in the form of cones. (a) *Stangerieae.*—Characterized by the fern-like venation of the pinnae, which have a prominent midrib, giving off at a wide angle simple or forked and occasionally anastomosing lateral veins. A single genus, *Stangeria*, confined to South Africa, (b) *Euzamieae.*—The pinnae are traversed by several parallel veins. *Bowenia*, an Australian cycad, is peculiar in having bi-pinnate fronds (fig. 5). The various genera are distinguished from one another by the shape and manner of attachment of the pinnae, the form of the carpellary scales, and to some extent by anatomical characters. *Encephalartos* (South and Tropical Africa).—Large cones; the carpellary scales terminate in a peltate distal expansion. *Macrozamia* (Australia).—Similar to *Encephalartos* except in the presence of a spinous projection from the swollen distal end of the carpels. *Zamia* (South America, Florida, &c.).—Stem short and often divided into several columnar branches. Each carpel terminates in a peltate head. *Ceratozamia* (Mexico).—Similar in habit to *Macrozamia*, but distinguished by the presence of two horn-like spinous processes on

the apex of the carpels. *Microcycas* (Cuba).—Like *Zamia*, except that the ends of the stamens are flat, while the apices of the carpels are peltate. *Dioon* (Mexico) (fig. 4).—Characterized by the woolly scale-leaves and carpels; the latter terminate in a thick laminar expansion of triangular form, bearing two placental cushions, on which the ovules are situated. *Bowenia* (Australia).—Bi-pinnate fronds; stem short and tuberous (fig. 5).



From a photograph of a plant in Peradeniya Gardens, Ceylon, by Professor R. H. Yapp.

FIG. 4.—*Dioon edule*.



FIG. 5.—*Bowenia spectabilis*: frond.

The stems of cycads are often described as unbranched; it is true that in comparison with conifers, in which the numerous branches, springing from the main stem, give a characteristic form to the tree, the tuberous or columnar stem of the Cycadaceae constitutes a striking

Stem and leaf.

distinguishing feature. Branching, however, occurs not infrequently: in *Cycas* the tall stem often produces several candelabra-like arms; in *Zamia* the main axis may break up near the base into several cylindrical branches; in species of *Dioon* (fig. 4) lateral branches are occasionally produced. The South African *Encephalartos* frequently produces several branches. Probably the oldest example of this genus in cultivation is in the Botanic Garden of Amsterdam, its age is considered by Professor de Vries to be about two thousand years: although an accurate determination of age is impossible, there is no doubt that many cycads grow very slowly and are remarkable for longevity. The thick armour of petiole-bases enveloping the stem is a characteristic Cycadean feature; in *Cycas* the alternation of scale-leaves and fronds is more clearly shown than in other cycads; in *Encephalartos*, *Dioon*, &c., the persistent scale-leaf bases are almost equal in size to those of the foliage-leaves, and there is no regular alternation of zones such as characterizes some species of *Cycas*. Another type of stem is illustrated by *Stangeria* and *Zamia*, also by a few forms of *Cycas* (fig. 2), in which the fronds fall off completely, leaving a comparatively smooth stem. The *Cyas* type of frond, except as regards the presence of a midrib in each pinna, characterizes the cycads generally, except *Bowenia* and *Stangeria*. In the monotypic genus *Bowenia* the large fronds, borne singly on the short and thick stem, are bi-pinnate (fig. 5); the segments, which are broadly ovate or rhomboidal, have several forked spreading veins, and resemble the large pinnules of some species of *Adiantum*. In *Stangeria*, also a genus represented by one species (*S. paradoxa* of South Africa), the long and comparatively broad pinnae, with an entire or irregularly incised margin, are very fern-like, a circumstance which led Kunze to describe the plant in 1835 as a species of the fern *Lomaria*. In rare cases the pinnae of cycads are lobed or branched: in *Dioon spinulosum* (Central America) the margin of the segments bears numerous spinous processes; in some species of *Encephalartos*, e.g. *E. horridus*, the lamina is deeply lobed; and in a species of the Australian genus *Macrozamia*, *M. heteromera*, the narrow pinnae are dichotomously branched almost to the base (fig. 6), and resemble the frond of some species of the fern *Schizaea*, or the fossil genus *Baiera* (Ginkgoales). An interesting species of *Cycas*, *C. Micholitzii*, has recently been described by Sir William Thiselton-Dyer from Annam, where it was collected by one of Messrs Sanders & Son's collectors, in which the pinnae instead

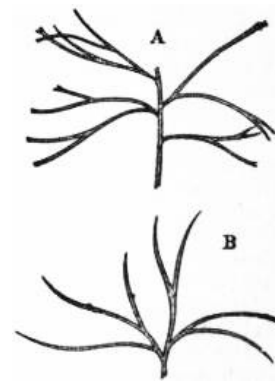


FIG. 6.—*Macrozamia heteromera*. A, part of frond; B, single pinna.

of being of the usual simple type are dichotomously branched as in *Macrozamia heteromera*. In *Ceratozamia* the broad petiole-base is characterized by the presence of two lateral spinous processes, suggesting stipular appendages, comparable, on a reduced scale, with the large stipules of the Marattiaceae among Ferns. The vernation varies in different genera; in *Cycas* the rachis is straight and the pinnae circinate-coiled (fig. 3); in *Encephalartos*, *Dioon*, &c., both rachis and segments are straight; in *Zamia* the rachis is bent or slightly coiled, bearing straight pinnae. The young leaves arise on the stem-apex as conical protuberances with winged borders on which the pinnae appear as rounded humps, usually in basipetal order; the scale-leaves in their young condition resemble fronds, but the lamina remains undeveloped. A feature of interest in connexion with the phylogeny of cycads is the presence of long hairs clothing the scale-leaves, and forming a cap on the summit of the stem-apex or attached to the bases of petioles; on some fossil cycadean plants these outgrowths have the form of scales, and are identical in structure with the rameta (paleae) of the majority of ferns.

The male flowers of cycads are constructed on a uniform plan, and in all cases consist of an axis bearing crowded, spirally disposed sporophylls. These are often wedge-shaped and angular; in some cases they consist of a short, thick stalk, terminating in a peltate expansion, or prolonged upwards in the form of a triangular lamina. The sporangia (pollen-sacs), which occur on the under-side of the stamens, are often arranged in more or less definite groups or sori, interspersed with hairs (paraphyses); dehiscence takes place along a line marked out by the occurrence of smaller and thinner-walled cells bounded by larger and thicker-walled elements, which form a fairly prominent cap-like "annulus" near the apex of the sporangium, not unlike the annulus characteristic of the Schizaeaceae among ferns. The sporangial wall, consisting of several layers of cells, encloses a cavity containing numerous oval spores (pollen-grains). In structure a cycadean sporangium recalls those of certain ferns (Marattiaceae, Osmundaceae and Schizaeaceae), but in the development of the spores there are certain peculiarities not met with among the Vascular Cryptogams. With the exception of *Cycas*, the female flowers are also in the form of cones, bearing numerous carpellary scales. In *Cycas revoluta* and *C. circinalis* each leaf-like carpel may produce several laterally attached ovules, but in *C. Normanbyana* the carpel is shorter and the ovules are reduced to two; this latter type brings us nearer to the carpels of *Dioon*, in which the flower has the form of a cone, and the distal end of the carpels is longer and more leaf-like than in the other genera of the *Zamiaceae*, which are characterized by shorter carpels with thick peltate heads bearing two ovules on the morphologically lower surface. The cones of cycads attain in some cases (e.g. *Encephalartos*) a considerable size, reaching a length of more than a foot. Cases have been recorded (by Thiselton-Dyer in *Encephalartos* and by Wieland in *Zamia*) in which the short carpellary cone-scales exhibit a foliaceous form. It is interesting that no monstrous cycadean cone

Flower.

has been described in which ovuliferous and staminate appendages are borne on the same axis: in the Bennettitales (see **PALAEOBOTANY: Mesozoic**) flowers were produced bearing on the same axis both androecium and gynoecium.

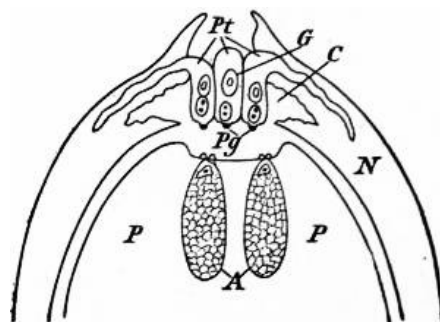


FIG. 7.—*Zamia*. Part of Ovule in longitudinal section. (After Webber.)

<i>P</i> , Prothallus.	<i>Pt</i> , Pollen-tube.
<i>A</i> , Archegonia.	<i>Pg</i> , Pollen-grain.
<i>N</i> , Nucellus.	<i>G</i> , Generative cell
<i>C</i> , Pollen-chamber.	(second cell of pollen-tube).

The pollen-grains when mature consist of three cells, two small and one large cell; the latter grows into the pollen-tube, as in the Coniferales, and from one of the small cells two large ciliated spermatozoids are eventually produced. A remarkable exception to this rule has recently been recorded by Caldwell, who found that in *Microcycas Calocoma* the body-cells may be eight or even ten in number and the sperm-cells twice as numerous. One of the most

Microspores and megaspores.

important discoveries made during the latter part of the 19th century was that by Ikeno, a Japanese botanist, who first demonstrated the existence of motile male cells in the genus *Cycas*. Similar spermatozoids were observed in some species of *Zamia* by H. J. Webber, and more recent work enables us to assume that all cycads produce ciliated male gametes. Before following the growth of the pollen-grain after pollination, we will briefly describe the structure of a cycadean ovule. An ovule consists of a conical nucellus surrounded by a single integument. At an early stage of development a large cell makes its appearance in the central region of the nucellus; this increases in size and eventually forms three cells; the lowest of these grows vigorously and constitutes the megaspore (embryo-sac), which ultimately absorbs the greater part of the nucellus. The megaspore-nucleus divides repeatedly, and cells are produced from the peripheral region inwards, which eventually fill the spore-cavity with a homogeneous tissue (prothallus); some of the superficial cells at the micropylar end of the megaspore increase in size and divide by a tangential wall into two, an upper cell which gives rise to the short two-celled neck of the archegonium, and a lower cell which develops into a large egg-cell. Each megaspore may contain 2 to 6 archegonia. During the growth of the ovum nourishment is supplied from the contents of the cells immediately surrounding the egg-cell, as in the development of the ovum of *Pinus* and other conifers. Meanwhile the tissue in the apical region of the nucellus has been undergoing disorganization, which results in the formation of a pollen-chamber (fig. 7, *C*) immediately above the megaspore. Pollination in cycads has always been described as anemophilous, but according to recent observations by Pearson on South African species it seems probable that, at least in some cases, the pollen is conveyed to the ovules by animal agency. The pollen-grains find their way between the carpophylls, which at the time of pollination are slightly apart owing to the elongation of the internodes of the flower-axis, and pass into the pollen-chamber; the large cell of the pollen-grain grows out into a tube (*Pt*), which penetrates the nucellar tissue and often branches repeatedly; the pollen-grain itself, with the prothallus-cells, projects freely into the pollen-chamber (fig. 7). The nucleus of the outermost (second) small cell (fig. 7, *G*) divides, and one of the daughter-nuclei passes out of the cell, and may enter the lowest (first) small cell. The outermost cell, by the division of the remaining nucleus, produces two large spermatozoids (fig. 8, *a, a*). In *Microcycas* 16 sperm-cells are produced. In the course of division two bodies appear in the cytoplasm, and behave as centrosomes during the karyokinesis; they gradually become threadlike and coil round each daughter nucleus. This thread gives rise to a spiral ciliated band lying in a depression on the body of each spermatozoid; the large spermatozoids eventually escape from the pollen-tube, and are able to perform ciliary movements in the watery liquid which occurs between the thin papery remnant of nucellar tissue and the archegonial necks. Before fertilization a neck-canal cell is formed by the division of the ovum-nucleus. After the body



FIG. 8.—*Zamia*. Proximal end of Pollen-tube, *a, a*, Spermatozoids from *G* of fig. 7; *Pg*, pollen-grain; *c*, proximal cell (first cell). (After Webber.)

of a spermatozoid has coalesced with the egg-nucleus the latter divides repeatedly and forms a mass of tissue which grows more vigorously in the lower part of the fertilized ovum, and extends upwards towards the apex of the ovum as a peripheral layer of parenchyma surrounding a central space. By further growth this tissue gives rise to a proembryo, which consists, at the micropylar end, of a sac; the tissue at the chalazal end grows into a long and tangled suspensor, terminating in a mass of cells, which is eventually differentiated into a radicle, plumule and two cotyledons. In the ripe seed the integument assumes the form of a fleshy envelope, succeeded internally by a hard woody shell, internal to which is a thin papery membrane—the apical portion of the nucellus—which is easily dissected out as a conical cap covering the apex of the endosperm. A thorough examination of cycadean seeds has recently been made by Miss Stopes, more particularly with a view to a comparison of their vascular supply with that in Palaeozoic gymnospermous seeds (*Flora*, 1904). The first leaves borne on the seedling axis are often scale-like, and these are followed by two or more larger laminae, which foreshadow the pinnae of the adult frond.

The anatomical structure of the vegetative organs of recent cycads is of special interest as affording important evidence of relationship with extinct types, and with other groups of recent plants.

Anatomy.

Brongniart, who was the first to investigate in detail the anatomy of a cycadean stem, recognized an agreement, as regards the secondary wood, with Dicotyledons and Gymnosperms, rather than with Monocotyledons. He drew attention also to certain structural similarities between *Cycas* and *Ginkgo*. The main anatomical features of a cycad stem may be summarized as follows: the centre is occupied by a large parenchymatous pith traversed by numerous secretory canals, and in some genera by cauline vascular bundles (*e.g.* *Encephalartos* and *Macrozamia*). In addition to these cauline strands (confined to the stem and not connected with the leaves), collateral bundles are often met with in the pith, which form the vascular supply of terminal flowers borne at intervals on the apex of the stem. These latter bundles may be seen in sections of old stems to pursue a more or less horizontal course, passing outwards through the main woody cylinder. This lateral course is due to the more vigorous growth of the axillary branch formed near the base of each flower, which is a terminal structure, and, except in the female flower of *Cycas*, puts a limit to the apical growth of the stem. The vigorous lateral branch therefore continues the line of the main axis. The pith is encircled by a cylinder of secondary wood, consisting of single or multiple radial rows of tracheids separated by broad medullary rays composed of large parenchymatous cells; the tracheids bear numerous bordered pits on the radial walls. The large medullary rays give to the wood a characteristic parenchymatous or lax appearance, which is in marked contrast to the more compact wood of a conifer. The protoxylem-elements are situated at the extreme inner edge of the secondary wood, and may occur as small groups of narrow, spirally-pitted elements scattered among the parenchyma which abuts on the main mass of wood. Short and reticulately-pitted tracheal cells, similar to tracheids, often occur in the circummedullary region of cycadean stems. In an old stem of *Cycas*, *Encephalartos* or *Macrozamia* the secondary wood consists of several rather unevenly concentric zones, while in some other genera it forms a continuous mass as in conifers and normal dicotyledons. These concentric rings of secondary xylem and phloem (fig. 9) afford a characteristic cycadean feature. After the cambium has been active for some time producing secondary xylem and phloem, the latter consisting of sieve-tubes, phloem-parenchyma and frequently thick-walled fibres, a second cambium is developed in the

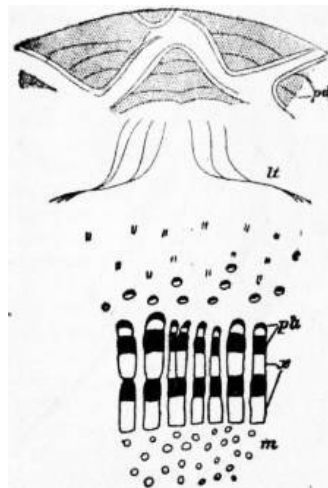


FIG. 9.—*Macrozamia*. Diagrammatic transverse section of part of Stem. (After Worsdell.)

- pd, Periderm in leaf-bases.
- lt, Leaf-traces in cortex.
- ph, Phloem.
- x, Xylem.
- m, Medullary bundles.
- c, Cortical bundles.

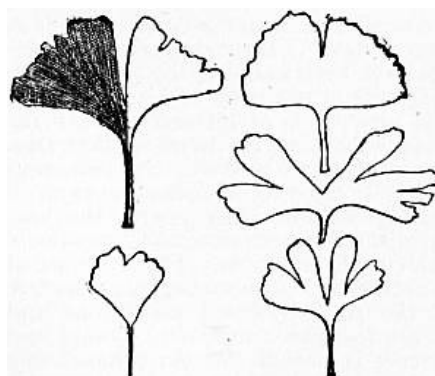
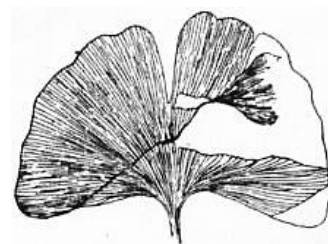


FIG. 10.—*Ginkgo biloba*. Leaves.



pericycle; this produces a second vascular zone, which is in turn followed by a third cambium, and so on, until several hollow cylinders are developed.

It has been recently shown that several cambium-zones may remain in a state of activity, so that the formation of a new cambium does not necessarily mark a cessation of growth in the more internal meristematic rings. It occasionally happens that groups of xylem and phloem are developed internally to some of the vascular rings; these are characterized by an inverse orientation of the tissues, the xylem being centrifugal and the phloem centripetal in its development. The broad cortical region, which contains many secretory canals, is traversed by numerous vascular bundles (fig. 9, *c*) some of which pursue a more or less vertical course, and by frequent anastomoses with one another form a loose reticulum of vascular strands; others are leaf-traces on their way from the stele of the stem to the leaves. Most of these cortical bundles are collateral in structure, but in some the xylem and phloem are concentrically arranged; the secondary origin of these bundles from procambium-strands was described by Mettenius in his classical paper of 1860. During the increase in thickness of a cycadean stem successive layers of cork-tissue are formed by phellogens in the persistent bases of leaves (fig. 9, *pd*), which increase in size to adapt themselves to the growth of the vascular zones. The leaf-traces of cycads are remarkable both on account of their course and their anatomy. In a transverse section of a stem (fig. 9) one sees some vascular bundles following a horizontal or slightly oblique course in the cortex, stretching for a longer or shorter distance in a direction concentric with the woody cylinder. From each leaf-base two main bundles spread right and left through the cortex of the stem (fig. 9, *lt*), and as they curve gradually towards the vascular ring they present the appearance of two rather flat ogee curves, usually spoken of as the leaf-trace girdles (fig. 9, *lt*). The distal ends of these girdles give off several branches, which traverse the petiole and rachis as numerous collateral bundles. The complicated girdle-like course is characteristic of the leaf-traces of most recent cycads, but in some cases, *e.g.* in *Zamia floridana*, the traces are described by Wieland in his recent monograph on American fossil cycads (*Carnegie Institution Publications*, 1906) as possessing a more direct course similar to that in Mesozoic genera. A leaf-trace, as it passes through the cortex, has a collateral structure, the protoxylem being situated at the inner edge of the xylem; when it reaches the leaf-base the position of the spiral tracheids is gradually altered, and the endarch arrangement (protoxylem internal) gives place to a mesarch structure (protoxylem more or less central and not on the edge of the xylem strand). In a bundle examined in the basal portion of a leaf the bulk of the xylem is found to be centrifugal in position, but internally to the protoxylem there is a group of centripetal tracheids; higher up in the petiole the xylem is mainly centripetal, the centrifugal wood being represented by a small arc of tracheids external to the protoxylem and separated from it by a few parenchymatous elements. Finally, in the pinnae of the frond the centrifugal xylem may disappear, the protoxylem being now exarch in position and abutting on the phloem. Similarly in the sporophylls of some cycads the bundles are endarch near the base and mesarch near the distal end of the stamen or carpel. The vascular system of cycadean seedlings presents some features worthy of note; centripetal xylem occurs in the cotyledonary bundles associated with transfusion-tracheids. The bundles from the cotyledons pursue a direct course to the stele of the main axis, and do not assume the girdle-form characteristic of the adult plant. This is of interest from the point of view of the comparison of recent cycads with extinct species (*Bennettites*), in which the leaf-traces follow a much more direct course than in modern cycads. The mesarch structure of the leaf-bundles is met with in a less pronounced form in the flower peduncles of some cycads. This fact is of importance as showing that the type of vascular structure, which characterized the stems of many Palaeozoic genera, has not entirely disappeared from the stems of modern cycads; but the mesarch bundle is

Roots.

now confined to the leaves and peduncles. The roots of some cycads resemble the stems in producing several cambium-rings; they possess 2 to 8 protoxylem-groups, and are characterized by a broad pericyclic zone. A common phenomenon in cycads is the production of roots which grow upwards (apogeotropic), and appear as coralline branched structures above the level of the ground; some of the cortical cells of these roots are hypertrophied, and contain numerous filaments of blue-green Algae (Nostocaceae), which live as endoparasites in the cell-cavities.

FIG. 11.—*Ginkgo adiantoides*. Fossil (Eocene) leaf from the Island of Mull.

GINKGOALES.—This class-designation has been recently proposed to give emphasis to the isolated position of the genus *Ginkgo* (*Salisburia*) among the Gymnosperms. *Ginkgo biloba*, the maidenhair tree, has usually been placed by botanists in the Taxeae in the neighbourhood of the yew (*Taxus*), but the proposal by Eichler in 1852 to institute a special family, the *Salisburieae*, indicated a recognition of the existence of special characteristics which distinguish the genus from other members of the Coniferae. The discovery by the Japanese botanist Hirase of the development of ciliated spermatozoids in the pollen-tube of *Ginkgo*, in place of the non-motile male cells of typical conifers, served as a cogent argument in favour of separating the genus

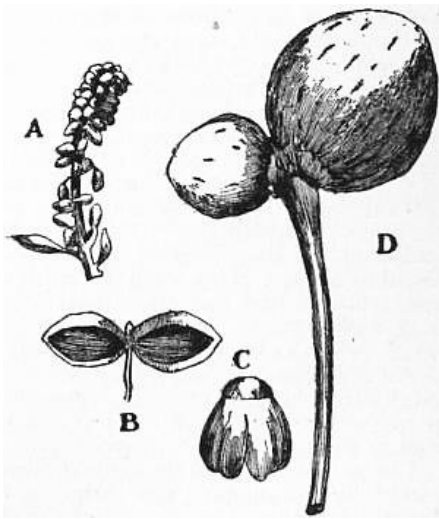


FIG. 12.—*Ginkgo biloba*. A, Male flower; B, C, single stamens; D, female flower.

biloba, which may reach a height of over 30 metres, forms a tree of pyramidal shape with a smooth grey bark. The leaves (figs. 10 and 11) have a long, slender petiole terminating in a fan-shaped lamina, which may be entire, divided by a median incision into two wedge-shaped lobes, or subdivided into several narrow segments. The venation is like that of many ferns, e.g. *Adiantum*; the lowest vein in each half of the lamina follows a course parallel to the edge, and gives off numerous branches, which fork repeatedly as they spread in a palmate manner towards the leaf margin. The foliage-leaves occur either scattered on long shoots of unlimited growth, or at the apex of short shoots (spurs), which may eventually elongate into long shoots.

The flowers are dioecious. The male flowers (fig. 12), borne in the axil of scale-leaves, consist of a stalked central axis bearing loosely disposed stamens; each stamen consists of a slender filament terminating in a small apical scale, which bears

Flowers.

usually two, but not infrequently three or four pollen-sacs (fig. 12, C). The axis of the flower is a shoot bearing leaves in the form of stamens. A mature pollen-grain contains a prothallus of 3 to 5 cells (Fig. 13, Pg); the exine extends over two-thirds of the circumference, leaving a thin portion of the wall, which on collapsing produces a longitudinal groove similar to the median depression on the pollen-grain of a cycad. The ordinary type of female flower has the form of a long, naked peduncle bearing a single ovule on either side of the apex (fig. 12), the base of each being enclosed by a small, collar-like rim, the nature of which has been variously interpreted. A young ovule consists of a conical nucellus surrounded by a single integument terminating as a two-lipped micropyle. A large pollen-chamber occupies the apex of the nucellus; immediately below this, two or more archegonia

(fig. 13, a) are developed in the upper region of the megaspore, each consisting of a large egg-cell surmounted by two neck-cells and a canal-cell which is cut off shortly before fertilization. After the entrance of the pollen-grain the pollen-chamber becomes roofed over by a blunt protuberance of nucellar tissue. The megaspore (embryo-sac) continues to grow after pollination until the greater part of the nucellus is gradually destroyed; it also gives rise to a vertical outgrowth, which projects from the apex of the megaspore as a short, thick column (fig. 13, e) supporting the remains of the nucellar tissue which forms the roof of the pollen-chamber (fig. 13, c). Surrounding the pitted wall of the ovum there is a definite layer of large cells, no doubt representing a tapetum, which, as in cycads and conifers, plays an important part in nourishing the growing egg-cell. The endosperm detached from a large *Ginkgo* ovule after fertilization bears a close resemblance to that of a cycad; the apex is occupied by a depression, on the floor of which two small holes mark the position of the archegonia, and the outgrowth from the megaspore apex projects from the centre as a short peg. After pollination the pollen-tube grows into the pollen-chamber; two large spirally ciliated spermatozoids are produced, their manner of development agreeing very closely with that of the corresponding cells in *Cycas* and *Zamia*. After fertilization the ovum-nucleus divides and cell-formation proceeds rapidly, especially in the lower part of the ovum, in

from the Coniferales and placing it in a class of its own. In 1712 Kaempfer published a drawing of a Japanese tree, which he described under the name *Ginkgo*; this term was adopted in 1771 by Linnaeus, who spoke of Kaempfer's plant as *Ginkgo biloba*. In 1797 Smith proposed to use the name *Salisburia adiantifolia* in preference to the "uncouth" genus *Ginkgo* and "incorrect" specific term *biloba*. Both names are still in common use. On account of the resemblance of the leaves to those of some species of *Adiantum*, the appellation maidenhair tree has long been given to *Ginkgo biloba*. *Ginkgo* is of special interest on account of its isolated position among existing plants, its restricted geographical distribution, and its great antiquity (see PALAEOBOTANY: Mesozoic). This solitary survivor of an ancient stock is almost extinct, but a few old and presumably wild trees are recorded by travellers in parts of China. *Ginkgo* is common as a sacred tree in the gardens of temples in the Far East, and often cultivated in North America and Europe. *Ginkgo*

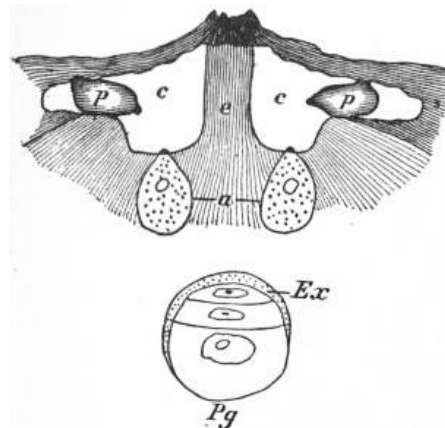


FIG. 13.—*Ginkgo*. Apex of Ovule, and Pollen-grain. (After Hirase.)

- p, Pollen-tube (proximal end).
- c, Pollen-chamber.
- e, Upward prolongation of megaspore.
- a, Archegonia.
- Pg, Pollen-grain.
- Ex, Exine.

which the cotyledon and axis of the embryo are differentiated; the long, tangled suspensor of the cycadean embryo is not found in *Ginkgo*. It is often stated that fertilization occurs after the ovules have fallen, but it has been demonstrated by Hirase that this occurs while the ovules are still attached to the tree. The ripe seed, which grows as large as a rather small plum, is enclosed by a thick, fleshy envelope covering a hard woody shell with two or rarely three longitudinal keels. A papery remnant of nucellus lines the inner face of the woody shell, and, as in cycadean seeds, the apical portion is readily separated as a cap covering the summit of the endosperm.

The morphology of the female flowers has been variously interpreted by botanists; the peduncle bearing the ovules has been described as homologous with the petiole of a foliage-leaf and as a shoot-structure, the collar-like envelope at the base of the ovules being referred to as a second integument or arillus, or as the representative of a carpel. The evidence afforded by normal and abnormal flowers appears to be in favour of the following interpretation: The peduncle is a shoot bearing two or more carpels. Each ovule is enclosed at the base by an envelope or collar homologous with the lamina of a leaf; the fleshy and hard coats of the nucellus constitute a single integument. The stalk of an ovule, considerably reduced in normal flowers and much larger in some abnormal flowers, is homologous with a leaf-stalk, with which it agrees in the structure and number of vascular bundles. The facts on which

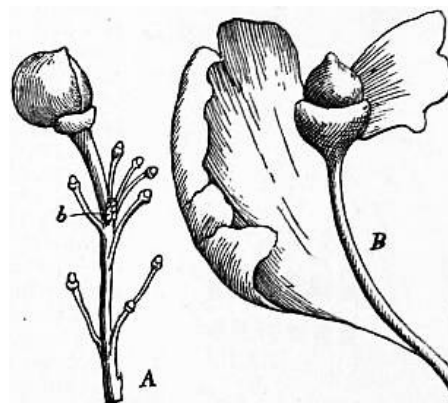


FIG. 14.—*Ginkgo*. Abnormal female Flowers. A, Peduncle; b, scaly bud; B, leaf bearing marginal ovule. (After Fujii.)

this description is based are derived partly from anatomical evidence, and in part from an account given by a Japanese botanist, Fujii, of several abnormal female flowers; in some cases the collar at the base of an ovule, often described as an arillus, is found to pass gradually into the lamina of a leaf bearing marginal ovules (fig. 14, B). The occurrence of more than two ovules on one peduncle is by no means rare; a particularly striking example is described by Fujii, in which an unusually thick peduncle bearing several stalked ovules terminates in a scaly bud (fig. 14, A, b). The frequent occurrence of more than two pollen-sacs and the equally common occurrence of additional ovules have been regarded by some authors as evidence in favour of the view that ancestral types normally possessed a greater number of these organs than are usually found in

Anatomy.

the recent species. This view receives support from fossil evidence. Close to the apex of a shoot the vascular bundles of a leaf make their appearance as double strands, and the leaf-traces in the upper part of a shoot have the form of distinct bundles, which in the older part of the shoot form a continuous ring. Each double leaf-trace passes through four internodes before becoming a part of the stele; the double nature of the trace is a characteristic feature. Secretory sacs occur abundantly in the leaf-lamina, where they appear as short lines between the veins; they are abundant also in the cortex and pith of the shoot, in the fleshy integument of the ovule, and elsewhere. The secondary wood of the shoot and root conforms in the main to the coniferous type; in the short shoots the greater breadth of the medullary rays in the more internal part of the xylem recalls the cycadean type. The secondary phloem contains numerous thick-walled fibres, parenchymatous cells, and large sieve-tubes with plates on the radial walls; swollen parenchymatous cells containing crystals are commonly met with in the cortex, pith and medullary-ray tissues. The wood consists of tracheids, with circular bordered pits on their radial walls, and in the late summer wood pits are unusually abundant on the tangential walls. A point of anatomical interest is the occurrence in the vascular bundles of the cotyledons, scale-leaves, and elsewhere of a few centripetally developed tracheids, which give to the xylem-strands a mesarch structure such as characterizes the foliar bundles of cycads. The root is diarch in structure, but additional protoxylem-strands may be present at the base of the main root; the pericycle consists of several layers of cells.

This is not the place to discuss in detail the past history of *Ginkgo* (see [PALAEOBOTANY: Mesozoic](#)). Among Palaeozoic genera there are some which bear a close resemblance to the recent type in

Geological history.

the form of the leaves; and petrified Palaeozoic seeds, almost identical with those of the maidenhair tree, have been described from French and English localities. During the Triassic and Jurassic periods the genus *Baiera*—no doubt a representative of the Ginkgoales—was widely spread throughout Europe and in other regions; *Ginkgo* itself occurs abundantly in Mesozoic and Tertiary rocks, and was a common plant in the Arctic regions as elsewhere during the Jurassic and Lower Cretaceous periods. Some unusually perfect *Ginkgo* leaves have been found in the Eocene leaf-beds between the lava-flows exposed in the cliffs of Mull (fig. 11). From an evolutionary point of view, it is of interest to note the occurrence of filicinean and cycadean characters in the maidenhair tree. The leaves at once invite a comparison with ferns; the numerous long hairs which form a delicate woolly covering on young leaves recall the hairs of certain ferns, but agree more closely with the long filamentous hairs of recent cycads. The spermatozoids constitute the most striking link with both cycads and ferns. The structure of the seed, the presence of two neck-cells in the archegonia, the late development of the embryo, the partially-fused cotyledons and certain

anatomical characters, are features common to *Ginkgo* and the cycads. The maidenhair tree is one of the most interesting survivals from the past; it represents a type which, in the Palaeozoic era, may have been merged into the extinct class Cordaitales. Through the succeeding ages the Ginkgoales were represented by numerous forms, which gradually became more restricted in their distribution and fewer in number during the Cretaceous and Tertiary periods, terminating at the present day in one solitary survivor.

CONIFERALES.—Trees and shrubs characterized by a copious branching of the stem and frequently by a regular pyramidal form. Leaves simple, small, linear or short and scale-like, usually persisting for more than one year. Flowers monoecious or dioecious, unisexual, without a perianth, often in the form of cones, but never terminal on the main stem.

The plants usually included in the Coniferae constitute a less homogeneous class than the Cycadaceae. Some authors use the term Coniferae in a restricted sense as including those genera

External features.

which have the female flowers in the form of cones, the other genera, characterized by flowers of a different type, being placed in the Taxaceae, and often spoken of as Taxads. In order to avoid confusion in the use of the term Coniferae, we may adopt as a class-designation the name Coniferales, including

both the Coniferae—using the term in a restricted sense—and the Taxaceae. The most striking characteristic of the majority of the Coniferales is the regular manner of the monopodial branching and the pyramidal shape. *Araucaria imbricata*, the Monkey-puzzle tree, *A. excelsa*, the Norfolk Island pine, many pines and firs, cedars and other genera illustrate the pyramidal form. The mammoth redwood tree of California, *Sequoia (Wellingtonia) gigantea*, which represents the tallest Gymnosperm, is a good example of the regular tapering main stem and narrow pyramidal form. The cypresses afford instances of tall and narrow trees similar in habit to Lombardy poplars. The common cypress (*Cupressus sempervirens*), as found wild in the mountains of Crete and Cyprus, is characterized by long and spreading branches, which give it a cedar-like habit. A pendulous or weeping habit is assumed by some conifers, e.g. *Picea excelsa* var. *virgata* represents a form in which the main branches attain a considerable horizontal extension, and trail themselves like snakes along the ground. Certain species of *Pinus*, the yews (*Taxus*) and some other genera grow as bushes, which in place of a main mast-like stem possess several repeatedly-branched leading shoots. The unfavourable conditions in Arctic regions have produced a dwarf form, in which the main shoots grow close to the ground. Artificially induced dwarfed plants of *Pinus*, *Cupressus*, *Sciadopitys* (umbrella pine) and other genera are commonly cultivated by the Japanese. The dying off of older branches and the vigorous growth of shoots nearer the apex of the stem produce a form of tree illustrated by the stone pine of the Mediterranean region (*Pinus Pinea*), which Turner has rendered familiar in his "Childe Harold's Pilgrimage" and other pictures of Italian scenery. Conifers are not infrequently seen in which a lateral branch has bent sharply upwards to take the place of the injured main trunk. An upward tendency of all the main lateral branches, known as fastigiation, is common in some species, producing well-marked varieties, e.g. *Cephalotaxus pedunculata* var. *fastigiata*; this fastigiate habit may arise as a sport on a tree with spreading branches. Another departure from the normal is that in which the juvenile or seedling form of shoot persists in the adult tree; the numerous coniferous plants known as species of *Retinospora* are examples of this. The name *Retinospora*, therefore, does not stand for a true genus, but denotes persistent young forms of *Juniperus*, *Thuja*, *Cupressus*, &c., in which the small scaly leaves of ordinary species are replaced by the slender, needle-like leaves, which stand out more or less at right angles from the branches. The flat branchlets of *Cupressus*, *Thuja* (*arbor vitae*), *Thujopsis dolabrata* (*Japanese arbor vitae*) are characteristic of certain types of conifers; in some cases the horizontal extension of the branches induces a dorsiventral structure. A characteristic feature of the genus *Agathis (Dammara)* the Kauri pine of New Zealand, is the deciduous habit of the branches; these become detached from the main trunk leaving a well-defined absciss-surface, which appears as a depressed circular scar on the stem. A new genus of conifers, *Taiwania*, has recently been described from the island of Formosa; it is said to agree in habit with the Japanese *Cryptomeria*, but the cones appear to have a structure which distinguishes them from those of any other genus.

With a few exceptions conifers are evergreen, and retain the leaves for several years (10 years in *Araucaria imbricata*, 8 to 10 in *Picea excelsa*, 5 in *Taxus baccata*; in *Pinus* the needles usually fall in October of their third year). The larch (*Larix*) sheds its leaves in the

Leaves.

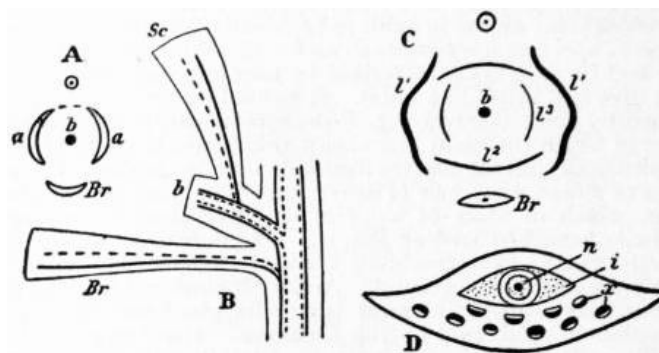
autumn, in the Chinese larch (*Pseudolarix Kaempferi*) the leaves turn a bright yellow colour before falling. In the swamp cypress (*Taxodium distichum*) the

tree assumes a rich brown colour in the autumn, and sheds its leaves together with the branchlets which bear them; deciduous branches occur also in some other species, e.g. *Sequoia sempervirens* (redwood), *Thuja occidentalis*, &c. The leaves of conifers are characterized by their small size, e.g. the needle-form represented by *Pinus*, *Cedrus*, *Larix*, &c., the linear flat or angular leaves, appressed to the branches, of *Thuja*, *Cupressus*, *Libocedrus*, &c. The flat and comparatively broad leaves of *Araucaria imbricata*, *A. Bidwillii*, and some species of the southern genus *Podocarpus* are traversed by several parallel veins, as are also the still larger leaves of *Agathis*, which may reach a length of several inches. In addition to the foliage-leaves several genera also possess scale-leaves of various kinds, represented by bud-scales in *Pinus*, *Picea*, &c., which frequently persist for a time at the base of a young shoot which has pushed its way through the yielding cap of protecting scales, while in some conifers the bud-scales adhere together, and

after being torn near the base are carried up by the growing axis as a thin brown cap. The cypresses, araucarias and some other genera have no true bud-scales; in some species, *e.g. Araucaria Bidwillii*, the occurrence of small foliage-leaves, which have functioned as bud-scales, at intervals on the shoots affords a measure of seasonal growth. The occurrence of long and short shoots is a characteristic feature of many conifers. In *Pinus* the needles occur in pairs, or in clusters of 3 or 5 at the apex of a small and inconspicuous short shoot of limited growth (spur), which is enclosed at its base by a few scale-leaves, and borne on a branch of unlimited growth in the axil of a scale-leaf. In the Californian *Pinus monophylla* each spur bears usually one needle, but two are not uncommon; it would seem that rudiments of two needles are always produced, but, as a rule, only one develops into a needle. In *Sciadopitys* similar spurs occur, each bearing a single needle, which in its grooved surface and in the possession of a double vascular bundle bears traces of an origin from two needle-leaves. A peculiarity of these leaves is the inverse orientation of the vascular tissue; each of the two veins has its phloem next the upper and the xylem towards the lower surface of the leaf; this unusual position of the xylem and phloem may be explained by regarding the needle of *Sciadopitys* as being composed of a pair of leaves borne on a short axillary shoot and fused by their margins (fig. 15, A). Long and short shoots occur also in *Cedrus* and *Larix*, but in these genera the spurs are longer and stouter, and are not shed with the leaves; this kind of short shoot, by accelerated apical growth, often passes into the condition of a long shoot on which the leaves are scattered and separated by comparatively long internodes, instead of being crowded into tufts such as are borne on the ends of the spurs. In the genus *Phyllocladus* (New Zealand, &c.) there are no green foliage-leaves, but in their place flattened branches (phylloclades) borne in the axils of small scale-leaves. The cotyledons are often two in number, but sometimes (*e.g. Pinus*) as many as fifteen; these leaves are usually succeeded by foliage-leaves in the form of delicate spreading needles, and these primordial leaves are followed, sooner or later, by the adult type of leaf, except in *Retinosporas*, which retain the juvenile foliage. In addition to the first foliage-leaves and the adult type of leaf, there are often produced leaves which are intermediate both in shape and structure between the seedling and adult foliage. Dimorphism or heterophylly is fairly common. One of the best known examples is the Chinese juniper (*Juniperus chinensis*), in which branches with spinous leaves, longer and more spreading than the ordinary adult leaf, are often found associated with the normal type of branch. In some cases, *e.g. Sequoia sempervirens*, the fertile branches bear leaves which are less spreading than those on the vegetative shoots. Certain species of the southern hemisphere genus *Dacrydium* afford particularly striking instances of heterophylly, *e.g. D. Kirkii* of New Zealand, in which some branches bear small and appressed leaves, while in others the leaves are much longer and more spreading. A well-known fossil conifer from Triassic strata—*Voltzia heterophylla*—also illustrates a marked dissimilarity in the leaves of the same shoot. The variation in leaf-form and the tendency of leaves to arrange themselves in various ways on different branches of the same plant are features which it is important to bear in mind in the identification of fossil conifers. In this connexion we may note the striking resemblance between some of the New Zealand Alpine Veronicas, *e.g. Veronica Hectori*, *V. cupressoides*, &c. (also *Polycladus cupressinus*, a Composite), and some of the cypresses and other conifers with small appressed leaves. The long linear leaves of some species of *Podocarpus*, in which the lamina is traversed by a single vein, recall the pinnae of *Cycas*; the branches of some *Dacrydiums* and other forms closely resemble those of lycopods; these superficial resemblances, both between different genera of conifers and between conifers and other plants, coupled with the usual occurrence of fossil coniferous twigs without cones attached to them, render the determination of extinct types a very unsatisfactory and frequently an impossible task.

A typical male flower consists of a central axis bearing numerous spirally-arranged sporophylls (stamens), each of which consists of a slender stalk (filament) terminating distally in a more or less prominent knob or triangular scale, and bearing two or more pollen-sacs (microsporangia) on its lower surface. The pollen-grains of some genera (*e.g. Pinus*) are furnished with bladder-like extensions of the outer wall, which serve as aids to wind-dispersal. The stamens of *Araucaria* and *Agathis* are peculiar in bearing several long, and narrow free pollen-sacs; these may be compared with the sporangiophores of the horsetails (*Equisetum*); in *Taxus* (yew) the filament is attached to the centre of a large circular distal expansion, which bears several pollen-sacs on its under surface. In the conifers proper the female reproductive organs have the form of cones, which may be styled flowers or inflorescences according to different interpretations of their morphology. In the *Taxaceae* the flowers have a simpler structure. The female flowers of the *Abietineae* may be taken as representing a common type. A pine cone reaches maturity in two years; a single year suffices for the full development in *Larix* and several other genera. The axis of the cone bears numerous spirally disposed flat scales (cone-scales), each of which, if examined in a young cone, is found to be double, and to consist of a lower and an upper portion. The latter is a thin flat scale bearing a median ridge or keel (*e.g. Abies*), on each side of which is situated an inverted ovule, consisting of a nucellus surrounded by a single integument. As the cone grows in size and becomes woody the lower half of the cone-scale, which we may call the carpellary scale, may remain small, and is so far outgrown by the upper half (seminiferous scale) that it is hardly recognizable in the mature cone. In many species of *Abies* (*e.g. Abies pectinata*, &c.) the ripe cone differs from those of *Pinus*, *Picea* and *Cedrus* in the large size of the carpellary scales, which project as conspicuous thin appendages beyond the distal margins of the broader and more woody seminiferous scales; the long carpellary scale is a

prominent feature also in the cone of the Douglas pine (*Pseudotsuga Douglasii*). The female flowers (cones) vary considerably in size; the largest are the more or less spherical cones of *Araucaria*—a single cone of *A. imbricata* may produce as many as 300 seeds, one seed to each fertile cone-scale—and the long pendent cones, 1 to 2 ft. in length, of the sugar pine of California (*Pinus Lambertiana*) and other species. Smaller cones, less than an inch long, occur in the larch, *Athrotaxis* (Tasmania), *Fitzroya* (Patagonia and Tasmania), &c. In the *Taxodiaceae* and *Araucariaceae* the cones are similar in appearance to those of the *Abietineae*, but they differ in the fact that the scales appear to be single, even in the young condition; each cone-scale in a genus of the *Taxodiinae* (*Sequoia*, &c.) bears several seeds, while in the *Araucariinae* (*Araucaria* and *Agathis*) each scale has one seed. The *Cupressineae* have cones composed of a few scales arranged in alternate whorls; each scale bears two or more seeds, and shows no external sign of being composed of two distinct portions. In the junipers the scales become fleshy as the seeds ripen, and the individual scales fuse together in the form of a berry. The female flowers of the *Taxaceae* assume another form; in *Microcachrys* (Tasmania) the reproductive structures are spirally disposed, and form small globular cones made up of red fleshy scales, to each of which is attached a single ovule enclosed by an integument and partially invested by an arillus; in *Dacrydium* the carpellary leaves are very similar to the foliage leaves—each bears one ovule with two integuments, the outer of which constitutes an arillus. Finally in the yew, as a type of the family *Taxaceae*, the ovules occur singly at the apex of a lateral branch, enclosed when ripe by a conspicuous red or yellow fleshy arillus, which serves as an attraction to animals, and thus aids in the dispersal of the seeds.



(C and D after Worsdell.)

FIG. 15.—Diagrammatic treatment of:

A, Double needle of *Sciadopitys* (*a*, leaves; *b*, shoot; *Br*, bract).

B, seminiferous scale as leaf of axillary shoot (*b*, shoot; *Sc*, seminiferous scale; *Br*, bract).

C, seminiferous scale as fused pair of leaves (l^1 , l^2 , l^3 , first, second and third leaves; *b*, shoot; *Br*, bract).

D, cone-scale of *Araucaria* (*n*, nucellus; *i*, integument; *x*, xylem).

It is important to draw attention to some structural features exhibited by certain cone-scales, in which there is no external sign indicative of the presence of a carpellary and a seminiferous scale. In *Araucaria*

Morphology of female flower.

Cookii and some allied species each scale has a small pointed projection from its upper face near the distal end; the scales of *Cunninghamia* (China) are characterized by a somewhat ragged membranous projection extending across the upper face between the seeds and the distal end of the scale; in the scales of *Athrotaxis* (Tasmania) a prominent rounded ridge occupies a corresponding position. These projections and ridges may be homologous with the seminiferous scale of the pines, firs, cedars, &c. The simplest interpretation of the cone of the *Abietineae* is that which regards it as a flower consisting of an axis bearing several open carpels, which in the adult cone may be large and prominent or very small, the scale bearing the ovules being regarded as a placental outgrowth from the flat and open carpel. In *Araucaria* the cone-scale is regarded as consisting of a flat carpel, of which the placenta has not grown out into the scale-like structure. The seminiferous scale of *Pinus*, &c., is also spoken of sometimes as a ligular outgrowth from the carpellary leaf. Robert Brown was the first to give a clear description of the morphology of the Abietineous cone in which carpels bear naked ovules; he recognized gymnospermy as an important distinguishing feature in conifers as well as in cycads. Another view is to regard the cone as an inflorescence, each carpellary scale being a bract bearing in its axil a shoot the axis of which has not been developed; the seminiferous scale is believed to represent either a single leaf or a fused pair of leaves belonging to the partially suppressed axillary shoot. In 1869 van Tieghem laid stress on anatomical evidence as a key to the morphology of the cone-scales; he drew attention to the fact that the collateral vascular bundles of the seminiferous scale are inversely orientated as compared with those of the carpellary scale; in the latter the xylem of each bundle is next the upper surface, while in the seminiferous scale



FIG. 16.—
Abnormal Cone of
Pinus rigida.
(After Masters.)

the phloem occupies that position. The conclusion drawn from this was that the seminiferous scale (fig. 15, B, *Sc*) is the first and only leaf of an axillary shoot (*b*) borne on that side of the shoot, the axis of which is suppressed, opposite the subtending bract (fig. 15, A, B, C, *Br*). Another view is to apply to the seminiferous scale an explanation similar to that suggested by von Mohl in the case of the double needle of *Sciadopitys*, and to consider the seed-bearing scale as being made up of a pair of leaves (fig. 15, A, *a, a*) of an axillary shoot (*b*) fused into one by their posterior margins (fig. 15, A). The latter view receives support from abnormal cones in which carpellary scales subtend axillary shoots, of which the first two leaves (fig. 15, C, *l', l'*) are often harder and browner than the others; forms have been described transitional between axillary shoots, in which the leaves are separate, and others in which two of the leaves are more or less completely fused. In a young cone the seminiferous scale appears as a hump of tissue at the base or in the axil of the carpellary scale, but Celakovský, a strong supporter of the axillary-bud theory, attaches little or no importance to this kind of evidence, regarding the present manner of development as being merely an example of a short cut adopted in the course of evolution, and replacing the original production of a branch in the axil of each carpellary scale. Eichler, one of the chief supporters of the simpler view, does not recognize in the inverse orientation of the vascular bundles an argument in support of the axillary-bud theory, but points out that the seminiferous scale, being an outgrowth from the surface of the carpellary scale, would, like outgrowths from an ordinary leaf, naturally have its bundles inversely orientated. In such cone-scales as show little or no external indication of being double in origin, *e.g. Araucaria* (fig. 15, D) *Sequoia*, &c., there are always two sets of bundles; the upper set, having the phloem uppermost, as in the seminiferous scale of *Abies* or *Pinus*, are regarded as belonging to the outgrowth from the carpellary scale and specially developed to supply the ovules. Monstrous cones are fairly common; these in some instances lend support to the axillary-bud theory, and it has been said that this theory owes its existence to evidence furnished by abnormal cones. It is difficult to estimate the value of abnormalities as evidence bearing on morphological interpretation; the chief danger lies perhaps in attaching undue weight to them, but there is also a risk of minimizing their importance. Monstrosities at least demonstrate possible lines of development, but when the abnormal forms of growth in various directions are fairly evenly balanced, trustworthy deductions become difficult. The occurrence of buds in the axils of carpellary scales may, however, simply mean that buds, which are usually undeveloped in the axils of sporophylls, occasionally afford evidence of their existence. Some monstrous cones lend no support to the axillary-bud theory. In *Larix* the axis of the cone often continues its growth; similarly in *Cephalotaxus* the cones are often proliferous. (In rare cases the proliferated portion produces male flowers in the leaf-axils.) In *Larix* the carpellary scale may become leafy, and the seminiferous scale may disappear. Androgynous cones may be produced, as in the cone of *Pinus rigida* (fig. 16), in which the lower part bears stamens and the upper portion carpellary and seminiferous scales. An interesting case has been figured by Masters, in which scales of a cone of *Cupressus Lawsoniana* bear ovules on the upper surface and stamens on the lower face. One argument that has been adduced in support of the axillary bud theory is derived from the Palaeozoic type *Cordaites*, in which each ovule occurs on an axis borne in the axil of a bract. The whole question is still unsolved, and perhaps insoluble. It may be that the interpretation of the female cone of the *Abietineae* as an inflorescence, which finds favour with many botanists, cannot be applied to the cones of *Agathis* and *Araucaria*. Without expressing any decided opinion as to the morphology of the double cone-scale of the *Abietineae*, preference may be felt in favour of regarding the cone-scale of the *Araucarieae* as a simple carpellary leaf bearing a single ovule. A discussion of this question may be found in a paper on the *Araucarieae* by Seward and Ford, published in the Transactions of the Royal Society of London (1906). *Cordaites* is an extinct type which in certain respects resembles *Ginkgo*, cycads and the *Araucarieae*, but its agreement with true conifers is probably too remote to justify our attributing much weight to the bearing of the morphology of its female flowers on the interpretation of that of the Coniferae. The greater simplicity of the Eichler theory may prejudice us in its favour; but, on the other hand, the arguments advanced in favour of the axillary-bud theories are perhaps not sufficiently cogent to lead us to accept an explanation based chiefly on the uncertain evidence of monstrosities.

A pollen-grain when first formed from its mother-cell consists of a single cell; in this condition it may be carried to the nucellus of the ovule (*e.g. Taxus, Cupressus, &c.*), or more usually (*Pinus, Larix, &c.*) it reaches maturity before the dehiscence of the microsporangium.

**Micro-spores
and
megaspores.**

The nucleus of the microspore divides and gives rise to a small cell within the large cell, a second small cell is then produced; this is the structure of the ripe pollen-grain in some conifers (*Taxus, &c.*). The large cell grows out as a pollen-tube; the second of the two small cells (body-cell) wanders into the tube, followed by the nucleus of the first small cell (stalk-cell). In *Taxus* the body-cell eventually divides into two, in which the products of division are of unequal size, the larger constituting the male generative cell, which fuses with the nucleus of the egg-cell. In *Juniperus* the products of division of the body-cell are equal, and both function as male generative cells. In the *Abietineae* cell-formation in the pollen-grain is carried farther. Three small cells occur inside the cavity of the microspore; two of them collapse and the third divides into two, forming a stalk-cell and a larger body-cell. The latter ultimately divides in the apex of the pollen-tube into two non-motile generative cells. Evidence has lately been adduced of the existence of numerous nuclei in the pollen-tubes of the *Araucarieae*, and it seems probable that in this as in several other respects

this family is distinguished from other members of the Coniferales. The precise method of fertilization in the Scots Pine was followed by V. H. Blackman, who also succeeded in showing that the nuclei of the sporophyte generation contain twice as many chromosomes as the nuclei of the gametophyte. Other observers have in recent years demonstrated a similar relation in other genera between the number of chromosomes in the nuclei of the two generations. The ovule is usually surrounded by one integument, which projects beyond the tip of the nucellus as a wide-open lobed funnel, which at the time of pollination folds inwards, and so assists in bringing the pollen-grains on to the nucellus. In some conifers (*e.g. Taxus, Cephalotaxus, Dacrydium, &c.*) the ordinary integument is partially enclosed by an arillus or second integument. It is held by some botanists (Celakovský) that the seminiferous scale of the *Abietineae* is homologous with the arillus or second integument of the Taxaceae, but this view is too strained to gain general acceptance. In *Araucaria* and *Saxegothaea* the nucellus itself projects beyond the open micropyle and receives the pollen-grains direct. During the growth of the cell which forms the megaspore the greater part of the nucellus is absorbed, except the apical portion, which persists as a cone above the megaspore; the partial disorganization of some of the cells in the centre of the nucellar cone forms an irregular cavity, which may be compared with the larger pollen-chamber of *Ginkgo* and the cycads. In each ovule one megaspore comes to maturity, but, exceptionally, two may be present (*e.g. Pinus sylvestris*). It has been shown by Lawson that in *Sequoia sempervirens* (*Annals of Botany*, 1904) and by other workers in the genera that several megaspores may attain a fairly large size in one prothallus. The megaspore becomes filled with tissue (prothallus), and from some of the superficial cells archegonia are produced, usually three to five in number, but in rare cases ten to twenty or even sixty may be present. In the genus *Sequoia* there may be as many as sixty archegonia (Arnoldi and Lawson) in one megaspore; these occur either separately or in some parts of the prothallus they may form groups as in the *Cupressineae*; they are scattered through the prothallus instead of being confined to the apical region as in the majority of conifers. Similarly in the *Araucarieae* and in *Widdringtonia* the archegonia are numerous and scattered and often sunk in the prothallus tissue. In *Libocedrus decurrens* (Cupressineae) Lawson describes the archegonia as varying in number from 6 to 24 (*Annals of Botany* xxi., 1907). An archegonium consists of a large oval egg-cell surmounted by a short neck composed of one or more tiers of cells, six to eight cells in each tier. Before fertilization the nucleus of the egg-cell divides and cuts off a ventral canal-cell; this cell may represent a second egg-cell. The egg-cells of the archegonia may be in lateral contact (*e.g. Cupressineae*) or separated from one another by a few cells of the prothallus, each ovum being immediately surrounded by a layer of cells distinguished by their granular contents and large nuclei. During the development of the egg-cell, food material is transferred from these cells through the pitted wall of the ovum. The tissue at the apex of the megaspore grows slightly above the level of the archegonia, so that the latter come to lie in a shallow depression. In the process of fertilization the two male generative nuclei, accompanied by the pollen-tube nucleus and that of the stalk-cell, pass through an open pit at the apex of the pollen-tube into the protoplasm of the ovum. After fertilization the nucleus of the egg divides, the first stages of karyokinesis being apparent even before complete fusion of the male and female nuclei has occurred. The result of this is the production of four nuclei, which eventually take up a position at the bottom of the ovum and become separated from one another by vertical cell-walls; these nuclei divide again, and finally three tiers of cells are produced, four in each tier. In the *Abietineae* the cells of the middle tier elongate and push the lowest tier deeper into the endosperm; the cells of the bottom tier may remain in lateral contact and produce together one embryo, or they may separate (*Pinus, Juniperus, &c.*) and form four potential embryos. The ripe albuminous seed contains a single embryo with two or more cotyledons. The seeds of many conifers are provided with large thin wings, consisting in some genera (*e.g. Pinus*) of the upper cell-layers of the seminiferous scale, which have become detached and, in some cases, adhere loosely to the seed as a thin membrane; the loose attachment may be of use to the seeds when they are blown against the branches of trees, in enabling them to fall away from the wing and drop to the ground. The seeds of some genera depend on animals for dispersal, the carpellary scale (*Microcachrys*) or the outer integument being brightly coloured and attractive. In some *Abietineae* (*e.g. Pinus* and *Picea*)—in which the cone-scales persist for some time after the seeds are ripe—the cones hang down and so facilitate the fall of the seeds; in *Cedrus, Araucaria* and *Abies* the scales become detached and fall with the seeds, leaving the bare vertical axis of the cone on the tree. In all cases, except some species of *Araucaria* (sect. *Colymbea*) the germination is epigeal. The seedling plants of some Conifers (*e.g. Araucaria imbricata*) are characterized by a carrot-shaped hypocotyl, which doubtless serves as a food-reservoir.

The roots of many conifers possess a narrow band of primary xylem-tracheids with a group of narrow spiral protoxylem-elements at each end (diarch). A striking feature in the roots of several genera, excluding the *Abietineae*, is the occurrence of thick and somewhat irregular bands of thickening on the cell-walls of the cortical layer next to the endodermis. These bands, which may serve to strengthen the central cylinder, have been compared with the netting surrounding the delicate wall of an inflated balloon. It is not always easy to distinguish a root from a stem; in some cases (*e.g. Sequoia*) the primary tetrarch structure is easily identified in the centre of an old root, but in other cases the primary elements are very difficult to recognize. The sudden termination of the secondary tracheids against the pith-cells may afford evidence of root-structure as distinct from stem-structure, in which the radial rows of secondary tracheids pass into the irregularly-arranged primary elements next the

pith. The annual rings in a root are often less clearly marked than in the stem, and the xylem-elements are frequently larger and thinner. The primary vascular bundles in a young conifer stem are collateral, and, like those of a Dicotyledon, they are arranged in a circle round a central pith and enclosed by a common endodermis. It is in the nature of the secondary xylem that the Coniferales are most readily distinguished from the Dicotyledons and Cycadaceae; the wood is homogeneous in structure, consisting almost entirely of tracheids with circular or polygonal bordered pits on the radial walls, more particularly in the late summer wood. In many genera xylem-parenchyma is present, but never in great abundance. A few Dicotyledons, *e.g.* *Drimys* (Magnoliaceae) closely resemble conifers in the homogeneous character of the wood, but in most cases the presence of large spring vessels, wood-fibres and abundant parenchyma affords an obvious distinguishing feature.

The abundance of petrified coniferous wood in rocks of various ages has led many botanists to investigate the structure of modern genera with a view to determining how far anatomical characters may be used as evidence of generic distinctions. There are a few well-marked types of wood which serve as convenient standards of comparison, but these cannot be used except in a few cases to distinguish individual genera. The genus *Pinus* serves as an illustration of wood of a distinct type characterized by the absence of xylem-parenchyma, except such as is associated with the numerous resin-canals that occur abundantly in the wood, cortex and medullary rays; the medullary rays are composed of parenchyma and of horizontal tracheids with irregular ingrowths from their walls. In a radial section of a pine stem each ray is seen to consist in the median part of a few rows of parenchymatous cells with large oval simple pits in their walls, accompanied above and below by horizontal tracheids with bordered pits. The pits in the radial walls of the ordinary xylem-tracheids occur in a single row or in a double row, of which the pits are not in contact, and those of the two rows are placed on the same level. The medullary rays usually consist of a single tier of cells, but in the *Pinus* type of wood broader medullary rays also occur and are traversed by horizontal resin-canals. In the wood of *Cypressus*, *Cedrus*, *Abies* and several other genera, parenchymatous cells occur in association with the xylem-tracheids and take the place of the resin-canals of other types. In the Araucarian type of wood (*Araucaria* and *Agathis*) the bordered pits, which occur in two or three rows on the radial walls of the tracheids, are in mutual contact and polygonal in shape, the pits of the different rows are alternate and not on the same level; in this type of wood the annual rings are often much less distinct than in *Cupressus*, *Pinus* and other genera. In *Taxus*, *Torreya* (California and the Far East) and *Cephalotaxus* the absence of resin-canals and the presence of spiral thickening-bands on the tracheids constitute well-marked characteristics. An examination of the wood of branches, stems and roots of the same species or individual usually reveals a fairly wide variation in some of the characters, such as the abundance and size of the medullary rays, the size and arrangement of pits, the presence of wood-parenchyma—characters to which undue importance has often been attached in systematic anatomical work. The phloem consists of sieve-tubes, with pitted areas on the lateral as well as on the inclined terminal walls, phloem-parenchyma and, in some genera, fibres. In the *Abietineae* the phloem consists of parenchyma and sieve-tubes only, but in most other forms tangential rows of fibres occur in regular alternation with the parenchyma and sieve-tubes. The characteristic companion-cells of Angiosperms are represented by phloem-parenchyma cells with albuminous contents; other parenchymatous elements of the bast contain starch or crystals of calcium oxalate. When tracheids occur in the medullary rays of the xylem these are replaced in the phloem-region by irregular parenchymatous cells known as albuminous cells. Resin-canals, which occur abundantly in the xylem, phloem or cortex, are not found in the wood of the yew. *Cephalotaxus* (*Taxeeae*) is also peculiar in having resin-canals in the pith (cf. *Ginkgo*). One form of *Cephalotaxus* is characterized by the presence of short tracheids in the pith, in shape like ordinary parenchyma, but in the possession of bordered pits and lignified walls agreeing with ordinary xylem-tracheids; it is probable that these short tracheids serve as reservoirs for storing rather than for conducting water. The vascular bundle entering the stem from a leaf with a single vein passes by a more or less direct course into the central cylinder of the stem, and does not assume the girdle-like form characteristic of the cycadean leaf-trace. In species of which the leaves have more than one vein (*e.g.* *Araucaria imbricata*, &c.) the leaf-trace leaves the stele of the stem as a single bundle which splits up into several strands in its course through the cortex. In the wood of some conifers, *e.g.* *Araucaria*, the leaf-traces persist for a considerable time, perhaps indefinitely, and may be seen in tangential sections of the wood of old stems. The leaf-trace in the Coniferales is simple in its course through the stem, differing in this respect from the double leaf-trace of *Ginkgo*. A detailed account of the anatomical characters of conifers has been published by Professor D. P. Penhallow of Montreal and Dr. Gothan of Berlin which will be found useful for diagnostic purposes. The characters of leaves most useful for diagnostic purposes are the position of the stomata, the presence and arrangement of resin-canals, the structure of the mesophyll and vascular bundles. The presence of hypodermal fibres is another feature worthy of note, but the occurrence of these elements is too closely connected with external conditions to be of much systematic value. A pine needle grown in continuous light differs from one grown under ordinary conditions in the absence of hypodermal fibres, in the absence of the characteristic infoldings of the mesophyll cell-walls, in the smaller size of the resin-canals, &c. The endodermis in *Pinus*, *Picea* and many other genera is usually a well-defined layer of cells enclosing the vascular bundles, and separated from them by a tissue consisting in part of ordinary parenchyma and to some extent of isodiametric tracheids; but this tissue, usually spoken of as the pericycle, is

in direct continuity with other stem-tissues as well as the pericycle. The occurrence of short tracheids in close proximity to the veins is a characteristic of coniferous leaves; these elements assume two distinct forms—(1) the short isodiametric tracheids (transfusion-tracheids) closely associated with the veins; (2) longer tracheids extending across the mesophyll at right angles to the veins, and no doubt functioning as representatives of lateral veins. It has been suggested that transfusion-tracheids represent, in part at least, the centripetal xylem, which forms a distinctive feature of cycadean leaf-bundles; these short tracheids form conspicuous groups laterally attached to the veins in *Cunninghamia*, abundantly represented in a similar position in the leaves of *Sequoia*, and scattered through the so-called pericycle in *Pinus*, *Picea*, &c. It is of interest to note the occurrence of precisely similar elements in the mesophyll of *Lepidodendron* leaves. An anatomical peculiarity in the veins of *Pinus* and several other genera is the continuity of the medullary rays, which extend as continuous plates from one end of the leaf to the other. The mesophyll of *Pinus* and *Cedrus* is characterized by its homogeneous character and by the presence of infoldings of the cell-walls. In many leaves, e.g. *Abies*, *Tsuga*, *Larix*, &c., the mesophyll is heterogeneous, consisting of palisade and spongy parenchyma. In the leaves of *Araucaria imbricata*, in which palisade-tissue occurs in both the upper and lower part of the mesophyll, the resin-canals are placed between the veins; in some species of *Podocarpus* (sect. *Nageia*) a canal occurs below each vein; in *Tsuga*, *Torreya*, *Cephalotaxus*, *Sequoia*, &c., a single canal occurs below the midrib; in *Larix*, *Abies*, &c., two canals run through the leaf parallel to the margins. The stomata are frequently arranged in rows, their position being marked by two white bands of wax on the leaf-surface.

The chief home of the Coniferales is in the northern hemisphere, where certain species occasionally extend into the Arctic circle and penetrate beyond the northern limit of

dicotyledonous trees. Wide areas are often exclusively occupied by conifers, which give the landscape a sombre aspect, suggesting a comparison with the forest vegetation of the Coal period. South of the tree-limit a belt of conifers stretches across north Europe, Siberia and Canada. In northern Europe this belt is characterized by such species as *Picea excelsa* (spruce), which extends south to the mountains of the Mediterranean region; *Pinus sylvestris* (Scottish fir), reaching from the far north to western Spain, Persia and Asia Minor; *Juniperus communis*, &c. In north Siberia *Pinus Cembra* (Cembra or Arolla Pine) has a wide range; also *Abies sibirica* (Siberian silver fir), *Larix sibirica* and *Juniperus Sabina* (savin). In the North American area *Picea alba*, *P. nigra*, *Larix americana*, *Abies balsamea* (balsam fir), *Tsuga canadensis* (hemlock spruce), *Pinus Strobus* (Weymouth pine), *Thuja occidentalis* (white cedar), *Taxus canadensis* are characteristic species. In the Mediterranean region occur *Cupressus sempervirens*, *Pinus Pinea* (stone pine), species of juniper, *Cedrus atlantica*, *C. Libani*, *Callitris quadrivalvis*, *Pinus montana*, &c. Several conifers of economic importance are abundant on the Atlantic side of North America—*Juniperus virginiana* (red cedar, used in the manufacture of lead pencils, and extending as far south as Florida), *Taxodium distichum* (swamp cypress), *Pinus rigida* (pitch pine), *P. mitis* (yellow pine), *P. taeda*, *P. palustris*, &c. On the west side of the American continent conifers play a still more striking rôle; among them are *Chamaecyparis nutkaensis*, *Picea sitchensis*, *Libocedrus decurrens*, *Pseudotsuga Douglasii* (Douglas fir), *Sequoia sempervirens*, *S. gigantea* (the only two surviving species of this generic type are now confined to a few localities in California, but were formerly widely spread in Europe and elsewhere), *Pinus Coulteri*, *P. Lambertiana*, &c. Farther south, a few representatives of such genera as *Abies*, *Cupressus*, *Pinus* and juniper are found in the Mexican Highlands, tropical America and the West Indies. In the far East conifers are richly represented; among them occur *Pinus densiflora*, *Cryptomeria japonica*, *Cephalotaxus*, species of *Abies*, *Larix*, *Thujopsis*, *Sciadopitys verticillata*, *Pseudolarix Kaempferi*, &c. In the Himalaya occur *Cedrus deodara*, *Taxus*, species of *Cupressus*, *Pinus excelsa*, *Abies Webbiana*, &c. The continent of Africa is singularly poor in conifers. *Cedrus atlantica*, a variety of *Abies Pinsapo*, *Juniperus thurifera*, *Callitris quadrivalvis*, occur in the north-west region, which may be regarded as the southern limit of the Mediterranean region. The greater part of Africa north of the equator is without any representatives of the conifers; *Juniperus procera* flourishes in Somaliland and on the mountains of Abyssinia; a species of *Podocarpus* occurs on the Cameroon mountains, and *P. milanjiana* is widely distributed in east tropical Africa. *Widdringtonia Whytei*, a species closely allied to *W. juniperoides* of the Cedarberg mountains of Cape Colony, is recorded from Nyassaland and from N.E. Rhodesia; while a third species, *W. cupressoides*, occurs in Cape Colony. *Podocarpus elongata* and *P. Thunbergii* (yellow wood) form the principal timber trees in the belt of forest which stretches from the coast mountains of Cape Colony to the north-east of the Transvaal. *Libocedrus tetragona*, *Fitzroya patagonica*, *Araucaria brasiliensis*, *A. imbricata*, *Saxegothaea* and others are met with in the Andes and other regions in South America. *Athrotaxis* and *Microcachrys* are characteristic Australian types. *Phyllocladus* occurs also in New Zealand, and species of *Dacrydium*, *Araucaria*, *Agathis* and *Podocarpus* are represented in Australia, New Zealand and the Malay regions.

GNETALES.—These are trees or shrubs with simple leaves. The flowers are dioecious, rarely monoecious, provided with one or two perianths. The wood is characterized by the presence of vessels in addition to tracheids. There are no resin-canals. The three existing genera, usually spoken of as members of the Gnetales, differ from one another more than is consistent with their inclusion in a single family; we may therefore better express their diverse characters by regarding them as types of three separate families—(1) *Ephedroideae*, genus *Ephedra*; (2)

Welwitschioideae, genus *Welwitschia*; (3) *Gnetoideae*, genus *Gnetum*. Our knowledge of the Gnetales leaves much to be desired, but such facts as we possess would seem to indicate that this group is of special importance as foreshadowing, more than any other Gymnosperms, the Angiospermous type. In the more heterogeneous structure of the wood and in the possession of true vessels the Gnetales agree closely with the higher flowering plants. It is of interest to note that the leaves of *Gnetum*, while typically Dicotyledonous in appearance, possess a Gymnospermous character in the continuous and plate-like medullary rays of their vascular bundles. The presence of a perianth is a feature suggestive of an approach to the floral structure of Angiosperms; the prolongation of the integument furnishes the flowers with a substitute for a stigma and style. The genus *Ephedra*, with its prothallus and archegonia, which are similar to those of other Gymnosperms, may be safely regarded as the most primitive of the Gnetales. In *Welwitschia* also the megaspore is filled with prothallus-tissue, but single egg-cells take the place of archegonia. In certain species of *Gnetum* described by Karsten the megaspore contains a peripheral layer of protoplasm, in which scattered nuclei represent the female reproductive cells; in *Gnetum Gnemon* a similar state of things exists in the upper half of the megaspore, while the lower half agrees with the megaspore of *Welwitschia* in being full of prothallus-tissue, which serves merely as a reservoir of food. Lotsy has described the occurrence of special cells at the apex of the prothallus of *Gnetum Gnemon*, which he regards as imperfect archegonia (fig. 17, C, a); he suggests they may represent vestigial structures pointing back to some ancestral form beyond the limits of the present group. The Gnetales probably had a separate origin from the other Gymnosperms; they carry us nearer to the Angiosperms, but we have as yet no satisfactory evidence that they represent a stage in the direct line of Angiospermic evolution. It is not improbable that the three genera of this ancient phylum survive as types of a blindly-ending branch of the Gymnosperms; but be that as it may, it is in the Gnetales more than in any other Gymnosperms that we find features which help us to obtain a dim prospect of the lines along which the Angiosperms may have been evolved.

Ephedra.—This genus is the only member of the Gnetales represented in Europe. Its species, which are characteristic of warm temperate latitudes, are usually much-branched shrubs. The finer branches are green, and bear a close resemblance to the stems of *Equisetum* and to the slender twigs of *Casuarina*; the surface of the long internodes is marked by fine longitudinal ribs, and at the nodes are borne pairs of inconspicuous scale-leaves. The flowers are small, and borne on axillary shoots. A single male flower consists of an axis enclosed at the base by an inconspicuous perianth formed of two concrescent leaves and terminating in two, or as many as eight, shortly stalked or sessile anthers. The female flower is enveloped in a closely fitting sac-like investment, which must be regarded as a perianth; within this is an orthotropous ovule surrounded by a single integument prolonged upwards as a beak-like micropyle. The flower may be described as a bud bearing a pair of leaves which become fused and constitute a perianth, the apex of the shoot forming an ovule. In function the perianth may be compared with a unilocular ovary containing a single ovule; the projecting integument, which at the time of pollination secretes a drop of liquid, serves the same purpose as the style and stigma of an angiosperm. The megaspore is filled with tissue as in typical Gymnosperms, and from some of the superficial cells 3 to 5 archegonia are developed, characterized by long multicellular necks. The archegonia are separated from one another, as in *Pinus*, by some of the prothallus-tissue, and the cells next the egg-cells (tapetal layer) contribute food-material to their development. After fertilization, some of the uppermost bracts below each flower become red and fleshy; the perianth develops into a woody shell, while the integument remains membranous. In some species of *Ephedra*, e.g. *E. altissima*, the fertilized eggs grow into tubular proembryos, from the tip of each of which embryos begin to be developed, but one only comes to maturity. In *Ephedra helvetica*, as described by Jaccard, no proembryo or suspensor is formed; but the most vigorous fertilized egg, after undergoing several divisions, becomes attached to a tissue, termed the columella, which serves the purpose of a primary suspensor; the columella appears to be formed by the lignification of certain cells in the central region of the embryo-sac. At a later stage some of the cells in the upper (micropylar) end of the embryo divide and undergo considerable elongation, serving the purpose of a secondary suspensor. The secondary wood of *Ephedra* consists of tracheids, vessels and parenchyma; the vessels are characterized by their wide lumen and by the large simple or slightly-bordered pits on their oblique end-walls.

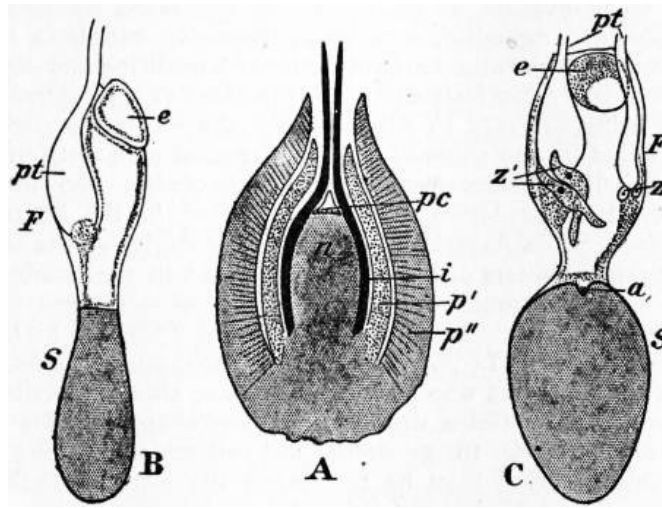


FIG. 17.—*Gnetum Gnemon*. (After Lotsy.)

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|----------------------|-----------------------------------|
| A, Female Flower. | a, Imperfect Archegonia. |
| n, Nucellus. | e, Partially developed Megaspore. |
| pc, Pollen-chamber. | F, Fertile half. |
| i, Integument. | S, Sterile half. |
| p', Inner Perianth. | pt, Pollen-tube. |
| p'', Outer Perianth. | z, Zygote. |
| B, C, Megaspore. | z', Prothallus. |

Gnetum.—This genus is represented by several species, most of which are climbing plants, both in tropical America and in warm regions of the Old World. The leaves, which are borne in pairs at the tumid nodes, are oval in form and have a Dicotyledonous type of venation. The male and female inflorescences have the form of simple or paniculate spikes. The spike of an inflorescence bears whorls of flowers at each node in the axils of concrescent bracts accompanied by numerous sterile hairs (paraphyses); in a male inflorescence numerous flowers occur at each node, while in a female inflorescence the number of flowers at each node is much smaller. A male flower consists of a single angular perianth, through the open apex of which the flower-axis projects as a slender column terminating in two anthers. The female flowers, which are more complex in structure, are of two types, complete and incomplete; the latter occur in association with male flowers in a male inflorescence. A complete female flower consists of a nucellus (fig. 17, A, *n*), surrounded by a single integument (fig. 17, A, *i*), prolonged upwards as a narrow tube and succeeded by an inner and an outer perianth (fig. 17, A, *p'* and *p''*). The whole flower may be looked upon as an adventitious bud bearing two pairs of leaves; each pair becomes concrescent and forms a perianth, the apex of the shoot being converted into an orthotropous ovule. The incomplete female flowers are characterized by the almost complete suppression of the inner perianth. Several embryo-sacs (megaspores) are present in the nucellus of a young ovule, but one only attains full size, the smaller and partially developed megaspores (fig. 17, B and C, *e*) being usually found in close association with the surviving and fully-grown megaspore. In *Gnetum Gnemon*, as described by Lotsy, a mature embryo-sac contains in the upper part a large central vacuole and a peripheral layer of protoplasm, including several nuclei, which take the place of the archegonia of *Ephedra*; the lower part of the embryo-sac, separated from the upper by a constriction, is full of parenchyma. The upper part of the megaspore may be spoken of as the fertile half (fig. 17, B and C, *F*) and the lower part, which serves only as food-reservoir for the growing embryo, may be termed the sterile half (fig. 17, B and C, *S*). (Coulter, *Bot. Gazette*, xlvii., 1908, regards this tissue as belonging to the nucellus.) At the time of pollination the long tubular integument secretes a drop of fluid at its apex, which holds the pollen-grains, brought by the wind, or possibly to some extent by insect agency, and by evaporation these are drawn on to the top of the nucellus, where partial disorganization of the cells has given rise to an irregular pollen-chamber (fig. 17, A, *pc*). The pollen-tube, containing two generative and one vegetative nucleus, pierces the wall of the megaspore and then becomes swollen (fig. 17, B and C, *pt*); finally the two generative nuclei pass out of the tube and fuse with two of the nuclei in the fertile half of the megaspore. As the result of fertilization, the fertilized nuclei of the megaspore become surrounded by a cell-wall, and constitute zygotes, which may attach themselves either to the wall of the megaspore or to the end of a pollen-tube (fig. 17, C, *z* and *z'*); they then grow into long tubes or proembryos, which make their way towards the prothallus (C, *z'*), and eventually embryos are formed from the ends of the proembryo tubes. One embryo only comes to maturity. The embryo of *Gnetum* forms an out-growth from the hypocotyl, which serves as a feeder and draws nourishment from the prothallus. The fleshy outer portion of the seed is formed from the outer perianth, the woody shell being derived from the inner perianth. The climbing species of

Gnetum are characterized by the production of several concentric cylinders of secondary wood and bast, the additional cambium-rings being products of the pericycle, as in *Cycas* and *Macrozamia*. The structure of the wood agrees in the main with that of *Ephedra*.

Welwitschia (Tumboa).—This is by far the most remarkable member of the Gnetales, both as regards habit and the form of its flowers. In a supplement to the systematic work of Engler and Prantl the well-known name *Welwitschia*, instituted by Hooker in 1864 in honour of Welwitsch, the discoverer of the plant, is superseded by that of *Tumboa*, originally suggested by Welwitsch. The genus is confined to certain localities in Damaraland and adjoining territory on the west coast of tropical South Africa. A well-grown plant projects less than a foot above the surface of the ground; the stem, which may have a circumference of more than 12 ft., terminates in a depressed crown resembling a circular table with a median groove across the centre and prominent broad ridges concentric with the margin. The thick tuberous stem becomes rapidly narrower, and passes gradually downwards into a tap-root. A pair of small strap-shaped leaves succeed the two cotyledons of the seedling, and persist as the only leaves during the life of the plant; they retain the power of growth in their basal portion, which is sunk in a narrow groove near the edge of the crown, and the tough lamina, 6 ft. in length, becomes split into narrow strap-shaped or thong-like strips which trail on the ground. Numerous circular pits occur on the concentric ridges of the depressed and wrinkled crown, marking the position of former inflorescences borne in the leaf-axil at different stages in the growth of the plant. An inflorescence has the form of a dichotomously-branched cyme bearing small erect cones; those containing the female flowers attain the size of a fir-cone, and are scarlet in colour. Each cone consists of an axis, on which numerous broad and thin bracts are arranged in regular rows; in the axil of each bract occurs a single flower; a male flower is enclosed by two opposite pairs of leaves, forming a perianth surrounding a central sterile ovule encircled by a ring of stamens united below, but free distally as short filaments, each of which terminates in a trilocular anther. The integument of the sterile ovule is prolonged above the nucellus as a spirally-twisted tube expanded at its apex into a flat stigma-like organ. A complete and functional female flower consists of a single ovule with two integuments, the inner of which is prolonged into a narrow tubular micropyle, like that in the flower of *Gnetum*. The megaspore of *Welwitschia* is filled with a prothallus-tissue before fertilization, and some of the prothallus-cells function as egg-cells; these grow upwards as long tubes into the apical region of the nucellus, where they come into contact with the pollen-tubes. After the egg-cells have been fertilized by the non-motile male cells they grow into tubular proembryos, producing terminal embryos. The stem is traversed by numerous collateral bundles, which have a limited growth, and are constantly replaced by new bundles developed from strands of secondary meristem. One of the best-known anatomical characteristics of the genus is the occurrence of numerous spindle-shaped or branched fibres with enormously-thickened walls studded with crystals of calcium oxalate. Additional information has been published by Professor Pearson of Cape Town based on material collected in Damaraland in 1904 and 1906-1907. In 1906 he gave an account of the early stages of development of the male and female organs and, among other interesting statements in regard to the general biology of *Welwitschia*, he expressed the opinion that, as Hooker suspected, the ovules are pollinated by insect-agency. In a later paper Pearson considerably extended our knowledge of the reproduction and gametophyte of this genus.

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(A. C. SE.)

GYMNOSTOMACEAE, an order of Ciliate Infusoria (*q.v.*), characterized by a closed mouth, which only opens to swallow food actively, and body cilia forming a general or partial investment (rarely represented by a girdle of membranellae), but not differentiated in different regions. With the Aspirotrichaceae (*q.v.*) it formed the Holotricha of Stein.

GYMPIE, a mining town of March county, Queensland, Australia, 107 m. N. of Brisbane, and 61 m. S. of Maryborough by rail. Pop. (1901) 11,959. Numerous gold mines are worked in the district, which also abounds in copper, silver, antimony, cinnabar, bismuth and nickel. Extensive undeveloped coal-beds lie 40 m. N. at Miva. Gympie became a municipality in 1880.

GYNAECEUM (Gr. γυναικεῖον, from γυνή, woman), that part in a Greek house which was specially reserved for the women, in contradistinction to the "andron," the men's quarters; in the larger houses there was an open court with peristyles round, and as a rule all the rooms were on the same level; in smaller houses the servants were placed in an upper storey, and this seems to have been the case to a certain extent in the Homeric house of the Odyssey. "Gynaecoonitis" is the term given by Procopius to the space reserved for women in the Eastern Church, and this separation of the sexes was maintained in the early Christian churches where there were separate entrances and accommodation for the men and women, the latter being placed in the triforium gallery, or, in its absence, either on one side of the church, the men being on the other, or occasionally in the aisles, the nave being occupied by the men.

GYNAECOLOGY (from Gr. γυνή, γυναικός, a woman, and λόγος, discourse), the name given to that branch of medicine which concerns the pathology and treatment of affections peculiar to the female sex.

Gynaecology may be said to be one of the most ancient branches of medicine. The papyrus of Ebers, which is one of the oldest known works on medicine and dates from 1550 B.C., contains references to diseases of women, and it is recorded that specialism in this branch was known amongst Egyptian medical practitioners. The Vedas contain a list of therapeutic agents used in

the treatment of gynaecological diseases. The treatises on gynaecology formerly attributed to Hippocrates (460 B.C.) are now said to be spurious, but the wording of the famous oath shows that he was at least familiar with the use of gynaecological instruments. Diocles Carystius, of the Alexandrian school (4th century B.C.), practised this branch, and Praxagoras of Cos, who lived shortly after, opened the abdomen by laparotomy. While the Alexandrine school represented Greek medicine, Greeks began to practise in Rome, and in the first years of the Christian era gynaecologists were much in demand (Häser). A speculum for gynaecological purposes has been found in the ruins of Pompeii, and votive offerings of anatomical parts found in the temples show that various gynaecological malformations were known to the ancients. Writers who have treated of this branch are Celsus (50 B.C.-A.D. 7) and Soranus of Ephesus (A.D. 98-138), who refers in his works to the fact that the Roman midwives frequently called to their aid practitioners who made a special study of diseases of women. These midwives attended the simpler gynaecological ailments. This was no innovation, as in Athens, as mentioned by Hyginus, we find one Agnodice, a midwife, disguising herself in man's attire so that she might attend lectures on medicine and diseases of women. After instruction she practised as a gynaecologist. This being contrary to Athenian law she was prosecuted, but was saved by the wives of some of the chief men testifying on her behalf. Besides Agnodice we have Sotira, who wrote a work on menstruation which is preserved in the library at Florence, while Aspasia is mentioned by Aetius as the author of several chapters of his work. It is evident that during the Roman period much of the gynaecological work was in the hands of women. Martial alludes to the "*feminae medicae*" in his epigram on Leda. These women must not be confounded with the midwives who on monuments are always described as "obstetrices." Galen devotes the sixth chapter of his work *De locis affectis* to gynaecological ailments. During the Byzantine period may be mentioned the work of Oribasius (A.D. 325) and Moschion (2nd century A.D.) who wrote a book in Latin for the use of matrons and midwives ignorant of Greek.

In modern times James Parsons (1705-1770) published his *Elenchus gynaicopathologicus et obstetricarius*, and in 1755 Charles Perry published his *Mechanical account and explication of the hysterical passion and of all other nervous disorders incident to the sex, with an appendix on cancers*. In the early part of the 19th century fresh interest in diseases of women awakened. Joseph Récamier (1774-1852) by his writings and teachings advocated the use of the speculum and sound. This was followed in 1840 by the writings of Simpson in England and Huguier in France. In 1845 John Hughes Bennett published his great work on inflammation of the uterus, and in 1850 Tilt published his book on ovarian inflammation. The credit of being the first to perform the operation of ovariectomy is now credited to McDowell of Kentucky in 1809, and to Robert Lawson Tait (1845-1899) in 1883 the first operation for ruptured ectopic gestation.

Menstruation.—Normal menstruation comprises the escape of from 4 to 6 oz. of blood together with mucus from the uterus at intervals of twenty-eight days (more or less). The flow begins at the age of puberty, the average age of which in England is between fourteen and sixteen years. It ceases between forty-five and fifty years of age, and this is called the menopause or climacteric period, commonly spoken of as "the change of life." Both the age of puberty and that of the menopause may supervene earlier or later according to local conditions. At both times the menstrual flow may be replaced by haemorrhage from distant organs (epistaxis, haematemesis, haemoptysis); this is called *vicarious menstruation*. Menstruation is usually but not necessarily coincident with ovulation. The usual disorders of menstruation are: (1) *amenorrhoea* (absence of flow), (2) *dysmenorrhoea* (painful flow), (3) *menorrhagia* (excessive flow), (4) *metrorrhagia* (excessive and irregular flow). Amenorrhoea may arise from physiological causes, such as pregnancy, lactation, the menopause; constitutional causes, such as phthisis, anaemia and chlorosis, febrile disorders, some chronic intoxications, such as morphinomania, and some forms of cerebral disease; local causes, which include malformations or absence of one or more of the genital parts, such as absence of ovaries, uterus or vagina, atresia of vagina, imperforate cervix, disease of the ovaries, or sometimes imperforate hymen. The treatment of amenorrhoea must be directed towards the cause. In anaemia and phthisis menstruation often returns after improvement in the general condition, with good food and good sanitary conditions, an outdoor life and the administration of iron or other tonics. In local conditions of imperforate hymen, imperforate cervix or ovarian disease, surgical interference is necessary. Amenorrhoea is permanent when due to absence of the genital parts. The causes of dysmenorrhoea are classified as follows: (1) ovarian, due to disease of the ovaries or Fallopian tubes; (2) obstructive, due to some obstacle to the flow, as stenosis, flexions and malpositions of the uterus, or malformations; (3) congestive, due to subinvolution, chronic inflammation of the uterus or its lining membrane, fibroid growths and polypi of the uterus, cardiac or hepatic disease; (4) neuralgic; (5) membranous. The foremost place in the treatment of dysmenorrhoea must be given to aperients and purgatives administered a day or two before the period is expected. By this means congestion is reduced. Hot baths are useful, and various drugs such as hyoscyamus, cannabis indica, phenalgin, ammonol or phenacetin have been prescribed. Medicinal treatment is, however, only palliative, and flexions and malpositions of the uterus must be corrected, stenosis treated by dilatation, fibroid growths if present removed, and endometritis when present treated by local applications or curetting according to its severity. Menorrhagia signifies excessive bleeding at the menstrual periods. Constitutional causes are purpura, haemophilia, excessive food and alcoholic

drinks and warm climates; while local causes are congestion and displacements of the uterus, endometritis, subinvolution, retention of the products of conception, new growths in the uterus such as mucous and fibroid polypi, malignant growths, tubo-ovarian inflammation and some ovarian tumours. Metrorrhagia is a discharge of blood from the uterus, independent of menstruation. It always arises from disease of the uterus or its appendages. Local causes are polypi, retention of the products of conception, extra uterine gestation, haemorrhages in connexion with pregnancy, and new growths in the uterus. In the treatment of both menorrhagia and metrorrhagia the local condition must be carefully ascertained. When pregnancy has been excluded, and constitutional causes treated, efforts should be made to relieve congestion. Uterine haemostatics, as ergot, ergotin, tincture of hydrastis or hamamelis, are of use, together with rest in bed. Fibroid polypi and other new growths must be removed. Irregular bleeding in women over forty years of age is frequently a sign of early malignant disease, and should on no account be neglected.

Diseases of the External Genital Organs.—The vulva comprises several organs and structures grouped together for convenience of description (see [REPRODUCTIVE SYSTEM](#)). The affections to which these structures are liable may be classified as follows: (1) Injuries to the vulva, either accidental or occurring during parturition; these are generally rupture of the perinaeum. (2) *Vulvitis*. Simple Vulvitis is due to want of cleanliness, or irritating discharges, and in children may result from threadworms. The symptoms are heat, itching and throbbing, and the parts are red and swollen. The treatment consists of rest, thorough cleanliness and fomentations. Infective vulvitis is nearly always due to gonorrhoea. The symptoms are the same as in simple vulvitis, with the addition of mucopurulent yellow discharge and scalding pain on micturition; if neglected, extension of the disease may result. The treatment consists of rest in bed, warm medicated baths several times a day or fomentations of boracic acid. The parts must be kept thoroughly clean and discharges swabbed away. Diphtheritic vulvitis occasionally occurs, and erysipelas of the vulva may follow wounds, but since the use of antiseptics is rarely seen. (3) Vascular disturbances may occur in the vulva, including varix, haematoma, oedema and gangrene; the treatment is the same as for the same disease in other parts. (4) The vulva is likely to be affected by a number of cutaneous affections, the most important being erythema, eczema, herpes, lichen, tubercle, elephantiasis, vulvitis pruriginosa, syphilis and kraurosis. These affections present the same characters as in other parts of the body. *Kraurosis vulvae*, first described by Lawson Tait in 1875, is an atrophic change accompanied by pain and a yellowish discharge; the cause is unknown. Pruritis vulvae is due to parasites, or to irritating discharges, as leucorrhoea, and is frequent in diabetic subjects. The hymen may be occasionally imperforate and require incision. Cysts and painful carunculae may occur on the clitoris. Any part of the vulva may be the seat of new growths, simple or malignant.

Diseases of the Vagina.—(1) Malformations. The vagina may be absent in whole or in part or may present a septum. Stenosis of the vagina may be a barrier to menstruation. (2) Displacements of the vagina; (a) cystocele, which is a hernia of the bladder into the vagina; (b) rectocele, a hernia of the rectum into the vagina. The cause of these conditions is relaxation of the tissues due to parturition. The palliative treatment consists in keeping up the parts by the insertion of a pessary; when this fails operative interference is called for. (3) Fistulae may form between the vagina and bladder or vagina and rectum; they are generally caused by injuries during parturition or the late stages of carcinoma. Persistent fistulae require operative treatment. The vagina normally secretes a thin opalescent acid fluid derived from the lymph serum and the shedding of squamous epithelium. This fluid normally contains the vagina bacillus. In pathological conditions of the vagina this secretion undergoes changes. For practical purposes three varieties of *vaginitis* may be described: (a) simple catarrhal vaginitis is due to the same causes as simple vulvitis, and occasionally in children is important from a medico-legal aspect when it is complicated by vulvitis. The symptoms are heat and discomfort with copious mucopurulent discharge. The only treatment required is rest, with vaginal douches of warm unirritating lotions such as boracic acid or subacetate of lead. (b) Gonorrhoeal vaginitis is most common in adults. The patient complains of pain and burning, pain on passing water and discharge which is generally green or yellow. The results of untreated gonorrhoeal vaginitis are serious and far-reaching. The disease may spread up the genital passages, causing endometritis, salpingitis and septic peritonitis, or may extend into the bladder, causing cystitis. Strict rest should be enjoined, douches of carbolic acid (1 in 40) or of perchloride of mercury (1 in 2000) should be ordered morning and evening, the vagina being packed with tampons of iodoform gauze. Saline purgatives and alkaline diuretics should be given, (c) Chronic vaginitis (leucorrhoea or “the whites”) may follow acute conditions and persist indefinitely. The vagina is rarely the seat of tumours, but cysts are common.

Diseases of the Uterus.—The uterus undergoes important changes during life, chiefly at puberty and at the menopause. At puberty it assumes the pear shape characteristic of the mature uterus. At the menopause it shares in the general atrophy of the reproductive organs. It is subject to various disorders and misplacements. (a) *Displacements of the Uterus.*—The normal position of the uterus, when the bladder is empty, is that of anteversion. We have therefore to consider the following conditions as pathological: antelexion, retroflexion, retroversion, inversion, prolapse and procidentia. Slight antelexion or bending forwards is normal; when exaggerated it gives rise to dysmenorrhoea, sterility and reflex nervous phenomena. This condition is usually congenital

and is often associated with under-development of the uterus, from which the sterility results. The treatment is by dilatation of the canal or by a plastic operation. Retroflexion is a bending over of the uterus backwards, and occurs as a complication of retroversion (or displacement backwards). The causes are (1) any cause tending to make the fundus or upper part of the uterus extra heavy, such as tumours or congestion, (2) loss of tone of the uterine walls, (3) adhesions formed after cellulitis, (4) violent muscular efforts, (5) weakening of the uterine supports from parturition. The symptoms are dysmenorrhoea, pain on defaecation and constipation from the pressure of the fundus on the rectum; the patient is often sterile. The treatment is the replacing of the uterus in position, where it can be kept by the insertion of a pessary; failing this, operative treatment may be required. Retroversion when pathological is rarer than retroflexion. It may be the result of injury or is associated with pregnancy or a fibroid. The symptoms are those of retroflexion with feeling of pain and weight in the pelvis and desire to micturate followed by retention of urine due to the pressure of the cervix against the base of the bladder. The uterus must be skilfully replaced in position; when pessaries fail to keep it there the operation of hysteropexy gives excellent results.

Inversion occurs when the uterus is turned inside out. It is only possible when the cavity is dilated, either after pregnancy or by a polypus. The greater number of cases follow delivery and are acute. Chronic inversions are generally due to the weight of a polypus. The symptoms are menorrhagia, metrorrhagia and bladder troubles; on examination a tumour-like mass occupies the vagina. Reduction of the condition is often difficult, particularly when the condition has lasted for a long time. The tumour which has caused the inversion must be excised. Prolapse and procidentia are different degrees of the same variety of displacement. When the uterus lies in the vagina it is spoken of as prolapse, when it protrudes through the vulva it is procidentia. The causes are directly due to increased intra-abdominal pressure, increased weight of the uterus by fibroids, violent straining, chronic cough and weakening of the supporting structures of the pelvic floor, such as laceration of the vagina and perinaeum. Traction on the uterus from below (as a cervical tumour) may be a cause; advanced age, laborious occupations and frequent pregnancies are indirect causes. The symptoms are a "bearing down" feeling, pain and fatigue in walking, trouble with micturition and defaecation. The condition is generally obvious on examination. As a rule the uterus is easy to replace in position. A rubber ring pessary will often serve to keep it there. If the perinaeum is very much torn it may be necessary to repair it. Various operations for retaining the uterus in position are described. (b) *Enlargements of the Uterus* (hypertrophy or hyperplasia). This condition may sometimes involve the uterus as a whole or may be most marked in the body or in the cervix. It follows chronic congestion or inflammatory prolapse, or any condition interfering with the circulation. The symptoms comprise local discomfort and sometimes dysmenorrhoea, leucorrhoea or menorrhagia. When the elongation occurs in the cervical portion the only possible treatment is amputation of the cervix. Atrophy of the uterus is normal after the menopause. It may follow the removal of the tubes and ovaries. Some constitutional diseases produce the same result, as tuberculosis, chlorosis, chronic morphinism and certain diseases of the central nervous system.

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(c) *Injuries and Diseases resultant from Pregnancy*.—The most frequent of these injuries is laceration of the cervix uteri, which is frequent in precipitate labour. Once the cervix is torn the raw surfaces become covered by granulations and later by cicatricial tissue, but as a rule they do not unite. The torn lips may become unhealthy, and the congestion and oedema spread to the body of the uterus. A lacerated cervix does not usually give rise to symptoms; these depend on the accompanying endometritis, and include leucorrhoea, aching and a feeling of weight. Lacerations are to be felt digitally. As lacerations predispose to abortion the operation of trachelorrhaphy or repair of the cervix is indicated. Perforation of the uterus may occur from the use of the sound in diseased conditions of the uterine walls. Superinvolution means premature atrophy following parturition. Subinvolution is a condition in which the uterus fails to return to its normal size and remains enlarged. Retention of the products of conception may cause irregular haemorrhages and may lead to a diagnosis of tumour. The uterus should be carefully explored.

(d) *Inflammations Acute and Chronic*.—The mucous membrane lining the cervical canal and body of the uterus is called the endometrium. Acute inflammation or endometritis may attack it. The chief causes are sepsis following labour or abortion, extension of a gonorrhoeal vaginitis, or gangrene or infection of a uterine myoma. The puerperal endometritis following labour is an avoidable disease due to lack of scrupulous aseptic precautions.

Gonorrhoeal endometritis is an acute form associated with copious purulent discharge and well-marked constitutional disturbance. The temperature ranges from 99° to 105° F., associated with pelvic pain, and rigors are not uncommon. The tendency is to recovery with more or less protracted convalescence. The most serious complications are extension of the disease and later sterility. Rest in bed and intrauterine irrigation, followed by the introduction of iodoform pencils into the uterine cavity, should be resorted to, while pain is relieved by hot fomentations and sitz baths. Chronic endometritis may be the sequela of the acute form, or may be septic in origin, or the result of chronic congestion, acute retroflexion or subinvolution following delivery or abortion. The varieties are glandular, interstitial, haemorrhagic and senile. The symptoms are disturbance of the menstrual function, headache, pain and pelvic discomfort, and more or less profuse thick leucorrhoeal discharge. The treatment consists in attention to the general health, with suitable laxatives and local injections, and in obstinate cases curettage is the most effectual

measure. The disease is frequently associated with adenomatous disease of the cervix, formerly called erosion. In this disease there is a new formation of glandular elements, which enlarge and multiply, forming a soft velvety areola dotted with pink spots. This was formerly erroneously termed ulceration. The cause is unknown. It occurs in virgins as well as in mothers, but it often accompanies lacerations of the cervix. The symptoms are indefinite pain and leucorrhoea. The condition is visible on inspection with a speculum. The treatment is swabbing with iodized phenol or curettage. The body of the uterus may also be the seat of adenomatous disease. Tuberculosis may attack the uterus; this usually forms part of a general tuberculosis.

(e) *New Growths in the Uterus.*—The uterus is the most common seat of new growths. From the researches of von Gurlt, compiled from the Vienna Hospital *Reports*, embracing 15,880 cases of tumour, females exceed males in the proportion of seven to three, and of this large majority uterine growths account for 25%. When we consider its periodic monthly engorgements and the alternate hypertrophy and involution it undergoes in connexion with pregnancy, we can anticipate the special proneness of the uterus to new growths. Tumours of the uterus are divided into benign and malignant. The benign tumours known as fibroids or myomata are very common. They are stated by Bayle to occur in 20% of women over 35 years of age, but happily in a great number of cases they are small and give rise to no symptoms. They are definitely associated with the period of sexual activity and occur more frequently in married women than in single, in the proportion of two to one (Winckel). It is doubtful if they ever originate after the menopause. Indeed if uncomplicated by changes in them they share in the general atrophy of the sexual organs which then takes place. They are divided according to their position in the tissues into intramural, subserous and submucous (the last when it has a pedicle forms a polypus), or as to the part of the uterus in which they develop into fibroids of the cervix and fibroids of the body. Intramural and submucous fibroids give rise to haemorrhage. The menses may be so increased that the patient is scarcely ever free from haemorrhage. The pressure of the growth may cause dysmenorrhoea, or pressure on the bladder and rectum may cause dysuria, retention or rectal tenesmus. The uterus may be displaced by the weight of the tumour. Secondary changes take place in fibroids, such as mucous degeneration, fatty metamorphosis, calcification, septic infection (sloughing fibroid) and malignant (sarcomatous) degeneration.

The modes in which fibroids imperil life are haemorrhage (the commonest of all), septic infection, which is one of the most dangerous, impaction when it fits the true pelvis so tightly that the tumour cannot rise, twisting of the pedicle by rotation, leading to sloughing and intestinal and urinary obstruction. When fibroids are complicated by pregnancy, impaction and consequent abortion may take place, or a cervical myoma may offer a mechanical obstacle to delivery or lead to serious post partem haemorrhage. In the treatment of fibroids various drugs (ergot, hamamelis, hydrastis canadensis) may be tried to control the haemorrhage, and repose and the injection of hot water (120° F.) are sometimes successful, together with electrical treatment. Surgical measures are needed, however, in severe recurrent haemorrhage, intestinal obstruction, sloughing and the co-existence of pregnancy. An endeavour must be made if possible to enucleate the fibroid, or hysterectomy (removal of the uterus) may be required. The operation of removal of the ovaries to precipitate the menopause has fallen into disuse.

(f) *Malignant Disease of the Uterus.*—The varieties of malignant disease met with in the uterus are sarcoma, carcinoma and chorion-epithelioma malignum. Sarcomata may occur in the body and in the neck. They occur at an earlier age than carcinomata. Marked enlargement and haemorrhage are the symptoms. The differential diagnosis is microscopic. Extirpation of the uterus is the only chance of prolonging life. The age at which women are most subject to carcinoma (cancer) of the uterus is towards the decline of sexual life. Of 3385 collected cases of cancer of the uterus 1169 occurred between 40 and 50, and 856 between 50 and 60. In contradistinction to fibroid tumours it frequently arises after the menopause. It may be divided into cancer of the body and cancer of the neck (cervix). Cancer of the neck of the uterus is almost exclusively confined to women who have been pregnant (Bland-Sutton). Predisposing causes may be injuries during delivery. The symptoms which induce women to seek medical aid are haemorrhage, foetid discharge, and later pain and cachexia. An unfortunate belief amongst the public that the menopause is associated with irregular bleeding and offensive discharges has prevented many women from seeking medical advice until too late. It cannot be too widely understood that cancer of the cervix is in its early stages a purely local disease, and if removed in this stage usually results in cure. So important is the recognition of this fact in the saving of human life that at the meeting of the British Medical Association in April 1909 the council issued for publication a special appeal to medical practitioners, midwives and nurses, and directed it to be published in British and colonial medical and nursing journals. It will be useful to quote here a part of the appeal directed to midwives and nurses: "Cancer may occur at any age and in a woman who looks quite well, and who may have no pain, no wasting, no foul discharge and no profuse bleeding. To wait for pain, wasting, foul discharge or profuse bleeding is to throw away the chance of successful treatment. The early symptoms of cancer of the womb are:—(1) bleeding which occurs after the change of life, (2) bleeding after sexual intercourse or after a vaginal douche, (3) bleeding, slight or abundant, even in young women, if occurring between the usual monthly periods, and especially when accompanied by a bad-smelling or watery blood-tinged discharge, (4) thin watery discharge occurring at any age." On examination the cervix presents certain characteristic signs, though these may be modified according to the variety of cancer

present. Hard nodules or definite loss of substance, extreme friability and bleeding after slight manipulation, are suspicious. Epithelial cancer of the cervix may assume a proliferating ulcerative type, forming the well-known "cauliflower" excrescence. The treatment of cancer of the cervix is free removal at the earliest possible moment. Cancer of the body of the uterus is rare before the 45th year. It is most frequent at or subsequent to the menopause. The majority of the patients are nulliparae (Bland-Sutton). The signs are fitful haemorrhages after the menopause, followed by profuse and offensive discharges. The uterus on examination often feels enlarged. The diagnosis being made, hysterectomy (removal of the uterus) is the only treatment. Cancer of the body of the uterus may complicate fibroids. Chorion-epithelioma malignum (deciduoma) was first described in 1889 by Sanger and Pfeiffer. It is a malignant disease presenting microscopic characters resembling decidua tissue. It occurs in connexion with recent pregnancy, and particularly with the variety of abortion termed hydatid mole. In many cases it destroys life with a rapidity unequalled by any other kind of growth. It quickly ulcerates and infiltrates the uterine tissues, forming metastatic growths in the lung and vagina. Clinically it is recognized by the occurrence after pregnancy of violent haemorrhages, progressive cachexia and fever with rigors. Recent suggestions have been made as to chorion-epithelioma being the result of pathological changes in the lutein tissue of the ovary. The growth is usually primary in the uterus, but may be so in the Fallopian tubes and in the vagina. A few cases have been recorded unconnected with pregnancy. The virulence of chorion-epithelioma varies, but in the present state of our knowledge immediate removal of the primary growth along with the affected organ is the only treatment.

Diseases of the Fallopian Tubes.—The Fallopian tubes or oviducts are liable to inflammatory affections, tuberculosis, sarcomata, cancer, chorion-epithelioma and tubal pregnancy. Salpingitis (inflammation of the oviducts) is nearly always secondary to septic infection of the genital tract. The chief causes are septic endometritis following labour or abortion, gangrene of a myoma, gonorrhoea, tuberculosis and cancer of the uterus; it sometimes follows the specific fevers. When the pus escapes from the tubes into the coelom it sets up pelvic peritonitis. When the inflammation is adjacent to the ostium it leads to the matting together of the tubal fimbriae and glues them to an adjacent organ. This seals the ostium. The occluded tube may now have an accumulation of pus in it (pyosalpinx). When in consequence of the sealing of the ostium the tube becomes distended with serous fluid it is termed hydrosalpinx. Haematosalpinx is a term applied to the non-gravid tube distended with blood; later the tubes may become sclerosed. Acute septic salpingitis is ushered in by a rigor, the temperature rising to 103°, 104° F., with severe pain and constitutional disturbance. The symptoms may become merged in those of general peritonitis. In chronic disease there is a history of puerperal trouble followed by sterility, with excessive and painful menstruation. Acute salpingitis requires absolute rest, opium suppositories and hot fomentations. With urgent symptoms removal of the inflamed adnexa must be resorted to. Chronic salpingitis often renders a woman an invalid. Permanent relief can only be afforded by surgical intervention. Tuberculous salpingitis is usually secondary to other tuberculous infections. The Fallopian tubes may be the seat of malignant disease. This is rarely primary. By far the most important of the conditions of the Fallopian tubes is tubal pregnancy (or ectopic gestation). It is now known that fertilization of the human ovum by the spermatozoon may take place even when the ovum is in its follicle in the ovary, for oosperms have been found in the ovary and Fallopian tubes as well as in the uterus. Belief in ovarian pregnancy is of old standing, and had been regarded as possible but unproved, no case of an early embryo in its membranes in the sac of an ovary being forthcoming, until the remarkable case published by Dr Catherine van Tussenboek of Amsterdam in 1899 (Bland-Sutton). Tubal pregnancy is most frequent in the left tube; it sometimes complicates uterine pregnancy; rarely both tubes are pregnant. When the oosperm lodges in the ampulla or isthmus it is called tubal gestation; when it is retained in the portion traversing the uterine wall it is called tubo-uterine gestation. Wherever the fertilized ovum remains and implants its villi the tube becomes turgid and swollen, and the abdominal ostium gradually closes. The ovum in this situation is liable to apoplexy, forming tubal mole. When the abdominal ostium remains pervious the ovum may escape into the coelomic cavity (tubal abortion); death from shock and haemorrhage into the abdominal cavity may result. When neither of these occurrences has taken place the ovum continues to grow inside the tube, the rupture of the distended tube usually taking place between the sixth and the tenth week. The rupture of the tube may be intraperitoneal or extraperitoneal. The danger is death from haemorrhage occurring during the rupture, or adhesions may form, the retained blood forming a haematocoele. The ovum may be destroyed or may continue to develop. In rare cases rupture may not occur, the tube bulging into the peritoneal cavity; and the foetus may break through the membranes and lie free among the intestines, where it may die, becoming encysted or calcified. The tubal placenta possesses foetal structures, the true decidua forming in the uterus. The signs suggestive of tubal pregnancy before rupture are missed periods, pelvic pains and the presence of an enlarged tube. When rupture takes place it is attended in both varieties with sudden and severe pain and more or less marked collapse, and a tumour may or may not be felt according to the situation of the rupture. There is a general "feeling of something having given way." If diagnosed before rupture, the sac must be removed by abdominal section. In intraperitoneal rupture immediate operation affords the only chance of saving life. In extraperitoneal rupture the foetus may occasionally remain alive until full term and be rescued by abdominal section, if the condition is recognized, or a false labour may take place, accompanied by death of the foetus.

Diseases of the Ovaries and Parovarium.—The ovaries undergo striking changes at puberty, and

again at the menopause, after which there is a gradual shrinkage. One or both may be absent or malformed, or they are subject to displacements, being either undescended, contained in a hernia or prolapsed. Either of these conditions, if a source of pain, may necessitate their removal. The ovary is also subject to haemorrhage or apoplexy. Acute inflammations (oöphorites) are constantly associated with salpingitis or other septic conditions of the genital tract or with an attack of mumps. The relation of oöphoritis to mumps is at present unknown. Acute oöphoritis may culminate in abscess but more usually adhesions are formed. The surgical treatment is that of pyosalpinx. Chronic inflammation may follow acute or be consequent on pelvic cellulitis. Its constant features are more or less pain followed by sterility. The ovary may be the seat of tuberculosis, which is generally secondary to other lesions. Suppuration and abscess of the ovary also occur. Perioöphoritis, or chronic inflammation in the neighbourhood, may also involve the gland. The cause of cirrhosis of the ovaries is unknown, though it may be associated with cirrhotic liver. The change is met with in women between 20 and 40 years of age, the ovaries being in a shrunken, hard, wrinkled condition. Under ovarian neuralgia are grouped indefinite painful symptoms occurring frequently in neurotic and alcoholic subjects, and often worse during menstruation. The treatment, whether local or operative, is usually unsatisfactory. The ovary is frequently the seat of tumours, dermoids and cysts. Cysts may be simple, unilocular or multilocular, and may attain an enormous size. The largest on record was removed by Dr Elizabeth Reifsnnyder of Shanghai, and contained 100 litres of fluid, and the patient recovered. The operation is termed ovariectomy. Dermoid cysts containing skin, bones, teeth and hair, are of frequent growth in the ovary, and have attained the weight of from 20 to 40 kilogrammes. In one case a girl weighed 27 kilogrammes and her tumour 44 kilogrammes (Keen). Papillomatous cysts also occur in the ovary. Parovarian and Gärtnerian cysts are found, and adenomata form 20% of all ovarian cysts. Occasionally the tunic of peritoneum surrounding the ovary becomes distended with serous fluid. This is termed ovarian hydrocele. Ovarian fibroids occur, and malignant disease (sarcoma and carcinoma) is fairly frequent, sarcoma being the most usual ovarian tumour occurring before puberty. Carcinoma of the ovary is rarely primary, but it is a common situation for secondary cancer to that of the breast, gall-bladder or gastro-intestinal tract. The treatment of all rapidly-growing tumours of the ovary is removal.

Diseases of the Pelvic Peritoneum and Connective Tissue.—Women are excessively liable to peritoneal infections. (1) Septic infection often follows acute salpingitis and may give rise to pelvic peritonitis (perimetritis), which may be adhesive, serous or purulent. It may follow the rupture of ovarian or dermoid cysts, rupture of the uterus, extra uterine pregnancy or extension from pyosalpinx. The symptoms are severe pain, fever, 103° F. and higher, marked constitutional disturbances, vomiting, restlessness, even delirium. The abdomen is fixed and tympanic. Its results are the formation of adhesions causing abnormal positions of the organs, or chronic peritonitis may follow. The treatment is rest in bed, opium, hot stupes to the abdomen and quinine. (2) Epithelial infections take place in the peritoneum in connexion with other malignant growths. (3) Hydroperitoneum, a collection of free fluid in the abdominal cavity, may be due to tumours of the abdominal viscera or to tuberculosis of the peritoneum. (4) Pelvic cellulitis (parametritis) signifies the inflammation of the connective tissue between the folds of the broad ligament (mesometrium). The general causes are septic changes following abortion, delivery at term (especially instrumental delivery), following operations on the uterus or salpingitis. The symptoms are chill followed by severe intrapelvic pain and tension, fever 100° to 102° F. There may be nausea and vomiting, diarrhoea, rectal tenseness and dysuria. If consequent on parturition the lochia cease or become offensive. On examination there is tenderness and swelling in one flank and the uterus becomes fixed and immovable in the exudate as if embedded in plaster of Paris. The illness may go to resolution if treated by rest, opium, hot stupes or icebags and glycerine tampons, or may go on to suppuration forming pelvic abscess, which signifies a collection of pus between the layers of the broad ligament. The pus in a pelvic abscess may point and escape through the walls of the vagina, rectum or bladder. It occasionally points in the groin. If the pus can be localized an incision should be made and the abscess drained. The tumours which arise in the broad ligament are haematocele, solid tumours (as myomata, lipomata and sarcomata), and echinococcus colonies (hydatids).

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(H. L. H.)

GYÖNGYÖSI, ISTVÁN [STEPHEN] (1620-1704), Hungarian poet, was born of poor but noble parents in 1620. His abilities early attracted the notice of Count Ferencz Wesselényi, who in 1640 appointed him to a post of confidence in Fülek castle. Here he remained till 1653, when he married and became an assessor of the judicial board. In 1681 he was elected as a representative

of his county at the diet held at Soprony (Oedenburg). From 1686 to 1693, and again from 1700 to his death in 1704, he was deputy lord-lieutenant of the county of Gömör. Of his literary works the most famous is the epic poem *Murányi Venus* (Caschau, 1664), in honour of his benefactor's wife Maria Szécsi, the heroine of Murány. Among his later productions the best known are *Rózsa-Koszorú*, or Rose-Wreath (1690), *Kemény-János* (1693), *Cupidó* (1695), *Palinodia* (1695) and *Chariklia* (1700).

The earliest edition of his collected poetical works is by Dugonics (Pressburg and Pest, 1796); the best modern selection is that of Toldy, entitled *Gyöngyösi István válogatott poétai munkái* (Select poetical works of Stephen Gyöngyösi, 2 vols., 1864-1865).

GYÖR (Ger. *Raab*), a town of Hungary, capital of a county of the same name, 88 m. W. of Budapest by rail. Pop. (1900) 27,758. It is situated at the confluence of the Raab with the Danube, and is composed of the inner town and three suburbs. Győr is a well-built town, and is the seat of a Roman Catholic bishop. Amongst its principal buildings are the cathedral, dating from the 12th century, and rebuilt in 1639-1654; the bishop's palace; the town hall; the Roman Catholic seminary for priests and several churches. There are manufactures of cloth, machinery and tobacco, and an active trade in grain and horses. Twenty miles by rail W. S. W. of the town is situated Csorna, a village with a Premonstratensian abbey, whose archives contain numerous valuable historical documents.

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Győr is one of the oldest towns in Hungary and occupies the site of the Roman *Arabona*. It was already a place of some importance in the 10th century, and its bishopric was created in the 11th century. It was a strongly fortified town which resisted successfully the attacks of the Turks, into whose hands it fell by treachery in 1594, but they retained possession of it only for four years. Montecucculi made Győr a first-class fortress, and it remained so until 1783, when it was abandoned. At the beginning of the 19th century, the fortifications were re-erected, but were easily taken by the French in 1809, and were again stormed by the Austrians on the 28th of June 1849.

About 11 m. S.E. of Győr on a spur of the Bakony Forest lies the famous Benedictine abbey of Pannonhalma (Ger. *St Martinsberg*; Lat. *Mons Sancti Martini*), one of the oldest and wealthiest abbeys of Hungary. It was founded by King St Stephen, and the original deed from 1001 is preserved in the archives of the abbey. The present building is a block of palaces, containing a beautiful church, some of its parts dating from the 12th century, and lies on a hill 1200 ft. high. The church has a tower 130 ft. high. In the convent there are a seminary for priests, a normal school, a gymnasium and a library of 120,000 vols. The chief abbot has the rank of a bishop, and is a member of the Upper House of the Hungarian parliament, while in spiritual matters he is subordinate immediately to the Roman curia.

GYP, the pen name of SIBYLLE GABRIELLE MARIE ANTOINETTE RIQUETI DE MIRABEAU, Comtesse de Martel de Janville (1850-) French writer, who was born at the château of Koetsal in the Morbihan. Her father, who was the grandson of the vicomte de Mirabeau and great-nephew of the orator, served in the Papal Zouaves, and died during the campaign of 1860. Her mother, the comtesse de Mirabeau, in addition to some graver compositions, contributed to the *Figaro* and the *Vie parisienne*, under various pseudonyms, papers in the manner successfully developed by her daughter. Under the pseudonym of "Gyp" Madame de Martel, who was married in 1869, sent to the *Vie parisienne*, and later to the *Revue des deux mondes*, a large number of social sketches and dialogues, afterwards reprinted in volumes. Her later work includes stories of a more formal sort, essentially differing but little from the shorter studies. The following list includes some of the best known of Madame de Martel's publications, nearly seventy in number: *Petit Bob* (1882); *Autour du mariage* (1883); *Ce que femme veut* (1883); *Le Monde à côté* (1884), *Sans voiles* (1885); *Autour du divorce* (1886); *Dans le train* (1886); *Mademoiselle Loulou* (1888); *Bob au salon* (1888-1889); *L'Education d'un prince* (1890); *Passionette* (1891); *Ohé! la grande vie* (1891); *Une Élection à Tigre-sur-mer* (1890), an account of "Gyp's" experiences in support of a Boulangist candidate; *Mariage civil* (1892); *Ces bons docteurs* (1892); *Du haut en bas* (1893); *Mariage de chiffon* (1894); *Leurs âmes* (1895); *Le Cœur d'Ariane* (1895); *Le Bonheur de Ginette* (1896); *Totote* (1897); *Lune de miel* (1898); *Israël* (1898); *L'Entrevue* (1899); *Le Pays des champs* (1900); *Trop de chic* (1900); *Le Friquet* (1901); *La Fée* (1902); *Un Mariage chic* (1903); *Un*

Ménage dernier cri (1903); *Maman* (1904); *Le Cœur de Pierrette* (1905). From the first "Gyp," writing of a society to which she belonged, displayed all the qualities which have given her a distinct, if not pre-eminent, position among writers of her class. Those qualities included an intense faculty of observation, much skill in innuendo, a mordant wit combined with some breadth of humour, and a singular power of animating ordinary dialogues without destroying the appearance of reality. Her Parisian types of the spoiled child, of the precocious schoolgirl, of the young bride, and of various masculine figures in the gay world, have become almost classical, and may probably survive as faithful pictures of luxurious manners in the 19th century. Some later productions, inspired by a violent anti-Semitic and Nationalist bias, deserve little consideration. An earlier attempt to dramatize *Autour du mariage* was a failure, not owing to the audacities which it shares with most of its author's works, but from lack of cohesion and incident. More successful was *Mademoiselle Ève* (1895), but indeed "Gyp's" successes are all achieved without a trace of dramatic faculty. In 1901 Madame de Martel furnished a sensational incident in the Nationalist campaign during the municipal elections in Paris. She was said to have been the victim of a kidnapping outrage or piece of horseplay provoked by her political attitude, but though a most circumstantial account of the outrages committed on her and of her adventurous escape was published, the affair was never clearly explained or verified.

GYPSUM, a common mineral consisting of hydrous calcium sulphate, named from the Gr. γύψος, a word used by Theophrastus to denote not only the raw mineral but also the product of its calcination, which was employed in ancient times, as it still is, as a plaster. When crystallized, gypsum is often called selenite, the σεληνίτης of Dioscorides, so named from σελήνη, "the moon," probably in allusion to the soft moon-like reflection of light from some of its faces, or, according to a legend, because it is found at night when the moon is on the increase. The granular, marble-like gypsum is termed alabaster (*q.v.*).

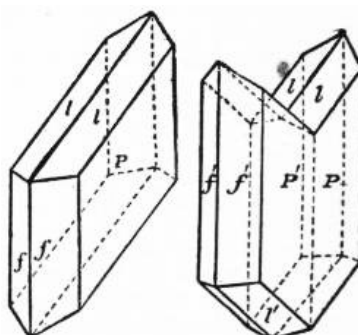


FIG. 1.

FIG. 2.

Gypsum crystallizes in the monoclinic system, the habit of the crystals being usually either prismatic or tabular; in the latter case the broad planes are parallel to the faces of the clinopinacoid. The crystals may become lenticular by curvature of certain faces. In the characteristic type represented in fig. 1, *f* represents the prism, *l* the hemi-pyramid and *P* the clinopinacoid. Twins are common, as in fig. 2, forming in some cases arrow-headed and swallow-tailed crystals. Cleavage is perfect parallel to the clinopinacoid, yielding thin plates, often diamond-shaped, with pearly lustre; these flakes are usually flexible, but may be brittle, as in the gypsum of Montmartre. Two other cleavages are recognized, but they are imperfect. Crystals of gypsum, when occurring in clay, may enclose much muddy matter; in other cases a large proportion of sand may be mechanically entangled in the crystals without serious disturbance of form; whilst certain crystals occasionally enclose cavities with liquid and an air-bubble. Gypsum not infrequently becomes fibrous. This variety occurs in veins, often running through gypseous marls, with the fibres disposed at right angles to the direction of the vein. Such gypsum when cut and polished has a pearly opalescence, or satiny sheen, whence it is called satin-spar (*q.v.*).

Gypsum is so soft as to be scratched even by the finger-nail ($H = 1.5$ to 2). Its specific gravity is about 2.3. The mineral is slightly soluble in water, one part of gypsum being soluble, according to G. K. Cameron, in 372 parts of pure water at 26° C. Waters percolating through gypseous strata, like the Keuper marls, dissolve the calcium sulphate and thus become permanently hard or "selenitic." Such water has special value for brewing pale ale, and the water used by the Burton breweries is of this character; hence the artificial dissolving of gypsum in water for brewing purposes is known as "burtonization." Deposits of gypsum are formed in boilers using selenitic water.

Pure gypsum is colourless or white, but it is often tinted, especially in the alabaster variety, grey, yellow or pink. Gypsum crystallizes with two molecules of water, equal to about 21% by weight, and consequently has the formula $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. By exposure to strong heat all the water may be expelled, and the substance then has the composition of anhydrite (*q.v.*). When the calcination, however, is conducted at such a temperature that only about 75% of the water is lost, it yields a white pulverulent substance, known as "plaster of Paris," which may readily be caused to recombine with water, forming a hard cement. The gypsum quarries of Montmartre, in the north of Paris, were worked in Tertiary strata, rich in fossils. Gypsum is largely quarried in England for conversion into plaster of Paris, whence it is sometimes known as "plaster stone," and since much is sent to the Staffordshire potteries for making moulds it is also termed "potter's stone." The chief workings are in the Keuper marls near Newark in Nottinghamshire, Fauld in Staffordshire and Chellaston in Derbyshire. It is also worked in Permian beds in Cumberland and Westmorland, and in Purbeck strata near Battle in Sussex.

Gypsum frequently occurs in association with rock-salt, having been deposited in shallow basins of salt water. Much of the calcium in sea-water exists as sulphate; and on evaporation of a drop of sea-water under the microscope this sulphate is deposited as acicular crystals of gypsum. In salt-lagoons the deposition of the gypsum is probably effected in most cases by means of micro-organisms. Waters containing sulphuretted hydrogen, on exposure to the air in the presence of limestone, may yield gypsum by the formation of sulphuric acid and its interaction with the calcium carbonate. In volcanic districts gypsum is produced by the action of sulphuric acid, resulting from the oxidation of sulphurous vapours, on lime-bearing minerals, like labradorite and augite, in the volcanic rocks: hence gypsum is common around solfataras. Again, by the oxidation of iron-pyrites and the action of the resulting sulphuric acid on limestone or on shells, gypsum may be formed; whence its origin in most clays. Gypsum is also formed in some cases by the hydration of anhydrite, the change being accompanied by an increase of volume to the extent of about 60%. Conversely gypsum may, under certain conditions, be dehydrated or reduced to anhydrite.

Some of the largest known crystals of selenite have been found in southern Utah, where they occur in huge geodes, or crystal-lined cavities, in deposits from the old salt-lakes. Fine crystals, sometimes curiously bent, occur in the Permian rocks of Friedrichroda, near Gotha, where there is a grotto called the Marienglashöhle, close to Rheinhardbrunn. Many of the best localities for selenite are in the New Red Sandstone formation (Trias and Permian), notably the salt-mines of Hall and Hallein, near Salzburg, and of Bex in Switzerland. Excellent crystals, usually of a brownish colour arranged in groups, are often found in the brine-chambers and the launders used in salt-works. Selenite also occurs in fine crystals in the sulphur-bearing marls of Girgenti and other Sicilian localities; whilst in Britain very bold crystals are yielded by the Kimeridge clay of Shotover Hill near Oxford. Twisted crystals and rosettes of gypsum found in the Mammoth Cave, Kentucky, have been called "oulopholites" (οὔλος, "woolly"; φωλεός, "cave").

In addition to the use of gypsum in cement-making, the mineral finds application as an agricultural agent in dressing land, and it has also been used in the manufacture of porcelain and glass. Formerly it was employed, in the form of thin cleavage-plates, for glazing windows, and seems to have been, with mica, called *lapis specularis*. It is still known in Germany as *Marienglas* and *Frauneis*. Delicate cleavage-plates of gypsum are used in microscopic petrography for the determination of certain optical constants in the rock-forming minerals.

(F. W. R.*)

GYROSCOPE AND GYROSTAT. These are scientific models or instruments designed to illustrate experimentally the dynamics of a rotating body such as the spinning-top, hoop and bicycle, and also the precession of the equinox and the rotation of the earth.

The gyroscope (Gr. γῦρος, ring, σκοπεῖν, to see) may be distinguished from the gyrostat (γῦρος, and στατικός, stationary) as an instrument in which the rotating wheel or disk is mounted in gimbals so that the principal axis of rotation always passes through a fixed point (fig. 1). It can be made to imitate the motion of a spinning-top of which the point is placed in a smooth agate cup as in Maxwell's dynamical top (figs. 2, 3). (*Collected Works*, i. 248.) A bicycle wheel, with a prolongation of the axle placed in a cup, can also be made to serve (fig. 4).

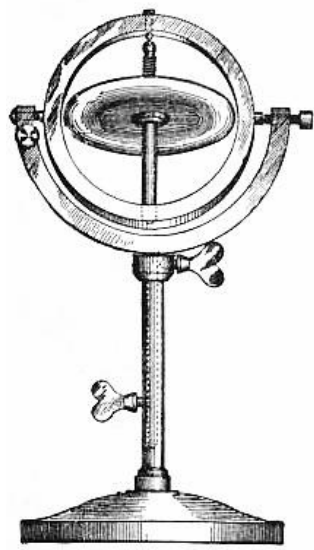


FIG. 1.

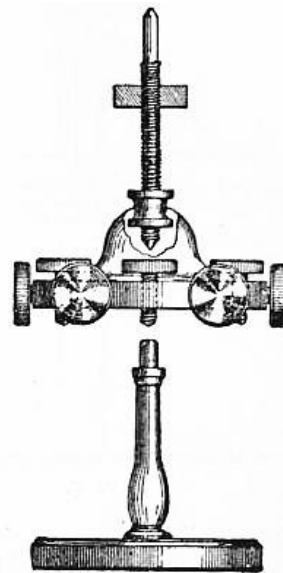


FIG. 2.

The gyrostatis is an instrument designed by Lord Kelvin (*Natural Philosophy*, § 345) to illustrate the more complicated state of motion of a spinning body when free to wander about on a horizontal plane, like a top spun on the pavement, or a hoop or bicycle on the road. It consists essentially of a massive fly-wheel concealed in a metal casing, and its behaviour on a table, or with various modes of suspension or support, described in Thomson and Tait, *Natural Philosophy*, serves to illustrate the curious reversal of the ordinary laws of statical equilibrium due to the *gyrostatic domination* of the interior invisible fly-wheel, when rotated rapidly (fig. 5).

The toy shown in figs. 6 and 7, which can be bought for a shilling, is acting as a gyroscope in fig. 6 and a gyrostatis in fig. 7.

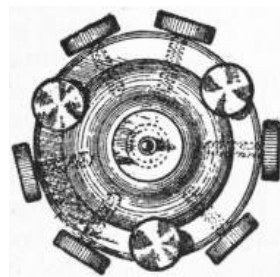


FIG. 3.

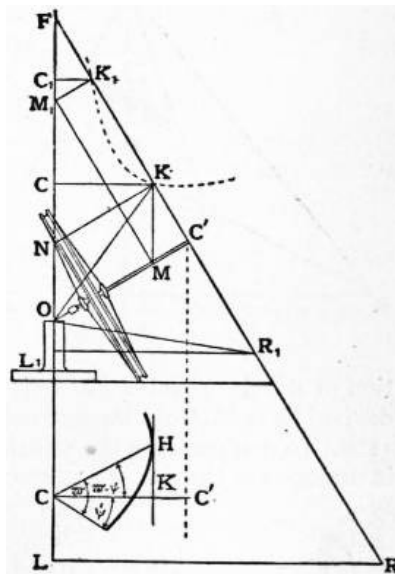


FIG. 4.

The gyroscope, as represented in figs. 2 and 3 by Maxwell's dynamical top, is provided with screws by which the centre of gravity can be brought into coincidence with the point of support. It can then be used to illustrate Poincot's theory of the motion of a body under no force, the gyroscope being made kinetically unsymmetrical by a setting of the screws. The discussion of this movement is required for Jacobi's theorems on the allied motion of a top and of a body under no force (Poincot, *Théorie nouvelle de la rotation des corps*, Paris, 1857; Jacobi, *Werke*, ii. Note B, p. 476).

To imitate the movement of the top the centre of gravity is displaced from the point of support so as to give a preponderance. When the motion takes place in the neighbourhood of the downward vertical, the bicycle wheel can be made to serve again mounted as in fig. 8 by a stalk in the prolongation of the axle, suspended from a universal joint at O; it can then be spun by hand and projected in any manner.

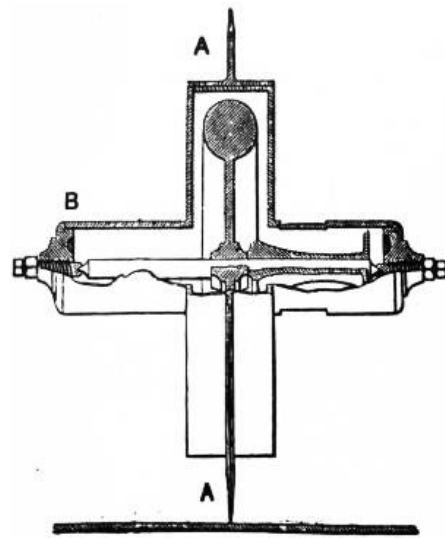


FIG. 5.



FIG. 6.

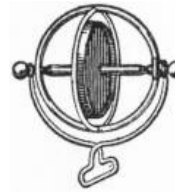


FIG. 7.

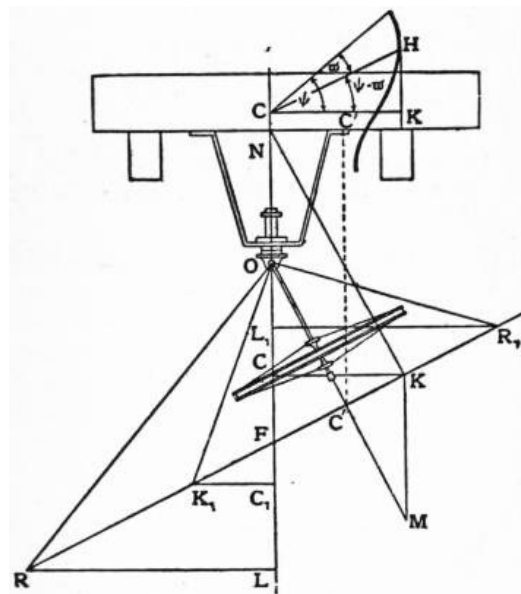


FIG. 8.

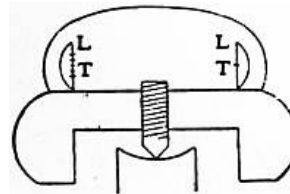


FIG. 9.

The first practical application of the gyroscopic principle was invented and carried out (1744) by Serson, with a spinning top with a polished upper plane surface for giving an artificial horizon at sea, undisturbed by the motion of the ship, when the real horizon was obscured. The instrument has been perfected by Admiral Georges Ernest Fleuriais (fig. 9), and is interesting theoretically as showing the correction required practically for the rotation of the earth. Gilbert's barogyroscope is devised for the same purpose of showing the earth's rotation; a description of it, and of the latest form employed by Föppl, is given in the *Ency. d. math. Wiss.*, 1904, with bibliographical references in the article "Mechanics of Physical Apparatus." The rotation of the fly-wheel is maintained here by an electric motor, as devised by G. M. Hopkins, and described in the *Scientific American*, 1878. To demonstrate the rotation of the earth by the constancy in direction of the axis of a gyroscope is a suggestion that has often been made; by E. Sang in 1836, and others. The experiment was first carried out with success by Foucault in 1851, by a simple pendulum swung in the dome of the Pantheon, Paris, and it has been repeated frequently (*Mémoires sur le pendule*, 1889).

A gyroscopic fly-wheel will preserve its original direction in space only when left absolutely free in all directions, as required in the experiments above. If employed in steering, as of a torpedo, the gyroscope must act through the intermediary of a light relay; but if direct-acting, the reaction will cause precession of the axis, and the original direction is lost.

The gyrostatic principle, in which one degree of freedom is suppressed in the axis, is useful for imparting steadiness and stability in a moving body; it is employed by Schlick to mitigate the rolling of a ship and to maintain the upright position of Brennan's monorail car.

Lastly, as an application of gyroscopic theory, a stretched chain of fly-wheels in rotation was employed by Kelvin as a mechanical model of the rotary polarization of light in an electromagnetic field; the apparatus may be constructed of bicycle wheels connected by short links, and suspended vertically.

1. The physical constants of a given symmetrical top, expressed in C.G.S. units, which are employed in the subsequent formulae, are denoted by M , h , C and A . M is the weight in grammes (g) as given by the number of gramme weights which equilibrate the top when weighed in a balance; h is the distance OG in centimetres (cm.) between G the centre of gravity and O the point of support, and Mh may be called the preponderance in g.-cm.; Mh and M can be measured by a spring balance holding up in a horizontal position the axis OC in fig. 8 suspended at O . Then gMh (dyne-cm. or ergs) is the moment of gravity about O when the axis OG is horizontal, $gMh \sin \theta$ being the moment when the axis OG makes an angle θ with the vertical, and $g = 981$ (cm./s²) on the average; C is the moment of inertia of the top about OG , and A about any axis through O at right angles to OG , both measured in g-cm.².

To measure A experimentally, swing the top freely about O in small plane oscillation, and determine the length, l cm., of the equivalent simple pendulum; then

$$(1) \quad l = A/Mh, \quad A = Mhl.$$

Next make the top, or this simple pendulum, perform small conical revolutions, nearly coincident with the downward vertical position of equilibrium, and measure n , the mean angular velocity of the conical pendulum in radians / second; and T its period in seconds; then

$$(2) \quad 4\pi^2/T^2 = n^2 = g/l = gMh/A;$$

and $f = n/2\pi$ is the number of revolutions per second, called the *frequency*, $T = 2\pi/n$ is the period of a revolution, in seconds.

2. In the popular explanation of the steady movement of the top at a constant inclination to the vertical, depending on the composition of angular velocity, such as given in Perry's *Spinning Tops*, or Worthington's *Dynamics of Rotation*, it is asserted that the moment of gravity is always generating an angular velocity about an axis OB perpendicular to the vertical plane COC' through the axis of the top OC' ; and this angular velocity, compounded with the resultant angular velocity about an axis OI , nearly coincident with OC' , causes the axes OI and OC' to keep taking up a new position by moving at right angles to the plane COC' , at a constant precessional angular velocity, say μ rad./sec., round the vertical OC (fig. 4).

If, however, the axis OC' is prevented from taking up this precessional velocity, the top at once falls down; thence all the ingenious attempts—for instance, in the swinging cabin of the Bessemer ship—to utilise the gyroscope as a mechanical directive agency have always resulted in failure (*Engineer*, October 1874), unless restricted to actuate a light relay, which guides the mechanism, as in steering a torpedo.

An experimental verification can be carried out with the gyroscope in fig. 1; so long as the vertical spindle is free to rotate in its socket, the rapidly rotating wheel will resist the impulse of tapping on the gimbal by moving to one side; but when the pinch screw prevents the rotation of the vertical spindle in the massive pedestal, this resistance to the tapping at once disappears, provided the friction of the table prevents the movement of the pedestal; and if the wheel has any preponderance, it falls down.

Familiar instances of the same principles are observable in the movement of a hoop, or in the steering of a bicycle; it is essential that the handle of the bicycle should be free to rotate to secure the stability of the movement.

The bicycle wheel, employed as a spinning top, in fig. 4, can also be held by the stalk, and will thus, when rotated rapidly, convey a distinct muscular impression of resistance to change of direction, if brandished.

3. A demonstration, depending on the elementary principles of dynamics, of the exact conditions required for the axis OC' of a spinning top to spin steadily at a constant inclination θ to the vertical OC , is given here before proceeding to the more complicated question of the general motion, when θ , the inclination of the axis, is varying by nutation.

Elementary demonstration of the condition of steady motion.

It is a fundamental principle in dynamics that if OH is a vector representing to scale the angular momentum of a system, and if Oh is the vector representing the axis of the impressed couple or torque, then OH will vary so that the velocity of H is represented to scale by the impressed couple Oh , and if the top is moving freely about O , Oh is at right angles to the vertical plane COC' , and

$$(1) \quad Oh = gMh \sin \theta.$$

In the case of the steady motion of the top, the vector OH lies in the vertical plane COC' , in OK suppose (fig. 4), and has a component $OC = G$ about the vertical and a component $OC' = G'$, suppose, about the axis OC ; and $G' = CR$, if R denotes the angular velocity of the top with which it is spun about OC' .

If μ denotes the constant precessional angular velocity of the vertical plane COC' the components of angular velocity and momentum about OA are $\mu \sin \theta$ and $A\mu \sin \theta$, OA being perpendicular to OC' in the plane COC'; so that the vector OK has the components

$$(2) \quad OC' = G', \text{ and } C'K = A\mu \sin \theta,$$

and the horizontal component

$$(3) \quad \begin{aligned} CK &= OC' \sin \theta - C'K \cos \theta \\ &= G' \sin \theta - A\mu \sin \theta \cos \theta. \end{aligned}$$

The velocity of K being equal to the impressed couple Oh,

$$(4) \quad gMh \sin \theta = \mu \cdot CK = \sin \theta (G'\mu - A\mu^2 \cos \theta),$$

and dropping the factor $\sin \theta$,

$$(5) \quad A\mu^2 \cos \theta - G'\mu + gMh = 0, \text{ or } A\mu^2 \cos \theta - CR\mu + An^2 = 0,$$

the condition for steady motion.

Solving this as a quadratic in μ , the roots μ_1, μ_2 are given by

$$(6) \quad \mu_1, \mu_2 = \frac{G'}{2A} \sec \theta \left[1 \pm \sqrt{1 - \frac{4A^2 n^2}{G'^2} \cos \theta} \right];$$

and the minimum value of $G' = CR$ for real values of μ is given by

$$(7) \quad \frac{G'^2}{4A^2 n^2} = \cos \theta, \quad \frac{CR}{An} = 2\sqrt{\cos \theta};$$

for a smaller value of R the top cannot spin steadily at the inclination θ to the upward vertical.

Interpreted geometrically in fig. 4

$$(8) \quad \mu = gMh \sin \theta / CK = An^2 / KN, \text{ and } \mu = C'K / A \sin \theta = KM / A,$$

$$(9) \quad KM \cdot KN = A^2 n^2,$$

so that K lies on a hyperbola with OC, OC' as asymptotes.

4. Suppose the top or gyroscope, instead of moving freely about the point O, is held in a ring or frame which is compelled to rotate about the vertical axis OC with constant angular velocity μ ; then if N denotes the couple of reaction of the frame keeping the top from falling, acting in the plane COC', equation (4) § 3 becomes modified into

Constrained motion of the gyroscope.

$$(1) \quad gMh \sin \theta - N = \mu \cdot CK = \sin \theta (G'\mu - A\mu^2 \cos \theta),$$

$$(2) \quad \begin{aligned} N &= \sin \theta (A\mu^2 \cos \theta - G'\mu + gMh) \\ &= A \sin \theta \cos \theta (\mu - \mu_1) (\mu - \mu_2); \end{aligned}$$

and hence, as μ increases through μ_2 and μ_1 , the sign of N can be determined, positive or negative, according as the tendency of the axis is to fall or rise.

When $G' = CR$ is large, μ_2 is large, and

$$(3) \quad \mu_1 \approx gMh / G' = An^2 / CR,$$

the same for all inclinations, and this is the precession observed in the spinning top and centrifugal machine of fig. 10 This is true accurately when the axis OC' is horizontal, and then it agrees with the result of the popular explanation of § 2.

If the axis of the top OC' is pointing upward, the precession is in the same direction as the rotation, and an increase of μ from μ_1 makes N negative, and the top rises; conversely a decrease of the procession μ causes the axis to fall (Perry, *Spinning Tops*, p. 48).

If the axis points downward, as in the centrifugal machine with upper support, the precession is in the opposite direction to the rotation, and to make the axis approach the vertical position the precession must be reduced.

This is effected automatically in the Weston centrifugal machine (fig. 10) used for the separation of water and molasses, by the friction of the indiarubber cushions above the support; or else the spindle is produced downwards below the drum a short distance, and turns in a hole in a weight resting on the bottom of the case, which weight is dragged

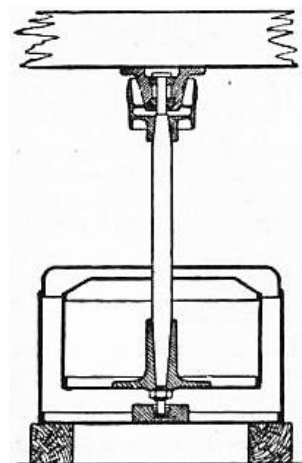


FIG. 10.

Centrifugal machine.

round until the spindle is upright; this second arrangement is more effective when a liquid is treated in the drum, and wave action is set up (*The Centrifugal Machine*, C. A. Matthey).

Similar considerations apply to the stability of the whirling bowl in a cream-separating machine.

We can write equation (1)

$$(4) \quad N = An^2 \sin \theta - \mu \cdot CK = (A^2n^2 - KM \cdot KN) \sin \theta / A,$$

so that N is negative or positive, and the axis tends to rise or fall according as K moves to the inside or outside of the hyperbola of free motion. Thus a tap on the axis tending to hurry the precession is equivalent to an impulse couple giving an increase to C'K, and will make K move to the interior of the hyperbola and cause the axis to rise; the steering of a bicycle may be explained in this way; but K₁ will move to the exterior of the hyperbola, and so the axis will fall in this second more violent motion.

Friction on the point of the top may be supposed to act like a tap in the direction opposite to the precession; and so the axis of a top spun violently rises at first and up to the vertical position, but falls away again as the motion dies out. Friction considered as acting in retarding the rotation may be compared to an impulse couple tending to reduce OC', and so make K and K₁ both move to the exterior of the hyperbola, and the axis falls in both cases. The axis may rise or fall according to the direction of the frictional couple, depending on the shape of the point; an analytical treatment of the varying motion is very intractable; a memoir by E. G. Gallop may be consulted in the *Trans. Camb. Phil. Soc.*, 1903.

The earth behaves in precession like a large spinning top, of which the axis describes a circle round the pole of the ecliptic of mean angular radius θ , about $23\frac{1}{2}^\circ$, in a period of 26,000 years, so that $R/\mu = 26000 \times 365$; and the mean couple producing precession is

$$(5) \quad CR\mu \sin \theta = CR^2 \sin 23\frac{1}{2}^\circ / 26000 \times 365,$$

one 12 millionth part of $\frac{1}{2}CR^2$, the rotation energy of the earth.

5. If the preponderance is absent, by making the C·G coincide with O, and if $A\mu$ is insensible compared with G' ,

$$(1) \quad N = -G'\mu \sin \theta,$$

the formula which suffices to explain most gyroscopic action.

Gyroscopic action of railway wheels.

Thus a carriage running round a curve experiences, in consequence of the rotation of the wheels, an increase of pressure Z on the outer track, and a diminution Z on the inner, giving a couple, if a is the gauge,

$$(2) \quad Za = G'\mu,$$

tending to help the centrifugal force to upset the train; and if c is the radius of the curve, b of the wheels, C their moment of inertia, and v the velocity of the train,

$$(3) \quad \mu = v/c, \quad G' = Cv/b,$$

$$(4) \quad Z = Cv^2/abc \text{ (dynes),}$$

so that Z is the fraction C/Mab of the centrifugal force Mv^2/c , or the fraction C/Mh of its transference of weight, with h the height of the centre of gravity of the carriage above the road. A Brennan carriage on a monorail would lean over to the inside of the curve at an angle α , given by

$$(6) \quad \tan \alpha = G'\mu/gMh = G'v/gMhc.$$

The gyroscopic action of a dynamo, turbine, and other rotating machinery on a steamer, paddle or screw, due to its rolling and pitching, can be evaluated in a similar elementary manner (*Worthington, Dynamics of Rotation*), and Schlick's gyroscopic apparatus is intended to mitigate the oscillation.

6. If the axis OC in fig. 4 is inclined at an angle α to the vertical, the equation (2) § 4 becomes

$$(1) \quad N = \sin \theta (A\mu^2 \cos \theta - G'\mu) + gMh \sin (\alpha - \theta).$$

Suppose, for instance, that OC is parallel to the earth's axis, and that the frame is fixed in the meridian; then α is the co-latitude, and μ is the angular velocity of the earth, the square of which may be neglected; so that, putting $N = 0$, $\alpha - \theta = E$,

$$(2) \quad gMh \sin E - G'\mu \sin (\alpha - E) = 0,$$

$$(3) \quad \tan E = \frac{G'\mu \sin \alpha}{gMh + G'\mu \cos \alpha} \approx \frac{G'\mu}{gMh} \sin \alpha.$$

This is the theory of Gilbert's barogyroscope, described in Appell's *Mécanique rationnelle*, ii. 387: it consists essentially of a rapidly rotated fly-wheel, mounted on knife-edges by an axis perpendicular to its axis of rotation and pointing east and west; spun with considerable angular momentum G' , and provided with a slight preponderance Mh , it should tilt to an angle E with the vertical, and thus demonstrate experimentally the rotation of the earth.

The barogyroscope.

Foucault's gyroscope.

In Foucault's gyroscope (*Comptes rendus*, 1852; Perry, p. 105) the preponderance is made zero, and the axis points to the pole, when free to move in the meridian.

Generally, if constrained to move in any other plane, the axis seeks the position nearest to the polar axis, like a dipping needle with respect to the magnetic pole. (*A gyrostatic working model of the magnetic compass*, by Sir W. Thomson. British Association Report, Montreal, 1884. A. S. Chessin, St Louis Academy of Science, January 1902.)

A spinning top with a polished upper plane surface will provide an artificial horizon at sea, when the real horizon is obscured. The first instrument of this kind was constructed by Serson, and is described in the *Gentleman's Magazine*, vol. xxiv., 1754; also by Segner in his *Specimen theoriae turbinum* (Halae, 1755). The inventor was sent to sea by the Admiralty to test his instrument, but he was lost in the wreck of the "Victory," 1744. A copy of the Serson top, from the royal collection, is now in the Museum of King's College, London. Troughton's Nautical Top (1819) is intended for the same purpose.

Gyroscopic horizon.

The instrument is in favour with French navigators, perfected by Admiral Fleuriais (fig. 9); but it must be noticed that the horizon given by the top is inclined to the true horizon at the angle E given by equation (3) above; and if μ_1 is the precessional angular velocity as given by (3) § 4, and $T = 2\pi/\mu$, its period in seconds,

$$(4) \quad \tan E = \frac{\mu}{\mu_1} \cos \text{lat} = \frac{T \cos \text{lat}}{86400}, \text{ or } E = \frac{T \cos \text{lat}}{8\pi},$$

if E is expressed in minutes, taking $\mu = 2\pi/86400$; thus making the true latitude E nautical miles to the south of that given by the top (*Revue maritime*, 1890; *Comptes rendus*, 1896).

This can be seen by elementary consideration of the theory above, for the velocity of the vector OC' of the top due to the rotation of the earth is

$$(5) \quad \mu \cdot OC' \cos \text{lat} = gMh \sin E = \mu_1 \cdot OC' \sin E, \quad \sin E = \frac{\mu}{\mu_1} \cos \text{lat}, \quad E = \frac{T \cos \text{lat}}{8\pi},$$

in which 8π can be replaced by 25, in practice; so that the Fleuriais gyroscopic horizon is an illustration of the influence of the rotation of the earth and of the need for its allowance.

7. In the ordinary treatment of the general theory of the gyroscope, the motion is referred to two sets of rectangular axes; the one Ox, Oy, Oz fixed in space, with Oz vertically upward and the other OX, OY, OZ fixed in the rotating wheel with OZ in the axis of figure OC .

Euler's coordinate angles.

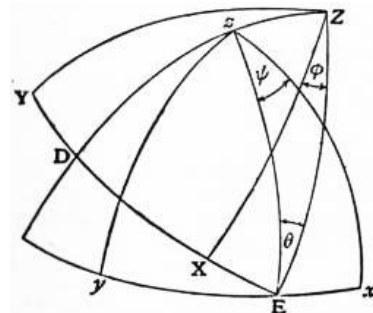


FIG. 11.

The relative position of the two sets of axes is given by means of Euler's unsymmetrical angles θ, ϕ, ψ , such that the successive turning of the axes Ox, Oy, Oz through the angles (i.) ψ about Oz , (ii.) θ about OE , (iii.) ϕ about OZ , brings them into coincidence with OX, OY, OZ , as shown in fig. 11, representing the concave side of a spherical surface.

The component angular velocities about OD, OE, OZ are

$$(1) \quad \bar{\psi} \sin \theta, \bar{\theta}, \bar{\phi} + \bar{\psi} \cos \theta;$$

so that, denoting the components about OX, OY, OZ by P, Q, R ,

$$(2) \quad \begin{aligned} P &= \bar{\theta} \cos \phi + \bar{\psi} \sin \theta \sin \phi, \\ Q &= -\bar{\theta} \sin \phi + \bar{\psi} \sin \theta \cos \phi, \\ R &= \bar{\phi} + \bar{\psi} \cos \theta. \end{aligned}$$

Consider, for instance, the motion of a fly-wheel of preponderance Mh , and equatoreal moment of inertia A , of which the axis OC is held in a light ring ZCX at a constant angle γ with OZ , while OZ is held by another ring zZ , which constrains it to move round the vertical Oz at a constant inclination θ with constant angular velocity μ , so that

$$(3) \quad \bar{\theta} = 0, \bar{\psi} = \mu;$$

$$(4) \quad P = \mu \sin \theta \sin \varphi, Q = \mu \sin \theta \cos \varphi, R = \bar{\varphi} + \mu \cos \theta.$$

With CXF a quadrant, the components of angular velocity and momentum about OF, OY, are

$$(5) \quad P \cos \gamma - R \sin \gamma, Q, \text{ and } A (P \cos \gamma - R \sin \gamma), AQ,$$

so that, denoting the components of angular momentum of the fly-wheel about OC, OX, OY, OZ by K or G', h_1, h_2, h_3 ,

$$(6) \quad h_1 = A (P \cos \gamma - R \sin \gamma) \cos \gamma + K \sin \gamma,$$

$$(7) \quad h_2 = AQ,$$

$$(8) \quad h_3 = -A (P \cos \gamma - R \sin \gamma) \sin \gamma + K \cos \gamma;$$

and the dynamical equation

$$(9) \quad \frac{dh_3}{dt} - h_1 Q + h_2 P = N,$$

with K constant, and with preponderance downward

$$(10) \quad N = gMh \cos zY \sin \gamma = gMh \sin \gamma \sin \theta \cos \varphi,$$

reduces to

$$(11) \quad A \frac{d^2 \varphi}{dt^2} \sin \gamma + A\mu^2 \sin \gamma \sin^2 \theta \sin \varphi \cos \varphi + A\mu^2 \cos \gamma \sin \theta \cos \theta \cos \varphi - (K\mu + gMh) \sin \theta \cos \varphi = 0.$$

The position of relative equilibrium is given by

$$(12) \quad \cos \varphi = 0, \text{ and } \sin \varphi = \frac{K\mu + gMh - A\mu^2 \cos \gamma \cos \theta}{A\mu^2 \sin \gamma \sin \theta}.$$

For small values of μ the equation becomes

$$(13) \quad A \frac{d^2 \varphi}{dt^2} \sin \gamma - (K\mu + gMh) \sin \theta \cos \varphi = 0,$$

so that $\varphi = \frac{1}{2}\pi$ gives the position of stable equilibrium, and the period of a small oscillation is $2\pi \sqrt{\{A \sin \gamma / (K\mu + gMh) \sin \theta\}}$.

In the general case, denoting the periods of vibration about $\varphi = \frac{1}{2}\pi, -\frac{1}{2}\pi$, and the sidelong position of equilibrium by $2\pi/(n_1, n_2, \text{ or } n_3)$, we shall find

$$(14) \quad n_1^2 = \frac{\sin \theta}{A \sin \gamma} \{ gMh + K\mu - A\mu^2 \cos (\gamma - \theta) \},$$

$$(15) \quad n_2^2 = \frac{\sin \theta}{A \sin \gamma} \{ -gMh - K\mu + A\mu^2 \cos (\gamma + \theta) \},$$

$$(16) \quad n_3 = n_1 n_2 / \mu \sin \theta.$$

The first integral of (11) gives

$$(17) \quad \frac{1}{2}A \left(\frac{d\varphi}{dt} \right)^2 \sin \gamma + \frac{1}{2}A\mu^2 \sin \gamma \sin^2 \theta \sin^2 \varphi - A\mu^2 \cos \gamma \sin \theta \cos \theta \sin \varphi + (K\mu + gMh) \sin \theta \sin \varphi - H = 0,$$

and putting $\tan (\frac{1}{4}\pi + \frac{1}{2}\varphi) = z$, this reduces to

$$(18) \quad \frac{dz}{dt} - n \sqrt{Z}$$

where Z is a quadratic in z^2 , so that z is a Jacobian elliptic function of t, and we have

$$(19) \quad \tan (\frac{1}{4}\pi + \frac{1}{2}\varphi) = C (tn, dn, nc, \text{ or } cn) nt,$$

according as the ring ZC performs complete revolutions, or oscillates about a sidelong position of equilibrium, or oscillates about the stable position of equilibrium $\varphi = \pm \frac{1}{2}\pi$.

Suppose Oz is parallel to the earth's axis, and μ is the diurnal rotation, the square of which may be neglected, then if Gilbert's barogyroscope of § 6 has the knife-edges turned in azimuth to make an angle β with E. and W., so that OZ lies in the horizon at an angle $E \cdot \beta \cdot N$., we must put $\gamma = \frac{1}{2}\pi$, $\cos \theta = \sin \alpha \sin \beta$; and putting $\varphi = \frac{1}{2}\pi - \delta + E$, where δ denotes the angle between Zz and the vertical plane Z ζ through the zenith ζ ,

$$(20) \quad \sin \theta \cos \delta = \cos \alpha, \sin \theta \sin \delta = \sin \alpha \cos \beta;$$

so that equations (9) and (10) for relative equilibrium reduce to

$$(21) \quad gMh \sin E = KQ = K\mu \sin \theta \cos \varphi = K\mu \sin \theta \sin (\delta - E),$$

and will change (3) § 6 into

$$(22) \quad \tan E = \frac{K\mu \sin \alpha \cos \beta}{gMh + K\mu \cos \alpha},$$

a multiplication of (3) § 6 by $\cos \beta$ (Gilbert, *Comptes rendus*, 1882).

Changing the sign of K or h and E and denoting the revolutions/second of the gyroscope wheel by F , then in the preceding notation, T denoting the period of vibration as a simple pendulum,

$$(23) \quad \tan E = \frac{K\mu \sin \alpha \cos \beta}{gMh - K\mu \cos \alpha} = \frac{F \sin \alpha \cos \beta}{86400 A/T^2 C - F \cos \alpha},$$

so that the gyroscope would reverse if it were possible to make $F \cos \alpha > 86400 A/T^2 C$ (Föppl, *Münch. Ber.*, 1904).

A gyroscopic pendulum is made by the addition to it of a fly-wheel, balanced and mounted, as in Gilbert's barogyroscope, in a ring movable about an axis fixed in the pendulum, in the vertical plane of motion.

As the pendulum falls away to an angle θ with the upward vertical, and the axis of the fly-wheel makes an angle φ with the vertical plane of motion, the three components of angular momentum are

$$(24) \quad h_1 = K \cos \varphi, \quad h_2 = A\bar{\theta} + K \sin \varphi, \quad h_3 = A\bar{\varphi},$$

where h_3 is the component about the axis of the ring and K of the fly-wheel about its axis; and if L, M', N denote the components of the couple of reaction of the ring, L may be ignored, while N is zero, with $P = 0, Q = \bar{\theta}, R = 0$, so that

$$(25) \quad M' = h_2 = A\bar{\theta} + K\bar{\varphi} \cos \varphi,$$

$$(26) \quad 0 = h_3 - h_1\bar{\theta} = A\bar{\varphi} - K\bar{\theta} \cos \varphi.$$

For the motion of the pendulum, including the fly-wheel,

$$(27) \quad MK^2\bar{\theta} = gMH \sin \theta - M' = gMH \sin \theta - A\bar{\theta} - K\bar{\varphi} \cos \varphi.$$

If θ and φ remain small,

$$(28) \quad A\bar{\varphi} = K\bar{\theta}, \quad A\bar{\varphi} = K(\theta - \alpha),$$

$$(29) \quad (MK^2 + A)\bar{\theta} + (K^2/A)(\theta - \alpha) - gMH\theta = 0;$$

so that the upright position will be stable if $K^2 > gMHA$, or the rotation energy of the wheel greater than $\frac{1}{2}A/C$ times the energy acquired by the pendulum in falling between the vertical and horizontal position; and the vibration will synchronize with a simple pendulum of length

$$(30) \quad (MK^2 + A) / [(K^2/gA) - MH].$$

This gyroscopic pendulum may be supposed to represent a ship among waves, or a carriage on a monorail, and so affords an explanation of the gyroscopic action essential in the apparatus of Schlick and Brennan.

8. Careful scrutiny shows that the steady motion of a top is not steady absolutely; it reveals a small nutation superposed, so that a complete investigation requires a return to the equations of unsteady motion, and for the small oscillation to consider them in a penultimate form.

General motion of the top.

In the general motion of the top the vector OH of resultant angular momentum is no longer compelled to lie in the vertical plane COC' (fig. 4), but since the axis Oh of the gravity couple is always horizontal, H will describe a curve in a fixed horizontal plane through C . The vector OC' of angular momentum about the axis will be constant in length, but vary in direction; and OK will be the component angular momentum in the vertical plane COC' , if the planes through C and C' perpendicular to the lines OC and OC' intersect in the line KH ; and if KH is the component angular momentum perpendicular to the plane COC' , the resultant angular momentum OH has the three components $OC', C'K, KH$, represented in Euler's angles by

$$(1) \quad KH = A \, d\theta/dt, \quad C'K = A \sin \theta \, d\psi/dt, \quad OC' = G'.$$

Drawing KM vertical and KN parallel to OC' , then

$$(2) \quad KM = A \, d\psi/dt, \quad KN = CR - A \cos \theta \, d\psi/dt = (C - A) R + A \, d\varphi/dt$$

so that in the spherical top, with $C = A, KN = A \, d\varphi/dt$.

The velocity of H is in the direction KH perpendicular to the plane COC', and equal to $gMh \sin \theta$ or $An^2 \sin \theta$, so that if a point in the axis OC' at a distance An^2 from O is projected on the horizontal plane through C in the point P on CK, the curve described by P, turned forwards through a right angle, will be the hodograph of H; this is expressed by

$$(3) \quad An^2 \sin \theta e^{(\psi + 1/2m)i} = iAn^2 \sin \theta e^{\psi i} = \frac{d}{dt} (\rho e^{\omega i})$$

where $\rho e^{\omega i}$ is the vector CH; and so the curve described by P and the motion of the axis of the top is derived from the curve described by H by a differentiation.

Resolving the velocity of H in the direction CH,

$$(4) \quad d \cdot CH/dt = An^2 \sin \theta \sin KCH = An^2 \sin \theta KH/CH,$$

$$(5) \quad d \cdot \frac{1}{2}CH^2/dt = A^2 n^2 \sin \theta d\theta/dt.$$

and integrating

$$(6) \quad \frac{1}{2}CH^2 = A^2 n^2 (E - \cos \theta),$$

$$(7) \quad \frac{1}{2}OH^2 = A^2 n^2 (F - \cos \theta),$$

$$(8) \quad \frac{1}{2}C'H^2 = A^2 n^2 (D - \cos \theta),$$

where D, E, F are constants, connected by

$$(9) \quad F = E + G^2/2A^2 n^2 = D + G^2/2A^2 n^2.$$

Then

$$(10) \quad KH^2 = OH^2 - OK^2,$$

$$(11) \quad OK^2 \sin^2 \theta = CC'^2 = G^2 - 2GG' \cos \theta + G'^2,$$

$$(12) \quad A^2 \sin^2 \theta (d\theta/dt)^2 = 2A^2 n^2 (F - \cos \theta) \sin^2 \theta - G^2 + 2GG' \cos \theta - G'^2;$$

and putting $\cos \theta = z$,

$$(13) \quad \left(\frac{dz}{dt} \right) = 2n^2 (F - z) (1 - z^2) - (G^2 - 2GG'z + G'^2) / A^2$$

$$= 2n^2 (E - z) (1 - z^2) - (G' - Gz)^2 / A^2$$

$$= 2n^2 (D - z) (1 - z^2) - (G - G'z)^2 / A^2$$

$$= 2n^2 Z \text{ suppose.}$$

Denoting the roots of $Z = 0$ by z_1, z_2, z_3 , we shall have them arranged in the order

$$(14) \quad z_1 > 1 > z_2 > z > z_3 > -1.$$

$$(15) \quad (dz/dt)^2 = 2n^2 (z_1 - z) (z_2 - z) (z - z_3).$$

$$(16) \quad nt = \int_{z_3}^z dz / \sqrt{(2Z)},$$

an elliptic integral of the first kind, which with

$$(17) \quad m = n \sqrt{\frac{z_1 - z_3}{2}}, \quad k^2 = \frac{z_2 - z_3}{z_1 - z_2},$$

can be expressed, when normalized by the factor $\sqrt{(z_1 - z_3)}/2$, by the inverse elliptic function in the form

$$(18) \quad mt = \int_{z_3}^z \frac{\sqrt{(z_1 - z_3)} dz}{\sqrt{[4(z_1 - z)(z_2 - z)(z - z_3)]}}$$

$$= \text{sn}^{-1} \sqrt{\frac{z - z_3}{z_2 - z_3}} = \text{cn}^{-1} \sqrt{\frac{z_2 - z}{z_2 - z_3}} = \text{dn}^{-1} \sqrt{\frac{z_1 - z}{z_1 - z_3}}.$$

$$(19) \quad z - z_3 = (z_2 - z_3) \text{sn}^2 mt, \quad z_2 - z = (z_2 - z_3) \text{cn}^2 mt, \quad z_1 - z = (z_1 - z_3) \text{dn}^2 mt.$$

$$(20) \quad z = z_2 \text{sn}^2 mt + z_3 \text{cn}^2 mt.$$

Interpreted dynamically, the axis of the top keeps time with the beats of a simple pendulum of length

$$(21) \quad L = l^{1/2} (z_1 - z_3),$$

suspended from a point at a height $\frac{1}{2} (z_1 + z_3)l$ above O, in such a manner that a point on the pendulum at a distance

$$(22) \quad \frac{1}{2} (z_1 - z_3) l = l^2/L$$

from the point of suspension moves so as to be always at the same level as the centre of oscillation of the top.

The polar co-ordinates of H are denoted by ρ , $\tilde{\omega}$ in the horizontal plane through C; and, resolving the velocity of H perpendicular to CH,

$$(23) \quad \rho d\tilde{\omega}/dt = An^2 \sin \theta \cos KCH.$$

$$(24) \quad \rho^2 d\tilde{\omega}/dt = An^2 \sin \theta \cdot CK = An^2 (G' - G \cos \theta)$$

$$(25) \quad \tilde{\omega} = \frac{1}{2} \int \frac{G' - Gz}{E - z} \frac{dt}{A} = \int_{z_3} \frac{(G' - Gz) / 2An}{E - z} \frac{dz}{\sqrt{(2Z)}},$$

an elliptic integral, of the third kind, with pole at $z = E$; and then

$$(26) \quad \begin{aligned} \tilde{\omega} - \psi &= KCH = \tan^{-1} KH/CH \\ &= \tan^{-1} \frac{A \sin \theta d\theta/dt}{G' - G \cos \theta} = \tan^{-1} \frac{\sqrt{(2Z)}}{(G' - Gz) / An}, \end{aligned}$$

which determines ψ .

Otherwise, from the geometry of fig. 4,

$$(27) \quad CK \sin \theta = OC - OC' \cos \theta,$$

$$(28) \quad A \sin^2 \theta d\psi/dt = G - G' \cos \theta,$$

$$(29) \quad \psi = \int \frac{G - G'z}{1 - z^2} \frac{dt}{A} = \frac{1}{2} \int \frac{G - G'}{1 - z} \frac{dt}{A} + \frac{1}{2} \int \frac{G + G'}{1 + z} \frac{dt}{A},$$

the sum of two elliptic integrals of the third kind, with pole at $z = \pm 1$; and the relation in (25) (26) shows the addition of these two integrals into a single integral, with pole at $z = E$.

The motion of a sphere, rolling and spinning in the interior of a spherical bowl, or on the top of a sphere, is found to be of the same character as the motion of the axis of a spinning top about a fixed point.

The curve described by H can be identified as a Poincot herpolhode, that is, the curve traced out by rolling a quadric surface with centre fixed at O on the horizontal plane through C; and Darboux has shown also that a deformable hyperboloid made of the generating lines, with O and H at opposite ends of a diameter and one generator fixed in OC, can be moved so as to describe the curve H; the tangent plane of the hyperboloid at H being normal to the curve of H; and then the other generator through O will coincide in the movement with OC', the axis of the top; thus the Poincot herpolhode curve H is also the trace made by rolling a line of curvature on an ellipsoid confocal to the hyperboloid of one sheet, on the plane through C.

Kirchhoff's *Kinetic Analogue* asserts also that the curve of H is the projection of a tortuous elastica, and that the spherical curve of C' is a hodograph of the elastica described with constant velocity.

Writing the equation of the focal ellipse of the Darboux hyperboloid through H, enlarged to double scale so that O is the centre,

$$(30) \quad x^2/\alpha^2 + y^2/\beta^2 + z^2/O = 1,$$

with $\alpha^2 + \lambda$, $\beta^2 + \lambda$, λ denoting the squares of the semiaxes of a confocal ellipsoid, and λ changed into μ and ν for a confocal hyperboloid of one sheet and of two sheets.

$$(31) \quad \lambda > 0 > \mu > -\beta^2 > \nu > -\alpha^2,$$

then in the deformation of the hyperboloid, λ and ν remain constant at H; and utilizing the theorems of solid geometry on confocal quadrics, the magnitudes may be chosen so that

$$(32) \quad \alpha^2 + \lambda + \beta^2 + \mu + \nu = OH^2 = \frac{1}{2}k^2 (F - z) = \rho^2 + OC^2.$$

$$(33) \quad \alpha^2 + \mu = \frac{1}{2}k^2 (z_1 - z) = \rho^2 - \rho_1^2,$$

$$(34) \quad \beta^2 + \mu = \frac{1}{2}k^2 (z_2 - z) = \rho^2 - \rho_2^2,$$

$$(35) \quad \mu = \frac{1}{2}k^2 (z_3 - z) = \rho^2 - \rho_3^2,$$

$$(36) \quad \rho_1^2 < 0 < \rho_2^2 < \rho^2 < \rho_3^2,$$

$$(37) \quad F = z_1 + z_2 + z_3,$$

$$(38) \quad \lambda - 2\mu + \nu = k^2z, \quad \lambda - \nu = k^2,$$

$$(39) \quad \frac{\lambda - \mu}{\lambda - \nu} = \frac{1 + z}{2}, \quad \frac{\mu - \nu}{\lambda - \nu} = \frac{1 - z}{2}$$

with $z = \cos \theta$, θ denoting the angle between the generating lines through H; and with $OC = \delta$,

$OC' = \delta'$, the length k has been chosen so that in the preceding equations

$$(40) \quad \delta/k = G/2An, \delta'/k = G'/2An;$$

and δ, δ', k may replace $G, G', 2An$; then

$$(41) \quad \frac{2Z}{1-z^2} = \frac{1}{n^2} \left(\frac{d\theta}{dt} \right)^2 = \frac{4KH^2}{k^2},$$

while from (33-39)

$$(42) \quad \frac{2Z}{1-z^2} = \frac{4(\alpha^2 + \mu)(\beta^2 + \mu)\mu}{k^2(\mu - \lambda)(\mu - \nu)},$$

which verifies that KH is the perpendicular from O on the tangent plane of the hyperboloid at H , and so proves Darboux's theorem.

Planes through O perpendicular to the generating lines cut off a constant length $HQ = \delta, HQ' = \delta'$, so the line of curvature described by H in the deformation of the hyperboloid, the intersection of the fixed confocal ellipsoid λ and hyperboloid of two sheets ν , rolls on a horizontal plane through C and at the same time on a plane through C' perpendicular to OC' .

Produce the generating line HQ to meet the principal planes of the confocal system in V, T, P ; these will also be fixed points on the generator; and putting

$$(43) \quad (HV, HT, HP,)/HQ = D/(A, B, C,),$$

then

$$(44) \quad Ax^2 + By^2 + Cz^2 = D\delta^2$$

is a quadric surface with the squares of the semiaxes given by $HV \cdot HQ, HT \cdot HQ, HP \cdot HQ$, and with HQ the normal line at H , and so touching the horizontal plane through C ; and the direction cosines of the normal being

$$(45) \quad x/HV, y/HT, z/HP,$$

$$(46) \quad A^2x^2 + B^2y^2 + C^2z^2 = D^2\delta^2,$$

the line of curvature, called the polhode curve by Poinsot, being the intersection of the quadric surface (44) with the ellipsoid (46).

There is a second surface associated with (44), which rolls on the plane through C' , corresponding to the other generating line HQ' through H , so that the same line of curvature rolls on two planes at a constant distance from O, δ and δ' ; and the motion of the top is made up of the combination. This completes the statement of Jacobi's theorem (*Werke*, ii. 480) that the motion of a top can be resolved into two movements of a body under no force.

Conversely, starting with Poinsot's polhode and herpolhode given in (44) (46), the normal plane is drawn at H , cutting the principal axes of the rolling quadric in X, Y, Z ; and then

$$(47) \quad \alpha^2 + \mu = x \cdot OX, \beta^2 + \mu = y \cdot OY, \mu = z \cdot OZ,$$

this determines the deformable hyperboloid of which one generator through H is a normal to the plane through C ; and the other generator is inclined at an angle θ , the inclination of the axis of the top, while the normal plane or the parallel plane through O revolves with angular velocity $d\psi/dt$.

The curvature is useful in drawing a curve of H ; the diameter of curvature D is given by

$$(48) \quad D = \frac{dp^2}{dp} = \frac{1/2k^2 \sin^3 \theta}{\delta - \delta'}, \frac{1/2D}{p} = \frac{1/4k^2}{KM \cdot KN}.$$

The curvature is zero and H passes through a point of inflexion when C' comes into the horizontal plane through C ; ψ will then be stationary and the curve described by C' will be looped.

In a state of steady motion, z oscillates between two limits z_2 and z_3 which are close together; so putting $z_2 = z_3$ the coefficient of z in Z is

$$(49) \quad 2Z_1z_3 + z^2_3 = -1 + \frac{GG'}{A^2n^2} = -1 + \frac{(OM \cos \theta + ON)(OM + ON \cos \theta)}{OM \cdot ON},$$

$$(50) \quad 2z_1z_3 = \frac{OM^2 + ON^2}{OM \cdot ON} \cos \theta, z_1 = \frac{OM^2 + ON^2}{2OM \cdot ON},$$

$$(51) \quad 2(z_1 - z_3) = \frac{OM^2 - 2OM \cdot ON \cos \theta + ON^2}{OM \cdot ON} = \frac{MN^2}{OM \cdot ON}.$$

With $z_2 = z_3, \kappa = 0, K = 1/2\pi$; and the number of beats per second of the axis is

$$(52) \quad \frac{m}{\pi} = \frac{n}{\pi} \sqrt{\frac{z_1 - z_3}{2}} = \frac{MN}{\sqrt{OM \cdot ON}} \frac{n}{2\pi},$$

beating time with a pendulum of length

$$(53) \quad L = \frac{1}{\frac{1}{2}(z_1 - z_3)} = \frac{4OM \cdot ON}{MN^2} l.$$

The wheel making $R/2\pi$ revolutions per second,

$$(54) \quad \frac{\text{beats/second}}{\text{revolutions/second}} = \frac{MN}{\sqrt{OM \cdot ON}} \cdot \frac{n}{R} = \frac{C}{A} \cdot \frac{MN}{OC'},$$

from (8) (9) § 3; and the apsidal angle is

$$(55) \quad \mu \frac{\frac{1}{2}\pi}{m} = \frac{A\mu}{An} \cdot \frac{n}{m} \cdot \frac{1}{2}\pi = \frac{ON}{\sqrt{OM \cdot ON}} \cdot \frac{2\sqrt{OM \cdot ON}}{MN} \cdot \frac{1}{2}\pi = \frac{ON}{MN} \pi,$$

and the height of the equivalent conical pendulum λ is given by

$$(56) \quad \frac{\lambda}{l} = \frac{g}{l\mu^2} = \frac{n^2}{\mu^2} = \frac{OM}{ON} = \frac{KC}{KC'} = \frac{OL}{OC'},$$

if OR drawn at right angles to OK cuts KC' in R, and RL is drawn horizontal to cut the vertical CO in L; thus if OC^2 represents l to scale, then OL will represent λ .

9. The gyroscope motion in fig. 4 comes to a stop when the rim of the wheel touches the ground; and to realize the motion when the axis is inclined at a greater angle with the upward vertical, the stalk is pivoted in fig. 8 in a lug screwed to the axle of a bicycle hub, fastened vertically in a bracket bolted to a beam. The wheel can now be spun by hand, and projected in any manner so as to produce a desired gyroscopic motion, undulating, looped, or with cusps if the stalk of the wheel is dropped from rest.

As the principal part of the motion takes place now in the neighbourhood of the lowest position, it is convenient to measure the angle θ from the downward vertical, and to change the sign of z and G .

Equation (18) § 8 must be changed to

$$(1) \quad mt = nt \sqrt{\frac{z_3 - z_1}{2}} = \int_z^{z_3} \frac{\sqrt{(z_3 - z_1) dz}}{\sqrt{(4Z)}},$$

$$\begin{aligned} Z &= (z - F)(1 - z^2) - (G^2 - 2GG'z + G'^2) / 2A^2n^2 \\ &= (z - D)(1 - z^2) - (G - G'z)^2 / 2A^2n^2 \\ &= (z - E)(1 - z^2) - (G' - Gz)^2 / 2A^2n^2 \\ &= (z_3 - z)(z - z_2)(z - z_1), \end{aligned}$$

(2)

$$(3) \quad 1 > z_3 > z > z_2 > -1, D, E > z_1,$$

$$(4) \quad z_1 + z_2 + z_3 = F = D - G^2 / 2A^2n^2 = E - G'^2 / 2A^2n^2,$$

and expressed by the inverse elliptic function

$$(5) \quad mt = \text{sn}^{-1} \sqrt{\frac{z_3 - z}{z_3 - z_2}} = \text{cn}^{-1} \sqrt{\frac{z - z_2}{z_3 - z_2}} = \text{dn}^{-1} \sqrt{\frac{z - z_1}{z_3 - z_1}},$$

$$(6) \quad z = z_2 \text{sn}^2 mt + z_3 \text{cn}^2 mt, \kappa^2 = (z_3 - z_2) / (z_3 - z_1).$$

Equation (25) and (29) § 8 is changed to

$$(7) \quad \tilde{\omega} = \frac{1}{2} \int \frac{G' - Gz}{z - E} \frac{dt}{A} = \frac{1}{2} \int \frac{G' - GE}{z - E} \frac{dt}{A} - \frac{Gt}{2A},$$

$$(8) \quad \psi = \int \frac{G'z - G}{1 - z^2} \frac{dt}{A} = \frac{1}{2} \int \frac{G' + G}{1 - z} \frac{dt}{A} - \frac{1}{2} \int \frac{G' - G}{1 + z} \frac{dt}{A},$$

while ψ and $\tilde{\omega}$ change places in (26).

The Jacobian elliptic parameter of the third elliptic integral in (7) can be given by ν , where

$$(9) \quad \nu = \int_E^{z_3} \frac{\sqrt{(z_3 - z_1)}}{\sqrt{(4Z)}} dz = \int_{z_2}^{z_3} + \int_E^{z_2} = K + (1 - f) K',$$

where f is a real fraction,

$$(10) \quad (1 - f) K' = \int_E^{z_2} \frac{\sqrt{(z_3 - z_1)}}{\sqrt{(-4Z)}} dz,$$

$$\begin{aligned} fK' &= \int_{z_1}^E \frac{\sqrt{(z_3 - z_1)}}{\sqrt{(-4Z)}} dz, \\ (11) \quad &= \text{sn}^{-1} \sqrt{\frac{E - z_1}{z_2 - z_1}} = \text{cn}^{-1} \sqrt{\frac{z_2 - E}{z_2 - z_1}} = \text{dn}^{-1} \sqrt{\frac{z_3 - E}{z_3 - z_1}}, \end{aligned}$$

with respect to the comodulus κ' .

Then, with $z = E$, and

$$(12) \quad 2Z_E = -\{(G' - GE) / An\}^2,$$

if Π denotes the apsidal angle of $\tilde{\omega}$, and T the time of a single beat of the axle, up or down,

$$\begin{aligned} \Pi + \frac{GT}{2A} &= \int_{z_2}^{z_3} \frac{\sqrt{(-2Z_E)}}{z - E} \frac{dz}{\sqrt{(2Z)}}, \\ (13) \qquad \qquad \qquad &= \frac{1}{2}\pi f + K \operatorname{zn} f K', \end{aligned}$$

in accordance with the theory of the complete elliptic integral of the third kind.

Interpreted geometrically on the deformable hyperboloid, flattened in the plane of the focal ellipse, if OQ is the perpendicular from the centre on the tangent HP , $AOQ = amfK'$, and the eccentric angle of P , measured from the minor axis, is $am(1 - f)K'$, the eccentricity of the focal ellipse being the comodulus κ' .

A point L is taken in QP such that

$$(14) \qquad \qquad \qquad QL/OA = \operatorname{zn} f K',$$

$$(15) \qquad \qquad \qquad QV, QT, QP = OA (z_s, z_c, z_d) f K';$$

and with

$$(16) \qquad \qquad \qquad mT = K, m/n = \sqrt{(z_3 - z_1)}/2 = OA/k,$$

$$(17) \qquad \qquad \qquad \frac{GT}{2A} = \frac{G}{2An} \cdot \frac{k}{OA} K = \frac{QH}{OA} K,$$

$$(18) \qquad \qquad \qquad \Pi = \frac{1}{2}\pi f + \frac{QL + QH}{OA} K = \frac{1}{2}\pi f + \frac{HL}{OA} K.$$

By choosing for f a simple rational fraction, such as $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \dots$ an algebraical case of motion can be constructed (*Annals of Mathematics*, 1904).

Thus with $G' - GE = 0$, we have $E = z_1$ or z_2 , never z_3 ; $f = 0$ or 1 ; and P is at A or B on the focal ellipse; and then

$$(19) \qquad \qquad \qquad \tilde{\omega} = -pt, p = G/2A,$$

$$(20) \qquad \qquad \qquad \psi + pt = \tan^{-1} \frac{n\sqrt{(2Z)}}{2p(z - E)},$$

$$\sin \theta \exp(\psi + pt)i = i\sqrt{[(-z_2 - z_3)(z - z_1)]} + \sqrt{[(z_3 - z)(z - z_2)]},$$

$$(21) \qquad \qquad \qquad z_1 = \frac{1 + z_2 z_3}{z_2 + z_3}, \sqrt{\frac{-z_2 - z_3}{2}} = \frac{G}{2An} = \frac{p}{n} = \frac{G'}{2Anz_1}, \text{ or}$$

$$\sin \theta \exp(\psi + pt)i = i\sqrt{[(-z_1 - z_3)(z - z_2)]} + \sqrt{[(z_3 - z)(z - z_1)]},$$

$$(22) \qquad \qquad \qquad z_2 = \frac{1 + z_1 z_3}{z_1 + z_3}, \sqrt{\frac{-z_1 - z_3}{2}} = \frac{G}{2An} = \frac{p}{n} = \frac{G'}{2Anz_1}.$$

Thus $z_2 = 0$ in (22) makes $G' = 0$; so that if the stalk is held out horizontally and projected with angular velocity $2p$ about the vertical axis OC without giving any spin to the wheel, the resulting motion of the stalk is like that of a spherical pendulum, and given by

$$\sin \theta \exp(\psi + pt)i = i\sqrt{\left(\frac{2p^2}{n^2} \cos \theta\right)} + \sqrt{\left(\sin^2 \theta - 2\frac{p^2}{n^2} \cos \theta\right)},$$

$$(23) \qquad \qquad \qquad = i \sin \alpha \sqrt{(\sec \alpha \cos \theta)} + \sqrt{[(\sec \alpha + \cos \theta)(\cos \alpha - \cos \theta)]},$$

if the axis falls in the lowest position to an angle α with the downward vertical.

With $z_3 = 0$ in (21) and $z_2 = -\cos \beta$, and changing to the upward vertical measurement, the motion is given by

$$(24) \qquad \sin \theta e^{\psi i} = e^{int} \sqrt{\frac{1}{2} \cos \beta} [\sqrt{(1 - \cos \beta \cos \theta)} + i\sqrt{(\cos \beta \cos \theta - \cos^2 \theta)}],$$

and the axis rises from the horizontal position to a series of cusps; and the mean precessional motion is the same as in steady motion with the same rotation and the axis horizontal.

The special case of $f = \frac{1}{2}$ may be stated here; it is found that

$$(25) \qquad \frac{p}{a} \exp(\tilde{\omega} - pt)i = \sqrt{\frac{(1+x)(\kappa-x)}{2}} + i\sqrt{\frac{(1-x)(\kappa+x)}{2}},$$

$$(26) \qquad \qquad \qquad \rho^2 = a^2(\kappa - x^2),$$

$$(27) \qquad \frac{1}{2}\lambda^2 \sin \theta \exp(\psi - pt)i = (L - 1 + \kappa - x) \sqrt{\frac{(1-x)(\kappa+x)}{2}} \\ + i(L - 1 + \kappa + x) \sqrt{\frac{(1+x)(\kappa-x)}{2}},$$

$$(28) \qquad \qquad \qquad L = \frac{1}{2}(1 - \kappa) + \lambda p/n,$$

so that $p = 0$ and the motion is made algebraical by taking $L = \frac{1}{2} (1 - \kappa)$.

The stereoscopic diagram of fig. 12 drawn by T. I. Dewar shows these curves for $\kappa = \frac{15}{17}$, $\frac{3}{5}$, and $\frac{1}{3}$ (cusps).

10. So far the motion of the axis OC' of the top has alone been considered; for the specification of any point of the body, Euler's third angle φ must be introduced, representing the angular displacement of the wheel with respect to the stalk. This is given by

$$(1) \quad \frac{d\varphi}{dt} + \cos \theta \frac{d\psi}{dt} = R,$$

$$\frac{d(\varphi + \psi)}{dt} = \left(1 - \frac{C}{A}\right) R + \frac{G' + G}{A(1 + \cos \theta)},$$

$$(2) \quad \frac{d(\varphi - \psi)}{dt} = \left(1 - \frac{C}{A}\right) R + \frac{G' - G}{A(1 - \cos \theta)}.$$

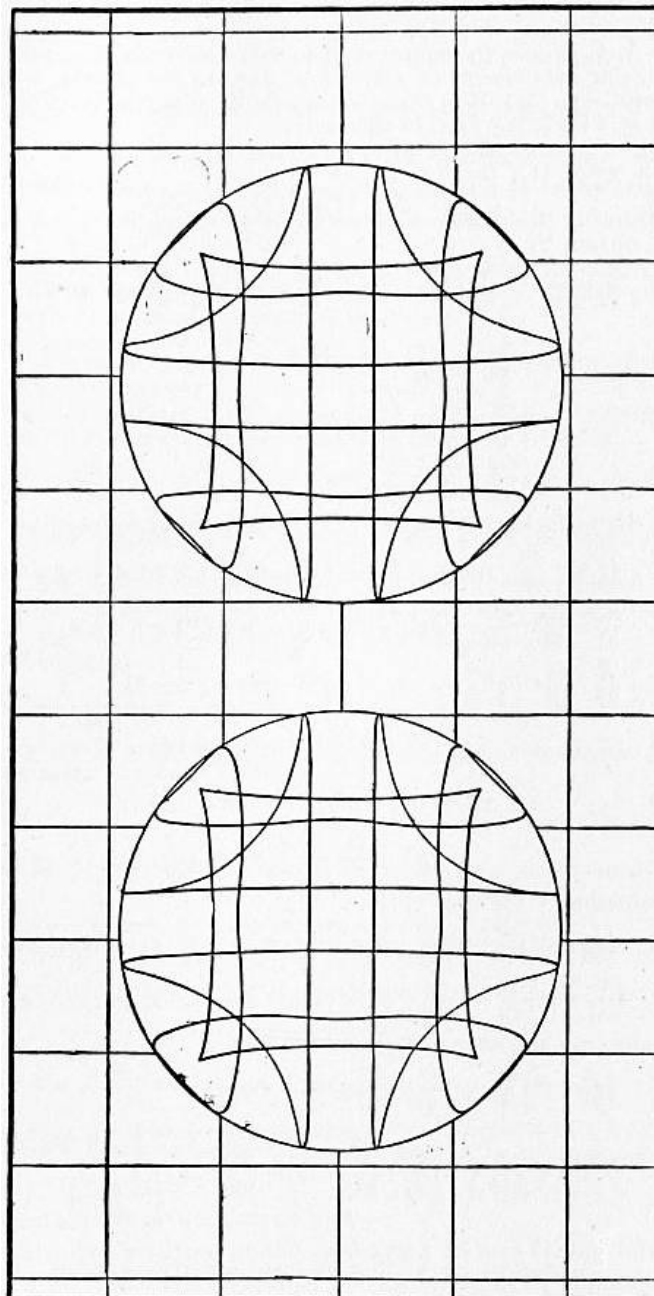
It will simplify the formulas by cancelling a secular term if we make $C = A$, and the top is then called a *spherical top*; OH becomes the axis of instantaneous angular velocity, as well as of resultant angular momentum.

When this secular term is restored in the general case, the axis OI of angular velocity is obtained by producing $Q'H$ to I , making

$$(3) \quad \frac{HI}{Q'H} = \frac{A - C}{C}, \quad \frac{HI}{Q'I} = \frac{A - C}{A},$$

and then the four vector components OC' , $C'K$, KH , HI give a resultant vector OI , representing the angular velocity ω , such that

$$(4) \quad OI/Q'I = \omega/R.$$



The point I is then fixed on the generating line Q'H of the deformable hyperboloid, and the other generator through I will cut the fixed generator OC of the opposite system in a fixed point O', such that IO' is of constant length, and may be joined up by a link, which constrains I to move on a sphere.

In the spherical top then,

$$(5) \quad \frac{1}{2}(\varphi + \psi) = \int \frac{G' + G}{1 + z} \frac{dt}{2A}, \quad \frac{1}{2}(\varphi - \psi) = \int \frac{G' - G}{1 - z} \frac{dt}{2A}$$

depending on the two elliptic integrals of the third kind, with pole at $z = \pm 1$; and measuring θ from the downward vertical, their elliptic parameters are:—

$$(6) \quad v_1 = \int_1^\infty \frac{\sqrt{(z_3 - z_1)} dz}{\sqrt{(4Z)}} = f_1 K'i,$$

$$(7) \quad v_2 = \int_{-\infty}^{-1} \frac{\sqrt{(z_3 - z_1)} dz}{\sqrt{(4Z)}} K + (1 - f_2) K'i,$$

$$(8) \quad \begin{aligned} f_1 K' &= \int_1^\infty \frac{\sqrt{(z_3 - z_1)} dz}{\sqrt{(-4Z)}} \\ &= \operatorname{sn}^{-1} \sqrt{\frac{z_3 - z_1}{1 - z_1}} = \operatorname{cn}^{-1} \sqrt{\frac{1 - z_3}{1 - z_1}} = \operatorname{dn}^{-1} \sqrt{\frac{1 - z_2}{1 - z_1}}, \end{aligned}$$

$$(9) \quad \begin{aligned} (1 - f_2) K' &= \int_{z_1}^{-1} \frac{\sqrt{(z_3 - z_1)} dz}{\sqrt{(-4Z)}} \\ &= \operatorname{sn}^{-1} \sqrt{\frac{-1 - z_1}{z_2 - z_1}} = \operatorname{cn}^{-1} \sqrt{\frac{1 + z_2}{z_2 - z_1}} = \operatorname{dn}^{-1} \sqrt{\frac{1 + z_3}{z_3 - z_1}}. \end{aligned}$$

Then if $v' = K + (1 - f)K'i$ is the parameter corresponding to $z = D$, we find

$$(10) \quad f = f_2 - f_1, \quad f' = f_2 + f_1,$$

$$(11) \quad v = v_1 + v_2, \quad v' = v_1 - v_2.$$

The most symmetrical treatment of the motion of any point fixed in the top will be found in Klein and Sommerfeld, *Theorie des Kreisels*, to which the reader is referred for details; four new functions, $\alpha, \beta, \gamma, \delta$, are introduced, defined in terms of Euler's angles, θ, ψ, φ , by

$$(12) \quad \alpha = \cos \frac{1}{2}\theta \exp \frac{1}{2}(\varphi + \psi) i,$$

$$(13) \quad \beta = i \sin \frac{1}{2}\theta \exp \frac{1}{2}(-\varphi + \psi) i,$$

$$(14) \quad \gamma = i \sin \frac{1}{2}\theta \exp \frac{1}{2}(\varphi - \psi) i,$$

$$(15) \quad \delta = \cos \frac{1}{2}\theta \exp \frac{1}{2}(-\varphi - \psi) i.$$

Next Klein takes two functions or co-ordinates λ and Λ , defined by

$$(16) \quad \lambda = \frac{x + yi}{r - z} = \frac{r + z}{x - yi},$$

and Λ the same function of X, Y, Z , so that λ, Λ play the part of stereographic representations of the same point (x, y, z) or (X, Y, Z) on a sphere of radius r , with respect to poles in which the sphere is intersected by Oz and OZ .

These new functions are shown to be connected by the bilinear relation

$$(17) \quad \lambda = \frac{\alpha\Lambda + \beta}{\gamma\Lambda + \delta}, \quad \alpha\delta - \beta\gamma = 1,$$

in accordance with the annexed scheme of transformation of co-ordinates—

	Ξ	H	Z
ξ	α^2	β^2	$2\alpha\beta$
η	γ^2	δ^2	$2\gamma\delta$
ζ	$\alpha\gamma$	$\beta\delta$	$\alpha\delta + \beta\gamma$

where

$$(18) \quad \begin{aligned} \xi &= x + yi, & \eta &= -x + yi, & \zeta &= -z, \\ \Xi &= X + Yi, & H &= -X + Yi, & Z &= -Z; \end{aligned}$$

and thus the motion in space of any point fixed in the body defined by Λ is determined completely by means of $\alpha, \beta, \gamma, \delta$; and in the case of the symmetrical top these functions are elliptic transcendents, to which Klein has given the name of *multiplicative elliptic functions*; and

$$\alpha\delta = \cos^2 \frac{1}{2}\theta, \quad \beta\gamma = -\sin^2 \frac{1}{2}\theta,$$

Draw GR perpendicular to GK to meet the horizontal AL in R, and draw RQC'K perpendicular to the axis Gz, and KC perpendicular to LG.

The velocity of the vector GK of angular momentum is μ times the horizontal component, and

$$(1) \quad \text{horizontal component} / A\mu \sin \alpha = KC/KC',$$

so that

$$(2) \quad gM \cdot Gm = A\mu^2 \sin \alpha (KC/KC'),$$

$$(3) \quad \frac{A}{M} = \frac{KC'}{KC} \frac{g}{\mu^2 \sin \alpha} Gm = GQ \cdot Gm.$$

The instantaneous axis of rotation of the case of a gyrostat would be OP; drawing GI parallel to OP, and KK' parallel to OG, making $\tan K'GC' = (A/C) \tan IGC'_1$; then if GK represents the resultant angular momentum, K'K will represent the part of it due to the rotation of the fly-wheel. Thus in the figure for the body rolling as a solid, with the fly-wheel clamped, the points m and Q move to the other side of G. The gyrostat may be supposed swung round the vertical at the end of a thread PA' fastened at A' where Pm produced cuts the vertical AB, and again at the point where it crosses the axis GO. The discussion of the small oscillation superposed on the state of steady motion requisite for stability is given in the next paragraph.

General motion of a gyrostat rolling on a plane.

12. In the theoretical discussion of the general motion of a gyrostat rolling on a horizontal plane the safe and shortest plan apparently is to write down the most general equations of motion, and afterwards to introduce any special condition.

Drawing through G the centre of gravity any three rectangular axes Gx, Gy, Gz, the notation employed is

- u, v, w, the components of linear velocity of G;
- p, q, r, the components of angular velocity about the axes;
- h_1, h_2, h_3 , the components of angular momentum;
- $\theta_1, \theta_2, \theta_3$, the components of angular velocity of the coordinate axes;
- x, y, z, the co-ordinates of the point of contact with the horizontal plane;
- X, Y, Z, the components of the reaction of the plane;
- α, β, γ , the direction cosines of the downward vertical.

The geometrical equations, expressing that the point of contact is at rest on the plane, are

$$(1) \quad u - ry + qz = 0,$$

$$(2) \quad v - pz + rx = 0,$$

$$(3) \quad w - qx + py = 0.$$

The dynamical equations are

$$(4) \quad du/dt - \theta_3v + \theta_2w = g\alpha + X/M,$$

$$(5) \quad dv/dt - \theta_1w + \theta_2u = g\beta + Y/M,$$

$$(6) \quad dw/dt - \theta_2u + \theta_1v = g\gamma + Z/M,$$

and

$$(7) \quad dh_1/dt - \theta_3h_2 + \theta_2h_3 = yZ - zY,$$

$$(8) \quad dh_2/dt - \theta_1h_3 + \theta_3h_1 = zX - xZ,$$

$$(9) \quad dh_3/dt - \theta_2h_1 + \theta_1h_2 = xY - yX.$$

In the special case of the gyrostat where the surface is of revolution round Gz, and the body is kinetically symmetrical about Gz, we take Gy horizontal and Gzx through the point of contact so that $y = 0$; and denoting the angle between Gz and the downward vertical by θ (fig. 13)

$$(10) \quad \alpha = \sin \theta, \quad \beta = 0, \quad \gamma = \cos \theta.$$

The components of angular momentum are

$$(11) \quad h_1 = Ap, \quad h_2 = Aq, \quad h_3 = Cr + K,$$

where A, C denote the moment of inertia about Gx, Gz, and K is the angular momentum of a fly-wheel fixed in the interior with its axis parallel to Gz; K is taken as constant during the motion.

The axis Gz being fixed in the body,

$$\theta_1 = p, \quad \theta_2 = q = -d\theta/dt, \quad \theta_3 = p \cot \theta.$$

(12)

With $y = 0$, (1), (2), (3) reduce to

$$(13) \quad u = -qz, \quad v = pz - rx, \quad w = qx;$$

and, denoting the radius of curvature of the meridian curve of the rolling surface by ρ ,

$$(14) \quad \frac{dx}{dt} = \rho \cos \theta \frac{d\theta}{dt} = -q \rho \cos \theta, \quad \frac{dz}{dt} = -\rho \sin \theta \frac{d\theta}{dt} = q \rho \sin \theta;$$

so that

$$(15) \quad \frac{du}{dt} = -\frac{dq}{dt} z - q^2 \rho \sin \theta,$$

$$(16) \quad \frac{dv}{dt} = \frac{dp}{dt} z - \frac{dr}{dt} x + p q \rho \sin \theta + q r \rho \sin \theta,$$

$$(17) \quad \frac{dw}{dt} = \frac{dq}{dt} x - q^2 \rho \cos \theta.$$

The dynamical equations (4)...(9) can now be reduced to

$$(18) \quad \frac{X}{M} = -\frac{dq}{dt} z - p^2 z \cot \theta + q^2 (x - \rho \sin \theta) + p r x \cot \theta - g \sin \theta,$$

$$(19) \quad \frac{Y}{M} = \frac{dp}{dt} z - \frac{dr}{dt} x - p q (x + z \cot \theta - \rho \sin \theta) + q r p \cos \theta,$$

$$(20) \quad \frac{Z}{M} = \frac{dq}{dt} x + q^2 (z - \rho \cos \theta) + p^2 z - p r x - g \cos \theta,$$

$$(21) \quad -zY = A \frac{dp}{dt} - A p q \cot \theta + q h_3,$$

$$-zX - xZ = A \frac{dq}{dt} + A p^2 \cot \theta - p h_3,$$

$$(23) \quad xY = \frac{dh_3}{dt} = C \frac{dr}{dt} = -C q \frac{d}{d\theta}.$$

Eliminating Y between (19) and (23),

$$(24) \quad \left(\frac{C}{M} + x^2 \right) \frac{dr}{dt} - xz \frac{dp}{dt} + p q x (x + z \cot \theta - \rho \sin \theta) - q r x p \cos \theta = 0,$$

$$(A) \quad \left(\frac{C}{M} + x^2 \right) \frac{dr}{d\theta} - xz \frac{dp}{d\theta} - p x (x + z \cot \theta - \rho \sin \theta) + r x p \cos \theta = 0.$$

Eliminating Y between (19) and (21)

$$(25) \quad \left(\frac{A}{M} + z^2 \right) \frac{dp}{dt} - xz \frac{dr}{dt} - \frac{A}{M} p q \cot \theta + q \frac{h_3}{M}$$

$$- p q z (x + z \cot \theta - \rho \sin \theta) + q r z p \cos \theta = 0,$$

$$-xz \frac{dr}{d\theta} + \left(\frac{A}{M} + z^2 \right) \frac{dp}{d\theta} + \frac{A}{M} p \cot \theta - \frac{h_3}{M}$$

$$(B) \quad + p z (x + z \cot \theta - \rho \sin \theta) + r z p \cos \theta = 0.$$

In the special case of a gyrostat rolling on the sharp edge of a circle passing through G , $z = 0$, $\rho = 0$, (A) and (B) reduce to

$$(26) \quad p = \left(\frac{C}{Mx^2} + 1 \right) \frac{dr}{d\theta} = \left(\frac{1}{Mx^2} + \frac{1}{C} \right) \frac{dh_3}{d\theta},$$

$$(27) \quad \frac{dp}{d\theta} + p \cot \theta = \frac{h_3}{A}, \quad \frac{d \cdot p \sin \theta}{d\theta} = \frac{h_3 \sin \theta}{A};$$

$$(28) \quad \frac{d^2 h_3}{d\theta^2} + \frac{dh_3}{d\theta} \cot \theta = \frac{CMx^2}{A(Mx^2 + C)} h_3,$$

a differential equation of a hypergeometric series, of the form of Legendre's zonal harmonic of fractional order n , given by

$$(29) \quad n(n+1) = CMx^2 / A(Mx^2 + C).$$

For a sharp point, $x = 0$, $\rho = 0$, and the previous equations are obtained of a spinning top.

The elimination of X and Z between (18) (20) (22), expressed symbolically as

$$(30) \quad (22) - z(18) + x(20) = 0,$$

gives

$$\left(\frac{A}{M} + x^2 + z^2 \right) \frac{dq}{dt} - p \frac{h_3}{M} + \left(\frac{A}{M} + z^2 \right) p^2 \cot \theta + p^2 x z$$

$$(C) \quad + q^2 \rho (x \cos \theta - z \sin \theta) - p r x (x + z \cot \theta) - g (x \cos \theta - z \sin \theta) = 0,$$

and this combined with (A) and (B) will lead to an equation the integral of which is the equation of energy.

13. The equations (A) (B) (C) are intractable in this general form; but the restricted case may be considered when the axis moves in steady motion at a constant inclination α to the vertical; and the stability is secured if a small nutation of the axis can be superposed.

It is convenient to put $p = \Omega \sin \theta$, so that Ω is the angular velocity of the plane Gzx about the vertical; (A) (B) (C) become

$$(A^*) \quad \left(\frac{C}{M} + x^2 \right) \frac{dr}{d\theta} - xz \sin \theta \frac{d\Omega}{d\theta} - \Omega x (x \sin \theta - 2z \cos \theta - \rho \sin^2 \theta) + r x \rho \cos \theta = 0,$$

$$(B^*) \quad -xz \frac{dr}{d\theta} + \left(\frac{A}{M} + z^2 \right) \sin \theta \frac{d\Omega}{d\theta} - \frac{h_3}{M} + 2\Omega \left(\frac{A}{M} + z^2 \right) \cos \theta + \Omega z \sin \theta (x - \rho \sin \theta) - r z \rho \cos \theta = 0,$$

$$(C^*) \quad \left(\frac{A}{M} + x^2 + z^2 \right) \frac{dq}{dt} + q^2 p (x \cos \theta - z \sin \theta) - \Omega \frac{h_3}{M} \sin \theta + \Omega^2 \left(\frac{A}{M} + z^2 \right) \sin \theta \cos \theta + \Omega^2 x z \sin^2 \theta - \Omega r x (x \sin \theta + z \cos \theta) - g (x \cos \theta - z \sin \theta) = 0.$$

The steady motion and nutation superposed may be expressed by

$$(1) \quad \theta = \alpha + L, \sin \theta = \sin \alpha + L \cos \alpha, \cos \theta = \cos \alpha - L \sin \alpha, \Omega = \mu + N, r = R + Q,$$

where L, N, Q are small terms, involving a factor e^{nti} , to express the periodic nature of the nutation; and then if a, c denote the mean value of x, z , at the point of contact

$$(2) \quad x = a + L\rho \cos \alpha, z = c - L\rho \sin \alpha,$$

$$(3) \quad x \sin \theta + z \cos \theta = a \sin \alpha + c \cos \alpha + L (a \cos \alpha - c \sin \alpha),$$

$$(4) \quad x \cos \theta - z \sin \theta = a \cos \alpha - c \sin \alpha - L (a \sin \alpha + c \cos \alpha - \rho).$$

Substituting these values in (C*) with $dq/dt = -d^2\theta/dt^2 = n^2L$, and ignoring products of the small terms, such as L^2, LN, \dots

$$(C^{**}) \quad \left(\frac{A}{M} + a^2 + c^2 \right) Ln^2 - (\mu + N) \left(\frac{CR + K}{M} + \frac{CQ}{M} \right) (\sin \alpha + L \cos \alpha) + (\mu^2 + 2\mu N) (A/M + c^2 - 2L\rho c \sin \alpha) (\sin \alpha \cos \alpha + L \cos \alpha) + (\mu^2 + 2\mu N) [ac - L\rho (a \sin \alpha - c \sin \alpha)] (\sin^2 \alpha + L \sin 2\alpha) - (\mu + N) (R + Q) (a + L\rho \cos \alpha) [a \sin \alpha + c \cos \alpha + L (a \cos \alpha - c \sin \alpha)] - g (a \cos \alpha - c \sin \alpha) + gL (a \sin \alpha + c \cos \alpha - \rho) = 0,$$

which is equivalent to

$$(5) \quad -\mu \frac{CR + K}{M} \sin \alpha + \mu^2 \left(\frac{A}{M} + c^2 \right) \sin \alpha \cos \alpha + \mu^2 ac \sin^2 \alpha - \mu Ra (a \sin \alpha + c \cos \alpha) - g (a \cos \alpha - c \sin \alpha) = 0,$$

the condition of steady motion; and

$$(6) \quad DL + EQ + FN = 0,$$

where

$$(7) \quad D = \left(\frac{A}{M} + a^2 + c^2 \right) n^2 - \mu \frac{CK + K}{M} \cos \alpha - 2\mu^2 \rho c \sin^2 \alpha \cos \alpha + \mu^2 (A/M + c^2) \cos \alpha - \mu^2 \rho (a \sin \alpha - c \cos \alpha) \sin^2 \alpha + \mu^2 ac \sin 2\alpha - \mu R \rho \cos \alpha (a \sin \alpha + c \cos \alpha) - \mu Ra (a \cos \alpha - c \sin \alpha) + g (a \sin \alpha + c \cos \alpha - \rho),$$

$$(8) \quad E = -\mu \frac{C}{M} \sin \alpha - \mu a (a \sin \alpha + c \cos \alpha),$$

$$(9) \quad F = -\frac{CR + K}{M} \sin \alpha + 2\mu \left(\frac{A}{M} + c^2 \right) \sin \alpha \cos \alpha + 2\mu ac \sin^2 \alpha - Ra (a \sin \alpha + c \cos \alpha).$$

With the same approximation (A*) and (B*) are equivalent to

$$(A^{**}) \left(\frac{C}{M} + a^2 \right) \frac{Q}{L} - ac \sin \alpha \frac{N}{L} - \mu a (a \sin \alpha + 2c \cos \alpha - \rho \sin^2 \alpha) + Rap \cos \alpha = 0,$$

$$-ac \frac{Q}{L} + \left(\frac{A}{M} + c^2 \right) \sin \alpha \frac{N}{L} - \frac{CR + K}{M} + 2\mu \left(\frac{A}{M} + c^2 \right) \cos \alpha$$

$$(B^{**}) \quad + \mu c \sin \alpha (a - \rho \sin \alpha) - Rcp \cos \alpha = 0.$$

The elimination of L, Q, N will lead to an equation for the determination of n^2 , and n^2 must be positive for the motion to be stable.

If b is the radius of the horizontal circle described by G in steady motion round the centre B,

$$(10) \quad b = v/\mu = (cP - aR) / \mu = c \sin \alpha - aR / \mu,$$

and drawing GL vertically upward of length $\lambda = g/\mu^2$, the height of the equivalent conical pendulum, the steady motion condition may be written

$$(CR + K) \mu \sin \alpha - \mu^2 \sin \alpha \cos \alpha = -gM (a \cos \alpha - c \sin \alpha)$$

$$+ M (\mu^2 c \sin \alpha - \mu Ra) (a \sin \alpha + c \cos \alpha)$$

$$= gM [b\lambda^{-1} (a \sin \alpha + c \cos \alpha) - a \cos \alpha + c \sin \alpha]$$

$$(11) \quad = gM \cdot PT,$$

LG produced cuts the plane in T.

Interpreted dynamically, the left-hand side of this equation represents the velocity of the vector of angular momentum about G, so that the right-hand side represents the moment of the applied force about G, in this case the reaction of the plane, which is parallel to GA, and equal to $gM \cdot GA/GL$; and so the angle AGL must be less than the angle of friction, or slipping will take place.

Spinning upright, with $\alpha = 0$, $a = 0$, we find $F = 0$, $Q = 0$, and

$$(12) \quad -\frac{CR + K}{M} + 2\mu \left(\frac{A}{M} + c^2 \right) - Rcp = 0,$$

$$(13) \quad \left(\frac{A}{M} + c^2 \right) n^2 = \mu \frac{CR + K}{M} - \mu^2 \left(\frac{A}{M} + c^2 \right) + \mu Rpc - g(c - \rho),$$

$$(14) \quad \left(\frac{A}{M} + c^2 \right)^2 n^2 = \frac{1}{4} \left(\frac{CK + R}{M} + Rcp \right)^2 - g \left(\frac{A}{M} + c^2 \right) (c - \rho).$$

Thus for a top spinning upright on a rounded point, with $K = 0$, the stability requires that

$$(15) \quad R > 2k' \sqrt{\{g(c - \rho)\} / (k^2 + cp)},$$

where k, k' are the radii of gyration about the axis Gz , and a perpendicular axis at a distance c from G; this reduces to the preceding case of § 3 (7) when $\rho = 0$.

Generally, with $\alpha = 0$, but $a \neq 0$, the condition (A) and (B) becomes

$$\left(\frac{C}{M} + a^2 \right) \frac{Q}{L} = 2\mu ac - Rap,$$

$$(16) \quad -ac \frac{Q}{L} = \frac{CR + K}{M} + Rcp - 2\mu \left(\frac{A}{M} + a^2 \right),$$

so that, eliminating Q/L ,

$$(17) \quad 2 \left[\left(\frac{A}{M} + c^2 \right) \left(\frac{C}{M} + a^2 \right) - a^2 c^2 \right] \mu = \left(\frac{C}{M} + a^2 \right) \left(\frac{CR + K}{M} \right) + \frac{C}{M} Rcp,$$

the condition when a coin or platter is rolling nearly flat on the table.

Rolling along in a straight path, with $\alpha = \frac{1}{2}\pi$, $c = 0$, $\mu = 0$, $E = 0$; and

$$(18) \quad N/L = (CR + K)/A,$$

$$D = \left(\frac{A}{M} + a^2 \right) n^2 + g(a - \rho),$$

$$(19) \quad F = -\frac{CR + K}{M} - Ra^2,$$

$$(20) \quad \frac{N}{L} = -\frac{D}{F} = \frac{\left(\frac{A}{M} + a^2 \right) n^2 + g(a - \rho)}{\left(\frac{C}{M} + a^2 \right) R + \frac{K}{M}},$$

$$(21) \quad \left(\frac{A}{M} + a^2 \right) n^2 = \frac{(CR + K)}{A} \left[\left(\frac{C}{M} + a^2 \right) R + \frac{K}{M} \right] - g(a - \rho).$$

Thus with $K = 0$, and rolling with velocity $V = Ra$, stability requires

$$(22) \quad \frac{V^2}{2g} > \frac{a - \rho}{2C/A (C/Ma^2 + 1)} > \frac{1}{2} \frac{A}{C} \frac{a - \rho}{C/Ma^2 + 1},$$

or the body must have acquired velocity greater than attained by rolling down a plane through a vertical height $\frac{1}{2} (a - \rho) A/C$.

On a sharp edge, with $\rho = 0$, a thin uniform disk or a thin ring requires

$$(23) \quad V^2/2g > a/6 \text{ or } a/8.$$

The gyrostat can hold itself upright on the plane without advance when $R = 0$, provided

$$(24) \quad K^2/AM - g (a - \rho) \text{ is positive.}$$

For the stability of the monorail carriage of § 5 (6), ignoring the rotary inertia of the wheels by putting $C = 0$, and replacing K by G the theory above would require

$$\frac{G}{A} \left(aV + \frac{G}{A} \right) > gh.$$

For further theory and experiments consult Routh, *Advanced Rigid Dynamics*, chap. v., and Thomson and Tait, *Natural Philosophy*, § 345; also Bourlet, *Traité des bicycles* (analysed in Appell, *Mécanique rationnelle*, ii. 297, and Carvallo, *Journal de l'école polytechnique*, 1900); Whipple, *Quarterly Journal of Mathematics*, vol. xxx., for mathematical theories of the bicycle, and other bodies.

14. Lord Kelvin has studied theoretically and experimentally the vibration of a chain of stretched gyrostats (*Proc. London Math. Soc.*, 1875; J. Perry, *Spinning Tops*, for a diagram). Suppose each gyrostat to be equivalent dynamically to a fly-wheel of axial length $2a$, and that each connecting link is a light cord or steel wire of length $2l$, stretched to a tension T .

Gyrostatic chain.

Denote by x, y the components of the slight displacement from the central straight line of the centre of a fly-wheel; and let $p, q, 1$ denote the direction cosines of the axis of a fly-wheel, and $r, s, 1$ the direction cosines of a link, distinguishing the different bodies by a suffix.

Then with the previous notation and to the order of approximation required,

$$(1) \quad \theta_1 = -dq/dt, \theta_2 = dp/dt,$$

$$(2) \quad h_1 = A\theta_1, h_2 = A\theta_2, h_3 = K,$$

to be employed in the dynamical equations

$$(3) \quad \frac{dh_1}{dt} - \theta_3 h_2 + \theta_2 h_3 = L, \dots$$

in which $\theta_3 h_1$ and $\theta_3 h_2$ can be omitted.

For the k th fly-wheel

$$(4) \quad -A\bar{q}_k + K\bar{p}_k = Ta (q_k - s_k) + Ta (q_k - s_{k+1}),$$

$$(5) \quad A\bar{p}_k + K\bar{q}_k = -Ta (p_k - r_k) - Ta (p_k - r_{k+1});$$

and for the motion of translation

$$(6) \quad M\bar{x}_k = T (r_{k+1} - r_k), M\bar{y}_k = T (s_{k+1} - s_k);$$

while the geometrical relations are

$$(7) \quad x_{k+1} - x_k = a (p_{k+1} + p_k) + 2lr_{k+1},$$

$$(8) \quad y_{k+1} - y_k = a (q_{k+1} + q_k) + 2ls_{k+1}.$$

Putting

$$(9) \quad x + yi = w, p + qi = \omega, r + si = \sigma,$$

these three pairs of equations may be replaced by the three equations

$$(10) \quad A\bar{\omega}_k - K\bar{\omega}_k i + 2Ta\dot{\omega}_k - Ta (\sigma_{k+1} + \sigma_k) = 0,$$

$$(11) \quad M\bar{\omega}_k - T (\sigma_{k+1} - \sigma_k) = 0,$$

$$(12) \quad \omega_{k+1} - \omega_k - a(\dot{\omega}_{k+1} + \dot{\omega}_k - 2l\sigma_{k+1}) = 0.$$

For a vibration of circular polarization assume a solution

$$(13) \quad \omega_k, \dot{\omega}_k, \sigma_k = (L, P, Q) \exp (nt + kc) i,$$

so that c/n is the time-lag between the vibration of one fly-wheel and the next; and the wave velocity is

$$(14) \quad U = 2(a + l)n/c.$$

Then

$$(15) \quad P(-An^2 + Kn + 2Ta) - QTa(e^{ci} + 1) = 0,$$

$$(16) \quad -LMn^2 - QT(e^{ci} - 1) = 0,$$

$$(17) \quad L(e^{ci} - 1) - Pa(e^{ci} + 1) - 2Qle^{ci} = 0,$$

leading, on elimination of L, P, Q, to

$$(18) \quad \cos c = \frac{(2Ta + Kn - An^2)(1 - Mn^2l/T) - Mna^2}{2Ta + Kn - An^2 + Mna^2},$$

$$(19) \quad 2 \sin^2 \frac{1}{2}c = \frac{Mn^2 2Ta(a + l) + KNl - An^2l}{T 2Ta + Kn - An^2 + Mn^2a^2}.$$

With $K = 0$, $A = 0$, this reduces to Lagrange's condition in the vibration of a string of beads.

Putting

$$(20) \quad \rho = M/2(a + l), \quad \text{the mass per unit length of the chain,}$$

$$(21) \quad \kappa = K/2(a + l), \quad \text{the gyrostatic angular momentum per unit length,}$$

$$(22) \quad \alpha = A/2(a + l), \quad \text{the transverse moment of inertia per unit length,}$$

$$(23) \quad 1/2c = (a + l)n/U,$$

equation (19) can be written

$$(24) \quad \begin{aligned} & \{\sin(a + l)n/U\}^2 \\ & = (a + l)^2 n^2 \frac{\rho}{T} \cdot \frac{Ta + \kappa n l - \alpha n^2 l}{Ta + \kappa n(a + l) - \alpha n^2(a + l) + \rho n^2 a^2(a + l)}, \end{aligned}$$

$$(25) \quad = \frac{T}{\rho} \cdot \frac{\left\{ \frac{(a + l)n}{\sin(a + l)n/U} \right\}^2 \cdot T + (\kappa n - \alpha n^2)(1 + l/a) + \rho n^2 a(a + l)}{T + (\kappa n - \alpha n^2)l/a}.$$

In a continuous chain of such gyrostatic links, with a and l infinitesimal,

$$(26) \quad U^2 = \frac{T}{\rho} \left\{ 1 + \frac{\kappa n - \alpha n^2}{T + (\kappa n - \alpha n^2)l/a} \right\}$$

for the vibration of helical nature like circular polarization.

Changing the sign of n for circular polarization in the opposite direction

$$(27) \quad U^2 = \frac{T}{\rho} \left\{ 1 - \frac{\kappa n + \alpha n^2}{T - (\kappa n + \alpha n^2)l/a} \right\}$$

In this way a mechanical model is obtained of the action of a magnetized medium on polarized light, κ representing the equivalent of the magnetic field, while α may be ignored as insensible (J. Larmor, *Proc. Lond. Math. Soc.*, 1890; *Aether and Matter*, Appendix E).

We notice that U^2 in (26) can be positive, and the gyrostatic chain stable, even when T is negative, and the chain is supporting a thrust, provided κn is large enough, and the thrust does not exceed

$$(28) \quad (\kappa n - \alpha n^2)(1 + l/a);$$

while U^2 in (27) will not be positive and the straight chain will be unstable unless the tension exceeds

$$(29) \quad (\kappa n + \alpha n^2)(1 + l/a).$$

15. *Gyrostat suspended by a Thread.*—In the discussion of the small vibration of a single gyrostat fly-wheel about the vertical position when suspended by a single thread of length $2l = b$, the suffix k can be omitted in the preceding equations of § 14, and we can write

$$(1) \quad A\bar{\omega} - K\bar{\omega}_i + Ta\bar{\omega} - T\alpha\sigma = 0,$$

$$(2) \quad M\bar{w} + T\sigma = 0, \text{ with } T = gM,$$

$$(3) \quad w - a\bar{\omega} - b\sigma = 0.$$

Assuming a periodic solution of these equations

$$(4) \quad w, \dot{\omega}, \sigma, = (L, P, Q) \exp nti,$$

and eliminating L, P, Q, we obtain

$$(5) \quad (-An^2 + Kn + gMa)(g - n^2b) - gMn^2a^2 = 0,$$

and the frequency of a vibration in double beats per second is $n/2\pi$, where n is a root of this quartic equation.

For upright spinning on a smooth horizontal plane, take $b = \infty$ and change the sign of a, then

$$(6) \quad An^2 - Kn + gMa = 0,$$

so that the stability requires

$$(7) \quad K^2 > 4gAMa.$$

Here A denotes the moment of inertia about a diametral axis through the centre of gravity; when the point of the fly-wheel is held in a small smooth cup, $b = 0$, and the condition becomes

$$(8) \quad (A + Ma^2)n^2 - Kn + gMa = 0,$$

requiring for stability, as before in § 3,

$$(9) \quad K^2 > 4g(A + M^2)Ma.$$

For upright spinning inside a spherical surface of radius b, the sign of a must be changed to obtain the condition at the lowest point, as in the gyroscopic horizon of Fleuriais.

For a gyrostat spinning upright on the summit of a sphere of radius b, the signs of a and b must be changed in (5), or else the sign of g, which amounts to the same thing.

Denoting the components of horizontal displacement of the point of the fly-wheel by ξ, η , then

$$(10) \quad br = \xi, bs = \eta, b\sigma = \xi + \eta i = \lambda \text{ (suppose),}$$

$$(11) \quad \omega = \alpha\dot{\omega} + \lambda.$$

If the point is forced to take the motion (ξ, η, ζ) by components of force X, Y, Z, the equations of motion become

$$(12) \quad -A\bar{q} + K\bar{p} = Ya - Zaq,$$

$$(13) \quad A\bar{p} + K\bar{q} = -Xa + Zap,$$

$$(14) \quad M\bar{\omega} = X + Yi, M(\bar{\zeta} - g) = Z;$$

so that

$$(15) \quad A\bar{\omega} - K\bar{\omega}i + gMa\dot{\omega} + Ma\bar{w} = Ma\dot{\omega}\bar{\zeta},$$

or

$$(16) \quad (A + Ma^2)\bar{\omega} - K\bar{\omega}i + gMa\dot{\omega} + Ma\lambda = Ma\dot{\omega}\bar{\zeta}.$$

Thus if the point of the gyrostat is made to take the periodic motion given by $\lambda = R \exp nti$, $\zeta = 0$, the forced vibration of the axis is given by $\dot{\omega} = P \exp nti$, where

$$(17) \quad P \{ -(A + Ma^2)n^2 + Kn + gMa \} - RMn^2a = 0;$$

and so the effect may be investigated on the Fleuriais gyroscopic horizon of the motion of the ship.

Suppose the motion λ is due to the suspension of the gyrostat from a point on the axis of a second gyrostat suspended from a fixed point.

Distinguishing the second gyrostat by a suffix, then $\lambda = b\dot{\omega}_1$, if b denotes the distance between the points of suspension of the two gyrostats; and the motion of the second gyrostat influenced by the reaction of the first, is given by

$$(18) \quad \begin{aligned} & (A_1 + M_1h_1^2)\bar{\omega}_1 - K_1\bar{\omega}_1i \\ & = -g(M_1h_1 + Mb)\dot{\omega}_1 - b(X + Yi) \\ & = -g(M_1h_1 + Mb)\dot{\omega}_1 - Mb(a\bar{\omega} + \lambda); \end{aligned}$$

so that, in the small vibration,

$$(19) \quad \frac{R}{b} \{ -(A_1 + M_1h_1^2)n^2 + K_1n + g(M_1h_1 + Mb) \} = Mn^2b(aP + R),$$

$$(20) \quad R \{ -(A_1 + M_1h_1^2 + Mb^2)n^2 + K_1n + g(M_1h_1 + Mb) \} - PMn^2ab^2 = 0.$$

Eliminating the ratio of P to R, we obtain

$$(21) \quad \begin{aligned} & \{ -(A + Ma^2) n^2 + Kn + gMa \} \\ & \times \{ -(A_1 + M_1 h_1^2 + Mb^2) n^2 + K_1 n + g (M_1 h_1 + Mb) \} - M^2 n^4 a^2 b^2 = 0, \end{aligned}$$

a quartic for n, giving the frequency $n/2\pi$ of a fundamental vibration.

Change the sign of g for the case of the gyrostats spinning upright, one on the top of the other, and so realize the gyrostat on the top of a gyrostat described by Maxwell.

In the gyrostatic chain of § 14, the tension T may change to a limited pressure, and U^2 may still be positive, and the motion stable; and so a motion is realized of a number of spinning tops, superposed in a column.

16. *The Flexure Joint.*—In Lord Kelvin's experiment the gyrostats are joined up by equal light rods and short lengths of elastic wire with rigid attachment to the rod and case of a gyrostat, so as to keep the system still, and free from entanglement and twisting due to pivot friction of the fly-wheels.

When this gyrostatic chain is made to revolve with angular velocity n in relative equilibrium as a plane polygon passing through Oz the axis of rotation, each gyrostatic case moves as if its axis produced was attached to Oz by a flexure joint. The instantaneous axis of resultant angular velocity bisects the angle $\pi - \theta$, if the axis of the case makes an angle θ with Oz, and, the components of angular velocity being n about Oz, and $-n$ about the axis, the resultant angular velocity is $2n \cos \frac{1}{2}(\pi - \theta) = 2n \sin \frac{1}{2}\theta$; and the components of this angular velocity are

$$(1) \quad -2n \sin \frac{1}{2}\theta \sin \frac{1}{2}\theta = -n (1 - \cos \theta), \text{ along the axis, and}$$

(2) $-2n \sin \frac{1}{2}\theta \cos \frac{1}{2}\theta = -n \sin \theta$, perpendicular to the axis of the case. The flexure joint behaves like a pair of equal bevel wheels engaging.

The component angular momentum in the direction Ox is therefore

$$(3) \quad L = -An \sin \theta \cos \theta - Cn (1 - \cos \theta) \sin \theta + K \sin \theta,$$

and Ln is therefore the couple acting on the gyrostat.

If α denotes the angle which a connecting link makes with Oz, and T denotes the constant component of the tension of a link parallel to Oz, the couple acting is

$$(4) \quad Ta \cos \theta_k (\tan \alpha_{k+1} + \tan \alpha_k) - 2T\alpha \sin \theta_k,$$

which is to be equated to Ln, so that

$$(5) \quad \begin{aligned} & -An^2 \sin \theta_k \cos \theta_k - Cn (1 - \cos \theta_k) \sin \theta_k + Kn \sin \theta_k \\ & -Ta \cos \theta_k (\tan \alpha_{k+1} + \tan \alpha_k) + 2T\alpha \sin \theta_k = 0. \end{aligned}$$

In addition

$$(6) \quad Mn^2 x_k + T (\tan \alpha_{k+1} - \tan \alpha_k) = 0,$$

with the geometrical relation

$$(7) \quad x_{k+1} - x_k - a (\sin \theta_{k+1} + \sin \theta_k) - 2l \sin \alpha_{k+1} = 0.$$

When the polygon is nearly coincident with Oz, these equations can be replaced by

$$(8) \quad (-An^2 + Kn + 2Ta) \theta_k - Ta (\alpha_{k+1} + \alpha_k) = 0,$$

$$(9) \quad Mn^2 x_k + T (\alpha_{k+1} - \alpha_k) = 0,$$

$$(10) \quad x_{k+1} - x_k - a (\theta_{k+1} + \theta_k) - 2la_k = 0,$$

and the rest of the solution proceeds as before in § 14, putting

$$(11) \quad x_k, \theta_k, \alpha_k = (L, P, Q) \exp cki.$$

A half wave length of the curve of gyrostats is covered when $ck = \pi$, so that π/c is the number of gyrostats in a half wave, which is therefore of wave length $2\pi (a + l)/c$.

A plane polarized wave is given when $\exp cki$ is replaced by $\exp (nt + ck) i$, and a wave circularly polarized when $w, \hat{\omega}, \sigma$ of § 14 replace this x, θ, α .

Gyroscopic Pendulum.—The elastic flexure joint is useful for supporting a rod, carrying a fly-wheel, like a gyroscopic pendulum.

Expressed by Euler's angles, θ, φ, ψ , the kinetic energy is

$$(12) \quad T = \frac{1}{2}A (\bar{\theta}^2 + \sin^2 \bar{\theta} \bar{\psi}^2) + \frac{1}{2}C' (1 - \cos \theta)^2 \bar{\psi}^2 + \frac{1}{2}C (\bar{\varphi} + \bar{\psi} \cos \theta)^2,$$

where A refers to rod and gyroscope about the transverse axis at the point of support, C' refers to

rod about its axis of length, and C refers to the revolving fly-wheel.

The elimination of $\bar{\psi}$ between the equation of conservation of angular momentum about the vertical, viz.

(13) $A \sin^2 \theta \bar{\psi} - C' (1 - \cos \theta) \cos \theta \bar{\psi} + C(\bar{\varphi} + \bar{\psi} \cos \theta) \cos \theta = G$, a constant, and the equation of energy, viz.

(14) $T - gMh \cos \theta = H$, a constant, with θ measured from the downward vertical, and

(15) $\bar{\varphi} + \bar{\psi} \cos \theta = R$, a constant, will lead to an equation for $d\theta/dt$, or dz/dt , in terms of $\cos \theta$ or z , the integral of which is of hyperelliptic character, except when $A = C'$.

In the suspension of fig. 8, the motion given by $\bar{\varphi}$ is suppressed in the stalk, and for the fly-wheel $\bar{\varphi}$ gives the rubbing angular velocity of the wheel on the stalk; the equations are now

(16) $T = \frac{1}{2}A(\bar{\theta}^2 + \sin^2 \theta \bar{\psi}^2) + \frac{1}{2}C' \cos^2 \theta \bar{\psi}^2 + \frac{1}{2}CR^2 = H + gMh \cos \theta$,

(17) $A \sin^2 \theta \bar{\psi} + C' \cos^2 \theta \bar{\psi} + CR \cos \theta = G$,

and the motion is again of hyperelliptic character, except when $A = C'$, or $C' = 0$. To realize a motion given completely by the elliptic function, the suspension of the stalk must be made by a smooth ball and socket, or else a Hooke universal joint.

Finally, there is the case of the general motion of a top with a spherical rounded point on a smooth plane, in which the centre of gravity may be supposed to rise and fall in a vertical line. Here

(18) $T = \frac{1}{2}(A + Mh^2 \sin^2 \theta) \bar{\theta}^2 + \frac{1}{2}A \sin^2 \theta \bar{\psi}^2 + \frac{1}{2}CR^2 = H - gMh \cos \theta$,

with θ measured from the upward vertical, and

(19) $A \sin^2 \theta \bar{\psi} + CR \cos \theta = G$,

where A now refers to a transverse axis through the centre of gravity. The elimination of $\bar{\psi}$ leads to an equation for $z = \cos \theta$, of the form

(20) $\left(\frac{dz}{dt}\right)^2 = 2 \frac{g}{h} \frac{Z}{1 - z^2 + A/Mh^2} = 2 \frac{g}{h} \frac{(z_1 - z)(z_2 - z)(z_3 - z)}{(z_4 - z)(z - z_5)}$,

with the arrangement

(21) $z_1, z_4 > / > z_2 > z > z_3 > - / > z_5;$

so that the motion is hyperelliptic.

AUTHORITIES.—In addition to the references in the text the following will be found useful:—*Ast. Notices*, vol. i.; *Comptes rendus*, Sept. 1852; Paper by Professor Magnus translated in Taylor's *Foreign Scientific Memoirs*, n.s., pt. 3, p. 210; *Ast. Notices*, xiii. 221-248; *Theory of Foucault's Gyroscope Experiments*, by the Rev. Baden Powell, F.R.S.; *Ast. Notices*, vol. xv.; articles by Major J. G. Barnard in *Silliman's Journal*, 2nd ser., vols. xxiv. and xxv.; E. Hunt on "Rotatory Motion," *Proc. Phil. Soc. Glasgow*, vol. iv.; J. Clerk Maxwell, "On a Dynamical Top," *Trans. R.S.E.* vol. xxi.; *Phil. Mag.* 4th ser. vols. 7, 13, 14; *Proc. Royal Irish Academy*, vol. viii.; Sir William Thomson on "Gyrostatis," *Nature*, xv. 297; G. T. Walker, "The Motion of a Celt," *Quar. Jour. Math.*, 1896; G. T. Walker, *Math. Ency.* iv. 1, xi. 1; Gallop, *Proc. Camb. Phil. Soc.* xii. 82, pt. 2, 1903, "Rise of a Top"; Price's *Infinitesimal Calculus*, vol. iv.; Worms, *The Earth and its Mechanism*; Routh, *Rigid Dynamics*; A. G. Webster, *Dynamics* (1904); H. Crabtree, *Spinning Tops and Gyroscopic Motion* (1909). For a complete list of the mathematical works on the subject of the Gyroscope and Gyrostat from the outset, Professor Cayley's Report to the British Association (1862) on the *Progress of Dynamics* should be consulted. Modern authors will be found cited in Klein and Sommerfeld, *Theorie des Kreisels* (1897), and in the *Encyclopädie der mathematischen Wissenschaften*.

(G. G.)

GYTHIUM, the harbour and arsenal of Sparta, from which it was some 30 m. distant. The town lay at the N.W. extremity of the Laconian Gulf, in a small but fertile plain at the mouth of the Gythius. Its reputed founders were Heracles and Apollo, who frequently appear on its coins: the former of these names may point to the influence of Phoenician traders, who, we know, visited the Laconian shores at a very early period. In classical times it was a community of *perioeci*, politically dependent on Sparta, though doubtless with a municipal life of its own. In 455 B.C., during the first Peloponnesian War, it was burned by the Athenian admiral Tolmides. In 370 B.C. Epaminondas besieged it unsuccessfully for three days. Its fortifications were strengthened by

the tyrant Nabis, but in 195 B.C. it was invested and taken by Titus and Lucius Quintus Flamininus, and, though recovered by Nabis two or three years later, was recaptured immediately after his murder (192 B.C.) by Philopoemen and Aulus Atilius and remained in the Achaean League until its dissolution in 146 B.C. Subsequently it formed the most important of the Eleutherolaconian towns, a group of twenty-four, later eighteen, communities leagued together to maintain their autonomy against Sparta and declared free by Augustus. The highest officer of the confederacy was the general (στρατηγός), who was assisted by a treasurer (ταμίης), while the chief magistrates of the several communities bore the title of ephors (ἔφοροι).

Pausanias (iii. 21 f.) has left us a description of the town as it existed in the reign of Marcus Aurelius, the agora, the Acropolis, the island of Cranae (Marathonisi) where Paris celebrated his nuptials with Helen, the Migonion or precinct of Aphrodite Migonitis (occupied by the modern town of Marathonisi or Gythium), and the hill Larysium (Koumaro) rising above it. The numerous remains extant, of which the theatre and the buildings partially submerged by the sea are the most noteworthy, all belong to the Roman period.



The modern town is a busy and flourishing port with a good harbour protected by Cranae, now connected by a mole with the mainland: it is the capital of the prefecture (νομός) of Λακωνική with a population in 1907 of 61,522.

See G. Weber, *De Gytheo et Lacedaemoniorum rebus navalibus* (Heidelberg, 1833); W. M. Leake, *Travels in the Morea*, i. 244 foll.; E. Curtius, *Peloponnesos*, ii. 267 foll. Inscriptions: Le Bas-Foucart, *Voyage archéologique*, ii. Nos. 238-248 f.; Collitz-Bechtel, *Sammlung d. griech. Dialekt-Inschriften*, iii. Nos. 4562-4573; *British School Annual*, x. 179 foll. Excavations: Α. Σκιαῦς, Πρακτικά τῆς Ἀρχ. Ἐταιρείας, 1891, 69 foll.

(M. N. T.)

GYULA-FEHÉRVÁR (Ger. *Karlsburg*), a town of Hungary, in Transylvania, in the county of Alsó-Feliér, 73 m. S. of Kolozsvár by rail. Pop. (1900) 11,507. It is situated on the right bank of the Maros, on the outskirts of the Transylvanian Erzgebirge or Ore Mountains, and consists of the upper town, or citadel, and the lower town. Gyula-Fehérvár is the seat of a Roman Catholic bishop, and has a fine Roman Catholic cathedral, built in the 11th century in Romanesque style, and rebuilt in 1443 by John Hunyady in Gothic style. It contains among other tombs that of John Hunyady. Near the cathedral is the episcopal palace, and in the same part of the town is the Batthyaneum, founded by Bishop Count Batthyány in 1794. It contains a valuable library with many incunabula and old manuscripts, amongst which is one of the *Nibelungenlied*, an astronomical observatory, a collection of antiquities, and a mineral collection. Gyula-Fehérvár carries on an active trade in cereals, wine and cattle.

Gyula-Fehérvár occupies the site of the Roman colony *Apulum*. Many Roman relics found here, and in the vicinity, are preserved in the museum of the town. The bishopric was founded in the 11th century by King Ladislaus I. (1078-1095). In the 16th century, when Transylvania separated from Hungary, the town became the residence of the Transylvanian princes. From this period dates the castle, and also the buildings of the university, founded by Gabriel Bethlen, and now used as barracks. After the reversion of Transylvania in 1713 to the Habsburg monarchy the actual strong fortress was built in 1716-1735 by the emperor Charles VI., whence the German name of the town.

H The eighth symbol in the Phoenician alphabet, as in its descendants, has altered less in the course of ages than most alphabetic symbols. From the beginning of Phoenician records it has consisted of two uprights connected by transverse bars, at first either two or three in number. The uprights are rarely perpendicular and the cross bars are not so precisely arranged as they are in early Greek and Latin inscriptions. In these the symbol takes the form of two rectangles  out of which the ordinary **H** develops by the omission of the cross bars at top and bottom. It is very exceptional for this letter to have more than three cross bars, though as many as five are occasionally found in N.W. Greece. Within the same inscription the appearance of the letter often varies considerably as regards the space between and the length of the uprights. When only one bar is found it regularly crosses the uprights about the middle. In a few cases the rectangle is closed at top and bottom but has no middle cross bar . The Phoenician name for the letter was Heth (Hêṯ). According to Semitic scholars it had two values, (1) a glottal spirant, a very strong *h*,

(2) an unvoiced velar spirant like the German *ch* in *ach*. The Greeks borrowed it with the value of the ordinary aspirate and with the name ἥτα. Very early in their history, however, most of the Greeks of Asia Minor lost the aspirate altogether, and having then no further use for the symbol with this value they adopted it to represent the long *e*-sound, which was not originally distinguished by a different symbol from the short sound (see Ε). With this value its name has always been ἥτα in Greek. The alphabet of the Asiatic Greeks was gradually adopted elsewhere. In official documents at Athens H represented the rough breathing or aspirate ' till 403 B.C.; henceforth it was used for η. The Western Greeks, however, from whom the Romans obtained their alphabet, retained their aspirate longer than those of Asia Minor, and hence the symbol came to the Romans with the value not of a long vowel but of the aspirate, which it still preserves. The Greek aspirate was itself the first or left-hand half of this letter Η, while the smooth breathing ' was the right-hand portion Η. At Tarentum Η is found for Η in inscriptions. The Roman aspirate was, however, a very slight sound which in some words where it was etymologically correct disappeared at an early date. Thus the cognate words of kindred languages show that the Lat. *anser* "goose" ought to begin with *h*, but nowhere is it so found. In none of the Romance languages is there any trace of initial or medial *h*, which shows that vulgar Latin had ceased to have the aspirate by 240 B.C. The Roman grammarians were guided to its presence by the Sabine forms where *f* occurred; as the Sabines said *fasena* (sand), it was recognised that the Roman form ought to be *harena*, and so for *haedus* (goat), *hordeum* (barley), &c. Between vowels *h* was lost very early, for *ne-hemo* (no man) is throughout the literature *nēmo*, *bi-himus* (two winters old) *bīmus*. In the Ciceronian age greater attention was paid to reproducing the Greek aspirates in borrowed words, and this led to absurd mistakes in Latin words, mistakes which were satirized by Catullus in his epigram (84) upon Arrius, who said *chommoda* for *commoda* and *hinsidias* for *insidias*. In Umbrian *h* was often lost, and also used without etymological value to mark length, as in *comohota* (= Lat. *commota*), a practice to which there are some doubtful parallels in Latin.

In English the history of *h* is very similar to that in Latin. While the parts above the glottis are in position to produce a vowel, an aspirate is produced without vibration of the vocal chords, sometimes, like the pronunciation of Arrius, with considerable effort as a reaction against the tendency to "drop the h's." Though *h* survives in Scotland, Ireland and America as well as in the speech of cultivated persons, the sound in most of the vulgar dialects is entirely lost. Where it is not ordinarily lost, it disappears in unaccented syllables, as "*Give it 'im*" and the like. Where it is lost, conscious attempts to restore it on the part of uneducated speakers lead to absurd misplacements of *h* and to its restoration in Romance words when it never was pronounced, as *humble* (now recognized as standard English), *humour* and even *honour*.

(P. Gi.)

HAAG, CARL (1820-), a naturalized British painter, court painter to the duke of Saxe-Coburg and Gotha, was born in Bavaria, and was trained in the academies at Nuremberg and Munich. He practised first as an illustrator and as a painter, in oil, of portraits and architectural subjects; but after he settled in England, in 1847, he devoted himself to water colours, and was elected associate of the Royal Society of Painters in Water Colours in 1850 and member in 1853. He travelled much, especially in the East, and made a considerable reputation by his firmly drawn and carefully elaborated paintings of Eastern subjects. Towards the end of his professional career Carl Haag quitted England and returned to Germany.

See *A History of the "Old Water-Colour" Society, now the Royal Society of Painters in Water Colours*, by John Lewis Roget (2 vols., London, 1891).

HAAKON (Old Norse *Hákon*), the name of several kings of Norway, of whom the most important are the following:—

HAAKON I., surnamed "the Good" (d. 961), was the youngest son of Harald Haarfager. He was fostered by King Aethelstan of England, who brought him up in the Christian religion, and on the news of his father's death in 933 provided him with ships and men for an expedition against his half-brother Erik, who had been proclaimed king. On his arrival in Norway Haakon gained the support of the landowners by promising to give up the rights of taxation claimed by his father over inherited real property. Erik fled, and was killed a few years later in England. His sons allied

themselves with the Danes, but were invariably defeated by Haakon, who was successful in everything he undertook except in his attempt to introduce Christianity, which aroused an opposition he did not feel strong enough to face. He was killed at the battle of Fitje in 961, after a final victory over Erik's sons. So entirely did even his immediate circle ignore his religion that a court skald composed a poem on his death representing his welcome by the heathen gods into Valhalla.

HAAKON IV., surnamed "the Old" (1204-1263), was declared to be the son of Haakon III., who died shortly before the former's birth in 1204. A year later the child was placed under the protection of King Inge, after whose death in 1217 he was chosen king; though until 1223 the church refused to recognize him, on the ground of illegitimacy, and the Pope's dispensation for his coronation was not gained until much later. In the earlier part of his reign much of the royal power was in the hands of Earl Skule, who intrigued against the king until 1239, when he proceeded to open hostility and was put to death. From this time onward Haakon's reign was marked by more peace and prosperity than Norway had known for many years, until in 1263 a dispute with the Scottish king concerning the Hebrides, a Norwegian possession, induced Haakon to undertake an expedition to the west of Scotland. A division of his army seems to have repulsed a large Scottish force at Largs (though the later Scottish accounts claim this battle as a victory), and, having won back the Norwegian possessions in Scotland, Haakon was wintering in the Orkneys, when he was taken ill and died on the 15th of December 1263. A great part of his fleet had been scattered and destroyed by storms. The most important event in his reign was the voluntary submission of the Icelandic commonwealth. Worn out by internal strife fostered by Haakon's emissaries, the Icelandic chiefs acknowledged the Norwegian king as overlord in 1262. Their example was followed by the colony of Greenland.

HAAKON VII. (1872-), the second son of Frederick VIII., king of Denmark, was born on the 3rd of August 1872, and was usually known as Prince Charles of Denmark. When in 1905 Norway decided to separate herself from Sweden the Norwegians offered their crown to Charles, who accepted it and took the name of Haakon VII., being crowned at Trondhjem in June 1906. The king married Maud, youngest daughter of Edward VII., king of Great Britain, their son, Prince Olav, being born in 1903.

HAARLEM, a town of Holland in the province of North Holland, on the Spaarne, having a junction station 11 m. by rail W. of Amsterdam. It is connected by electric and steam tramways with Zandvoort, Leiden, Amsterdam and Alkmaar. Pop. (1900) 65,189. Haarlem is the seat of the governor of the province of North Holland, and of a Roman Catholic and a Jansenist bishopric. In appearance it is a typical Dutch town, with numerous narrow canals and quaintly gabled houses. Of the ancient city gates the Spaarnewouder or Amsterdam gate alone remains. Gardens and promenades have taken the place of the old ramparts, and on the south the city is bounded by the Frederiks and the Flora parks, between which runs the fine avenue called the Dreef, leading to the Haarlemmer Hout or wood. In the Frederiks Park is a pump-room supplied with a powerful chalybeate water from a spring, the Wilhelminabron, in the Haarlemmer Polder not far distant, and in connexion with this there is an orthopaedic institution adjoining. In the great market place in the centre of the city are gathered together the larger number of the most interesting buildings, including the quaint old Fleshers' Hall, built by Lieven de Key in 1603, and now containing the archives; the town hall; the old Stadsdoelen, where the burgesses met in arms; the Groote Kerk, or Great Church; and the statue erected in 1856 to Laurenz Janszoon Koster, the printer. The Great Church, dedicated to St Bavo, with a lofty tower (255 ft.), is one of the most famous in Holland, and dates from the end of the 15th and the beginning of the 16th centuries. Its great length (460 ft.) and the height and steepness of its vaulted cedar-wood roof (1538) are very impressive. The choir-stalls and screen (1510) are finely carved, and of further interest are the ancient pulpit sounding-board (1432), some old stained glass, and the small models of ships, copies dating from 1638 of yet earlier models originally presented by the Dutch-Swedish Trading Company. The church organ was long considered the largest and finest in existence. It was constructed by Christian Müller in 1738, and has 4 keyboards, 64 registers and 5000 pipes, the largest of which is 15 in. in diameter and 32 ft. long. Among the monuments in the church are those of the poet Willem Bilderdyk (d. 1831) and the engineer Frederik Willem Conrad (d. 1808), who designed the sea-slucices at Katwyk. In the belfry are the *damiaatjes*, small bells presented to the town, according to tradition, by William I., count of Holland (d. 1222), the crusader. The town hall was originally a palace of the counts of Holland, begun in the 12th century, and some old 13th-century beams still remain; but the building was remodelled in the beginning of the 17th century. It contains a collection of antiquities (including some beautiful goblets) and a picture gallery which, though small, is celebrated for its fine collection of paintings by Frans Hals. The town library contains several *incunabula* and an interesting collection of early Dutch literature.

At the head of the scientific institutions of Haarlem may be placed the Dutch Society of Sciences (*Hollandsche Maatschappij van Wetenschappen*), founded in 1752, which possesses valuable collections in botany, natural history and geology. Teyler's Stichting (*i.e.* foundation), enlarged in modern times, was instituted by the will of Pieter Teyler van der Hulst (d. 1778), a wealthy merchant, for the study of theology, natural science and art, and has lecture-theatres, a large library, and a museum containing a physical and a geological cabinet, as well as a collection of paintings, including many modern pictures, and a valuable collection of drawings and engravings by old masters. The Dutch Society for the Promotion of Industry (*Nederlandsche Maatschappij ter Bevordering van Nijverheid*), founded in 1777, has its seat in the Pavilion Welgelegen, a villa on the south side of the Frederiks Park, built by the Amsterdam banker John Hope in 1778, and afterwards acquired by Louis Bonaparte, king of Holland. The colonial museum and the museum of industrial art were established in this villa by the society in 1871 and 1877 respectively. Besides these there are a museum of ecclesiastical antiquities, chiefly relating to the bishopric of Haarlem; the old weigh-house (1598) and the orphanage for girls (1608), originally an almshouse for old men, both built by the architect Lieven de Key of Ghent.

The staple industries of Haarlem have been greatly modified in the course of time. Cloth weaving and brewing, which once flourished exceedingly, declined in the beginning of the 16th century. A century later, silk, lace and damask weaving were introduced by French refugees, and became very important industries. But about the close of the 18th century this remarkable prosperity had also come to an end, and it was not till after the Belgian revolution of 1830-1831 that Haarlem began to develop the manufactures in which it is now chiefly engaged. Cotton manufacture, dyeing, printing, bleaching, brewing, type-founding, and the manufacture of tram and railway carriages are among the more important of its industries. One of the printing establishments has the reputation of being the oldest in the Netherlands, and publishes the oldest Dutch paper, *De Opragte Haarlemmer Courant*. Market-gardening, especially horticulture, is extensively practised in the vicinity, so that Haarlem is the seat of a large trade in Dutch bulbs, especially hyacinths, tulips, fritillaries, spiraeas and japonicas.

Haarlem, which was a prosperous place in the middle of the 12th century, received its first town charter from William II., count of Holland and king of the Romans, in 1245. It played a considerable part in the wars of Holland with the Frisians. In 1492 it was captured by the insurgent peasants of North Holland, was re-taken by the duke of Saxony, the imperial stadholder, and deprived of its privileges. In 1572 Haarlem joined the revolt of the Netherlands against Spain, but on the 13th of July 1573, after a seven months' siege, was forced to surrender to Alva's son Frederick, who exacted terrible vengeance. In 1577 it was again captured by William of Orange and permanently incorporated in the United Netherlands.

See Karl Hegel, *Städte und Gilden* (Leipzig, 1891); Allan, *Geschiedenis en beschrijving van Haarlem* (Haarlem, 1871-1888).

HAARLEM LAKE (Dutch *Harlemmer Meer*), a commune of the province of North Holland, constituted by the law of the 16th of July 1855. It has an area of about 46,000 acres, and its population increased from 7237 in 1860 to 16,621 in 1900. As its name indicates, the commune was formerly a lake, which is said to have been a relic of a northern arm of the Rhine which passed through the district in the time of the Romans. In 1531 the Haarlemmer Meer had an area of 6430 acres, and in its vicinity were three smaller sheets of water—the Leidsche Meer or Leiden Lake, the Spiering Meer, and the Oude Meer or Old Lake, with a united area of about 7600 acres. The four lakes were formed into one by successive inundations, whole villages disappearing in the process, and by 1647 the new Haarlem Lake had an area of about 37,000 acres, which a century later had increased to over 42,000 acres. As early as 1643 Jan Adriaanszoon Leeghwater proposed to endike and drain the lake; and similar schemes, among which those of Nikolaas Samuel Cruquius in 1742 and of Baron van Lijnden van Hemmen in 1820 are worthy of special mention, were brought forward from time to time. But it was not till a furious hurricane in November 1836 drove the waters as far as the gates of Amsterdam, and another on Christmas Day sent them in the opposite direction to submerge the streets of Leiden, that the mind of the nation was seriously turned to the matter. In August 1837 the king appointed a royal commission of inquiry; the scheme proposed by the commission received the sanction of the Second Chamber in March 1839, and in the following May the work was begun. A canal was first dug round the lake for the reception of the water and the accommodation of the great traffic which had previously been carried on. This canal was 38 m. in length, 123-146 ft. wide, and 8 ft. deep, and the earth which was taken out of it was used to build a dike from 30 to 54 yds. broad containing the lake. The area enclosed by the canal was rather more than 70 sq. m., and the average depth of the lake 13 ft. 1½ in., and as the water had no natural outfall it was calculated

that probably 1000 million tons would have to be raised by mechanical means. This amount was 200 million tons in excess of that actually discharged. Pumping by steam-engines began in 1848, and the lake was dry by the 1st of July 1852. At the first sale of the highest lands along the banks on the 16th of August 1853, about £28 per acre was paid; but the average price afterwards was less. The whole area of 42,096 acres recovered from the waters brought in 9,400,000 florins, or about £780,000, exactly covering the cost of the enterprise; so that the actual cost to the nation was only the amount of the interest on the capital, or about £368,000. The soil is of various kinds, loam, clay, sand and peat; most of it is sufficiently fertile, though in the lower portions there are barren patches where the scanty vegetation is covered with an ochreous deposit. Mineral springs occur containing a very high percentage (3.245 grams per litre) of common salt; and in 1893 a company was formed for working them. Corn, seeds, cattle, butter and cheese are the principal produce. The roads which traverse the commune are bordered by pleasant-looking farm-houses built after the various styles of Holland, Friesland or Brabant. Hoofddorp, Vennepedorp or Nieuw Vennep, Abbenes and the vicinities of the pumping-stations are the spots where the population has clustered most thickly. The first church was built in 1855; in 1877 there were seven. In 1854 the city of Leiden laid claim to the possession of the new territory, but the courts decided in favour of the nation.

HAASE, FRIEDRICH (1827-), German actor, was born on the 1st of November 1827, in Berlin, the son of a valet to King Frederick William IV., who became his godfather. He was educated for the stage under Ludwig Tieck and made his first appearance in 1846 in Weimar, afterwards acting at Prague (1849-1851) and Karlsruhe (1852-1855). From 1860 to 1866 he played in St Petersburg, then was manager of the court theatre in Coburg, and in 1869 (and again in 1882-1883) visited the United States. He was manager of the Stadt Theater in Leipzig from 1870 to 1876, when he removed to Berlin, where he devoted his energies to the foundation and management of the Deutsches Theater. He finally retired from the stage in 1898. Haase's aristocratic appearance and elegant manner fitted him specially to play high comedy parts. His chief rôles were those of Rocheferrier in the *Partie Piquet*; Richelieu; Savigny in *Der feiner Diplomat*, and der Fürst in *Der geheime Agent*. He is the author of *Ungeschminkte Briefe and Was ich erlebte 1846-1898* (Berlin, 1898).

See Simon, *Friedrich Haase* (Berlin, 1898).

HAASE, FRIEDRICH GOTTLÖB (1808-1867), German classical scholar, was born at Magdeburg on the 4th of January 1808. Having studied at Halle, Greifswald and Berlin, he obtained in 1834 an appointment at Schulpforta, from which he was suspended and sentenced to six years' imprisonment for identifying himself with the *Burschenschaften* (students' associations). Having been released after serving one year of his sentence, he visited Paris, and on his return in 1840 he was appointed professor at Breslau, where he remained till his death on the 16th of August 1867. He was undoubtedly one of the most successful teachers of his day in Germany, and exercised great influence upon all his pupils.

He edited several classic authors: Xenophon (Λακεδαιμονίων πολιτεία, 1833); Thucydides (1840); Velleius Paterculus (1858); Seneca the philosopher (2nd ed., 1872, not yet superseded); and Tacitus (1855), the introduction to which is a masterpiece of Latinity. His *Vorlesungen über lateinische Sprachwissenschaft* was published after his death by F. A. Eckstein and H. Peter (1874-1880). See C Bursian, *Geschichte der klassischen Philologie in Deutschland* (1883); G. Fickert, *Friderici Haasii memoria* (1868), with a list of works; T. Oelsner in *Rübezahl (Schlesische Provinzialblätter)*, vii. Heft 3 (Breslau, 1868).

HAAST, SIR JOHANN FRANZ JULIUS VON (1824-1887), German and British geologist, was born at Bonn on the 1st of May 1824. He received his early education partly in that town and partly in Cologne, and then entered the university at Bonn, where he made a special study of geology and mineralogy. In 1858 he started for New Zealand to report on the suitability of the

colony for German emigrants. He then became acquainted with Dr von Hochstetter, and rendered assistance to him in the preliminary geological survey which von Hochstetter had undertaken. Afterwards Dr Haast accepted offers from the governments of Nelson and Canterbury to investigate the geology of those districts, and the results of his detailed labours greatly enriched our knowledge with regard to the rocky structure, the glacial phenomena and the economic products. He discovered gold and coal in Nelson, and he carried on important researches with reference to the occurrence of *Dinornis* and other extinct wingless birds (Moas). His *Geology of the Provinces of Canterbury and Westland, N.Z.*, was published in 1879. He was the founder of the Canterbury museum at Christchurch, of which he became director, and which he endeavoured to render the finest collection in the southern hemisphere. He was surveyor-general of Canterbury from 1861 to 1871, and professor of geology at Canterbury College. He was elected F.R.S. in 1867; and he was knighted for his services at the time of the colonial exhibition in London in 1887. He died at Wellington, N.Z., on the 15th of August 1887.

HABABS (AZ-HIBBEHS), a nomadic pastoral people of Hamitic stock, living in the coast region north-west of Massawa. Physically they are Beja, by language and traditions Abyssinians. They were Christians until the 19th century, but are now Mahommedans. Their sole wealth consists in cattle.

HABAKKUK, the name borne by the eighth book of the Old Testament "Minor Prophets." It occurs twice in the book itself (i. 1, iii. 1) in titles, but nowhere else in the Old Testament. The meaning of the name is uncertain. If Hebrew, it might be derived from the root חבק (to embrace) as an intensive term of affection. It has also been connected more plausibly with an Assyrian plant name, *ḥambakūku* (Delitzsch, *Assyrisches Handwörterbuch*, p. 281). The Septuagint has Ἀμβακούμ. Of the person designated, no more is known than may be inferred from the writing which bears his name. Various legends are connected with him, of which the best known is given in the Apocryphal story of "Bel and the Dragon" (v. 33-39); but none of these has any historic value.¹

The book itself falls into three obvious parts, viz. (1) a dialogue between the prophet and God (i. 2-ii. 4); (2) a series of five woes pronounced on wickedness (ii. 5-ii. 20); (3) a poem describing the triumphant manifestation of God (iii.). There is considerable difficulty in regard to the interpretation of (1), on which that of (2) will turn; while (3) forms an independent section, to be considered separately.

In the dialogue, the prophet cries to God against continued violence and injustice, though it is not clear whether this is done *within* or *to* Israel (i. 2-4). The divine answer declares that God raises up the Chaldaeans, whose formidable resources are invincible (i. 5-11). The prophet thereupon calls God's attention to the tyranny which He apparently allows to triumph, and declares his purpose to wait till an answer is given to his complaint (i. 12-ii. 2). God answers by demanding patience, and by declaring that the righteous shall live by his faithfulness (ii. 3-4).

The interpretation of this dialogue which first suggests itself is that the prophet is referring to wickedness *within* the nation, which is to be punished by the Chaldaeans as a divine instrument; in the process, the tyranny of the instrument itself calls for punishment, which the prophet is bidden to await in patient fidelity. On this view of the dialogue, the subsequent woes will be pronounced against the Chaldaeans, and the date assigned to the prophecy will be about 600 B.C., *i.e.* soon after the battle of Carchemish (605 B.C.), when the Chaldaean victory over Egypt inaugurated a period of Chaldaean supremacy which lasted till the Chaldaeans themselves were overthrown by Cyrus in 538 B.C. Grave objections, however, confront this interpretation, as is admitted even by such recent defenders of it as Davidson and Driver. Is it likely that a prophet would begin a complaint against Chaldaean tyranny (admittedly central in the prophecy) by complaining of that wickedness of his fellow-countrymen which seems partly to justify it? Are not the terms of reference in i. 2 f. and 1. 12 f. too similar for the supposition that two distinct, even contradictory, complaints are being made (cf. "wicked" and "righteous" in i. 4 and i. 13, interchanged in regard to Israel, on above theory)? And if i. 5-11 is a genuine *prophecy* of the raising up of the Chaldaeans, whence comes that long experience of their rule required to explain the *detailed* denunciation of their tyranny? To meet the last objection, Davidson supposes i. 5-11 to be really a reference to the past, prophetic in form only, and brings down the whole section to

a later period of Chaldaean rule, "hardly, one would think, before the deportation of the people under Jehoiachin in 597" (p. 49). Driver prefers to bisect the dialogue by supposing i. 2-11 to be written at an earlier period than i. 12 f. (p. 57). The other objections, however, remain, and have provoked a variety of theories from Old Testament scholars, of which three call for special notice. (1) The first of these, represented by Giesebrecht,² Nowack and Wellhausen, refers i. 2-4 to Chaldaean oppression of Israel, the same subject being continued in i. 12 f. Obviously, the reference to the Chaldaeans as a divine instrument could not then stand in its present place, and it is accordingly regarded as a misplaced earlier prophecy. This is the minimum of critical procedure required to do justice to the facts. (2) Budde, followed by Cornill, also regards i. 2-4 as referring to the oppression of Israel by a foreign tyrant, whom, however, he holds to be Assyria. He also removes i. 5-11 from its present place, but makes it part of the divine answer, following ii. 4. On this view, the Chaldaeans are the divine instrument for punishing the tyranny of the Assyrians, to whom the following woes will therefore refer. The date would fall between Josiah's reformation (621) and his death (609). This is a plausible and even attractive theory; its weakness seems to lie in the absence of any positive evidence in the prophecy itself, as is illustrated by the fact that even G. A. Smith, who follows it, suggests "Egypt from 608-605" as an alternative to Assyria (p. 124). (3) Marti (1904) abandons the attempt to explain the prophecy as a unity, and analyses it into three elements, viz. (a) The original prophecy by Habakkuk, consisting of i. 5-10, 14 f., belonging to the year 605, and representing the emergent power of the Chaldaeans as a divine scourge of the faithless people; (b) Woes against the Chaldaeans, presupposing not only tyrannous rule over many peoples, but the beginning of their decline and fall, and therefore of date about 540 B.C. (ii. 5-19); (c) A psalm of post-exilic origin, whose fragments, i. 2-4, 12 a, 13, ii. 1-4, have been incorporated into the present text from the margins on which they were written, its subject being the suffering of the righteous. Each of these three theories³ encounters difficulties of detail; none can be said to have secured a dominant position. The great variety of views amongst competent critics is significant of the difficulty of the problem, which can hardly be regarded as yet solved; this divergence of opinion perhaps points to the impossibility of maintaining the unity of chs. i. and ii., and throws the balance of probability towards some such analysis as that of Marti, which is therefore accepted in the present article.

In regard to the poem which forms the third and closing chapter of the present book of Habakkuk, there is much more general agreement. Its most striking characteristic lies in the superscription ("A prayer of Habakkuk the prophet, set to Shigionoth"), the subscription ("For the chief musician, on my stringed instruments"), and the insertion of the musical term "Selah" in three places (v. 3, 9, 13). These liturgical notes make extremely probable the supposition that the poem has been taken from some collection like that of our present book of Psalms, probably on the ground of the authorship asserted by the superscription there attached to it. It cannot, however, be said that the poem itself supports this assertion, which carries no more intrinsic weight than the Davidic titles of the Psalms. The poem begins with a prayer that God will renew the historic manifestation of the exodus, which inaugurated the national history and faith; a thunderstorm moving up from the south is then described, in which God is revealed (3-7); it is asked whether this manifestation, whose course is further described, is against nature only (8-11); the answer is given that it is for the salvation of Israel against its wicked foes (12-15); the poet describes the effect in terror upon himself (16) and declares his confidence in God, even in utter agricultural adversity (17-19). As Wellhausen says (p. 171): "The poet appears to believe that in the very act of describing enthusiastically the ancient deed of deliverance, he brings home to us the new; we are left sometimes in doubt whether he speaks of the past to suggest the new by analogy, or whether he is concerned directly with the future, and simply paints it with the colours of the past." In any case, there is nothing in this fine poem to connect it with the conception of the Chaldaeans as a divine instrument. It is the nation that speaks through the poet (cf. v. 14), but at what period of its post-exilic history we have no means of inferring.

Our estimate of the theological teaching of this book will naturally be influenced by the particular critical theory which is adopted. The reduction of the book to four originally independent sections requires that the point of each be stated separately. When this is done, it will, however, be found that there is a broad unity of subject, and of natural development in its treatment, such as to some extent justifies the instinct or the judgment of those who were instrumental in effecting the combination of the separate parts. (1) The poem (iii.), though possibly latest in date,⁴ claims first consideration, because it avowedly moves in the circle of primitive ideas, and supplicates a divine intervention, a direct and immediate manifestation of the transcendent God. He is conceived as controlling or overcoming the forces of nature; and though an earlier mythology has supplied some of the ideas, yet, as with the opening chapters of Genesis, they are transfigured by the moral purpose which animates them, the purpose to subdue all things that could frustrate the destiny of God's anointed (v. 13). The closing verses strike that deep note of absolute dependence on God, which is the glory of the religion of the Old Testament and its chief contribution to the spirit of the Gospels. (2) The prophecy of the Chaldaeans as the instruments of the divine purpose involves a different, yet related, conception of the divine providence. The philosophy of history, by which Hebrew prophets could read a deep moral significance into national disaster and turn the flank of resistless attack, became one of the most

important elements in the nation's faith. If the world-powers were hard as flint in their dealings with Israel, the people of God were steeled to such moral endurance that each clash of their successive onsets kindled some new flame of devotion. Through the Chaldaeans God worked a work which required centuries of life and literature to disclose its fulness (i. 5). (3) When we turn from this view of the Chaldaeans to the denunciation of their tyranny in "taunt songs" (ii. 5-20), we have simply a practical application of the doctrine of divine government. God being what He is, at once moral and all-powerful, the immoral life is doomed to overthrow, whether the immorality consist in grasping rapacity, proud self-aggrandizement, cruel exaction, exulting triumph or senseless idolatry. (4) Yet, because the doom so often tarries, there arises the problem of the suffering of the innocent and the upright. How can God look down with tolerance that seems favour on so much that conflicts with His declared will and character? This is the great problem of Israel, finding its supreme expression for all time in the book of Job (*q.v.*). In that book the solution of the problem of innocent suffering lies hidden from the sufferer, even to the end, for he is not admitted with the reader to the secret of the prologue; it is the practical solution of faithfulness resting on faith which is offered to us. So here, with the principle of ii. 4, "the righteous shall live by his faithfulness." The different application of these words in the New Testament to "faith" is well known (Rom. i. 17; Gal. iii. 11; Heb. x. 38) though the difference is apt to be exaggerated by those who forget how much of the element of *אמונה*: lies in Paul's conception of *πίστις*. In G. A. Smith's words, "as Paul's adaptation, 'the just shall live by faith,' has become the motto of evangelical Christianity, so we may say that Habakkuk's original of it has been the motto and the fame of Judaism: 'the righteous shall live by his faithfulness.'"

The Hebrew text of this impressive and varied book is unfortunately corrupt in many places; even so cautious a critic as Driver accepts or favourably notices eighteen textual emendations in the three chapters, and suspects the text in at least seven other cases. For the interpretation of the book in detail, the English reader will find Driver's commentary (1906) the most useful.

References to earlier literature will be found in the following noteworthy studies of recent date: Davidson, "Nahum, Habakkuk and Zephaniah," in *Cambridge Bible* (1896); Nowack, *Die kleinen Propheten* (Hdkr.) (1897); Wellhausen, *Die kleinen Propheten*³ (1898); G. A. Smith, "The Book of the Twelve Prophets," in *The Expositor's Bible*, vol. ii. (1898); Driver, article "Habakkuk" in Hastings' *Dictionary of the Bible*, vol. ii. pp. 269-272 (1900); Budde, article "Habakkuk" in *Ency. Biblica*, vol. ii., c. 1921-1928 (1901); Stevenson, "The Interpretation of Habakkuk," in *The Expositor* (1902), pp. 388-401; Peake, *The Problem of Suffering in the Old Testament* (1904), pp. 4-11 and app. A, "Recent Criticism of Habakkuk"; Marti, *Dodekapropheten* (K. H. C.) (1904); Driver, "Minor Prophets," vol. ii., in *Century Bible* (1906); Duhm, *Das Buch Habakkuk* (Text, Übersetzung und Erklärung), 1906 (regards the book as a unity belonging to the time of Alexander the Great). Max L. Margolis discusses the anonymous Greek version of Habakkuk iii. in a volume of *Old Test. and Semitic Studies: in Memory of William Rainey Harper* (Chicago, 1908).
(H. W. R.*)

- 1 These legends are collected in Hastings, D. B. vol. ii. p. 272. He is the watchman of Is. xxi. 6 (cf. Hab. ii. 1); the son of the Shunammite (2 Kings iv. 16); and is miraculously lifted by his hair to carry his own dinner to Daniel in the lions' den (*supra*).
- 2 Followed by Peake in *The Problem of Suffering*, pp. 4 f., 151 f., to whose appendix (A) reference may be made for further details of recent criticism.
- 3 For the less probable theories of Rothstein, Lauterburg, Happel and Peiser (amongst others), cf. Marti's *Commentary*, pp. 328 f. and 332. Stevenson (*The Expositor*, 1902) states clearly the difficulties for those who regard ch. i. as a unity. He sees two independent sections, 2-4 + 12-13, and 5-11 + 14-17.
- 4 Earlier, however, than Ps. lxxvii. 17-20, which is drawn from it.

HABDALA (lit. "separation"), a Hebrew term chiefly appropriated to ceremonies at the conclusion of Sabbath and festivals, marking the separation between times sacred and secular. On the Saturday night the ceremony consists of three items: (*a*) benediction over a cup of wine (common to many other Jewish functions); (*b*) benediction over a lighted taper, of which possibly the origin is utilitarian, as no light might be kindled on the Sabbath day, but the rite may be symbolical; and (*c*) benediction over a box of sweet-smelling spices. The origin of the latter has been traced to the bowl of burning spice which in Talmudic times was introduced after each meal. But here too symbolic ideas must be taken into account. Both the light and the spices would readily fit into the conception of the Sabbath "Over-soul" of the mystics.

(I. A.)

HABEAS CORPUS, in English law, a writ issued out of the High Court of Justice commanding the person to whom it is directed to bring the body of a person in his custody before that or some other court for a specified purpose.

There are various forms of the writ, of which the most famous is that known as *habeas corpus ad subjiciendum*, the well-established remedy for violation of personal liberty. From the earliest records of the English law no free man could be detained in custody except on a criminal charge or conviction or for a civil debt. That right is expressed in the Great Charter in the words: "*Nullus liber homo capiatur vel imprisonetur aut dissaisietur aut utlagetur, aut exuletur aut aliquo modo destruatur nec super eum ibimus nec super eum mittemus, nisi per legale iudicium parium suorum, vel per legem terrae.*"¹ The writ is a remedial mandatory writ of right existing by the common law, *i.e.* it is one of the extraordinary remedies—such as *mandamus*, *certiorari* and prohibitions, which the superior courts may grant. While "of right," it is not "of course," and is granted only on application to the High Court or a judge thereof, supported by a sworn statement of facts setting up at least a probable case of illegal confinement. It is addressed to the person in whose custody another is detained, and commands him to bring his prisoner before the court immediately after the receipt of the writ, together with the day and cause of his being taken and detained, to undergo and receive (*ad subjiciendum et recipiendum*) whatsoever the court awarding the writ "may consider of concerning him in that behalf."

It is often stated that the writ is founded on the article of the Great Charter already quoted; but there are extant instances of the issue of writs of *habeas corpus* before the charter. Other writs having somewhat similar effect were in use at an early date, *e.g.* the writ *de odio et atia*, used as early as the 12th century to prevent imprisonment on vexatious appeals of felony, and the writ of mainprise (*de manucaptione*), long obsolete if not abolished in England but which it was attempted to use in India so late as 1870. In the ease of imprisonment on accusation of crime the writ issued from the court of king's bench (or from the chancery), and on its return the court judged of the legality of the imprisonment, and discharged the prisoner or admitted him to bail or remanded him to his former custody according to the result of the examination.

By the time of Charles I. the writ was fully established as the appropriate process for checking illegal imprisonment by inferior courts or by public officials. But it acquired its full and present constitutional importance by legislation.

In Darnel's case (1627) the judges held that the command of the king was a sufficient answer to a writ of *habeas corpus*. The House of Commons thereupon passed resolutions to the contrary, and after a conference with the House of Lords the measure known as the Petition of Right was passed (1627, 3 Car. I. c. i.) which, *inter alia*, recited (s. 5) that, contrary to the Great Charter and the good laws and statutes of the realm, divers of the king's subjects had of late been imprisoned without any cause shown, and when they were brought up on *habeas corpus ad subjiciendum*, and no cause was shown other than the special command of the king signified by the privy council, were nevertheless remanded to prison, and enacted "that no freeman in any such manner as is before mentioned be imprisoned or detained." The Petition of Right was disregarded in Selden's case (1629), when it was successfully returned to a *habeas corpus* that Selden and others were committed by the king's special command "for notable contempts against the king and his government and for stirring up sedition against him."² This led to legislation in 1640 by which, after abolishing the Star Chamber, the right to a *habeas corpus* was given to test the legality of commitments by command or warrant of the king or the privy council.³

The reign of Charles II. was marked by further progress towards securing the freedom of the subject from wrongful imprisonment. Lord Clarendon was impeached, *inter alia*, for causing many persons to be imprisoned against law and to be conveyed in custody to places outside England. In 1668 a writ of *habeas corpus* was issued to test the legality of an imprisonment in Jersey. Though the authority of the courts had been strengthened by the Petition of Right and the act of 1640, it was still rendered insufficient by reason of the insecurity of judicial tenure, the fact that only the chancellor (a political as well as a legal officer) and the court of king's bench had undoubted right to issue the writ, and the inability or hesitation of the competent judges to issue the writ except during the legal term, which did not cover more than half the year. A series of bills was passed through the Commons between 1668 and 1675, only to be rejected by the other House. In Jenkes's case (1676) Lord Chancellor Nottingham refused to issue the writ in vacation in a case in which a man had been committed by the king in council for a speech at Guildhall, and could get neither bail nor trial. In 1679, but rather in consequence of Lord Clarendon's arbitrary proceedings⁴ than of Jenkes's case, a fresh bill was introduced which passed both Houses (it is said the upper House by the counting of one stout peer as ten) and became the famous Habeas Corpus Act of 1679 (31 Car. II. c. 2). The passing of the act was largely due to the experience and energy of Lord Shaftesbury, after whom it was for some time called. The act, while a most important landmark in the constitutional history of England, in no sense creates any right to personal freedom, but is essentially a procedure act for improving the legal mechanism by means of which that acknowledged right may be enforced.⁵ It declares no principles and defines no rights, but is for practical purposes worth a hundred articles guaranteeing constitutional liberty.⁶

In the manner characteristic of English legislation the act is limited to the particular grievances immediately in view and is limited to imprisonment for criminal or supposed criminal matters, leaving untouched imprisonment on civil process or by private persons. It recites that great delays have been used by sheriffs and gaolers in making returns of writs of *habeas corpus* directed to them; and for the prevention thereof, and the more speedy relief of all persons imprisoned for criminal or supposed criminal matters, it enacts in substance as follows: (1) When a writ of *habeas corpus* is directed to a sheriff or other person in charge of a prisoner, he must within 3, 10 or 20 days, according to the distance of the place of commitment, bring the body of his prisoner to the court, with the true cause of his detainer or imprisonment—unless the commitment was for treason or felony plainly expressed in the warrant of commitment. (2) If any person be committed for any crime—unless for treason or felony plainly expressed in the warrant—it shall be lawful for such person or persons (other than persons convicted or in execution by legal process) *in time of vacation*, to appeal to the lord chancellor as a judge, who shall issue a *habeas corpus* returnable immediately, and on the return thereof shall discharge the prisoner on giving security for his appearance before the proper court—unless the party so committed is detained upon a legal process or under a justice's warrant for a non-bailable offence. Persons neglecting for two terms to pray for a *habeas corpus* shall have none in vacation. (3) Persons set at large on *habeas corpus* shall not be recommitted for the same offence unless by the legal order and process of the court having cognizance of the case. (4) A person committed to prison for treason or felony shall, if he requires it, in the first week of the next term or the first day of the next session of oyer and terminer, be indicted in that term or session or else admitted to bail, unless it appears on affidavit that the witnesses for the crown are not ready; and if he is not indicted and tried in the second term or session after commitment, or if after trial he is acquitted, he shall be discharged from imprisonment. (5) No inhabitant of England (except persons contracting, or, after conviction for felony, electing to be transported) shall be sent prisoner to Scotland, Ireland, Jersey, &c., or any place beyond the seas. Stringent penalties are provided for offences against the act. A judge delaying *habeas corpus* forfeits £500 to the party aggrieved. Illegal imprisonment beyond seas renders the offender liable in an action by the injured party to treble costs and damages to the extent of not less than £500, besides subjecting him to the penalties of *praemunire* and to other disabilities. "The great rank of those who were likely to offend against this part of the statute was," says Hallam, "the cause of this unusual severity." Indeed as early as 1591 the judges had complained of the difficulty of enforcing the writ in the case of imprisonment at the instance of magnates of the realm. The effect of the act was to impose upon the judges under severe sanction the duty of protecting personal liberty in the case of criminal charges and of securing speedy trial upon such charges when legally framed; and the improvement of their tenure of office at the revolution, coupled with the veto put by the Bill of Rights on excessive bail, gave the judicature the independence and authority necessary to enable them to keep the executive within the law and to restrain administrative development of the scope or penalties of the criminal law; and this power of the judiciary to control the executive, coupled with the limitations on the right to set up "act of state" as an excuse for infringing individual liberty is the special characteristic of English constitutional law.

It is to be observed that neither at common law nor under the act of 1679 was the writ the appropriate remedy in the case of a person convicted either on indictment or summarily. It properly applied to persons detained before or without trial or sentence; and for convicted persons the proper remedy was by writs of error or *certiorari* to which a writ of *habeas corpus* might be used as ancillary.

As regards persons imprisoned for debt or on civil process the writ was available at common law to test the legality of the detention: but the practice in these cases is unaffected by the act of 1679, and is of no present interest, since imprisonment on civil process is almost abolished. As regards persons in private custody, *e.g.* persons not *sui juris* detained by those not entitled to their guardianship or lunatics, or persons kidnapped, *habeas corpus ad subjiciendum* seems not to have been the ordinary common law remedy. The appropriate writ for such cases was that known as *de homine replegiando*. The use of this writ in most if not all criminal cases was forbidden in 1553; but it was used in the 17th century in a case of kidnapping (Designy's case, 1682), and against Lord Grey for abducting his wife's sister (1682), and in the earl of Banbury's case to recover his wife (1704). The latest recorded instance of its use is Trebilcock's case (1736), in which a ward sought to free himself from the custody of his guardian.

Since that date the *habeas corpus ad subjiciendum* has been used in cases of illegal detention in private custody. In 1758 questions arose as to its application to persons in naval or military custody, including pressed men, which led to the introduction of a bill in parliament and to the consultation by the House of Lords of the judges (see Wilmot's *Opinions*, p. 77). In the same year the writ was used to release the wife of Earl Ferrers from his custody and maltreatment, and was unsuccessfully applied for by John Wilkes to get back his wife, who was separated from him by mutual agreement. But perhaps the most interesting instances of that period are the case of the negro Somerset (1771), who was released from a claim to hold him as a slave in England: and that of the Hottentot Venus (1810), where an alien woman on exhibition in England was brought

before the court by Zachary Macaulay in order to ascertain whether she was detained against her will.

The experience of the 18th century disclosed defects in the procedure for obtaining liberty in cases not covered by the act of 1679. But it was not till 1816 that further legislation was passed for more effectually securing the liberty of the subject. The act of 1816 (56 Geo. III. c. 100), does not touch cases covered by the act of 1679. It enacts (1) that a writ of *habeas corpus* shall be issued in vacation time in favour of a person restrained of his liberty otherwise than for some criminal or supposed criminal matter (except persons imprisoned for debt or by civil process); (2) that though the return to the writ be good and sufficient in law, the judge shall examine into the truth of the facts set forth in such return, and if they appear doubtful the prisoner shall be bailed; (3) that the writ shall run to any port, harbour, road, creek or bay on the coast of England, although not within the body of any county. The last clause was intended to meet doubts on the applicability of *habeas corpus* in cases of illegal detention on board ship, which had been raised owing to a case of detention on a foreign ship in an English port.

It will appear from the foregoing statement that the issue and enforcement of the writ rests on the common law as strengthened by the acts of 1627, 1640, 1679 and 1816, and subject also to the regulations as to procedure contained in the *Crown Office Rules*, 1906. The effect of the statutes is to keep the courts always open for the issue of the writ. It is available to put an end to all forms of illegal detention in public or private custody. In the case of the Canadian prisoners (1839) it was used to obtain the release of persons sentenced in Canada for participating in the rebellion of 1837, who were being conveyed throughout England in custody on their way to imprisonment in another part of the empire, and it is matter of frequent experience for the courts to review the legality of commitments under the Extradition Acts and the Fugitive Offenders Act 1881, of fugitives from the justice of a foreign state or parts of the king's dominions outside the British Islands.

In times of public danger it has occasionally been thought necessary to "suspend" the Habeas Corpus Act 1679 by special and temporary legislation. This was done in 1794 (by an act annually renewed until 1801) and again in 1817, as to persons arrested and detained by his majesty for conspiring against his person and government. The same course was adopted in Ireland in 1866 during a Fenian rising. It has been the practice to make such acts annual and to follow their expiration by an act of indemnity. In cases where martial law exists the use of the writ is *ex hypothesi* suspended during conditions amounting to a state of war within the realm or the British possession affected (*e.g.* the Cape Colony and Natal during the South African War), and it would seem that the acts of courts martial during the period are not the subject of review by the ordinary courts. The so-called "suspension of the Habeas Corpus Act" bears a certain similarity to what is called in Europe "suspending the constitutional guarantees" or "proclaiming a state of siege," but "is not in reality more than suspension of one particular remedy for the protection of personal freedom."

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There are various other forms of the writ according to the purpose for which it is granted. Thus *habeas corpus ad respondendum* is used to bring up a prisoner confined by the process of an inferior court in order to charge him in another proceeding (civil or criminal) in the superior court or some other court. As regards civil proceedings, this form of the writ is now rarely used, owing to the abolition of arrest on mesne process and the restriction of imprisonment for debt, or in execution of a civil judgment. The right to issue the writ depends on the common law, supplemented by an act of 1802. It is occasionally used for the purpose of bringing a person in custody for debt or on a criminal charge before a criminal court to be charged in respect of a criminal proceeding; but the same result may be obtained by means of an order of a secretary of state, made under s. 11 of the Prison Act 1898, or by the written order of a court of criminal jurisdiction before which he is required to take his trial on indictment (Criminal Law Amendment Act 30 & 31 Vict. c. 35, s. 10.)

Other forms are *ad satisfaciendum*; *ad faciendum et recipiendum*, to remove into a superior court proceedings under which the defendant is in custody: *ad testificandum*, where a prisoner is required as a witness, issued under an act of 1804 (s. 11), which is in practice replaced by orders under s. 11 of the Prison Act 1898 (*supra*) or the order of a judge under s. 9 of the Criminal Procedure Act 1853; and *ad deliberandum et recipias*, to authorize the transfer from one custody to another for purposes of trial, which is in practice superseded by the provisions of the Prison Acts 1865, 1871 and 1898, and the Criminal Law Amendment Act 1867 (*supra*).

The above forms are now of little or no importance; but the procedure for obtaining them and the forms of writ are included in the *Crown Office Rules* 1906.

Ireland.—The common law of Ireland as to the writs of *habeas corpus* is the same as that in England. The writ has in past times been issued from the English court of king's bench into Ireland; but does not now so issue. The acts of 1803 and 1816 already mentioned apply to Ireland. The Petition of Right is not in terms applicable to Ireland. The Habeas Corpus Act 1679 does not apply to Ireland; but its equivalent is supplied by an act of 1781-1782 of the Irish parliament (21 & 22 Geo. III. c. 11). Sec. 16 contains a provision empowering the chief governor and privy

council of Ireland by a proclamation under the great seal of Ireland to suspend the act during such time only as there shall be an actual invasion or rebellion in Ireland; and it is enacted that during the currency of the proclamation no judge or justices shall bail or try any person charged with being concerned in the rebellion or invasion without an order from the lord lieutenant or lord deputy and senior of the privy council. In Ireland by an act of 1881 the Irish executive was given an absolute power of arbitrary and preventive arrest on suspicion of treason or of an act tending to interfere with the maintenance of law and order: but the warrant of arrest was made conclusive. This act continued by annual renewals until 1906, when it expired.

Scotland.—The writ of *habeas corpus* is unknown to Scots law, nor will it issue from English courts into Scotland. Under a Scots act of 1701 (c. 6) provision is made for preventing wrongous imprisonment and against undue delay in trials. It was applied to treason felony in 1848. The right to speedy trial is now regulated by s. 43 of the Criminal Procedure Scotland Act 1887. These enactments are as to Scotland equivalent to the English Act of 1679. Under the Court of Exchequer Scotland Act 1856 (19 & 20 V. c. 56) provision is made for bringing before the court of session persons and proceedings before inferior courts and public officers—which is analogous to the powers to issue *habeas corpus* in such cases out of the English court of exchequer (now the revenue side of the king's bench division).

British Possessions.—The act of 1679 expressly applies to Wales, Berwick-on-Tweed, Jersey and Guernsey, and the act of 1816 also extends to the Isle of Man. The court of king's bench has also issued the writ to the king's foreign dominions beyond seas, *e.g.* to St Helena, and so late as 1861 to Canada (Anderson's case 1861, 30 L.J.Q.B. 129). In consequence of the last decision it was provided by the Habeas Corpus Act 1862 that no writ of *habeas corpus* should issue out of England by authority of any court or judge "into any colony or foreign dominion of the crown where the crown has a lawfully established court of justice having authority to grant or issue the writ and to ensure its due execution in the 'colony' or dominion" (25 & 26 V. c. 20). The expression "foreign dominion" is meant to apply to places outside the British Islands, and does not include the Isle of Man or the Channel Islands (see *re Brown* [1864], 33 L.J.Q.B. 193).

In Australasia and Canada and in most if not all the British possessions whose law is based on the common law, the power to issue and enforce the writ is possessed and is freely exercised by colonial courts, under the charters or statutes creating and regulating the courts. The writ is freely resorted to in Canada, and in 1905, 1906, two appeals came to the privy council from the dominion, one with reference to an extradition case, the other with respect to the right to expel aliens.

Under the Roman-Dutch law as applied in British Guiana the writ was unknown and no similar process existed (2nd report of West Indian law commissioners). But by the Supreme Court Ordinance of 1893 that court possesses (*inter alia*) all the authorities, powers and functions belonging to or incident to a superior court of record in England, which appears to include the power to issue the writ of *habeas corpus*. Under the Roman-Dutch law as applied to South Africa free persons appear to have a right to release under a writ *de libero homine exhibendo*, which closely resembles the writ of *habeas corpus*, and the procedure described as "manifestation" used in the kingdom of Aragon (Hallam, *Middle Ages*, vol. ii., c. iv.). The writ of *habeas corpus* has not been formally adopted or the Habeas Corpus Acts formally extended to South Africa; but in the Cape Colony, under the charter of justice and colonial legislation, the supreme court on petition grants a remedy equivalent to that obtained in England by writ of *habeas corpus*; and the remedy is sometimes so described (*Koke v. Balie*, 1879, 9 Buchanan, 45, 64, arising out of a rising in Griqualand). During and after the South African War of 1899-1902 many attempts were made by this procedure to challenge or review the sentences of courts martial; see *re Fourie* (1900). 18 *Cape Rep.* 8.

The laws of Ceylon being derived from the Roman-Dutch law, the writ of *habeas corpus* is not indigenous: but, under s. 49 of the Supreme Court Ordinance 1889, the court or a judge has power to grant and issue "mandates in the nature of writs of *habeas corpus*." The chartered high courts in India have power to issue and enforce the writ of *habeas corpus*. The earliest record of its use was in 1775, when it was directed to Warren Hastings. It has been used to test the question whether Roman Catholic religious orders could enter India, and in 1870 an attempt was made thereby to challenge the validity of a warrant in the nature of a *lettre de cachet* issued by the viceroy (Ind. L. Rep. 6 Bengal, 392, 456, 498), and it has also been applied to settle controversies between Hindus and missionaries as to the custody of a young convert (*R. v. Vaughan*, 1870, 5 Bengal, 418), and between a Mahomedan husband and his mother-in-law as to the custody of a girl-wife (*Khatija Bibi*, 1870, 5 Bengal, 557).

United States.—Before the Declaration of Independence some of the North American colonies had adopted the act of 1679; and the federal and the other state legislatures of the United States have founded their procedure on that act. The common law as to the writ of *habeas corpus* has been inherited from England, and has been generally made to apply to commitments and detentions of all kinds. Difficult questions, unknown to English law, have arisen from the peculiar features of the American state-system. Thus the constitution provides that "the privilege of the writ of *habeas corpus* shall not be suspended unless when, in cases of rebellion or invasion, the public safety may require it"; and it has been the subject of much dispute whether the power of

suspension under this provision is vested in the president or the congress. The weight of opinion seems to lean to the latter alternative. Again, conflicts have arisen between the courts of individual states and the courts of the union. It seems that a state court has no right to issue a *habeas corpus* for the discharge of a person held under the authority of the federal government. On the other hand, the courts of the union issue the writ only in those cases in which the power is expressly conferred on them by the constitution.

AUTHORITIES.—Paterson, *Liberty of the Subject* (1877); Short and Mellor, *Crown Practice* (1890); American: Church on *Habeas Corpus* (2nd ed. 1893).

(W. F. C.)

- 1 See Hallam, *Const. Hist.* vol. i., c. vii. (12th ed.) p. 384.
- 2 Hallam, *Const. Hist.* vol. ii., c. viii. (12th ed.) p. 2.
- 3 *Ibid.* c. ix. (12th ed.) p. 98.
- 4 *Ibid.* vol. iii., c. xiii. (12th ed.) p. 12.
- 5 Dicey, *Law of the Constitution* (6th ed.), p. 217.
- 6 Dicey, *Law of the Constitution* (6th ed.), p. 195.

HABERDASHER, a name for a tradesman who sells by retail small articles used in the making or wearing of dress, such as sewing cottons or silks, tapes, buttons, pins and needles and the like. The sale of such articles is not generally carried on alone, and a "haberdashery counter" usually forms a department of drapers' shops. The word, found in Chaucer, and even earlier (1311), is of obscure origin; the suggestion that it is connected with an Icelandic *haprtask*, "haversack," is, according to the *New English Dictionary*, impossible. *Haperlas* occurs in an early Anglo-French customs list, which includes articles such as were sold by haberdashers, but this word may itself have been a misspelling of "haberdash." The obscurity of origin has left room for many conjectures such as that of Minsheu that "haberdasher" was perhaps merely a corruption of the German *Habt ihr das?* "Have you that?" or *Habe das, Herr*, "Have that, sir," used descriptively for a general dealer in miscellaneous wares. The Haberdashers' Company is one of the greater Livery Companies of the City of London. Originally a branch of the mercers, the fraternity took over the selling of "small wares," which included not only articles similar to those sold as "haberdashery" now, but such things as gloves, daggers, glass, pens, lanterns, mousetraps and the like. They were thus on this side connected with the Milliners. On the other hand there was early a fusion with the old guild of the "Hurers," or cap makers, and the hatters, and by the reign of Henry VII. the amalgamation was complete. There were long recognized two branches of the haberdashers, the haberdashers of "small wares," and the haberdashers of hats (see further [LIVERY COMPANIES](#)). The haberdashers are named, side by side with the *capellarii*, in the White Book (*Liber Albus*) of the city of London (see *Munimenta Gildhallae Londiniensis*, ed. H. T. Riley, Rolls Series, 12, 1859-1862), and a haberdasher forms one of the company of pilgrims in the *Canterbury Tales* (Prologue, 361).

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HABINGTON, WILLIAM (1605-1654), English poet, was born at Hendlip Hall, Worcestershire, on the 4th of November 1605. He belonged to a well-known Catholic family. His father, Thomas Habington (1560-1647), an antiquary and historical scholar, had been implicated in the plots on behalf of Mary queen of Scots; his uncle, Edward Habington, was hanged in 1586 on the charge of conspiring against Elizabeth in connexion with Anthony Babington; while to his mother, Mary Habington, was attributed the revelation of the Gunpowder Plot. The poet was sent to the college at St Omer, but, pressure being brought to bear on him to induce him to become a Jesuit, he removed to Paris. He married about 1632 Lucy, second daughter of Sir William Herbert, first Baron Powys. This lady he had addressed in the volume of lyrical poems arranged in two parts and entitled *Castara*, published anonymously in 1634. In 1635 appeared a second edition enlarged by three prose characters, fourteen new lyrics and eight touching elegies on his friend and kinsman, George Talbot. The third edition (1640) contains a third part consisting of a prose character of "A Holy Man" and twenty-two devotional poems. Habington's lyrics are full of the far-fetched "conceits" which were fashionable at court, but his verse is quite free from the prevailing looseness of morals. Indeed his reiterated praises of Castara's virtue grow wearisome.

He is at his best in his reflective poems on the uncertainty of human life and kindred topics. He also wrote a *Historie of Edward the Fourth* (1640), based on notes provided by his father; a tragedy, *The Queene of Arragon* (1640), published without his consent by his kinsman, the earl of Pembroke, and revived at the Restoration; and six essays on events in modern history, *Observations upon History* (1641). Anthony à Wood insinuated that during the Commonwealth the poet "did run with the times, and was not unknown to Oliver the usurper." He died on the 30th of November 1654.

The works of Habington have not been collected. *The Queene of Arragon* was reprinted in Dodsley's "Old Plays," vol. ix. (1825); *Castara* was edited by Charles Elton (1812), and by E. Arber with a compact and comprehensive introduction (1870) for his "English Reprints."

HABIT (through the French from Lat. *habitus*, from *habere*, to have, hold, or, in a reflective sense, to be in a certain condition; in many of the English senses the French use *habitude*, not *habit*), condition of body or mind, especially one that has become permanent or settled by custom or persistent repetition, hence custom, usage. In botany and zoology the term is used both in the above sense of instinctive action of animals and tendencies of plants, and also of the manner of growth or external appearance of a plant or animal. From the use of the word for external appearances comes its use for fashion in dress, and hence as a term for a lady's riding dress and for the particular form of garment adopted by the members of a religious order, like "cowl" applied as the mark of a monk or nun.

HABITAT (a French word derived from *habiter*, Lat. *habitare*, to dwell), in botany and zoology, the term for the locality in which a particular species of plants or animals thrives.

HABSBURG, OR HAPSBURG, the name of the famous family from which have sprung the dukes and archdukes of Austria from 1282, kings of Hungary and Bohemia from 1526, and emperors of Austria from 1804. They were also Roman emperors and German kings from 1438 to 1806, and kings of Spain from 1516 to 1700, while the minor dignities held by them at different times are too numerous to mention.

The name Habsburg, a variant of an older form, Habichtsburg (hawk's castle), was taken from the castle of Habsburg, which was situated on the river Aar not far from its junction with the Rhine. The castle was built about 1020 by Werner, bishop of Strassburg, and his brother, Radbot, the founder of the abbey of Muri. These men were grandsons of a certain Guntram, who, according to some authorities, is identical with a Count Guntram who flourished during the reign of the emperor Otto the Great, and whose ancestry can be traced back to the time of the Merovingian kings. This conjecture, however, is extremely problematical. Among Radbot's sons was one Werner, and Werner and his son Otto were called counts of Habsburg, Otto being probably made landgrave of upper Alsace late in the 11th or early in the 12th century. At all events Otto's son Werner (d. 1167), and the latter's son Albert (d. 1199), held this dignity, and both landgraves increased the area of the Habsburg lands. Albert became count of Zürich and protector of the monastery of Säkingen, and obtained lands in the cantons of Unterwalden and Lucerne; his son Rudolph, having assisted Frederick of Hohenstaufen, afterwards the emperor Frederick II., against the emperor Otto IV., received the county of Aargau. Both counts largely increased their possessions in the districts now known as Switzerland and Alsace, and Rudolph held an influential place among the Swabian nobility. After his death in 1232 his two sons, Albert and Rudolph, divided his lands and founded the lines of Habsburg-Habsburg and Habsburg-Laufenburg. Rudolph's descendants, counts of Habsburg-Laufenburg, were soon divided into two branches, one of which became extinct in 1408 and the other seven years later. Before this date, however, Laufenburg and some other districts had been sold to the senior branch of the family, who thus managed to retain the greater part of the Habsburg lands.

Rudolph's brother Albert (d. 1239), landgrave of Alsace, married Hedwig of Kyburg (d. 1260),

and from this union there was born in 1218 Rudolph, the founder of the greatness of the house of Habsburg, and the first of the family to ascend the German throne. Through his mother he inherited a large part of the lands of the extinct family of Zähringen; he added in other ways to his possessions, and was chosen German king in September 1273. Acting vigorously in his new office, he defeated and killed his most formidable adversary, Ottakar II., king of Bohemia, in 1278, and in December 1282 he invested his sons, Albert and Rudolph, with the duchies of Austria and Styria, which with other lands had been taken from Ottakar. This was an event of supreme moment in the history of the Habsburgs, and was the first and most important stage in the process of transferring the centre of their authority from western to eastern Europe, from the Rhine to the Danube. On Rudolph's death in July 1291 the German crown passed for a time away from the Habsburgs, but in July 1298 it was secured by his son, Albert, whose reign, however, was short and uneventful. But before 1308, the year of Albert's death, the long and troubled connexion of the Habsburgs with Bohemia had already begun. In 1306 Wenceslas III., the last Bohemian king of the Přemyslide dynasty, was murdered. Seizing the opportunity and declaring that the vacant kingdom was an imperial fief, King Albert bestowed it upon his eldest son, Rudolph, and married this prince to Elizabeth, widow of Wenceslas II. and stepmother of Wenceslas III. But Rudolph died in 1307, and his father's attempt to keep the country in his own hands was ended by his murder in 1308.

Albert's successor as German king was Henry of Luxemburg (the emperor Henry VII.), and this election may be said to initiate the long rivalry between the houses of Habsburg and Luxemburg. But the immediate enemy of the Habsburgs was not a Luxemburg but a Wittelsbach. Without making any definite partition, Albert's five remaining sons spent their time in governing their lands until 1314, when one of them, Frederick called the Fair, forsook this comparatively uneventful occupation and was chosen by a minority of the electors German king in succession to Henry VII. At the same time the Wittelsbach duke of Bavaria, Louis, known to history as the emperor Louis the Bavarian, was also chosen. War was inevitable, and the battle of Mühldorf, fought in September 1322, sealed the fate of Frederick. Louis was victorious: his rival went into an honourable captivity, and the rising Habsburg sun underwent a temporary eclipse.

For more than a century after Frederick's death in 1330 the Habsburgs were exiles from the German throne. But they were not inactive. In 1335 his two surviving brothers, Albert and Otto, inherited Carinthia and part of Carniola by right of their mother, Elizabeth; in 1363 Albert's son Rudolph received Tirol; and during the same century part of Istria, Trieste and other districts were acquired. All King Albert's six sons had died without leaving male issue save Otto, whose family became extinct in 1344, and Albert, the ancestor of all the later Habsburgs. Of Albert's four sons two also left no male heirs, but the remaining two, Albert III. and Leopold III., were responsible for a division of the family which is of some importance. By virtue of a partition made upon their brother Rudolph's death in 1365 Albert and his descendants ruled over Austria, while Leopold and his sons took Styria, Carinthia and Tirol, Alsace remaining undivided as heretofore.

Towards the middle of the 15th century the German throne had been occupied for nearly a hundred years by members of the Luxemburg family. The reigning emperor Sigismund, who was also king of Hungary and Bohemia, was without sons, and his daughter Elizabeth was the wife of Albert of Habsburg, the grandson and heir of Duke Albert III., who had died in 1395. Sigismund died in December 1437, leaving his two kingdoms to his son-in-law, who was crowned king of Hungary in January 1438 and king of Bohemia in the following June. Albert was also chosen and crowned German king in succession to Sigismund, thus beginning the long and uninterrupted connexion of his family with the imperial throne, a connexion which lasted until the dissolution of the Holy Roman Empire in 1806. He did not, however, enjoy his new dignities for long, as he died in October 1439 while engaged in a struggle with the Turks. Albert left no sons, but soon after his death one was born to him, called Ladislaus, who became duke of Austria and king of Hungary and Bohemia. Under the guardianship of his kinsman, the emperor Frederick III., the young prince's reign was a troubled one, and when he died unmarried in 1457 his branch of the family became extinct, and Hungary and Bohemia passed away from the Habsburgs, who managed, however, to retain Austria.

Leopold III., duke of Carinthia and Styria, who was killed in 1386 at the battle of Sempach, had four sons, of whom two only, Frederick and Ernest, left male issue. Frederick and his only son, Sigismund, confined their attention mainly to Tirol and Alsace, leaving the larger destinies of the family in the hands of Ernest of Carinthia and Styria (d. 1424) and his sons, Frederick and Albert and after the death of King Ladislaus in 1457 these two princes and their cousin Sigismund were the only representatives of the Habsburgs. In February 1440 Frederick of Styria was chosen German king in succession to his kinsman Albert. He was a weak and incompetent ruler, but a stronger and abler man might have shrunk from the task of administering his heterogeneous and unruly realm. Although very important in the history of the house of Habsburg, Frederick's long reign was a period of misfortune, and the motto which he assumed, *A.E.I.O.U. (Austriae est imperare orbi universo)*, seemed at the time a particularly foolish boast. He acted as guardian both to Ladislaus of Hungary, Bohemia and Austria, and to Sigismund of Tirol, and in all these countries his difficulties were increased by the hostility of his brother Albert. Having disgusted

the Tirolese he gave up the guardianship of their prince in 1446, while in Hungary and Bohemia he did absolutely nothing to establish the authority of his ward; in 1452 the Austrians besieged him in Vienna Neustadt and compelled him to surrender the person of Ladislaus, thus ending even his nominal authority. When the young king died in 1457 the Habsburgs lost Hungary and Bohemia, but they retained Austria, which, after some disputing, Frederick and Albert divided between themselves, the former taking lower and the latter upper Austria. This arrangement was of short duration. In 1461 Albert made war upon his brother and forced him to resign lower Austria, which, however, he recovered after Albert's death in December 1463. Still more unfortunate was the German king in Switzerland. For many years the Swiss had chafed under the rule of the Habsburgs; during the reign of Rudolph I. they had shown signs of resentment as the kingly power increased; and the struggle which had been carried on for nearly two centuries had been almost uniformly in their favour. It was marked by the victory of Morgarten over Duke Leopold I. in 1315, and by that of Sempach over Leopold III. in 1386, by the conquest of Aargau at the instigation of the emperor Sigismund early in the 15th century, and by the final struggle for freedom against Frederick III. and Sigismund of Tirol. Taking advantage of some dissensions among the Swiss, the king saw an opportunity to recover his lost lands, and in 1443 war broke out. But his allies, the men of Zürich, were defeated, and when in August 1444 some French mercenaries, who had advanced to his aid, suffered the same fate at St Jakob, he was compelled to give up the struggle. A few years later Sigismund became involved in a war with the same formidable foemen; he too was worsted, and the "Perpetual Peace" of 1474 ended the rule of the Habsburgs in Switzerland. This humiliation was the second great step in the process of removing the Habsburgs from western to eastern Europe. In 1453, just after his coronation as emperor at Rome, Frederick legalized the use of the title archduke, which had been claimed spasmodically by the Habsburgs since 1361. This title is now peculiar to the house of Habsburg.

The reverses suffered by the Habsburgs during the reign of Frederick III. were many and serious, but an improvement was at hand. The emperor died in August 1493, and was followed on the imperial throne by his son Maximilian I., perhaps the most versatile and interesting member of the family. Before his father's death Maximilian had been chosen German king, or king of the Romans, and had begun to repair the fortunes of his house. He had married Mary, daughter and heiress of Charles the Bold, duke of Burgundy; he had driven the Hungarians from Vienna and the Austrian archduchies, which Frederick had, perforce, allowed them to occupy; and he had received Tirol on the abdication of Sigismund in 1490. True it is that upon Mary's death in 1482 part of her inheritance, the rich and prosperous Netherlands, held that her husband's authority was at an end, while another part, the two Burgundies and Artois, had been seized by the king of France; nevertheless, after a protracted struggle the German king secured almost the whole of Charles the Bold's lands for his son, the archduke Philip, the duchy of Burgundy alone remaining in the power of France after the conclusion of the peace of Senlis in 1493. Maximilian completed his work by adding a piece of Bavaria, Görz and then Gradiska to the Habsburg lands.

After Sigismund's death in 1496 Maximilian and Philip were the only living male members of the family. Philip married Joanna, daughter of Ferdinand and Isabella of Spain, and died in 1506 leaving two sons, Charles and Ferdinand. Charles succeeded his father in the Netherlands; he followed one grandfather, Ferdinand, as king of Spain in 1516, and when the other, Maximilian, died in 1519 he became the emperor Charles V., and succeeded to all the hereditary lands of the Habsburgs. But provision had to be made for Ferdinand, and in 1521 this prince was given the Austrian archduchies, Austria, Styria, Carinthia and Carniola; in the same year he married Anne, daughter of Wladislaus, king of Hungary and Bohemia, and when his childless brother-in-law, King Louis, was killed at the battle of Mohacs in August 1526 he claimed the two kingdoms, both by right of his wife and by treaty. After a little trouble Bohemia passed under his rule, but Hungary was more recalcitrant. A long war took place between Ferdinand and John Zapolya, who was also crowned king of Hungary, but in 1538 a treaty was made and the country was divided, the Habsburg prince receiving the western and smaller portion. However, he was soon confronted with a more formidable foe, and he spent a large part of his subsequent life in defending his lands from the attacks of the Turks.

The Habsburgs had now reached the summit of their power. The prestige which belonged to Charles as head of the Holy Roman Empire was backed by the wealth and commerce of the Netherlands and of Spain, and by the riches of the Spanish colonies in America. In Italy he ruled over Sardinia, Naples and Sicily, which had passed to him with Spain, and the duchy of Milan, which he had annexed in 1535; to the Netherlands he had added Friesland, the bishopric of Utrecht, Gröningen and Gelderland, and he still possessed Franche-Comté and the fragments of the Habsburg lands in Alsace and the neighbourhood. Add to this Ferdinand's inheritance, the Austrian archduchies and Tirol, Bohemia with her dependent provinces, and a strip of Hungary, and the two brothers had under their sway a part of Europe the extent of which was great, but the wealth and importance of which were immeasurably greater. Able to scorn the rivalry of the other princely houses of Germany, the Habsburgs saw in the kings of the house of Valois the only foemen worthy of their regard.

When Charles V. abdicated he was succeeded as emperor, not by his son Philip, but by his

brother Ferdinand. Philip became king of Spain, ruling also the Netherlands, Franche-Comté, Naples, Sicily, Milan and Sardinia, and the family was definitely divided into the Spanish and Austrian branches. For Spain and the Spanish Habsburgs the 17th century was a period of loss and decay, the seeds of which were sown during the reign of Philip II. The northern provinces of the Netherlands were lost practically in 1609 and definitely by the treaty of Westphalia in 1648; Roussillon and Artois were annexed to France by the treaty of the Pyrenees in 1659, while Franche-Comté and a number of towns in the Spanish Netherlands suffered a similar fate by the treaty of Nijmegen in 1678. Finally Charles II., the last Habsburg king of Spain, died childless in November 1700, and his lands were the prize of the War of the Spanish Succession. The Austrian Habsburgs fought long and valiantly for the kingdom of their kinsman, but Louis XIV. was too strong for them, and by the peace of Rastatt Spain passed from the Habsburgs to the Bourbons. However, the Austrian branch of the family received in 1714 the Italian possessions of Charles II., except Sicily, which was given to the duke of Savoy, and also the southern Netherlands, which are thus often referred to as the Austrian Netherlands; and retained the duchy of Mantua, which it had seized in 1708.

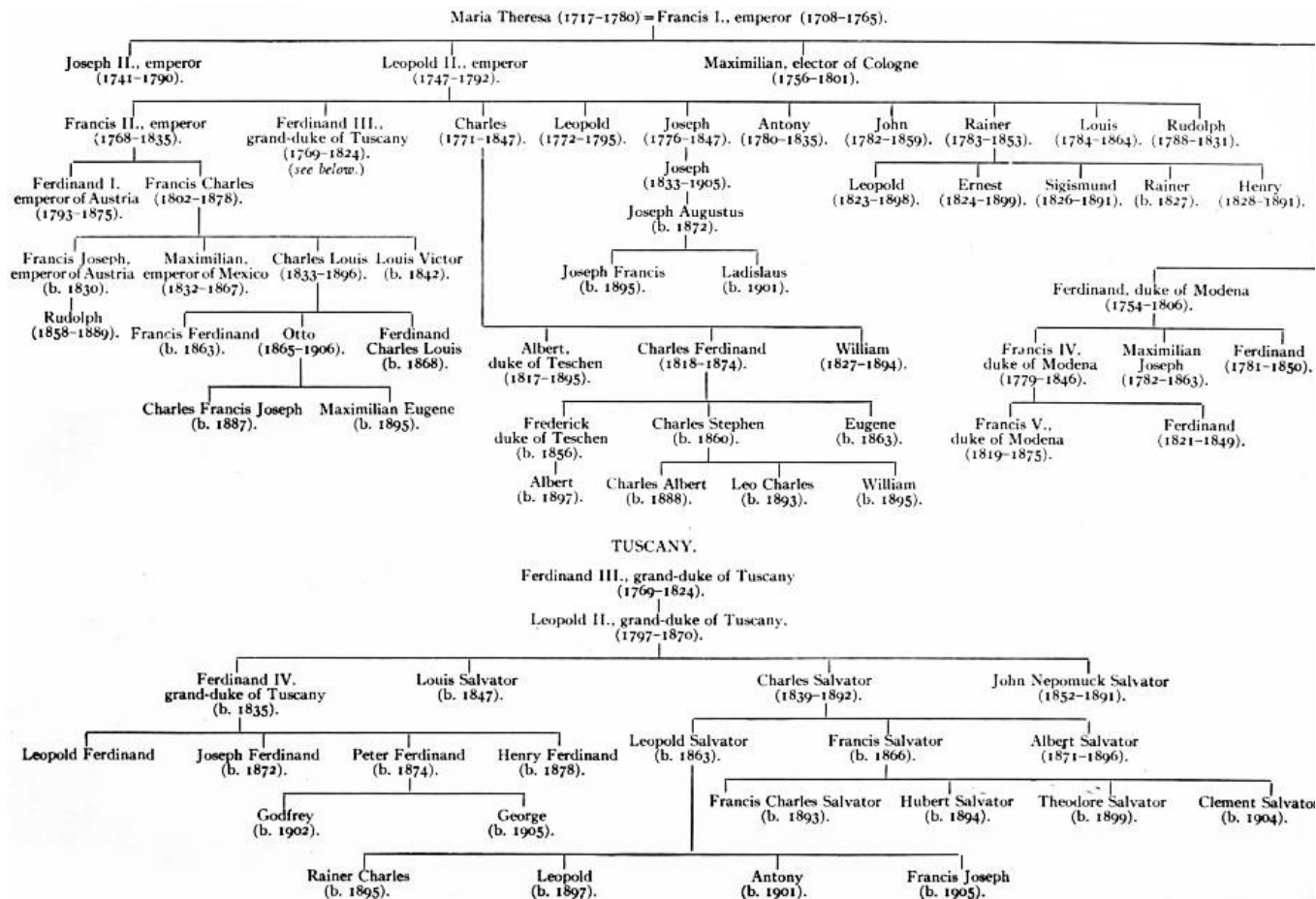
Ferdinand I., the founder of the line of the Austrian Habsburgs, arranged a division of his lands among his three sons before his death in 1564. The eldest, Maximilian II., received Austria, Bohemia and Hungary, and succeeded his father as emperor; he married Maria, a daughter of Charles V., and though he had a large family his male line became extinct in 1619. The younger sons were Ferdinand, ruler of Tirol, and Charles, archduke of Styria. The emperor Maximilian II. left five sons, two of whom, Rudolph and Matthias, succeeded in turn to the imperial throne, but, as all the brothers were without male issue, the family was early in the 17th century threatened with a serious crisis. Rudolph died in 1612, the reigning emperor Matthias was old and ill, and the question of the succession to the Empire, to the kingdoms of Hungary and Bohemia, and to the hereditary lands of the Habsburgs became acute. Turning to the collateral branches of the family, the sons of the archduke Ferdinand were debarred from the succession owing to their father'smorganatic marriage with Philippine Welser, and the only hope of the house was in the sons of Charles of Styria. To prevent the Habsburg monarchy from falling to pieces the emperor's two surviving brothers renounced their rights, and it was decided that Ferdinand, a son of Charles of Styria, should succeed his cousin Matthias. The difficulties which impeded the completion of this scheme were gradually overcome, and the result was that when Matthias died in 1619 the whole of the lands of the Austrian Habsburgs was united under the rule of the emperor Ferdinand II. Tirol, indeed, a few years later was separated from the rest of the monarchy and given to the emperor's brother, the archduke Leopold, but this separation was ended when Leopold's son died in 1665.

The arbitrary measures which followed Ferdinand's acquisition of the Bohemian crown contributed to the outbreak of the Thirty Years' War, but in a short time the Bohemians were subdued, and in 1627, following a precedent set in 1547, the emperor declared the throne hereditary in the house of Habsburg. The treaty of Westphalia which ended this war took comparatively little from the Habsburgs, though they ceded Alsace to France; but the Empire was greatly weakened, and its ruler was more than ever compelled to make his hereditary lands in the east of Europe the base of his authority, finding that he derived more strength from his position as archduke of Austria than from that of emperor. Ferdinand III. succeeded his father Ferdinand II., and during the long reign of the former's son, Leopold I., the Austrian, like the Spanish, Habsburgs were on the defensive against the aggressive policy of Louis XIV., and in addition they had to withstand the assaults of the Turks. In two ways they sought to strengthen their position. The unity of the Austrian lands was strictly maintained, and several marriages kept up a close and friendly connexion with Spain. A series of victories over the sultan during the later part of the 17th century rolled back the tide of the Turkish advance, and the peace of Karlowitz made in 1699 gave nearly the whole of Hungary to the Habsburgs. Against France Austria was less successful, and a number of humiliations culminated in 1714 in the failure to secure Spain, to which reference has already been made.

The hostility of Austria and France, or rather of Habsburg and Bourbon, outlived the War of the Spanish Succession. In 1717 Spain conquered Sardinia, which was soon exchanged by Austria for Sicily; other struggles and other groupings of the European powers followed, and in 1735, by the treaty of Vienna, Austria gave up Naples and Sicily and received the duchies of Parma and Piacenza. These surrenders were doubtless inevitable, but they shook the position of the house of Habsburg in Italy. However, a domestic crisis was approaching which threw Italian affairs into the shade. Charles VI., who had succeeded his brother, Joseph I., as emperor in 1711, was without sons, and his prime object in life was to secure the succession of his elder daughter, Maria Theresa, to the whole of his lands and dignities. But in 1713, four years before the birth of Maria Theresa, he had first issued the famous *Pragmatic Sanction*, which declared that the Habsburg monarchy was indivisible and that in default of male heirs a female could succeed to it. Then after the death of his only son and the birth of Maria Theresa the emperor bent all his energies to securing the acceptance of the Pragmatic Sanction. Promulgated anew in 1724, it was formally accepted by the estates of the different Habsburg lands; in 1731 it was guaranteed

by the imperial diet. By subordinating every other interest to this, Charles at length procured the assent of the various powers of Europe to the proposed arrangement; he married the young princess to Francis Stephen, duke of Lorraine, afterwards grand-duke of Tuscany, and when he died on the 20th of October 1740 he appeared to have realized his great ambition. With the emperor's death the house of Habsburg, strictly speaking, became extinct, its place being taken by the house of Habsburg-Lorraine, which sprang from the union of Maria Theresa and Francis Stephen; and it is interesting to note that the present Habsburgs are only descended in the female line from Rudolph I. and Maximilian I.

GENEALOGICAL TABLE OF THE HOUSE OF HABSBURG-LORRAINE.



Immediately after the death of Charles the Pragmatic Sanction was forgotten. A crowd of claimants called for various parts of the Habsburg lands; Frederick the Great, talking less but acting more, invaded and conquered Silesia, and it seemed likely that the dissolution of the Habsburg monarchy would at no long interval follow the extinction of the Habsburg race. A Wittelsbach prince, Charles Albert, elector of Bavaria, the emperor Charles VII., and not Francis Stephen, was chosen emperor in January 1742, and by the treaty of Breslau, made later in the same year, nearly all Silesia was formally surrendered to Prussia. But the worst was now over, and when in 1748 the peace of Aix-la-Chapelle, which practically confirmed the treaty of Breslau, had cleared away the dust of war, Maria Theresa and her consort were found to occupy a strong position in Europe. In the first place, in September 1745, Francis had been chosen emperor; then the imperial pair ruled Hungary and Bohemia, although the latter kingdom was shorn of Silesia; in spite of French conquests the Austrian Netherlands remained in their hands; and in Italy Francis had added Tuscany to his wife's heritage, although Parma and Piacenza had been surrendered to Spain and part of Milan to the king of Sardinia. The diplomatic *volte-face* and the futile attempts of Maria Theresa to recover Silesia which followed this treaty belong to the general history of Europe.

The emperor Francis I. died in 1765 and was succeeded by his son Joseph II., an ambitious and able prince, whose aim was to restore the Habsburgs and the Empire to their former great positions in Europe, and whose pride did not prevent him from learning from Frederick the Great, the despoiler of his house. His projects, however, including one of uniting Bavaria with Austria, which was especially cherished, failed completely, and when he died in February 1790 he left his lands in a state of turbulence which reflected the general condition of Europe. The Netherlands had risen against the Austrians, and in January 1790 had declared themselves

independent; Hungary, angered by Joseph's despotic measures, was in revolt, and the other parts of the monarchy were hardly more contented. But the 18th century saw a few successes for the Habsburgs. In 1718 a successful war with Turkey was ended by the peace of Passarowitz, which advanced the Austrian boundary very considerably to the east, and although by the treaty of Belgrade, signed twenty-one years later, a large part of this territory was surrendered, yet a residuum, the banate of Temesvar, was permanently incorporated with Hungary. The struggle over the succession to Bavaria, which was concluded in 1779 by the treaty of Teschen, was responsible for adding Innviertel, or the quarter of the Inn, to Austria; the first partition of Poland brought eastern Galicia and Lodomeria, and in 1777 the sultan ceded Bukovina. Joseph II. was followed by his brother, Leopold II., who restored the Austrian authority in the Netherlands, and the latter by his son Francis II., who resigned the crown of the Holy Roman Empire in August 1806, having two years before taken the title of emperor of Austria as Francis I.

Before the abdication of the emperor Francis in 1806 Austria had met and suffered from the fury of revolutionary France, but the cessions of territory made by her at the treaties of Campo Formio (1797), of Lunéville (1801) and of Pressburg (1805) were of no enduring importance. This, however, cannot be said for the treaties of Paris and of Vienna, which in 1814 and 1815 arranged the map of Europe upon the conclusion of the Napoleonic wars. These were highly favourable to the Habsburgs. In eastern and central Europe Austria regained her former position, the lands ceded to Bavaria and also eastern Galicia, which had been in the hands of Russia since 1809, being restored; she gave up the Austrian Netherlands, soon to be known as Belgium, to the new kingdom of the Netherlands, and acquiesced in the arrangement which had taken from her the Breisgau and the remnant of the Habsburg lands upon the Rhine. In return for these losses Austria became the dominant power in Italy. A mass of northern Italy, including her former possessions in Milan and the neighbourhood, and also the lands recently forming the republic of Venice, was made into the kingdom of Lombardy-Venetia, and this owned the emperor of Austria as king. Across the Adriatic Dalmatia was added to the Habsburg monarchy, the population of which, it has been estimated, was increased at this time by over four millions.

The illiberal and oppressive character of the Austrian rule in Italy made it very unpopular; it was hardly less so in Hungary and Bohemia, and the advent of the year 1848 found the subject kingdoms eager to throw off the Habsburg yoke. The whole monarchy was quickly in a state of revolution, in the midst of which the emperor Ferdinand, who had succeeded his father Francis in 1835, abdicated, and his place was taken by his young nephew Francis Joseph. The position of the Habsburg monarchy now seemed desperate. But it was strong in its immemorial tradition, which was enough to make the efforts of the Frankfurt parliament to establish German unity under Prussian hegemony abortive; it was strong also in the general loyalty to the throne of the imperial army; and its counsels were directed by statesmen who knew well how to exploit in the interests of the central power the national rivalries within the monarchy. With the crushing of the Hungarian revolt by the emperor Nicholas I. of Russia in 1849 the monarchy was freed from the most formidable of its internal troubles; in 1850 the convention of Olmütz restored its influence in Germany.

Though the *status quo* was thus outwardly re-established, the revolutions of 1848 had really unchained forces which made its maintenance impossible. In Germany Prussia was steadily preparing for the inevitable struggle with Austria for the mastery; in France Napoleon III. was preparing to pose as the champion of the oppressed nationalities which had once more settled down sullenly under the Habsburg yoke. The alliance of the French emperor and the king of Sardinia, and the Italian war of 1859 ended in the loss of Lombardy to the Habsburgs. Seven years later the crushing defeat of Königgrätz not only ended their long rule in Italy, based on the tradition of the medieval empire, by leading to the cession of Venetia to the new Italian kingdom, but led to their final exclusion from the German confederation, soon to become, under the headship of Prussia, the German empire.

By the loss of the predominance in Germany conceded to it by the treaties of Vienna, and by the shifting of its "centre of gravity" eastward, the Habsburg monarchy, however, perhaps gained more than it lost. One necessary result, indeed, was the composition (*Ausgleich*) with Hungary in 1867, by which the latter became an independent state (Francis Joseph being crowned king at Pest in June 1867) bound to the rest of the monarchy only by the machinery necessary for the carrying out of a common policy in matters of common interest. This at least restored the loyalty of the Hungarians to the Habsburg dynasty; it is too soon yet to say that it secured permanently the essential unity of the Habsburg monarchy. By the system of the Dual Monarchy the rest of the Austrian emperor's dominions (Cis-Leithan) were consolidated under a single central government, the history of which has been mainly that of the rival races within the empire struggling for political predominance. Since the development of the constitution has been consistently in a democratic direction and the Slavs are in a great majority, the tendency has been for the German element—strong in its social status and tradition of predominance—to be swamped by what it regards as an inferior race; and a considerable number of Austrian "Germans" have learned to look not to their Habsburg rulers, but to the power of the German empire for political salvation. The tendency eastwards of the monarchy was increased when in

1878 the congress of Berlin placed Bosnia and Herzegovina under Austrian rule. Old ambitions were now revived at the expense of the Ottoman empire, the goal of which was the port of Salonica; and not the least menacing aspect of the question of the near East has been that the rivalry of Italy and the Habsburg monarchy has been transferred to the Balkan peninsula. Yet, in spite of internal dissensions arising out of questions fundamentally insoluble, and in spite of the constant threat of external complications that may lead to war, the Habsburg monarchy as the result of the changes in the 19th and 20th centuries is seemingly stronger than ever. The shadow of universal claims to empire and sonorous but empty titles have vanished, but so have the manifold rivalries and entanglements which accompanied the Habsburg rule in Italy and the Netherlands and Habsburg preponderance in Germany. The monarchy is stronger because its sphere is more defined; because as preserving the *pax Romana* among the jostling races of eastern Europe, it is more than ever recognized as an essential element in the maintenance of European peace, and is recognized as necessary and beneficial even by the ambitious and restless nationalities that chafe under its rule.

A few words must be said about the cadet branches of the Habsburg family. When, in 1765, Francis I. died and Joseph II. became emperor, the grand-duchy of Tuscany passed by special arrangement not to Joseph, but to his younger brother Leopold. Then in 1791, after Leopold had succeeded Joseph as emperor, he handed over the grand-duchy to his second son, Ferdinand (1769-1824). In 1801 this prince was deposed by Napoleon and Tuscany was seized by France. Restored to the Habsburgs in the person of Ferdinand in 1814, it remained under his rule, and then under that of his son Leopold (1797-1870), until the rising of 1859, when the Austrians were driven out and the grand-duchy was added to the kingdom of Sardinia. A similar fate attended the duchy of Modena, which had passed to the Habsburgs through the marriage of its heiress Mary Beatrice of Este (d. 1829) with the archduke Ferdinand (1754-1806), brother of the emperor Leopold II. From 1814 to 1846 this duchy was governed by Ferdinand's son, Duke Francis IV., and from 1846 to 1859 by his grandson, Francis V. This family became extinct on the death of Francis V. in 1875.

In addition to his successor Francis II., and to Ferdinand, grand-duke of Tuscany, the emperor Leopold II. had eight sons, five of whom, including the archduke John (1782-1859), who saw a good deal of service during the Napoleonic Wars and was chosen regent (*Reichsverweser*) of Germany in 1848, have now no living male descendants. Thus the existing branches of the family are descended from Leopold's five other sons. The descendants of Leopold, the dispossessed grand-duke of Tuscany, were in 1909 represented by his son, Ferdinand (b. 1835), who still claimed the title of grand-duke of Tuscany, and his son and grandsons; by the numerous descendants of the archduke Charles Salvator (1830-1892); and by the archduke Louis Salvator (b. 1847), a great traveller and a voluminous writer. The grand-duke's fourth son was the archduke John Nepomuck Salvator, who, after serving in the Austrian army, resigned all his rights and titles and under the name of Johann Orth took command of a sailing vessel. He is supposed to have been drowned off the coast of South America in 1891, but reports of his continued existence were circulated from time to time after that date. Of the emperor Leopold's other sons the archduke Charles, perhaps the most distinguished soldier of the family, left four sons, including Albert, duke of Teschen (1817-1895), who inherited some of his father's military ability. Charles's family was in 1909 represented by his grandsons, the sons of the archduke Charles Ferdinand (1818-1874). The archduke Joseph (1776-1847), palatine of Hungary, was represented by a grandson, Joseph Augustus (b. 1872), and the archduke Rainer (1783-1853), viceroy of Lombardy-Venetia, by a son Rainer (b. 1827), and by several grandsons.

The eldest and reigning branch of the family was in 1909 represented by the emperor Francis Joseph, whose father was the archduke Francis Charles (1802-1878), and whose grandfather was the emperor Francis II. Francis Joseph's only son Rudolph died in 1889; consequently the heir to the Habsburg monarchy was the emperor's nephew Francis Ferdinand (b. 1863), the eldest of the three sons of his brother Charles Louis (1833-1896). In 1875 Francis Ferdinand inherited the wealth of the Este family and took the title of archduke of Austria-Este; in 1900 he contracted a morganatic marriage with Sophia, countess of Chotek, renouncing for his sons the succession to the monarchy. Thus after Francis Ferdinand this would pass to the sons of his brother, the archduke Otto (1865-1906). One of the emperor's three brothers was Maximilian, emperor of Mexico from 1863 to 1867.

With the exception of Charles V. the Habsburgs have produced no statesmen of great ability, while several members of the family have displayed marked traces of insanity. Nevertheless they secured, and for over 350 years they kept, the first place among the potentates of Europe; a dignity in origin and theory elective becoming in practice hereditary in their house. This position they owe to some extent to the tenacity with which they have clung to the various lands and dignities which have passed into their possession, but they owe it much more to a series of fortunate marriages and opportune deaths. The union of Maximilian and Mary of Burgundy, of Philip the Handsome and Joanna of Spain, of Ferdinand and Anna of Hungary and Bohemia; the death of Ottakar of Bohemia, of John, the only son of Ferdinand and Isabella of Spain, of Louis of Hungary and Bohemia—these are the corner-stones upon which the Habsburg monarchy has

been built.

For the origin and early history of the Habsburgs see G. de Roo, *Annales rerum ab Austriacis Habsburgicae gentis principibus a Rudolpho I. usque ad Carolum V. gestarum* (Innsbruck, 1592, fol.); M. Herrgott, *Genealogia diplomatica augustae gentis Habsburgicae* (Vienna, 1737-1738); E. M. Fürst von Lichnowsky, *Geschichte des Hauses Habsburg* (Vienna, 1836-1844); A. Schulte, *Geschichte der Habsburger in den ersten drei Jahrhunderten* (Innsbruck, 1887); T. von Liebenau, *Die Anfänge des Hauses Habsburg* (Vienna, 1883); W. Merz, *Die Habsburg* (Aarau, 1896); W. Gisi, *Der Ursprung der Häuser Zähringen und Habsburg* (1888); and F. Wehrich, *Stammtafel zur Geschichte des Hauses Habsburg* (Vienna, 1893). For the history of the Habsburg monarchy see Langl, *Die Habsburg und die denkwürdigen Stätten ihrer Umgebung* (Vienna, 1895); and E. A. Freeman, *Historical Geography of Europe* (1881). Two English books on the subject are J. Gilbert-Smith, *The Cradle of the Hapsburgs* (1907); and A. R. and E. Colquhoun, *The Whirlpool of Europe, Austria-Hungary and the Hapsburgs* (1906).

(A. W. H.*)

HACHETTE, JEAN NICOLAS PIERRE (1769-1834), French mathematician, was born at Mézières, where his father was a bookseller, on the 6th of May 1769. For his early education he proceeded first to the college of Charleville, and afterwards to that of Reims. In 1788 he returned to Mézières, where he was attached to the school of engineering as draughtsman to the professors of physics and chemistry. In 1793 he became professor of hydrography at Collioure and Port-Vendre. While there he sent several papers, in which some questions of navigation were treated geometrically, to Gaspard Monge, at that time minister of marine, through whose influence he obtained an appointment in Paris. Towards the close of 1794, when the École Polytechnique was established, he was appointed along with Monge over the department of descriptive geometry. There he instructed some of the ablest Frenchmen of the day, among them S. D. Poisson, F. Arago and A. Fresnel. Accompanying Guyton de Morveau in his expedition, earlier in the year, he was present at the battle of Fleurus, and entered Brussels with the French army. In 1816, on the accession of Louis XVIII., he was expelled from his chair by government. He retained, however, till his death the office of professor in the faculty of sciences in the École Normale, to which he had been appointed in 1810. The necessary royal assent was in 1823 refused to the election of Hachette to the Académie des Sciences, and it was not till 1831, after the Revolution, that he obtained that honour. He died at Paris on the 16th of January 1834. Hachette was held in high esteem for his private worth, as well as for his scientific attainments and great public services. His labours were chiefly in the field of descriptive geometry, with its application to the arts and mechanical engineering. It was left to him to develop the geometry of Monge, and to him also is due in great measure the rapid advancement which France made soon after the establishment of the École Polytechnique in the construction of machinery.

Hachette's principal works are his *Deux Suppléments à la Géométrie descriptive de Monge* (1811 and 1818); *Éléments de géométrie à trois dimensions* (1817); *Collection des épreuves de géométrie*, &c. (1795 and 1817); *Applications de géométrie descriptive* (1817); *Traité de géométrie descriptive*, &c. (1822); *Traité élémentaire des machines* (1811); *Correspondance sur l'École Polytechnique* (1804-1815). He also contributed many valuable papers to the leading scientific journals of his time.

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For a list of Hachette's writings see the *Catalogue of Scientific Papers of the Royal Society of London*; also F. Arago, *Œuvres* (1855); and Silvestre, *Notice sur J. N. P. Hachette* (Bruxelles, 1836).

HACHETTE, JEANNE, French heroine. Jeanne Lainé, or Fourquet, called Jeanne Hachette, was born about 1454. We have no precise information about her family or origin. She is known solely for her act of heroism which on the 27th of June 1472 saved Beauvais when it was on the point of being taken by the troops of Charles the Bold, duke of Burgundy. The town was defended by only 300 men-at-arms, commanded by Louis de Balagny. The Burgundians were making an assault, and one of their number had actually planted a flag upon the battlements, when Jeanne, axe in hand, flung herself upon him, hurled him into the moat, tore down the flag, and revived the drooping courage of the garrison. In gratitude for this heroic deed, Louis XI. instituted a procession in Beauvais called the Procession of the Assault, and married Jeanne to her chosen lover Colin Pilon, loading them with favours.

HACHETTE, LOUIS CHRISTOPHE FRANÇOIS (1800-1864), French publisher, was born at Rethel in the Ardennes on the 5th of May 1800. After studying three years at a normal school with the view of becoming a teacher, he was in 1822 on political grounds expelled from the seminary. He then studied law, but in 1826 he established in Paris a publishing business for the issue of works adapted to improve the system of school instruction, or to promote the general culture of the community. He published manuals in various departments of knowledge, dictionaries of modern and ancient languages, educational journals, and French, Latin and Greek classics annotated with great care by the most eminent authorities. Subsequently to 1850 he, in conjunction with other partners, published a cheap railway library, scientific and miscellaneous libraries, an illustrated library for the young, libraries of ancient literature, of modern foreign literature, and of modern foreign romance, a series of guide-books and a series of dictionaries of universal reference. In 1855 he also founded *Le Journal pour tous*, a publication with a circulation of 150,000 weekly. Hachette also manifested great interest in the formation of mutual friendly societies among the working classes, in the establishment of benevolent institutions, and in other questions relating to the amelioration of the poor, on which subjects he wrote various pamphlets; and he lent the weight of his influence towards a just settlement of the question of international literary copyright. He died on the 31st of July 1864.

HACHURE (French for "hatching"), the term for the conventional lines used in hill or mountain shading upon a map (*q.v.*) to indicate the slope of the surface, the depth of shading being greatest where the slope is steepest. The method is less accurate than that of contour lines, but gives an indication of the trend and extent of a range or mountain system, especially upon small-scale maps.

HACIENDA (O. Span, *facienda*, from the Latin, meaning "things to be done"), a Spanish term for a landed estate. It is commonly applied in Spanish America to a country estate, on which stock-raising, manufacturing or mining may be carried on, usually with a dwelling-house for the owner's residence upon it. It is thus used loosely for a country house.

HACKBERRY, a name given to the fruit of *Celtis occidentalis*, belonging to the natural botanical order *Ulmaceae*, to which also belongs the elm (*Ulmus*). It is also known under the name of "sugar-berry," "beaver-wood" and "nettle-tree." The hackberry tree is of middle size, attaining from 60 to 80 ft. in height (though sometimes reaching 130 ft.), and with the aspect of an elm. The leaves are ovate in shape, with a very long taper point, rounded and usually very oblique at the base, usually glabrous above and soft-pubescent beneath. The soft filmy flowers appear early in the spring before the expansion of the leaves. The fruit is oblong, about half to three-quarters of an inch long, of a reddish or yellowish colour when young, turning to a dark purple in autumn. This tree is distributed through the deep shady forests bordering river banks from Canada (where it is very rare) to the southern states. The fruit has a sweetish and slightly astringent taste, and is largely eaten in the United States. The seeds contain an oil like that of almonds. The bark is tough and fibrous like hemp, and the wood is heavy, soft, fragile and coarse-grained, and is used for making fences and furniture. The root has been used as a dye for linens.

HACKENSACK, a town and the county-seat of Bergen county, New Jersey, U.S.A., on the Hackensack river, 13 m. N. of Jersey City. Pop. (1890), 6004; (1900), 9443, of whom 2009 were foreign-born and 515 were negroes; (1905) 11,098; (1910) 14,050. It is served by the New York, Susquehanna & Western, and the New Jersey & New York railways, both being controlled by the Erie Company; and indirectly by the West Shore (at Bogota, ½ m. S.E.). Electric lines connect Hackensack with Newark, Passaic and Paterson, and with New York ferries. The town extends from the low bank of the river W. to the top of a ridge, about 40 ft. higher up, from which there are good views to the S. and E. Hackensack is principally a residential town, though there are a number of manufacturing establishments in and near it. Silk and silk goods and wall-paper are the principal manufactures. In 1905 the value of the town's factory product was \$1,488,358, an increase of 90.3% since 1900. There are an historic mansion-house and an interesting old Dutch church, both erected during the 18th century; and a monument marks the grave of General Enoch Poor (1736-1780), an officer in the War of Independence, who was born at Andover, Mass., entered the Continental Army from New Hampshire, and took part in the campaign against Burgoyne, in the battle of Monmouth and in General Sullivan's expedition against the Iroquois. Hackensack was settled by the Dutch about 1640, and was named after the Hackensack Indians, a division of the Unami Delawares, who lived in the valleys of the Hackensack and Passaic rivers, and whose best-known chief was Oritany, a friend of the whites. Hackensack is coextensive with the township of New Barbadoes, first incorporated with considerably larger territory in 1693.

HACKET, JOHN (1592-1670), bishop of Lichfield and Coventry, was born in London and educated at Westminster and Trinity College, Cambridge. On taking his degree he was elected a fellow of his college, and soon afterwards wrote the comedy of *Loiola* (London, 1648), which was twice performed before James I. He was ordained in 1618, and through the influence of John Williams (1582-1650) became rector in 1621 of Stoke Hammond, Bucks, and Kirkby Underwood, Lincolnshire. In 1623 he was chaplain to James, and in 1624 Williams presented him to the livings of St Andrew's, Holborn, and Cheam, Surrey. When the so-called "root-and-branch bill" was before parliament in 1641, Hacket was selected to plead in the House of Commons for the continuance of cathedral establishments. In 1645 his living of St Andrew's was sequestered, but he was allowed to retain the rectory of Cheam. On the accession of Charles II. his fortunes improved; he frequently preached before the king, and in 1661 was consecrated bishop of Lichfield and Coventry. His best-known book is the excellent biography of his patron, Archbishop Williams, entitled *Scrinia reserata: a Memorial offered to the great Deservings of John Williams, D.D.* (London, 1693).

HACKETT, HORATIO BALCH (1808-1875), American biblical scholar, was born in Salisbury, Massachusetts, on the 27th of December 1808. He was educated at Phillips-Andover Academy, at Amherst College, where he graduated as valedictorian in 1830, and at Andover Theological Seminary, where he graduated in 1834. He was adjunct professor of Latin and Greek Languages and Literature at Brown University in 1835-1838 and professor of Hebrew Literature there in 1838-1839, was ordained to the Baptist ministry in 1839—he had become a Baptist at Andover as the result of preparing a paper on baptism in the New Testament and the Fathers—and in 1839-1868 he was professor of Biblical literature and interpretation in Newton Theological Institution where his most important work was the introduction of the modern German methods of Biblical criticism, which he had learned from Moses Stuart at Andover and with which he made himself more familiar in Germany (especially under Tholuck at Halle) in 1841. He travelled in Egypt and Palestine in 1852, and in 1858-1859 in Greece, becoming proficient in modern Greek. From 1870 until his death in Rochester, New York, on the 2nd of November 1875, he was professor of Biblical literature and New Testament exegesis in the Rochester Theological Seminary. He was a great teacher but a greater critical and exegetical scholar.

He wrote *Christian Memorials of the War* (1864); an English version of Winer's *Grammar of the Chaldee Language* (1844); *Exercises in Hebrew Grammar* (1847); and various articles on the Semitic language and literature in periodicals; but his best-known work was in general commentary on the Bible and translation, and in the special text study of the New Testament. Under these two headings fall: *Illustrations of Scripture; suggested by a Tour through the Holy Land* (1855); the American revision, with Ezra Abbot, of Smith's *Dictionary of the Bible*, to the British edition of which he had contributed about thirty articles; *Commentary on the Original Text*

of the Acts of the Apostles (1852; 2nd edition, 1858), for many years the best English commentary; *Notes on the Greek Text of the Epistle of Paul to Philemon*, and a *Revised Version* of Philemon, both published in 1860; the English versions, in Schaff's edition of Lange's *Commentaries*, of Van Oosterzee's *Philemon* and Braune's *Philippians*; and for the American Bible Union Version of the Bible he translated the books of Ruth and Judges, and aided T. J. Conant in editorial revision; and he was one of the American translators for the English Bible revision.

See *Memorials of Horatio Batch Hackett* (Rochester, N.Y., 1876), edited by G. H. Whittemore.

HACKETT, JAMES HENRY (1800-1871), American actor, was born in New York. After an unsuccessful entry into business, in 1826 he went on the stage, where he soon established a reputation as a player of eccentric character parts. As Falstaff he was no less successful in England than in America. At various times he went into management, and he was the author of *Notes and Comments on Shakespeare* (1863).

His son, JAMES KETELTAS HACKETT (1869-), born at Wolfe Island, Ontario, and educated at the College of the City of New York, also became an actor. He came into prominence at the Lyceum in Daniel Frohman's company, and afterwards had considerable success in romantic parts. As a manager he stood outside the American syndicate of theatres, and organized several companies to play throughout the United States. In 1897 he married Mary Mannering, the Anglo-American actress.

HACKLÄNDER, FRIEDRICH WILHELM VON (1816-1877), German novelist and dramatist, was born at Burtscheid near Aix-la-Chapelle on the 1st of November 1816. Having served an apprenticeship in a commercial house, he entered the Prussian artillery, but, disappointed at not finding advancement, returned to business. A soldier's life had a fascination for him, and he made his début as an author with *Bilder aus dem Soldatenleben im Frieden* (1841). After a journey to the east, he was appointed secretary to the crown prince of Württemberg, whom he accompanied on his travels. *Wachtstubenabenteuer*, a continuation of his first work, appeared in 1845, and it was followed by *Bilder aus dem Soldatenleben im Kriege* (1849-1850). As a result of a tour in Spain in 1854, appeared *Ein Winter in Spanien* (1855). In 1857 he founded, in conjunction with Edmund von Zoller, the illustrated weekly, *Über Land und Meer*. In 1859 Hackländer was appointed director of royal parks and public gardens at Stuttgart, and in this post did much towards the embellishment of the city. In 1859 he was attached to the headquarters staff of the Austrian army during the Italian war; in 1861 he was raised to an hereditary knighthood in Austria; in 1864 he retired into private life, and died on the 6th of July 1877. Hackländer's literary talent is confined within narrow limits. There is much in his works of lively, adventurous and even romantic description, but the character-drawing is feeble and superficial.

Hackländer was a voluminous writer; the most complete edition of his works is the third, published at Stuttgart in 1876, in 60 volumes. There is also a good selection in 20 volumes (1881). Among his novels, *Namenlose Geschichten* (1851); *Eugen Stillfried* (1852); *Krieg und Frieden* (1859), and the comedies *Der geheime Agent* (1850) and *Magnetische Kuren* (1851) may be specially mentioned. His autobiography appeared in 1878 under the title, *Der Roman meines Lebens* (2 vols.). See H. Morning, *Erinnerungen an F. W. Hackländer* (1878).

HACKNEY, a north-eastern metropolitan borough of London, England, bounded W. by Stoke Newington and Islington, and S. by Shoreditch, Bethnal Green and Poplar, and extending N. and E. to the boundary of the county of London. Pop. (1901), 219,272. It is a poor and populous district, in which the main thoroughfares are Kingsland Road, continued N. as Stoke Newington Road and Stamford Hill; Mare Street, continued N.W. as Clapton Road to join Stamford Hill; and Lea Bridge Road running N.E. towards Walthamstow and Low Leyton. The borough includes the districts of Clapton in the north, Homerton in the east, and Dalston and part of Kingsland in the west. On the east lies the open flat valley of the Lea, which flows in several branches, and is

bordered, immediately outside the confines of the borough, by the extensive reservoirs of the East London water-works. In these low lands lie the Hackney Marshes (338 acres; among several so-called marshes in the Lea valley), and the borough also contains part of Victoria Park and a number of open spaces collectively called the Hackney Commons, including Mill Fields, Hackney Downs, London Fields, &c. The total area of open spaces exceeds 500 acres. The tower of the ancient parish church of St Augustine, with the chapel of the Rowe family, still stands, and is the only historic building of importance. Among institutions are the German hospital, Dalston, Metropolitan hospital, Kingsland Road, and Eastern Fever hospital, Homerton; and the Hackney polytechnic institute, with which is incorporated the Sir John Cass institute. Cass (1666-1718), a merchant of the city of London, also a member of parliament and sheriff, bequeathed £1000 for the foundation of a free school; in 1732 the bequest was increased in accordance with an unfinished codicil to his will; and the income provided from it is now about £6000, some 250 boys and girls being educated. The parliamentary borough of Hackney comprises north, central and south divisions, each returning one member; and the northern division includes the metropolitan borough of Stoke Newington. The metropolitan borough of Hackney includes part of the Hornsey parliamentary division of Middlesex. The borough council consists of a mayor, 10 aldermen and 60 councillors. Area, 3288.9 acres.

In the 13th century the name appears as *Hackenaye* or *Hacquenye*, but no certain derivation is advanced. Roman and other remains have been found in Hackney Marshes. In 1290 the bishop of London was lord of the manor, which was so held until 1550, when it was granted to Thomas, Lord Wentworth. In 1697 it came into the hands of the Tyssen family. Extensive property in the parish also belonged to the priory of the Knights Hospitallers of St John of Jerusalem at Clerkenwell. From the 16th to the early 19th century there were many fine residences in Hackney. The neighbourhood of Hackney had at one time an evil reputation as the haunt of highwaymen.

HACKNEY (from Fr. *haquenée*, Lat. *equus*, an ambling horse or mare, especially for ladies to ride; the English "hack" is simply an abbreviation), originally a riding-horse. At the present day, however, the hackney (as opposed to a thoroughbred) is bred for driving as well as riding (see [HORSE: Breeds](#)). From the hiring-out of hackneys, the word came to be associated with employment for hire (so "a hack," as a general term for "drudge"), especially in combination, *e.g.* hackney-chair, hackney-coach, hackney-boat. The hackney-coach, a coach with four wheels and two horses, was a form of hired public conveyance (see [CARRIAGE](#)).

HADAD, the name of a Syrian deity, is met with in the Old Testament as the name of several human persons; it also occurs in compound forms like Benhadad and Hadadezer. The divinity primarily denoted by it is the storm-god who was known also as Ramman, Bir and Dadda. The Syrian kings of Damascus seem to have habitually assumed the title of Benhadad, or son of Hadad (three of this name are mentioned in Scripture), just as a series of Egyptian monarchs are known to have been accustomed to call themselves sons of Amon-Ra. The word Hadadrimmon, for which the inferior reading Hadarrimmon is found in some MSS. in the phrase "the mourning of (or at) Hadadrimmon" (Zech. xii. 11), has been a subject of much discussion. According to Jerome and all the older Christian interpreters, the mourning for something that occurred at a place called Hadadrimmon (Maximianopolis) in the valley of Megiddo is meant, the event alluded to being generally held to be the death of Josiah (or, as in the Targum, the death of Ahab at the hands of Hadadrimmon); but more recently the opinion has been gaining ground that Hadadrimmon is merely another name for Adonis (*q.v.*) or Tammuz, the allusion being to the mournings by which the Adonis festivals were usually accompanied (Hitzig on Zech. xii. 11, Isa. xvii. 8; Movers, *Phönizier*, i. 196). T. K. Cheyne (*Encycl. Bibl.* s.v.) points out that the Septuagint reads simply Rimmon, and argues that this may be a corruption of Migdon (Megiddo), in itself a corruption of Tammuz-Adon. He would render the verse, "In that day there shall be a great mourning in Jerusalem, as the mourning of the women who weep for Tammuz-Adon" (*Adon* means lord).

HADDINGTON, EARL OF, a Scottish title bestowed in 1627 upon Thomas Hamilton, earl of Melrose (1563-1637). Thomas, who was a member of the great family of Hamilton, being a son of Thomas Hamilton of Priestfield, was a lawyer who became a lord of session as Lord Drumcairn in 1592. He was on very friendly terms with James VI., his legal talents being useful to the king, and he was one of the eight men who, called the Octavians, were appointed to manage the finances of Scotland in 1596. Having also become king's advocate in 1596, Hamilton was entrusted with a large share in the government of his country when James went to London in 1603; in 1612 he was appointed secretary of state for Scotland, and in 1613 he was created Lord Binning and Byres. In 1616 he became lord president of the court of session, and three years later was created earl of Melrose, a title which he exchanged in 1627 for that of earl of Haddington. After the death of James I. the earl resigned his offices of president of the court of session and secretary of state, but he served Charles I. as lord privy seal. He died on the 29th of May 1637. Haddington, who was both scholarly and wealthy, left a large and valuable collection of papers, which is now in the Advocates' library at Edinburgh. James referred familiarly to his friend as *Tam o' the Cowgate*, his Edinburgh residence being in this street.

The earl's eldest son THOMAS, the 2nd earl (1600-1640), was a covenanter and a soldier, being killed by an explosion at Dunglass castle on the 30th of August 1640. His sons, THOMAS (d. 1645) and JOHN (d. 1669), became respectively the 3rd and 4th earls of Haddington, and John's grandson THOMAS (1679-1735) succeeded his father CHARLES (c. 1650-1685), as 6th earl in 1685, although he was not the eldest but the second son. This curious circumstance arose from the fact that when Charles married Margaret (d. 1700), the heiress of the earldom of Rothes, it was agreed that the two earldoms should be left separate; thus the eldest son John became earl of Rothes while Thomas became earl of Haddington. Thomas was a supporter of George I. during the rising of 1715, and was a representative peer for Scotland from 1716 to 1734. He died on the 28th of November 1735.

The 6th earl was a writer, but in this direction his elder son, CHARLES, Lord Binning (1697-1732), is perhaps more celebrated. After fighting by his father's side at Sheriffmuir in 1715 and serving as member of parliament for St Germans, Binning died at Naples on the 27th of December 1732. His eldest son, THOMAS (c. 1720-1794), became the 7th earl in 1735, and the latter's grandson THOMAS (1780-1858) became the 9th earl in 1828. The 9th earl had been a member of parliament from 1802 to 1827, when he was made a peer of the United Kingdom as Baron Melros of Tynninghame, a title which became extinct upon his death. In 1834 he became lord-lieutenant of Ireland under Sir Robert Peel, leaving office in the following year, and in Peel's second administration (1841-1846) he served as first lord of the admiralty and then as lord privy seal. When he died without sons on the 1st of December 1858 the earldom passed to his kinsman, GEORGE BAILLIE (1802-1870), a descendant of the 6th earl. This nobleman took the name of Baillie-Hamilton, and his son GEORGE (b. 1827) became 11th earl of Haddington in 1870.

See *State Papers of Thomas, Earl of Melrose*, published by the Abbotsford Club in 1837, and Sir W. Fraser, *Memorials of the Earls of Haddington* (1889).

HADDINGTON, a royal, municipal and police burgh, and county town of Haddingtonshire, Scotland. Pop. (1901), 3993. It is situated on the Tyne, 18 m. E. of Edinburgh by the North British railway, being the terminus of a branch line from Longniddry Junction. Five bridges cross the river, on the right bank of which lies the old and somewhat decayed suburb of Nungate, interesting as having contained the Giffordgate, where John Knox was born, and where also are the ruins of the pre-Reformation chapel of St Martin. The principal building in the town is St Mary's church, a cruciform Decorated edifice in red sandstone, probably dating from the 13th century. It is 210 ft. long, and is surmounted by a square tower 90 ft. high. The nave, restored in 1892, is used as the parish church, but the choir and transepts are roofless, though otherwise kept in repair. In a vault is a fine monument in alabaster, consisting of the recumbent figures of John, Lord Maitland of Thirlestane (1545-1595), chancellor of Scotland, and his wife. The laudatory sonnet composed by James VI. is inscribed on the tomb. In the same vault John, duke of Lauderdale (1616-1682), is buried. In the choir is the tombstone which Carlyle erected over the grave of his wife, Jane Baillie Welsh (1801-1866), a native of the town. Other public edifices include the county buildings in the Tudor style, in front of which stands the monument to George, 8th marquess of Tweeddale (1787-1876), who was such an expert and enthusiastic coachman that he once drove the mail from London to Haddington without taking rest; the corn exchange, next to that of Edinburgh the largest in Scotland; the town house, with a spire 150 ft. high, in front of which is a monument to John Home, the author of *Douglas*; the district asylum to the north of the burgh; the western district hospital; the Tenterfield home for children; the free library and the Knox Memorial Institute. This last-named building was erected in 1879 to replace the old and

famous grammar school, where John Knox, William Dunbar, John Major and possibly George Buchanan and Sir David Lindsay were educated. John Brown (1722-1787), a once celebrated dissenting divine, author of the *Self-Interpreting Bible*, ministered in the burgh for 36 years and is buried there; his son John the theologian (1754-1832), and his grandson Samuel (1817-1856), the chemist, noted for his inquiries into the atomic theory, were natives. Samuel Smiles (1812-1904), author of *Character, Self-Help* and other works, was also born there, and Edward Irving was for years mathematical master in the grammar school. In Hardgate Street is "Bothwell Castle," the town house of the earl of Bothwell, where Mary Queen of Scots rested on her way to Dunbar. The ancient market cross has been restored. The leading industries are the making of agricultural implements, manufactures of woollens and sacking, brewing, tanning and coach-building, besides corn mills and engineering works.

The burgh is the retail centre for a large district, and its grain markets, once the largest in Scotland, are still of considerable importance. Haddington was created a royal burgh by David I. It also received charters from Robert Bruce, Robert II. and James VI. In 1139 it was given as a dowry to Ada, daughter of William de Warenne, earl of Surrey, on her marriage to Prince Henry, the only son of David I. It was occasionally the residence of royalty, and Alexander II. was born there in 1198. Lying in the direct road of the English invaders, the town was often ravaged. It was burned by King John in 1216 and by Henry III. in 1244. Fortified in 1548 by Lord Grey of Wilton, the English commander, it was besieged next year by the Scots and French, who forced the garrison to withdraw. So much slaughter had gone on during that period of storm and stress that it was long impossible to excavate in any direction without coming on human remains. The town has suffered much periodically from floods. One of the most memorable of these occurred on the 4th of October 1775, when the Tyne rose 8 ft. 9 in. above its bed and inundated a great part of the burgh. An inscription in the centre of the town records the event and marks the point to which the water rose.

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There are many interesting places within a few miles of Haddington. Five miles E. is Whittingehame House, and 5 m. N.E. is the thriving village of East Linton (pop. 919). About 2½ m. N. lies Athelstaneford (locally, Elshinford), so named from the victory of Hungus, king of the Picts, in the 8th century over the Northumbrian Athelstane. On a hill near Drem, 3½ m. N. by W., are traces of a Romano-British settlement, and the remains of the priest's house of the Knights Templars, to whom the barony once belonged. On the coast is the pretty village of Aberlady on a fine bay, and in the neighbourhood are some of the finest golf links in Scotland, such as Luffness, Gullane, Archerfield and Muirfield. On Gosford Bay is Gosford House, an 18th-century mansion, the seat of the earl of Wemyss. At Gladsmuir, 3½ m. W. of Haddington, alleged by some to have been the birthplace of George Heriot. Principal Robertson was minister and wrote most of his *History of Scotland*. Of the old seat of the Douglasses at Longniddry few traces remain, and in the chapel, now in ruins, at the eastern end of the village, John Knox is said to have preached occasionally. At Gifford, 4 m. to the S., John Witherspoon (1722-1794), president of the College of New Jersey (Princeton), and Charles Nisbet (1736-1804), president of Dickinson College, Carlisle, Pennsylvania, were born. A little to the south of Gifford are Yester House, a seat of the marquess of Tweeddale, finely situated in a park of old trees, and the ruins of Yester Castle. The cavern locally known as Hobgoblin Hall is described in *Marmion*, and is associated with all kinds of manifestations of the black art. Lennoxlove, 1½ m. to the S., a seat of Lord Blantyre, was originally called Lethington, and for a few centuries was associated with the Maitlands. Amisfield, adjoining Haddington on the N.E., is another seat of the earl of Wemyss.

HADDINGTONSHIRE, or *East Lothian*, a south-eastern county of Scotland, bounded N. by the Firth of Forth, N.E. by the North Sea, E., S.E. and S. by Berwickshire, and S.W. and W. by Edinburghshire. It covers an area of 171,011 acres, or 267 sq. m. Its sea-coast measures 41 m. The Bass Rock and Fidra Isle belong to the shire, and there are numerous rocks and reefs off the shore, especially between Dunbar and Gullane Bay. Broadly speaking, the northern half of the shire slopes gently to the coast, and the southern half is hilly. Several of the peaks of the Lammermuirs exceed 1500 ft., and the more level tract is broken by Traprain Law (724) in the parish of Prestonkirk, North Berwick Law (612), and Garleton Hill (590) to the north of the county town. The only important river is the Tyne, which rises to the south-east of Borthwick in Mid-Lothian, and, taking a generally north-easterly direction, reaches the sea just beyond the park of Tynninghame House, after a course of 28 m., for the first 7 m. of which it belongs to its parent shire. It is noted for a very fine variety of trout, and salmon are sometimes taken below the linn at East Linton. The Whiteadder rises in the parish of Whittingehame, but, flowing towards the south-east, leaves the shire and at last joins the Tweed near Berwick. There are no natural lakes, but in the parish of Stenton is found Pressmennan Loch, an artificial sheet of water of somewhat serpentine shape, about 2 m. in length, with a width of some 400 yds., which was constructed in 1819 by damming up the ravine in which it lies. The banks are wooded and

picturesque, and the water abounds with trout.

Geology.—The higher ground in the south, including the Lammermuir Hills, is formed by shales, greywackes and grits of Ordovician and Silurian age; a narrow belt of the former lying on the north-western side of the latter, the strike being S.W. to N.E. The granitic mass of Priestlaw and other felsitic rocks have been intruded into these strata. The lower Old Red Sandstone has not been observed in this county, but the younger sandstones and conglomerates fill up ancient depressions in the Silurian and Ordovician, such as that running northward from Oldhamstocks towards Dunbar and the valley of Lauderdale. A faulted-in tract of the same formation, about 1 m. in breadth, runs westward from Dunbar to near Gifford. Carboniferous rocks form the remainder of the county. The Calciferous Sandstone series, shales, thin limestones and sandstones, is exposed on the south-eastern coast; but between Gifford and North Berwick and from Aberlady to Dunbar it is represented by a great thickness of volcanic rocks consisting of tuffs and coarse breccias in the lower beds, and of porphyritic and andesitic lavas above. These rocks are well exposed on the coast, in the Garleton Hills and Traprain Law; the latter and North Berwick Law are volcanic necks or vents. The Carboniferous Limestone series which succeeds the Calciferous Sandstone consists of a middle group of sandstones, shales, coals and ironstones, with a limestone group above and below. The coal-field is synclinal in structure, Port Seton being about the centre; it contains ten seams of coal, and the area covered by it is some 30 sq. m. Glacial boulder clay lies over much of the lower ground, and ridges of gravel and sand flank the hills and form extensive sheets. Traces of old raised sea-beaches are found at several points along the coast. At North Berwick, Tynninghame and elsewhere there are stretches of blown sand. Limestone is worked at many places, and hematite was formerly obtained from the Garleton Hills.

Climate and Agriculture.—Though the county is exposed to the full sweep of the east wind during March, April and May, the climate is on the whole mild and equable. The rainfall is far below the average of Great Britain, the mean for the year being 25 in., highest in midsummer and lowest in spring. The average temperature for the year is 47°.5 F., for January 38° and for July 59°. Throughout nearly the whole of the 19th century East Lothian agriculture was held to be the best in Scotland, not so much in consequence of the natural fertility of the soil as because of the enterprise of the cultivators, several of whom, like George Hope of Fenton Barns (1811-1876), brought scientific farming almost to perfection. Mechanical appliances were adopted with exceptional alacrity, and indeed some that afterwards came into general use were first employed in Haddington. Drill sowing of turnips dates from 1734. The threshing machine was introduced by Andrew Meikle (1719-1811) in 1787, the steam plough in 1862, and the reaping machine soon after its invention, while tile draining was first extensively used in the county. East Lothian is famous for the richness of its grain and green crops, the size of its holdings (average 200 acres) and the good housing of its labourers. The soils vary. Much of the Lammermuirs is necessarily unproductive, though the lower slopes are cultivated, a considerable tract of the land being very good. In the centre of the shire occurs a belt of tenacious yellow clay on a tilly subsoil which is not adapted for agriculture. Along the coast the soil is sandy, but farther inland it is composed of rich loam and is very fertile. The land about Dunbar is the most productive, yielding a potato—the “Dunbar red”—which is highly esteemed in the markets. Of the grain crops oats and barley are the principal, and their acreage is almost a constant, but wheat, after a prolonged decline, has experienced a revival. Turnips and potatoes are cultivated extensively, and with marked success, and constitute nearly all the green crops raised. Although pasture-land is below the average, live-stock are reared profitably. About one-sixteenth of the total area is under wood.

Other Industries.—Fisheries are conducted from Dunbar, North Berwick, Port Seton and Prestonpans, the catch consisting chiefly of cod, haddock, whiting and shellfish. Fireclay as well as limestone is worked, and there are some stone quarries, but the manufactures are mainly agricultural implements, pottery, woollens, artificial manures, feeding-stuffs and salt, besides brewing. Coal of a very fair quality is extensively worked at Tranent, Ormiston, Macmerry and near Prestonpans, the coal-field having an area of about 30 sq. m. Limestone is found throughout the greater part of the shire. A vein of hematite of a peculiarly fine character was discovered in 1866 at Garleton Hill, and wrought for some years. Ironstone has been mined at Macmerry.

The North British Company possess the sole running powers in the county, through which is laid their main line to Berwick and the south. Branches are sent off at Drem to North Berwick, at Longniddry to Haddington and also to Gullane, at Smeaton (in Mid-Lothian) to Macmerry, and at Ormiston to Gifford.

Population and Government.—The population was 37,377 in 1891, and 38,665 in 1901, when 459 persons spoke Gaelic and English, and 7 spoke Gaelic only. The chief towns are Dunbar (pop. in 1901, 3581), Haddington (3993), North Berwick (2899), Prestonpans (2614) and Tranent (2584). The county, which returns one member to Parliament, forms part of the sheriffdom of the Lothians and Peebles, and there is a resident sheriff-substitute at Haddington, who sits also at Dunbar, Tranent and North Berwick. The shire is under school-board jurisdiction, and besides high schools at Haddington and North Berwick, some of the elementary schools earn grants for higher education. The county council spends a proportion of the “residue” grant in supporting short courses of instruction in technical subjects (chiefly agriculture), in experiments in the

feeding of cattle and the growing of crops, and in defraying the travelling expenses of technical students.

History.—Of the Celts, who were probably the earliest inhabitants, traces are found in a few place names and circular camps (in the parishes of Garvald and Whittinghame) and hill forts (in the parish of Bolton). After the Roman occupation, of which few traces remain, the district formed part of the Saxon kingdom of Northumbria until 1018, when it was joined to Scotland by Malcolm II. It was comparatively prosperous till the wars of Bruce and Baliol, but from that period down to the union of the kingdoms it suffered from its nearness to the Border and from civil strife. The last battles fought in the county were those of Dunbar (1650) and Prestonpans (1745).

See J. Miller, *History of Haddington* (1844); D. Croal, *Sketches of East Lothian* (Haddington, 1873); John Martine, *Reminiscences of the County of Haddington* (Haddington, 1890, 1894); Dr Wallace James, *Writs and Charters of Haddington* (Haddington, 1898).

HADDOCK (*Gadus aeglefinus*), a fish which differs from the cod in having the mental barbel very short, the first anal fin with 22 to 25 rays, instead of 17 to 20, and the lateral line dark instead of whitish; it has a large blackish spot above each pectoral fin—associated in legend with the marks of St Peter's finger and thumb, the haddock being supposed to be the fish from whose mouth he took the tribute-money. It attains to a weight of 15 lb and is one of the most valuable food fishes of Europe, both fresh and smoked, the "finnan haddie" of Scotland being famous. It is common round the British and Irish coasts, and generally distributed along the shores of the North Sea, extending across the Atlantic to the coast of North America.

HADDON HALL, one of the most famous ancient mansions in England. It lies on the left bank of the river Wye, 2 m. S.E. of Bakewell in Derbyshire. It is not now used as a residence, but the fabric is maintained in order. The building is of stone and oblong in form, and encloses two quadrangles separated by the great banqueting-hall and adjoining chambers. The greater part is of two storeys, and surmounted by battlements. To the south and south-east lie terraced gardens, and the south front of the eastern quadrangle is occupied by the splendid ball-room or long gallery. At the south-west corner of the mansion is the chapel; at the north-east the Peveril tower. The periods of building represented are as follows. Norman work appears in the chapel (which also served as a church for the neighbouring villagers), also in certain fundamental parts of the fabric, notably the Peveril tower. There are Early English and later additions to the chapel; the banqueting-hall, with the great kitchen adjacent to it, and part of the Peveril tower are of the 14th century. The eastern range of rooms, including the state-room, are of the 15th century; the western and north-western parts were built shortly after 1500. The ball-room is of early 17th-century construction, and the terraces and gardens were laid out at this time. A large number of interesting contemporary fittings are preserved, especially in the banqueting-hall and kitchen; and many of the rooms are adorned with tapestries of the 16th and 17th centuries, some of which came from the famous works at Mortlake in Surrey.

A Roman altar was found and is preserved here, but no trace of Roman inhabitants has been discovered. Haddon was a manor which before the Conquest and at the time of the Domesday Survey belonged to the king, but was granted by William the Conqueror to William Peverel, whose son, another William Peverel, forfeited it for treason on the accession of Henry II. Before that time, however, the manor of Haddon had been granted to the family of Avenell, who continued to hold it until one William Avenell died without male issue and his property was divided between his two daughters and heirs, one of whom married Richard Vernon, whose successors acquired the other half of the manor in the reign of Edward III. Sir George Vernon, who died in 1561, was known as the "King of the Peak" on account of his hospitality. His daughter Dorothy married John Manners, second son of the earl of Rutland, who is said to have lived for some time in the woods round Haddon Hall, disguised as a gamekeeper, until he persuaded Dorothy to elope with him. On Sir George's death without male issue Haddon passed to John Manners and Dorothy, who lived in the Hall. Their grandson John Manners succeeded to the title of earl of Rutland in 1641, and the duke of Rutland is still lord of the manor.

See *Victoria County History, Derbyshire*; S. Rayner, *History and Antiquities of Haddon Hall* (1836-1837); Haddon Hall, *History and Antiquities of Haddon Hall* (1867); G. le Blanc Smith,

HADEN, SIR FRANCIS SEYMOUR (1818-1910), English surgeon and etcher, was born in London on the 16th of September 1818, his father, Charles Thomas Haden, being a well-known doctor and amateur of music. He was educated at University College school and University College, London, and also studied at the Sorbonne, Paris, where he took his degree in 1840. He was admitted as a member of the College of Surgeons in London in 1842. Besides his many-sided activities in the scientific world, during a busy and distinguished career as a surgeon, he followed the art of original etching with such vigour that he became not only the foremost British exponent of that art but was the principal cause of its revival in England. By his strenuous efforts and perseverance, aided by the secretarial ability of Sir W. R. Drake, he founded the Royal Society of Painter-Etchers and Engravers. As president he ruled the destinies of that society with a strong hand from its first beginnings in 1880. In 1843-1844, with his friends Duval, Le Cannes and Col. Guibout, he had travelled in Italy and made his first sketches from nature. Haden attended no art school and had no art teachers, but in 1845, 1846, 1847 and 1848 he studied portfolios of prints belonging to an old second-hand dealer named Love, who had a shop in Bunhill Row, the old Quaker quarter of London. These portfolios he would carry home, and arranging the prints in chronological order, he studied the works of the great original engravers, Dürer, Lucas van Leyden and Rembrandt. These studies, besides influencing his original work, led to his important monograph on the etched work of Rembrandt. By lecture and book, and with the aid of the memorable exhibition at the Burlington Fine Arts Club in 1877, he endeavoured to give a just idea of Rembrandt's work, separating the true from the false, and giving altogether a nobler idea of the master's mind by taking away from the list of his works many dull and unseemly plates that had long been included in the lists. His reasons are founded upon the results of a study of the master's works in chronological order, and are clearly expressed in his monograph, *The Etched Work of Rembrandt critically reconsidered*, privately printed in 1877, and in *The Etched Work of Rembrandt True and False* (1895). Notwithstanding all this study of the old masters of his art, Haden's own plates are perhaps more individual than any artist's, and are particularly noticeable for a fine original treatment of landscape subjects, free and open in line, clear and well divided in mass, and full of a noble and dignified style of his own. Even when working from a picture his personality dominates the plate, as for example in the large plate he etched after J. M. W. Turner's "Calais Pier," which is a classical example of what interpretative work can do in black and white. Of his original plates, more than 250 in number, one of the most notable was the large "Breaking up of the Agamemnon." An early plate, rare and most beautiful, is "Thames Fisherman." "Mytton Hall" is broad in treatment, and a fine rendering of a shady avenue of yew trees leading to an old manor-house in sunlight. "Sub Tegmine" was etched in Greenwich Park in 1859; and "Early Morning—Richmond," full of the poetry and freshness of the hour, was done, the artist has said, actually at sunrise. One of the rarest and most beautiful of his plates is "A By-Road in Tipperary"; "Combe Bottom" is another; and "Shere Mill Pond" (both the small study and the larger plate), "Sunset in Ireland," "Penton Hook," "Grim Spain" and "Evening Fishing, Longparish," are also notable examples of his genius. A catalogue of his works was begun by Sir William Drake and completed by Mr N. Harrington (1880). During later years Haden began to practise the sister art of mezzotint engraving, with a measure of the same success that he had already achieved in pure etching and in dry-point. Some of his mezzotints are: "An Early Riser," a stag seen through the morning mists, "Grayling Fishing" and "A Salmon Pool on the Spey." He also produced some remarkable drawings of trees and park-like country in charcoal.

Other books by Haden not already mentioned are—*Études à l'eau forte* (Paris, 1865); *About Etching* (London, 1878-1879); *The Art of the Painter-Etcher* (London, 1890); *The Relative Claims of Etching and Engraving to rank as Fine Arts and to be represented in the Royal Academy* (London, 1883); *Address to Students of Winchester School of Art* (Winchester, 1888); *Cremation: a Pamphlet* (London, 1875); and *The Disposal of the Dead, a Plea for Legislation* (London, 1888). As the last two indicate, he was an ardent champion of a system of "earth to earth" burial.

Among numerous distinctions he received the Grand Prix, Paris, in 1889 and 1900, and was made a member of the Institut de France, Académie des Beaux-Arts and Société des Artistes Français. He was knighted in 1894, and died on the 1st of June 1910. He married in 1847 a sister of the artist J. A. M. Whistler; and his elder son, Francis Seymour Haden (b. 1850), had a distinguished career as a member of the government in Natal from 1881 to 1893, being made a C.M.G. in 1890.

HADENDOA (from Beja *Hada*, chief, and *endowa*, people), a nomad tribe of Africans of "Hamitic" origin. They inhabit that part of the eastern Sudan extending from the Abyssinian frontier northward nearly to Suakin. They belong to the Beja people, of which, with the Bisharin and the Ababda, they are the modern representatives. They are a pastoral people, ruled by a hereditary chief who is directly responsible to the (Anglo-Egyptian) Sudan government. Although the official capital of the Hadendoa country is Miktinab, the town of Fillik on an affluent of the Atbara is really their headquarters. A third of the total population is settled in the Suakin country. Osman Digna, one of the best-known chiefs during the Madhia, was a Hadendoa, and the tribe contributed some of the fiercest of the dervish warriors in the wars of 1883-98. So determined were they in their opposition to the Anglo-Egyptian forces that the name Hadendoa grew to be nearly synonymous with "rebel." But this was the result of Egyptian misgovernment rather than religious enthusiasm; for the Hadendoa are true Beja, and Mahommedans only in name. Their elaborate hairdressing gained them the name of "Fuzzy-wuzzies" among the British troops. They earned an unenviable reputation during the wars by their hideous mutilations of the dead on the battlefields. After the reconquest of the Egyptian Sudan (1896-98) the Hadendoa accepted the new order without demur.

See *Anglo-Egyptian Sudan*, edited by Count Gleichen (London, 1905); Sir F. R. Wingate, *Mahdism and the Egyptian Sudan* (London, 1891); G. Sergi, *Africa: Anthropology of the Hamitic Race* (1897); A. H. Keane, *Ethnology of the Egyptian Sudan* (1884).

HADERSLEBEN (Dan. *Haderslev*), a town of Germany, in the Prussian province of Schleswig-Holstein, 31 m. N. from Flensburg. Pop. (1905) 9289. It lies in a pleasant valley on the Hadersleben fjord, which is about 9 m. in length, and communicates with the Little Belt, and at the junction of the main line of railway from Woyens with three vicinal lines. The principal buildings are the beautiful church of St Mary, dating from the 13th century, the theological seminary established in 1870, the gymnasium and the hospital. The industries include iron-founding, tanning, and the manufacture of machines, tobacco and gloves. The harbour is only accessible to small vessels.

Hadersleben is first mentioned in 1228, and received municipal rights from Duke Waldemar II. in 1292. It suffered considerably during the wars between Schleswig and Holstein in the 15th century. In November 1864 it passed with Schleswig to Prussia. Two Danish kings, Frederick II. and Frederick III., were born at Hadersleben.

See A. Sach, *Der Ursprung der Stadt Hadersleben* (Hadersleben, 1892).

HADING, JANE (1859-), French actress, whose real name was Jeanne Alfrédine Tréfouret, was born on the 25th of November 1859 at Marseilles, where her father was an actor at the Gymnase. She was trained at the local Conservatoire and was engaged in 1873 for the theatre at Algiers, and afterwards for the Khedivial theatre at Cairo, where she played, in turn, coquette, soubrette and *ingénue* parts. Expectations had been raised by her voice, and when she returned to Marseilles she sang in operetta, besides acting in *Ruy Blas*. Her Paris début was in *La Chaste Suzanne* at the Palais Royal, and she was again heard in operetta at the Renaissance. In 1883 she had a great success at the Gymnase in *Le Maître de forges*. In 1884 she married Victor Koning (1842-1894), the manager of that theatre, but divorced him in 1887. In 1888 she toured America with Coquelin, and on her return helped to give success to Lavedan's *Prince d'Aurec*, at the Vaudeville. Her reputation as one of the leading actresses of the day was now established not only in France but in America and England. Her later répertoire included *Le Demi-monde*, Capus's *La Châtelaine*, Maurice Donnay's *Retour de Jérusalem*, *La Princesse Georges* by Dumas fils, and Émile Bergerat's *Plus que reine*.

HADLEIGH, a market town in the Sudbury parliamentary division of Suffolk, England; 70 m. N.E. from London, the terminus of a branch of the Great Eastern railway. Pop. of Urban district

(1901), 3245. It lies pleasantly in a well-wooded country on the small river Brett, a tributary of the Stour. The church of St Mary is of good Perpendicular work, with Early English tower and Decorated spire. The Rectory Tower, a turreted gate-house of brick, dates from c. 1495. The gild-hall is a Tudor building, and there are other examples of this period. There are a town-hall and corn exchange, and an industry in the manufacture of matting and in malting. Hadleigh was one of the towns in which the woollen industry was started by Flemings, and survived until the 18th century. Among the rectors of Hadleigh several notable names appear, such as Rowland Taylor, the martyr, who was burned at the stake outside the town in 1555, and Hugh James Rose, during whose tenancy of the rectory an initiatory meeting of the leaders of the Oxford Movement took place here in 1833.

Hadleigh, called by the Saxons Heapde-leag, appears in Domesday Book as Hetlega. About 885 Æthelflæd, lady of the Mercians, with the consent of Æthelred her husband, gave Hadleigh to Christ Church, Canterbury. The dean and chapter of Canterbury have held possession of it ever since the Dissolution. In the 17th century Hadleigh was famous for the manufacture of cloth, and in 1618 was sufficiently important to receive incorporation. It was constituted a free borough under the title of the mayor, aldermen and burgesses of Hadleigh. In 1635, in a list of the corporate towns of Suffolk to be assessed for ship money, Hadleigh is named as third in importance. In 1636, owing to a serious visitation of the plague, 200 families were thrown out of work, and in 1687 so much had its importance declined that it was deprived of its charter. An unsuccessful attempt to recover it was made in 1701. There is evidence of the existence of a market here as early as the 13th century. James I., in his charter of incorporation, granted fairs on Monday and Tuesday in Whitsun week, and confirmed an ancient fair at Michaelmas and a market on Monday.

HADLEY, ARTHUR TWINING (1856-), American political economist and educationist, president of Yale University, was born in New Haven, Connecticut, on the 23rd of April 1856. He was the son of James Hadley, the philologist, from whom, as from his mother—whose brother, Alexander Catlin Twining (1801-1884), was an astronomer and authority on constitutional law—he inherited unusual mathematical ability. He graduated at Yale in 1876 as valedictorian, having taken prizes in English, classics and astronomy; studied political science at Yale (1876-1877) and at Berlin (1878-1879); was a tutor at Yale in 1879-1883, instructor in political science in 1883-1886, professor of political science in 1886-1891, professor of political economy in 1891-1899, and dean of the Graduate School in 1892-1895; and in 1899 became president of Yale University—the first layman to hold that office. He was commissioner of the Connecticut bureau of labour statistics in 1885-1887. As an economist he first became widely known through his investigation of the railway question and his study of railway rates, which antedated the popular excitement as to rebates. His *Railroad Transportation, its History and Laws* (1885) became a standard work, and appeared in Russian (1886) and French (1887); he testified as an expert on transportation before the Senate committee which drew up the Interstate Commerce Law; and wrote on railways and transportation for the Ninth and Tenth Editions (of which he was one of the editors) of the *Encyclopaedia Britannica*, for Lalor's *Cyclopaedia of Political Science, Political Economy, and Political History of the United States* (3 vols., 1881-1884), for *The American Railway* (1888), and for *The Railroad Gazette* in 1884-1891, and for other periodicals. His idea of the broad scope of economic science, especially of the place of ethics in relation to political economy and business, is expressed in his writings and public addresses. In 1907-1908 he was Theodore Roosevelt professor of American History and Institutions in the university of Berlin.

Among his other publications are: *Economics: an Account of the Relations between Private Property and Public Welfare* (1896); *The Education of the American Citizen* (1901); *The Relations between Freedom and Responsibility in the Evolution of Democratic Government* (1903, in Yale Lectures on the Responsibilities of Citizenship); *Baccalaureate Addresses* (1907); and *Standards of Public Morality* (1907), being the Kennedy Lectures for 1906.

HADLEY, JAMES (1821-1872), American scholar, was born on the 30th of March 1821 in Fairfield, Herkimer county, New York, where his father was professor of chemistry in Fairfield Medical College. At the age of nine an accident lamed him for life. He graduated from Yale in 1842, having entered the Junior class in 1840; studied in the Theological Department of Yale, and in 1844-1845 was a tutor in Middlebury College. He was tutor at Yale in 1845-1848, assistant

professor of Greek in 1848-1851, and professor of Greek, succeeding President Woolsey, from 1851 until his death in Hew Haven on the 14th of November 1872. As an undergraduate he showed himself an able mathematician, but the influence of Edward Elbridge Salisbury, under whom Hadley and W. D. Whitney studied Sanskrit together, turned his attention toward the study of language. He knew Greek, Latin, Sanskrit, Hebrew, Arabic, Armenian, several Celtic languages and the languages of modern Europe; but he published little, and his scholarship found scant outlet in the college class-room. His most original written work was an essay on Greek accent, published in a German version in Curtius's *Studien zur griechischen und lateinischen Grammatik*. Hadley's *Greek Grammar* (1860; revised by Frederic de Forest Allen, 1884) was based on Curtius's *Schulgrammatik* (1852, 1855, 1857, 1859), and long held its place in American schools. Hadley was a member of the American Committee for the revision of the New Testament, was president of the American Oriental Society (1871-1872), and contributed to Webster's dictionary an essay on the *History of the English Language*. In 1873 were published his *Introduction to Roman Law* (edited by T. D. Woolsey) and his *Essays, Philological and Critical* (edited by W. D. Whitney).

See the memorial by Noah Porter in *The New Englander*, vol. xxxii. (Jan. 1873), pp. 35-55; and the sketch by his son, A. T. Hadley, in *Biographical Memoirs of the National Academy of Sciences*, vol. v. (1905), pp. 247-254.

HADLEY, a township of Hampshire county, Massachusetts, U.S.A., on the Connecticut river, about 20 m. N. of Springfield, served by the Boston & Maine railway. Pop. (1900), 1789; (1905, state census), 1895; (1910) 1999. Area, about 20 sq. m. The principal villages are Hadley (or Hadley Center) and North Hadley. The level country along the river is well adapted to tobacco culture, and the villages are engaged in the manufacture of tobacco and brooms. Hadley was settled in 1659 by members of the churches in Hartford and Wethersfield, Connecticut, who were styled "Strict Congregationalists" and withdrew from these Connecticut congregations because of ecclesiastical and doctrinal laxity there. At first the town was called Norwottuck, but within a year or two it was named after Hadleigh in England, and was incorporated under this name in 1661. Hopkins Academy (1815) developed from Hopkins school, founded here in 1664. The English regicides Edward Whalley and his son-in-law William Goffe found a refuge at Hadley from 1664 apparently until their deaths, and there is a tradition that Goffe or Whalley in 1675 led the people in repelling an Indian attack. From 1675 to 1713 Hadley, being in almost constant danger of attack from the Indians, was protected by a palisade enclosure and by stockades around the meeting-house. From Hadley, Hatfield was set apart in 1670, South Hadley in 1753, and Amherst in 1759.

See Alice M. Walker, *Historic Hadley* (New York, 1906); and Sylvester Judd, *History of Hadley* (Northampton, 1863; new ed., 1905).

HADRAMUT, a district on the south coast of Arabia, bounded W. by Yemen, E. by Oman and N. by the Dahna desert. The modern Arabs restrict the name to the coast between Balhāf and Sihut, and the valley of the Wadi Hadramut in the interior; in its wider and commonly accepted signification it includes also the Mahra and Gāra coasts extending eastwards to Mirbat; thus defined, its limits are between 14° and 18° N. and 47° 30' to 55° E., with a total length of 550 m. and a breadth of 150 m.

The coastal plain is narrow, rarely exceeding 10 m. in width, and in places the hills extend to the seashore. The principal ports are Mukalla and Shihr, both considerable towns, and Kusair and Raida, small fishing villages; inland there are a few villages near the foot of the hills, with a limited area of cultivation irrigated by springs or wells in the hill torrent beds. Behind the littoral plain a range of mountains, or rather a high plateau, falling steeply to the south and more gently to the north, extends continuously from the Yemen highlands on the west to the mouth of the Hadramut valley, from which a similar range extends with hardly a break to the border of Oman. Its crest-line is generally some 30 m. from the coast, and its average height between 4000 and 5000 ft. A number of wadis or ravines cutting deeply into the plateau run northward to the main Wadi Hadramut, a broad valley lying nearly east and west, with a total length from its extreme western heads on the Yemen highlands to its mouth near Sihut of over 500 m. Beyond the valley and steadily encroaching on it lies the great desert extending for 300 m. to the borders of Nejd. The most westerly village in the main valley is Shabwa, in ancient days the capital, but now

almost buried by the advancing desert. Lower down the first large villages are Henān and Ajlania, near which the wadis 'Amd, Duwān and el 'Ain unite, forming the W. Kasr. In the W. Duwān and its branches are the villages of Haura, el Hajrēn, Kaidun and al Khurēba. Below Haura for some 60 m. there is a succession of villages with fields, gardens and date groves; several tributaries join on either side, among which the W. bin Ali and W. Adim from the south contain numerous villages. The principal towns are Shibām, al Ghurfa, Saiyun, Tariba, el Ghuraf, Tarim, formerly the chief place, 'Ainat and el Kasm. Below the last-named place there is little cultivation or settled population. The shrines of Kabr Sālih and Kabr Hud are looked on as specially sacred, and are visited by numbers of pilgrims. The former, which is in the Wadi Ser about 20 m. N.W. of Shibām, was explored by Theodore Bent in 1894; the tomb itself is of no interest, but in the neighbourhood there are extensive ruins with Himyaritic inscriptions on the stones. Kabr Hud is in the main valley some distance east of Kasm; not far from it is Bir Borhut, a natural grotto, where fumes of burning sulphur issue from a number of volcanic vents; al-Masudi mentions it in the 10th century as an active volcano. Except after heavy rain, there is no running water in the Hadramut valley, the cultivation therefore depends on artificial irrigation from wells. The principal crops are wheat, millet, indigo, dates and tobacco; this latter, known as Hamumi tobacco, is of excellent quality.

Hadramut has preserved its name from the earliest times; it occurs in Genesis as Hazarmaveth and Hadoram, sons of Joktan; and the old Greek geographers mention Adramytta and Chadramotites in their accounts of the frankincense country. The numerous ruins discovered in the W. Duwān and Adim, as well as in the main valley, are evidences of its former prosperity and civilization.

The people, known as Hadrami (plural Ḥadārim), belong generally to the south Arabian stock, claiming descent from Ya'rab bin Kahtān. There is, however, a large number of Seyyids or descendants of the Prophet, and of townsmen of northern origin, besides a considerable class of African or mixed descent. Van den Berg estimates the total population of Hadramut (excluding the Mahra and Gāra) at 150,000, of which he locates 50,000 in the valley between Shibām and Tarim, 25,000 in the W. Duwān and its tributaries, and 25,000 in Mukalla, Shihr and the coast villages, leaving 50,000 for the non-agricultural population scattered over the rest of the country, probably an excessive estimate.

The Seyyids, descendants of Ḥosain, grandson of Mahomet, form a numerous and highly respected aristocracy. They are divided into families, the chiefs of which are known as Munsibs, who are looked on as the religious leaders of the people, and are even in some cases venerated as saints. Among the leading families are the Sheikh Abu Bakr of Aināt, the el-Aidrūs of Shihr and the Sakkāf of Saiyun. They do not bear arms, nor occupy themselves in trade or manual labour or even agriculture; though owning a large proportion of the land, they employ slaves or hired labourers to cultivate it. As compared with the other classes, they are well educated, and are strict in their observance of religious duties, and owing to the respect due to their descent, they exercise a strong influence both in temporal and spiritual affairs.

The tribesmen, as in Arabia generally, are the predominant class in the population; all the adults carry arms; some of the tribes have settled towns and villages, others lead a nomadic life, keeping, however, within the territory which is recognized as belonging to the tribe. They are divided into sections or families, each headed by a chief or abu (lit. father), while the head of the tribe is called the mukaddam or sultan; the authority of the chief depends largely on his personality: he is the leader in peace and in war, but the tribesmen are not his subjects; he can only rule with their support. The most powerful tribe at present in Hadramut is the Kaiti, a branch of the Yāfa tribe whose settlements lie farther west. Originally invited by the Seyyids to protect the settled districts from the attacks of marauding tribes, they have established themselves as practically the rulers of the country, and now possess the coast district with the towns of Shihr and Mukalla, as well as Haura, Hajrēn and Shibām in the interior. The head of the family has accumulated great wealth, and risen to the highest position in the service of the nizam of Hyderabad in India, as Jamadar, or commander of an Arab levy composed of his tribesmen, numbers of whom go abroad to seek their fortune. The Kathiri tribe was formerly the most powerful; they occupy the towns of Saiyun, Tarim and el-Ghuraf in the richest part of the main Hadramut valley. The chiefs of both the Kaiti and Kathiri are in political relations with the British government, through the resident at Aden (*q.v.*). The 'Amudi in the W. Duwān, and the Nahdi, Awāmīr and Tamimi in the main valley, are the principal tribes possessing permanent villages; the Saibān, Hamumi and Manāhil occupy the mountains between the main valley and coast.

The townsmen are the free inhabitants of the towns and villages as distinguished from the Seyyids and the tribesmen: they do not carry arms, but are the working members of the community, merchants, artificers, cultivators and servants, and are entirely dependent on the tribes and chiefs under whose protection they live. The servile class contains a large African element, brought over formerly when the slave trade flourished on this coast; as in all Mahomedan countries they are well treated, and often rise to positions of trust.

As already mentioned, a large number of Arabs from Hadramut go abroad; the Kaiti tribesmen

take service in India in the irregular troops of Hyderabad; emigration on a large scale has also gone on, to the Dutch colonies in Java and Sumatra, since the beginning of the 19th century. According to the census of 1885, quoted by Van den Berg in his *Report* published by the government of the Dutch East Indies in 1886, the number of Arabs in those colonies actually born in Arabia was 2500, while those born in the colonies exceeded 20,000; nearly all of the former are from the towns in the Hadramut valley between Shibām and Tarim. Mukalla and Shihr have a considerable trade with the Red Sea and Persian Gulf ports, as well as with the ports of Aden, Dhafar and Muscat; a large share of this is in the hands of Parsee and other British Indian traders who have established themselves in the Hadramut ports. The principal imports are wheat, rice, sugar, piece goods and hardware. The exports are small; the chief items are honey, tobacco and sharks' fins. In the towns in the interior the principal industries are weaving and dyeing.

The Mahra country adjoins the Hadramut proper, and extends along the coast from Sihut eastwards to the east of Kamar Bay, where the Gāra coast begins and stretches to Mirbat. The sultan of the Mahra, to whom Sokotra also belongs, lives at Kishin, a poor village consisting of a few scattered houses about 30 m. west of Rās Fartak. Sihut is a similar village 20 m. farther west. The mountains rise to a height of 4000 ft. within a short distance of the coast, covered in places with trees, among which are the myrrh- and frankincense-bearing shrubs. These gums, for which the coast was celebrated in ancient days, are still produced; the best quality is obtained in the Gāra country, on the northern slope of the mountains. Dhafar and the mountains behind it were visited and surveyed by Mr Bent's party in 1894. There are several thriving villages on the coast, of which el-Hafa is the principal port of export for frankincense; 9000 cwt. is exported annually to Bombay.

Ruins of Sabaeen buildings were found by J. T. Bent in the neighbourhood of Dhafar, and a remarkable cove or small harbour was discovered at Khor Rori, which he identified with the ancient port of Moscha.

AUTHORITIES.—L. Van den Berg, *Le Hadramut et les colonies arabes* (Batavia, 1885); L. Hirsch, *Reise in Südarabien* (Leiden, 1897); J. T. Bent, *Southern Arabia* (London, 1895); A. von Wrede, *Reise in Hadhramut* (Brunswick, 1870); H. J. Carter, *Trans. Bombay As. Soc.* (1845), 47-51; *Journal R.G.S.* (1837).

(R. A. W.)

HADRIA [mod. *Atri* (*q.v.*)], perhaps the original terminal point of the Via Caecilia, Italy. It belonged to the Praetutii. It became a colony of Rome in 290 B.C. and remained faithful to Rome. The coins which it issued (probably during the Punic Wars), are remarkable. The crypt of the cathedral of the modern town was originally a large Roman cistern; another forms the foundation of the ducal palace; and in the eastern portion of the town there is a complicated system of underground passages for collecting and storing water.

See *Notizie degli scavi* (1902), 3.

(T. As.)

HADRIAN (PUBLIUS AELIUS HADRIANUS), Roman emperor A.D. 117-138, was born on the 24th of January A.D. 76, at Italica in Hispania Baetica (according to others, at Rome), where his ancestors, originally from Hadria in Picenum, had been settled since the time of the Scipios. On his father's death in 85 or 86 he was placed under the guardianship of two fellow-countrymen, his kinsman Ulpus Trajanus (afterwards the emperor Trajan), and Caelius Attianus (afterwards prefect of the praetorian guard). He spent the next five years at Rome, but at the age of fifteen he returned to his native place and entered upon a military career. He was soon, however, recalled to Rome by Trajan, and appointed to the offices of *decemvir stlitibus judicandis*, *praefectus feriarum Latinarum*, and *sevir turmae equitum Romanorum*. About 95 he was military tribune in lower Moesia. In 97 he was sent to upper Germany to convey the congratulations of the army to Trajan on his adoption by Nerva; and, in January of the following year, he hastened to announce the death of Nerva to Trajan at Cologne. Trajan, who had been set against Hadrian by reports of his extravagance, soon took him into favour again, chiefly owing to the goodwill of the empress Plotina, who brought about the marriage of Hadrian with (Vibia) Sabina, Trajan's great-niece. In 101 Hadrian was quaestor, in 105 tribune of the people, in 106 praetor. He served with distinction in both Dacian campaigns: in the second Trajan presented him with a valuable ring which he himself had received from Nerva, a token of regard which seemed to designate Hadrian

as his successor. In 107 Hadrian was *legatus praetorius* of lower Pannonia, in 108 *consul suffectus*, in 112 *archon* at Athens, *legatus* in the Parthian campaign (113-117), in 117 *consul designatus* for the following year, in 119 consul for the third and last time only for four months. When Trajan, owing to a severe illness, decided to return home from the East, he left Hadrian in command of the army and governor of Syria. On the 9th of August 117, Hadrian, at Antioch, was informed of his adoption by Trajan, and, on the 11th, of the death of the latter at Selinus in Cilicia. According to Dio Cassius (lxix. 1) the adoption was entirely fictitious, the work of Plotina and Attianus, by whom Trajan's death was concealed for a few days in order to facilitate the elevation of Hadrian. Whichever may have been the truth, his succession was confirmed by the army and the senate. He hastened to propitiate the former by a donative of twice the usual amount, and excused his hasty acceptance of the throne to the senate by alleging the impatient zeal of the soldiers and the necessity of an emperor for the welfare of the state.

Hadrian's first important act was to abandon as untenable the conquests of Trajan beyond the Euphrates (Assyria, Mesopotamia and Armenia), a recurrence to the traditional policy of Augustus. The provinces were unsettled, the barbarians on the borders restless and menacing, and Hadrian wisely judged that the old limits of Augustus afforded the most defensible frontier. Mesopotamia and Assyria were given back to the Parthians, and the Armenians were allowed a king of their own. From Antioch Hadrian set out for Dacia to punish the Roxolani, who, incensed by a reduction of the tribute hitherto paid them, had invaded the Danubian provinces. An arrangement was patched up, and while Hadrian was still in Dacia he received news of a conspiracy against his life. Four citizens of consular rank were accused of being concerned in it, and were put to death by order of the senate before he could interfere. Hurrying back to Rome, Hadrian endeavoured to remove the unfavourable impression produced by the whole affair and to gain the goodwill of senate and people. He threw the responsibility for the executions upon the prefect of the praetorian guard, and swore that he would never punish a senator without the assent of the entire body, to which he expressed the utmost deference and consideration. Large sums of money and games and shows were provided for the people, and, in addition, all the arrears of taxation for the last fifteen years (about £10,000,000) were cancelled and the bonds burnt in the Forum of Trajan. Trajan's scheme for the "alimention" of poor children was carried out upon a larger scale under the superintendence of a special official called *praefectus alimentorum*.

The record of Hadrian's journeys¹ through all parts of the empire forms the chief authority for the events of his life down to his final settlement in the capital during his last years. They can only be briefly touched upon here. His first great journey probably lasted from 121 to 126. After traversing Gaul he visited the Germanic provinces on the Rhine, and crossed over to Britain (spring, 122), where he built the great rampart from the Tyne to the Solway, which bears his name (see [BRITAIN: Roman](#)). He returned through Gaul into Spain, and then proceeded to Mauretania, where he suppressed an insurrection. A war with the Parthians was averted by a personal interview with their king (123). From the Parthian frontier he travelled through Asia Minor and the islands of the Aegean to Athens (autumn, 125), where he introduced various political and commercial changes, was initiated at the Eleusinia, and presided at the celebration of the greater Dionysia. After visiting Central Greece and Peloponnesus, he returned by way of Sicily to Rome (end of 126). The next year was spent at Rome, and, after a visit to Africa, he set out on his second great journey (September 128). He travelled by way of Athens, where he completed and dedicated the buildings (see [ATHENS](#)) begun during his first visit, chief of which was the Olympieum or temple of Olympian Zeus, on which occasion Hadrian himself assumed the name of Olympius. In the spring of 129 he visited Asia Minor and Syria, where he invited the kings and princes of the East to a meeting (probably at Samosata). Having passed the winter at Antioch, he set out for the south (spring, 130). He ordered Jerusalem to be rebuilt (see [JERUSALEM](#)) under the name of Aelia Capitolina, and made his way through Arabia to Egypt, where he restored the tomb of Pompey at Pelusium with great magnificence. After a short stay at Alexandria he took an excursion up the Nile, during which he lost his favourite Antinous. On the 21st of November 130, Hadrian (or at any rate his wife Sabina) heard the music which issued at sunrise from the statue of Memnon at Thebes (see [MEMNON](#)). From Egypt Hadrian returned through Syria to Europe (his movements are obscure), but was obliged to hurry back to Palestine (spring, 133) to give his personal attention (this is denied by some historians) to the revolt of the Jews, which had broken out (autumn, 131, or spring, 132) after he had left Syria. The founding of a Roman colony on the site of Jerusalem (Dio Cass. lxix. 12) and the prohibition of circumcision (Spartianus, *Hadrianus*, 14) are said to have been the causes of the war, but authorities differ considerably as to this and as to the measures which followed the revolt (see art. [JEWS](#); also E. Schürer, *Hist. of the Jewish People*, Eng. tr., div. 1, vol. ii. p. 288; and S. Krauss in *Jewish Encyc.* s.v. "Hadrian"), which lasted till 135. Leaving the conduct of affairs in the hands of his most capable general, Julius Severus, in the spring of 134 Hadrian returned to Rome. The remaining years of his life were spent partly in the capital, partly in his villa at Tibur. His health now began to fail, and it became necessary for him to choose a successor, as he had no children of his own. Against the advice of his relatives and friends he adopted L. Ceionius Commodus under the name of L. Aelius Caesar, who was in a feeble state of health and died on the 1st of January 138, before

he had an opportunity of proving his capabilities. Hadrian then adopted Arrius Antoninus (see [ANTONINUS PIUS](#)) on condition that he should adopt M. Annius Verus (afterwards the emperor Marcus Aurelius) and the son of L. Aelius Caesar, L. Ceionius Commodus (afterwards the emperor Commodus). Hadrian died at Baiae on the 10th of July 138.

He was without doubt one of the most capable emperors who ever occupied the throne, and devoted his great and varied talents to the interests of the state. One of his chief objects was the abolition of distinctions between the provinces and the mother country, finally carried out by Caracalla, while at the same time he did not neglect reforms that were urgently called for in Italy. Provincial governors were kept under strict supervision; extortion was practically unheard of; the *jus Latii* was bestowed upon several communities; special officials were instituted for the control of the finances; and the emperor's interest in provincial affairs was shown by his personal assumption of various municipal offices. New towns were founded and old ones restored; new streets were laid out, and aqueducts, temples and magnificent buildings constructed. In Italy itself the administration of justice and the finances required special attention. Four *legati juridici* (or simply *juridici*) of consular rank were appointed for Italy, who took over certain important judicial functions formerly exercised by local magistrates (cases of *fideicommissa*, the nomination of guardians). The judicial council (*consilarii Augusti*, later called *consistorium*), composed of persons of the highest rank (especially jurists), became a permanent body of advisers, although merely consultative. Roman law owes much to Hadrian, who instructed Salvius Julianus to draw up an *edictum perpetuum*, to a great extent the basis of Justinian's *Corpus juris* (see M. Schanz, *Geschichte der römischen Literatur*, iii. p. 167). In the administration of finance, in addition to the remission of arrears already mentioned, a revision of claims was ordered to be made every fifteen years, thereby anticipating the "indictions" (see [CALENDAR](#); [CHRONOLOGY](#)). Direct collection of taxes by imperial procurators was substituted for the system of farming, and a special official (*advocatus fisci*) was instituted to look after the interests of the imperial treasury. The gift of "coronary gold" (*aurum coronarium*), presented to the emperor on certain occasions, was entirely remitted in the case of Italy, and partly in the case of the provinces. The administration of the postal service throughout the empire was taken over by the state, and municipal officials were relieved from the burden of maintaining the imperial posts. Humane regulations as to the treatment of slaves were strictly enforced; the master was forbidden to put his slave to death, but was obliged to bring him before a court of justice; if he ill-treated him it was a penal offence. The sale of slaves (male and female) for immoral and gladiatorial purposes was forbidden; the custom of putting all the household to death when their master was murdered was modified. The public baths were kept under strict supervision; the toga was ordered to be worn in public by senators and equites on solemn occasions; extravagant banquets were prohibited; rules were made to prevent the congestion of traffic in the streets. In military matters Hadrian was a strict disciplinarian, but his generosity and readiness to share their hardships endeared him to the soldiers. He effected a material and moral improvement in the conditions of service and mode of life, but in other respects he does not appear to have introduced any important military reforms. During his reign an advance was made in the direction of creating an organized body of servants at the disposal of the emperor by the appointment of equites to important administrative posts, without their having performed the *militiae equestres* (see [EQUITES](#)). Among these posts were various procuratorships (chief of which was that of the imperial fisc), and the offices *ab epistulis*, *a rationibus* and *a libellis* (secretary, accountant, receiver of petitions). The prefect of the praetorian guard was now the most important person in the state next to the emperor, and subsequently became a supreme judge of appeal. Among the magnificent buildings erected by Hadrian mention may be made of the following: In the capital, the temple of Venus and Roma; his splendid mausoleum, which formed the groundwork of the castle of St Angelo; the pantheon of Agrippa; the Basilica Neptuni; at Tibur the great villa 8 m. in extent, a kind of epitome of the world, with miniatures of the most celebrated places in the provinces. Athens, however, was the favourite site of his architectural labours; here he built the temple of Olympian Zeus, the Panhellenion, the Pantheon, the library, a gymnasium and a temple of Hera.

Hadrian was fond of the society of learned men—poets, scholars, rhetoricians and philosophers—whom he alternately humoured and ridiculed. In painting, sculpture and music he considered himself the equal of specialists. The architect Apollodorus of Damascus owed his banishment and death to his outspoken criticism of the emperor's plans. The sophist Favorinus was more politic; when reproached for yielding too readily to the emperor in some grammatical discussion, he replied that it was unwise to contradict the master of thirty legions. The Athenaeum (*q.v.*) owed its foundation to Hadrian. He was a man of considerable intellectual attainments, of prodigious memory, master of both Latin and Greek, and wrote prose and verse with equal facility. His taste, however, was curious; he preferred Cato the elder, Ennius and Caelius Antipater to Cicero, Virgil and Sallust, the obscure poet Antimachus to Homer and Plato. As a writer he displayed great versatility. He composed an autobiography, published under the name of his freedman Phlegon; wrote speeches, fragments of two of which are preserved in inscriptions (a panegyric on his mother-in-law Matidia, and an address to the soldiers at Lambaesis in Africa). In imitation of Antimachus he wrote a work called *Catachannae*, probably a kind of miscellanea. The Latin and Greek anthologies contain about a dozen epigrams under his name. The letter of Hadrian to the

consul Servianus (in Vopiscus, *Vita Saturnini*, 8) is no longer considered genuine. Hadrian's celebrated dying address to his soul may here be quoted:—

“Animula vagula, blandula,
Hospes comesque corporis,
Quae nunc abibis in loca
Pallidula, rigida, nudula;
Nec, ut soles, dabis iocos?”

The character of Hadrian exhibits a mass of contradictions, well summed up by Spartianus (14, 11). He was grave and gay, affable and dignified, cruel and gentle, mean and generous, eager for fame yet not vain, impulsive and cautious, secretive and open. He hated eminent qualities in others, but gathered round him the most distinguished men of the state; at one time affectionate towards his friends, at another he mistrusted and put them to death. In fact, he was only consistent in his inconsistency (*semper in omnibus varius*). Although he endeavoured to win the popular favour, he was more feared than loved. A man of unnatural passions and grossly superstitious, he was an ardent lover of nature. But, with all his faults, he devoted himself so indefatigably to the service of the state, that the period of his reign could be characterized as a “golden age.”

The chief ancient authorities for the reign of Hadrian are: the life by Aelius Spartianus in the *Scriptores historiae Augustae* (see [AUGUSTAN HISTORY](#) and bibliography); the epitome of Dio Cassius (lxix.) by Xiphilinus; Aurelius Victor, *Epit.* 14, probably based on Marius Maximus; Eutropius viii. 6; Zonaras xi. 23; Suidas, *s.v.* Ἀδριανός; and numerous inscriptions and coins. The autobiography was used by both Dio Cassius and Marius Maximus. Modern authorities: C. Merivale, *Hist. of the Romans under the Empire*, ch. lxvi.; H. Schiller, *Geschichte der römischen Kaiserzeit*, i. 2, p. 602 (1883); J. B. Bury, *The Student's Roman Empire* (1893), where a concise table of the journeys is given; P. von Rohden, *s.v.* “Aelius” (No. 64) in Pauly-Wissowa's *Realencyclopädie*, i. 1 (1894); J. Dürr, *Die Reisen des Kaisers Hadrian* (1881); F. Gregorovius, *The Emperor Hadrian* (Eng. tr. by Mary E. Robinson, 1898); A. Hausrath, *Neutestamentliche Zeitgeschichte*, iii. (1874); W. Schurz, *De mutationibus in imperio ordinando ab imp. Hadr. factis*, i. (Bonn, 1883); J. Plew, *Quellenuntersuchungen zur Geschichte des Kaisers Hadrian* (Strassburg, 1890); O. T. Schulz, “Leben des Kaisers Hadrian,” *Quellenanalysen* [of Spartianus' *Vita*] (1904); E. Kornemann, *Kaiser Hadrian und der letzte grosse Historiker von Rom* (1905); W. Weber, *Untersuchungen zur Geschichte des Kaisers Hadrianus* (1908); H. F. Hitzig, *Die Stellung Kaiser Hadrians in der römischen Rechtsgeschichte* (1892); C. Schultess, *Bauten des Kaisers Hadrian* (1898); G. Doublet, *Notes sur les œuvres littéraires de l'empereur Hadrien* (Toulouse, 1893); J. B. Lightfoot, *Apostolic Fathers*, ii. 1, 476 seq.; Sir W. M. Ramsay, *Church in the Roman Empire*, pp. 320 seq.; V. Schultze, in Herzog-Hauck's *Realencyklopädie*, vii. 315; histories of Roman literature by Teuffel-Schwabe and Schanz. On Aelius Caesar, see *Class. Quart.*, 1908, i.

(T. K.; J. H. F.)

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- 1 The chronology of Hadrian's journeys—indeed, of the whole reign—is confused and obscure. In the above the article by von Rohden in Pauly-Wissowa's *Realencyclopädie* has been followed. Weber's (see Bibliog.) is the most important discussion.

HADRIAN'S WALL, the name usually given to the remains of the Roman fortifications which defended the northern frontier of the Roman province of Britain, between the Tyne and the Solway. The works consisted of (1) a continuous defensive rampart with a ditch in front and a road behind; (2) various forts, blockhouses and towers along the rampart; and (3) an earthwork to the south of it, generally called the Vallum, of uncertain use. The defensive wall was probably first erected by Hadrian about A.D. 122 as a turf wall, and rebuilt in stone by Septimius Severus about A.D. 208. See further [BRITAIN: Roman](#).

HADRUMETUM, a town of ancient Africa on the southern extremity of the *sinus Neapolitanus* (mod. Gulf of Hammamet) on the east coast of Tunisia. The site is partly occupied by the modern town of Susa (*q.v.*). The form of the name Hadrumetum varied much in antiquity; the Greeks called it Ἀδρύμηξ, Ἀδρύμητος, Ἀδραμύτης, Ἀδράμητος: the Romans *Adrumetum*, *Adrimetum*, *Hadrumetum*, *Hadrymetum*, &c.; inscriptions and coins gave *Hadrumetum*. The town was

originally a Phoenician colony founded by Tyrians long before Carthage (Sallust, *Jug.* 19). It became subject to Carthage, but lost none of its prosperity. Often mentioned during the Punic Wars, it was captured by Agathocles in 310, and was the refuge of Hannibal and the remnants of his army after the battle of Zama in 202. During the last Punic War it gave assistance to the Romans; after the fall of Carthage in 146 it received an accession of territory and the title of *civitas libera* (Appian, *Punica*, xciv.; *C.I.L.* i. p. 84). Caesar landed there in 46 B.C. on his way to the victory of Thapsus (*De bello Afric.* iii.; Suetonius, *Div. Jul.* lix.).

In the organization of the African provinces Hadrumetum became a capital of the province of Byzacena. Its harbour was extremely busy and the surrounding country unusually fertile. Trajan made it a Latin colony under the title of *Colonia Concordia Ulpia Trajana Augusta Frugifera Hadrumetina*; a dedication to the emperor Gordian the Good, found by M. Cagnat at Susa in 1883 gives these titles to the town, and at the same time identifies it with Susa. Quarrels arose between Hadrumetum and its neighbour Thysdrus in connexion with the temple of Minerva situated on the borders of their respective territories (Frontinus, *Gromatici*, ed. Lachmannus, p. 57); Vespasian when pro-consul of Africa had to repress a sedition among its inhabitants (Suetonius, *Vesp.* iv.; Tissot, *Fastes de la prov. d'Afrique*, p. 66); it was the birthplace of the emperor Albinus. At this period the metropolis of Byzacena was after Carthage the most important town in Roman Africa. It was the seat of a bishopric, and its bishops are mentioned at the councils of 258, 348, 393 and even later. Destroyed by the Vandals in 434 it was rebuilt by Justinian and renamed Justinianopolis (Procop. *De aedif.* vi. 6). The Arabic invasion at the end of the 7th century destroyed the Byzantine towns, and the place became the haunt of pirates, protected by the Kasbah (citadel); it was built on the substructions of the Punic, Roman and Byzantine acropolis, and is used by the French for military purposes. The Arabic geographer Bakri gave a description of the chief Roman buildings which were standing in his time (Bakri, *Descr. de l'Afrique*, tr. by de Slane, p. 83 et seq.). The modern town of Susa, despite its commercial prosperity, occupies only a third of the old site.

In 1863 the French engineer, A. Daux, discovered the jetties and the moles of the commercial harbour, and the line of the military harbour (Cothon); both harbours, which were mainly artificial, are entirely silted up. There remains a fragment of the fortifications of the Punic town, which had a total length of 6410 metres, and remains of the substructions of the Byzantine acropolis, of the circus, the theatre, the water cisterns, and of other buildings, notably the interesting Byzantine basilica which is now used as an Arab café (Kahwat-el-Kubba). In the ruins there have been found numerous columns of Punic inscriptions, Roman inscriptions and mosaic, among which is one representing Virgil seated, holding the *Aeneid* in his hand; another represents the Cretan labyrinth with Theseus and the Minotaur (Héron de Villefosse, *Revue de l'Afrique française*, v., December 1887, pp. 384 and 394; *Comptes rendus de l'Acad. des Inscr. et Belles-Lettres*, 1892, p. 318; other mosaics, *ibid.*, 1896, p. 578; *Revue archéol.*, 1897). In 1904 Dr Carton and the abbé Leynaud discovered huge Christian catacombs with several miles of subterranean galleries to which access is obtained by a small vaulted chamber. In these catacombs we find numerous sarcophagi and inscriptions painted or engraved of the Roman and Byzantine periods (*Comptes rendus de l'Acad. des Inscr. et Belles-Lettres*, 1904-1907; Carton and Leynaud, *Les Catacombes d'Hadrumète*, Susa, 1905). We can recognize also the Punic and Pagan-Roman cemeteries (*C. R. de l'Acad. des Inscr. et Belles-Lettres*, 1887; *Bull. archéol. du Comité*, 1885, p. 149; 1903, p. 157). The town had no Punic coins, but under the Roman domination there were coins from the time of the Republic. These are of bronze and bear the name of the city in abbreviations, HADR or HADRVN accompanying the head of Neptune or the Sun. We find also the names of local duumvirs. Under Augustus the coins have on the obverse the imperial effigy, and on the reverse the names and often the effigies of the pro-consuls who governed the province, P. Quintilius Varus, L. Volusius Saturninus and Q. Fabius Maximus Africanus. After Augustus the mint was finally closed.

AUTHORITIES.—A. Daux, *Recherches sur l'origine et l'emplacement des emporia phéniciens dans le Zeugis et le Byzacium* (Paris, 1869); Ch. Tissot, *Géographie comparée de la province romaine d'Afrique*, ii. p. 149; Cagnat, *Explorations archéol. en Tunisie* (2nd and 3rd fasc., 1885); Lud. Müller, *Numismatique de l'Afrique ancienne*, ii p. 51; M. Palat, in the *Bulletin arch. du Comité des travaux historiques* (1885), pp. 121 and 150; *Revue archéologique* (1884 and 1897); *Bulletin des antiquités africaines* (1884 and 1885); *Bulletin de la Société archéologique de Sousse* (first published in 1903); *Atlas archéol. de Tunisie* (4th fascicule, with the plan of Hadrumetum).

(E. B.*)

HAECKEL, ERNST HEINRICH (1834-), German biologist, was born at Potsdam on the 16th of February 1834. He studied medicine and science at Würzburg, Berlin and Vienna, having for his masters such men as Johannes Müller, R. Virchow and R. A. Kölliker, and in 1857

graduated at Berlin as M.D. and M.Ch. At the wish of his father he began to practise as a doctor in that city, but his patients were few in number, one reason being that he did not wish them to be many, and after a short time he turned to more congenial pursuits. In 1861, at the instance of Carl Gegenbaur, he became *Privatdozent* at Jena; in the succeeding year he was chosen extraordinary professor of comparative anatomy and director of the Zoological Institute in the same university; in 1865 he was appointed to a chair of zoology which was specially established for his benefit. This last position he retained for 43 years, in spite of repeated invitations to migrate to more important centres, such as Strassburg or Vienna, and at Jena he spent his life, with the exception of the time he devoted to travelling in various parts of the world, whence in every case he brought back a rich zoological harvest.

As a field naturalist Haeckel displayed extraordinary power and industry. Among his monographs may be mentioned those on *Radiolaria* (1862), *Siphonophora* (1869), *Monera* (1870) and *Calcareous Sponges* (1872), as well as several *Challenger* reports, viz. *Deep-Sea Medusae* (1881), *Siphonophora* (1888), *Deep-Sea Keratosa* (1889) and *Radiolaria* (1887), the last being accompanied by 140 plates and enumerating over four thousand new species. This output of systematic and descriptive work would alone have constituted a good life's work, but Haeckel in addition wrote copiously on biological theory. It happened that just when he was beginning his scientific career Darwin's *Origin of Species* was published (1859), and such was the influence it exercised over him that he became the apostle of Darwinism in Germany. He was, indeed, the first German biologist to give a whole-hearted adherence to the doctrine of organic evolution and to treat it as the cardinal conception of modern biology. It was he who first brought it prominently before the notice of German men of science in his first memoir on the *Radiolaria*, which was completely pervaded with its spirit, and later at the congress of naturalists at Stettin in 1863. Darwin himself has placed on record the conviction that Haeckel's enthusiastic propagandism of the doctrine was the chief factor of its success in Germany. His book on *General Morphology* (1866), published when he was only thirty-two years old, was called by Huxley a suggestive attempt to work out the practical application of evolution to its final results; and if it does not take rank as a classic, it will at least stand out as a landmark in the history of biological doctrine in the 19th century. Although it contains a statement of most of the views with which Haeckel's name is associated, it did not attract much attention on its first appearance, and accordingly its author rewrote much of its substance in a more popular style and published it a year or two later as the *Natural History of Creation (Natürliche Schöpfungsgeschichte)*, which was far more successful. In it he divided morphology into two sections—tectology, the science of organic individuality; and promorphology, which aims at establishing a crystallography of organic forms. Among other matters, he laid particular stress on the "fundamental biogenetic law" that ontogeny recapitulates phylogeny, that the individual organism in its development is to a great extent an epitome of the form-modifications undergone by the successive ancestors of the species in the course of their historic evolution. His well-known "gastraea" theory is an outcome of this generalization. He divided the whole animal creation into two categories—the Protozoa or unicellular animals, and the Metazoa or multicellular animals, and he pointed out that while the former remain single-celled throughout their existence, the latter are only so at the beginning, and are subsequently built up of innumerable cells, the single primitive egg-cell (*ovum*) being transformed by cleavage into a globular mass of cells (*morula*), which first becomes a hollow vesicle and then changes into the *gastrula*. The simplest multicellular animal he conceived to resemble this gastrula with its two primary layers, ectoderm and endoderm, and the earliest hypothetical form of this kind, from which the higher animals might be supposed to be actually descended, he called the "gastraea." This theory was first put forward in the memoir on the calcareous sponges, which in its sub-title was described as an attempt at an analytical solution of the problem of the origin of species, and was subsequently elaborated in various *Studies on the Gastraea Theory* (1873-1884). Haeckel, again, was the first to attempt to draw up a genealogical tree (*Stammbaum*) exhibiting the relationship between the various orders of animals with regard both to one another and their common origin. His earliest attempt in the *General Morphology* was succeeded by many others, and his efforts in this direction may perhaps be held to culminate in the paper he read before the fourth International Zoological Congress, held at Cambridge in 1898, when he traced the descent of the human race in twenty-six stages from organisms like the still-existing *Monera*, simple structureless masses of protoplasm, and the unicellular *Protista*, through the chimpanzees and the *Pithecanthropus erectus*, of which a few fossil bones were discovered in Java in 1894, and which he held to be undoubtedly an intermediate form connecting primitive man with the anthropoid apes.

Not content with the study of the doctrine of evolution in its zoological aspects, Haeckel also applied it to some of the oldest problems of philosophy and religion. What he termed the integration of his views on these subjects he published under the title of *Die Welträtsel* (1899), which in 1901 appeared in English as *The Riddle of the Universe*. In this book, adopting an uncompromising monistic attitude, he asserted the essential unity of organic and inorganic nature. According to his "carbon-theory," which has been far from achieving general acceptance, the chemico-physical properties of carbon in its complex albuminoid compounds are the sole and the mechanical cause of the specific phenomena of movement which distinguish organic from

inorganic substances, and the first development of living protoplasm, as seen in the *Monera*, arises from such nitrogenous carbon-compounds by a process of spontaneous generation. Psychology he regarded as merely a branch of physiology, and psychical activity as a group of vital phenomena which depend solely on physiological actions and material changes taking place in the protoplasm of the organism in which it is manifested. Every living cell has psychic properties, and the psychic life of multicellular organisms is the sum-total of the psychic functions of the cells of which they are composed. Moreover, just as the highest animals have been evolved from the simplest forms of life, so the highest faculties of the human mind have been evolved from the soul of the brute-beasts, and more remotely from the simple cell-soul of the unicellular Protozoa. As a consequence of these views Haeckel was led to deny the immortality of the soul, the freedom of the will, and the existence of a personal God.

Haeckel's literary output was enormous, and at the time of the celebration of his sixtieth birthday at Jena in 1894 he had produced 42 works with 13,000 pages, besides numerous scientific memoirs. In addition to the works already mentioned, he wrote *Freie Wissenschaft und freie Lehre* (1877) in reply to a speech in which Virchow objected to the teaching of the doctrine of evolution in schools, on the ground that it was an unproved hypothesis; *Die systematische Phylogenie* (1894), which has been pronounced his best book; *Anthropogenie* (1874, 5th and enlarged edition 1903), dealing with the evolution of man; *Über unsere gegenwärtige Kenntnis vom Ursprung des Menschen* (1898, translated into English as *The Last Link*, 1898); *Der Kampf um den Entwicklungsgedanken* (1905, English version, *Last Words on Evolution*, 1906); *Die Lebenswunder* (1904), a supplement to the *Riddle of the Universe*; books of travel, such as *Indische Reisebriefe* (1882) and *Aus Insulinde* (1901), the fruits of journeys to Ceylon and to Java; *Kunstformen der Natur* (1904), with plates representing beautiful marine animal forms; and *Wanderbilder* (1905), reproductions of his oil-paintings and water-colour landscapes.

There are biographies by W. Bölsche (Dresden, 1900, translated into English by Joseph McCabe, with additions, London, 1906) and by Breitenbach (Odenkirchen, 1904). See also Walther May, *Ernst Haeckel; Versuch einer Chronik seines Lebens und Werks* (Leipzig, 1909).

HAEMATITE, or HEMATITE, a mineral consisting of ferric oxide (Fe_2O_3), named from the Greek word αἷμα "blood," in allusion to its typical colour, whence it is called also red iron ore. When crystallized, however, haematite often presents a dark colour, even iron-black; but on scratching the surface, the powder of the streak shows the colour of dried blood. Haematite crystallizes in the rhombohedral system, and is isomorphous with corundum (Al_2O_3). The habit of the crystals may be rhombohedral, pyramidal or tabular, rarely prismatic. In fig. 1 the crystal, from Elba, shows a combination of the fundamental rhombohedron (R), an obtuse rhombohedron (s), and the hexagonal bi-pyramid (n). Fig. 2 is a tabular crystal in which the basal pinacoid (o) predominates. Haematite has no distinct cleavage, but may show, in consequence of a lamellar structure, a tendency to parting along certain planes.

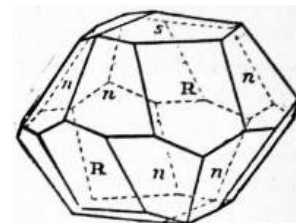


FIG. 1.

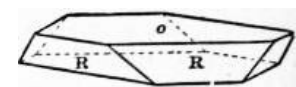


FIG. 2.

Crystallized haematite, such as that from the iron-mines of Elba, presents a steel-grey or iron-black colour, with a brilliant metallic lustre, sometimes beautifully iridescent. The splendid surface has suggested for this mineral such names as specular iron ore, looking-glass ore, and iron glance (*fer oligiste* of French writers). The hardness of the crystallized haematite is about 6, and the specific gravity 5.2. The so-called "iron roses" (*Eisenrosen*) of Switzerland are rosette-like aggregates of hexagonal tabular crystals, from fissures in the gneissose rocks of the Alps. Specular iron ore occurs in the form of brilliant metallic scales on many lavas, as at Vesuvius and Etna, in the Auvergne and the Eifel, and notably in the Island of Ascension, where the mineral forms beautiful tabular crystals. It seems to be a sublimation-product formed in volcanoes by the interaction of the vapour of ferric chloride and steam.

Specular haematite forms a constituent of certain schistose rocks, such as the Brazilian itabirite. In the Marquette district of Michigan (Lake Superior) schistose specular ore occurs in important deposits, associated with a jasper rock, in which the ore alternates with bands of red quartzite. Micaceous iron ore consists of delicate steel-grey scales of specular haematite, unctuous to the touch, used as a lubricant and also as a pigment. It is worked in Devonshire under the name of shining ore. Very thin laminae of haematite, blood-red by transmitted light, occur as microscopic enclosures in certain minerals, such as carnallite and sun-stone, to which they impart colour and lustre.

Much haematite occurs in a compact or massive form, often mammillary, and presenting on fracture a fibrous structure. The reniform masses are known as kidney ore. Such red ore is generally neither so dense nor so hard as the crystals. It often passes into an earthy form, termed soft red ore, and when mixed with more or less clay constitutes red ochre, ruddle or reddle (Ger. *Röte*).

The hard haematite is occasionally cut and polished as an ornamental stone, and certain kinds have been made into beads simulating black pearls. It was worked by the Assyrians for their engraved cylinder-seals, and was used by the gnostics for amulets. Some of the native tribes in the Congo basin employ it as a material for axes. The hard fibrous ore of Cumberland is known as pencil ore, and is employed for the burnishers used by bookbinders and others. Santiago de Compostela in Spain furnishes a considerable supply of haematite burnishers.

Haematite is an important ore of iron (*q.v.*), and is extensively worked in Elba, Spain (Bilbao), Scandinavia, the Lake Superior region and elsewhere. In England valuable deposits occur in the Carboniferous Limestone of west Cumberland (Whitehaven district) and north Lancashire (Ulverston district). The hard ore is siliceous, and fine crystallized specimens occur in association with smoky quartz. The ore is remarkably free from phosphorus, and is consequently valued for the production of pig-iron to be converted into Bessemer steel.

(F. W. R.*)

HAEMATOCELE (Gr. αἷμα, blood, and κήλη, tumour), the medical term for a localized collection of blood in the tunica vaginalis or cord. It is usually the result of a sudden blow or severe strain, but may arise from disease. At first it forms a smooth, fluctuating, opaque swelling, but later becomes hard and firm. In chronic cases the walls of the tunica vaginalis undergo changes. The treatment of a case seen soon after the injury is directed towards keeping the patient at rest, elevating the parts, and applying an evaporating lotion or ice-bag. In chronic cases it may be necessary to lay open the cavity and remove the coagulum.

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HAEMOPHILIA, the medical term for a condition of the vascular system, often running in families, the members of which are known as "bleeders," characterized by a disposition towards bleeding, whether with or without the provocation of an injury to the tissue. When this bleeding is spontaneous it comes from the mucous membranes, especially from the nose, but also from the mouth, bowel and bronchial tubes. Slight bruises are apt to be followed by extravasations of blood into the tissues; the swollen joints (knee especially) of a bleeder are probably due, in the first instance, to the escape of blood into the joint cavity or synovial membrane. It is always from the smallest vessels that the blood escapes, and may do so in such quantities as to cause death in a few hours.

HAEMORRHAGE (Gr. αἷμα, blood, and ῥηγνύναι, to burst), a general term for any escape of blood from a blood-vessel (see Blood). It commonly results from injury, as the tearing or cutting of a blood-vessel, but certain forms result from disease, as in scurvy and purpura. The chief varieties of haemorrhage are *arterial*, *venous* and *capillary*. Bleeding from an artery is of a bright red colour, and escapes from the end of the vessel nearest the heart in jets synchronous with the heart's beat. Bleeding from a vein is of a darker colour; the flow is steady, and the bleeding is from the distal end of the vessel. Capillary bleeding is a general oozing from a raw surface. By *extravasation of blood* is meant the pouring out of blood into the areolar tissues, which become boggy. This is termed a *bruise* or *ecchymosis*. *Epistaxis* is a term given to bleeding from the nose. *Haematemesis* is vomiting of blood, the colour of which may be altered by digestion, as is also the case in *melaena*, or passage of blood with the faeces, in which the blood becomes dark and tarry-looking from the action of the intestinal fluids. *Haemoptysis* denotes an escape of blood from the air-passages, which is usually bright red and frothy from admixture with air. *Haematuria* means passage of blood with the urine.

Cessation of bleeding may take place from natural or from artificial means. Natural arrest of haemorrhage arises from (1) the coagulation of the blood itself, (2) the diminution of the heart's action as in fainting, (3) changes taking place in the cut vessel causing its retraction and contraction. In the surgical treatment of haemorrhage minor means of arresting bleeding are: cold, which is most valuable in general oozing and local extravasations; very hot water, 130° to 160° F., a powerful haemostatic; position, such as elevation of the limb, valuable in bleeding from the extremities; styptics or astringents, applied locally, as perchloride of iron, tannic acid and others, the most valuable being suprarenal extract. In arresting haemorrhage temporarily the chief thing is to press directly on the bleeding part. The pressure to be effectual need not be severe, but must be accurately applied. If the bleeding point cannot be reached, the pressure should be applied to the main artery between the bleeding point and the heart. In small blood-vessels pressure will be sufficient to arrest haemorrhage permanently. In large vessels it is usual to pass a ligature round the vessel and tie it with a reef-knot. Apply the ligature, if possible, at the bleeding point, tying both ends of the cut vessel. If this cannot be done, the main artery of the limb must be exposed by dissection at the most accessible point between the wound and the heart, and there ligatured.

Haemorrhage has been classified as—(1) primary, occurring at the time of the injury; (2) reactionary, or within twenty-four hours of the accident, during the stage of reaction; (3) secondary, occurring at a later period and caused by faulty application of a ligature or septic condition of the wound. In severe haemorrhage, as from the division of a large artery, the patient may collapse and death ensue from syncope. In this case stimulants and strychnine may be given, but they should be avoided until it is certain the bleeding has been properly controlled, as they tend to increase it. Transfusion of blood directly from the vein of a healthy person to the blood-vessels of the patient, and infusion of saline solution into a vein, may be practised (see Shock). In a congenital condition known as *haemophylia* (*q.v.*) it is difficult to stop the flow of blood.

The surgical procedure for the treatment of an open wound is—(1) arrest of haemorrhage; (2) cleansing of the wound and removal of any foreign bodies; (3) careful apposition of its edges and surfaces—the edges being best brought in contact by sutures of aseptic silk or catgut, the surfaces by carefully applied pressure; (4) free drainage, if necessary, to prevent accumulation either of blood or serous effusion; (5) avoidance of sepsis; (6) perfect rest of the part. These methods of treatment require to be modified for wounds in special situations and for those in which there is much contusion and laceration. When a special poison has entered the wound at the time of its infliction or at some subsequent date, it is necessary to provide against septic conditions of the wound itself and blood-poisoning of the general circulation.

HAEMORRHOIDS, or Hemorrhoids (from Gr. αἷμα, blood, and ῥεῖν, to flow), commonly called *piles*, swellings formed by the dilatation of veins of the lowest part of the bowel, or of those just outside the margin of its aperture. The former, *internal piles*, are covered by mucous membrane; the latter, *external piles*, are just beneath the skin. As the veins of the lining of the bowel become dilated they form definite bulgings within the bowel, and, at last increasing in size, escape through the anus when a motion is being passed. Growing still larger, they may come down spontaneously when the individual is standing or walking, and they are apt to be a grave source of pain or annoyance. Eventually they may remain constantly protruded—nevertheless, they are still *internal piles* because they arise from the interior of the bowel. Though a pile is sometimes solitary, there are usually several of them. They are apt to become inflamed, and the inflammation is associated with heat, pain, discharge and general uneasiness; ulceration and bleeding are also common symptoms, hence the term “bleeding piles.” The *external pile* is covered by the thin dark-coloured skin of the anal margin. Severe pressure upon the large abdominal veins may retard the upward flow of blood to the heart and so give rise to piles; this is apt to happen in the case of disease of the liver, malignant and other tumours, and pregnancy. General weakness of the constitution or of the blood-vessels and habitual constipation may be predisposing causes of piles. The exciting cause may be vigorous straining at stool or exposure to damp, as from sitting on the wet ground. Piles are often only a symptom, and in their treatment this fact should be kept in view; if the cause is removed the piles may disappear. But in some cases it may be impossible to remove the cause, as when a widely-spreading cancerous growth of the rectum, or of the interior of the pelvis or abdomen, is blocking the upward flow of blood in the veins. Sometimes when a pile has been protruded, as during defaecation, it is tightly grasped by spasmodic contraction of the circular muscular fibres which guard the outlet of the bowel, and it then becomes swollen, engorged and extremely painful; the strangulation may be so severe that the blood in the vessels coagulates and the pile mortifies. This, indeed, is nature's attempt at curing a pile, but it is distressing, and, as a rule, it is not entirely successful.

The palliative treatment of piles consists in obtaining a daily and easy action of the bowels, in rest, cold bathing, astringent injections, lotions and ointments. The radical treatment consists in their removal by operation, but this should not be contemplated until palliative treatment has failed. The operation consists in drawing the pile well down, and strangling the vessels entering and leaving its base, either by a strong ligature tightly applied, by crushing, or by cautery. Before dealing with the pile the anus is vigorously dilated in order that the pile may be dealt with with greater precision, and also that the temporary paralysis of the sphincter muscle, which follows the stretching, may prevent the occurrence of painful and spasmodic contractions subsequently. The ligatures by which the base of the piles are strangulated slough off with the pile in about ten days, and in about ten days more the individual is, as a rule, well enough to return to his work. If, for one reason or another, no operation is to be undertaken, and the piles are troublesome, relief may be afforded by warm sponging and by sitz-baths, the pile being gently dried afterwards by a piece of soft linen, smeared with vaseline, and carefully returned into the bowel. Under surgical advice, cocaine or morphia may be brought in contact with the tender parts, either in the form of lotion, suppository or ointment. In operating upon internal piles it is undesirable to remove all the external piles around the anus, lest the contraction of the circumferential scar should cause permanent narrowing of the orifice. If, as often happens, blood clots in the vein of an external pile, the small, hard, tender swelling may be treated with anodyne fomentations, or it may be rendered insensitive by the ether spray and opened by a small incision, the clot being turned out.

(E. O.*)

HAEMOSPORIDIA, in zoology, an order of Ectospora, which although comparatively few in number and very inconspicuous in size and appearance, have of late years probably attracted greater attention and been more generally studied than any other Sporozoa; the reason being that they include the organisms well known as malarial parasites. In spite, however, of much and careful recent research—to a certain extent, rather, as a result of it—it remains the case that the Haemosporidia are, in some respects, the group of the Ectospora about which our knowledge is, for the time being, in the most unsatisfactory condition. Such important questions, indeed, as the scope and boundaries of the group, its exact origin and affinities, the rank and interclassification of the forms admittedly included in it, are answered quite differently by different workers. For example, one well-known Sporozoan authority (M. Lühe) has recently united the two groups, Haemosporidia and Haemoflagellates, bodily into one, while others (*e.g.* Novy and McNeal) deny that there is any connexion whatever between “Cytozoa” and Trypanosomes. Again, the inclusion or exclusion of forms like *Piroplasma* and *Halteridium* is also the subject of much discussion. The present writer accepts here the view that the Haemosporidia are derived from Haemoflagellates which have developed a gregariniform (Sporozoan) phase at the expense, largely or entirely, of the flagelliform one. The not inconsiderable differences met with among different types are capable of explanation on the ground that certain forms have advanced farther than others along this particular line of evolution. In other words, it is most probable that the Haemosporidia are to be regarded as comprising various parasites which represent different stages intermediate between, on the one side, a Flagellate, and on the other, a typical chlamyospore-forming Ectosporan parasite. While, however, it is easy enough sharply to separate off all Haemosporidia from other Ectospora, it is a very difficult matter to define their limits on the former side. Two principal criteria which a doubtful haemal parasite might very well be required to satisfy in order to be considered as a Haemosporidian rather than a Haemoflagellate are (*a*) the occurrence of schizogony during the “corpuscular” phase in the Vertebrate host, and (*b*) the formation of many germs (“sporozoites”) from the zygote; so long as these conditions were complied with, the present writer, at all events, would not feel he was countenancing any protozoological heresy in allowing for the possibility of a Flagellate (perhaps trypaniform) phase or features being present at some period or other in the life-cycle.¹ To render this article complete, however, one or two well-known parasites, hitherto referred to this order, must also be mentioned, which, judged by the above (arbitrary) standard, are, it may be, on the Haemoflagellate side of the dividing line (*e.g.* *Halteridium*, according to Schaudinn).

The chief characters which distinguish the Haemosporidia from other Ectospora are the following. They are invariably blood parasites, and for part or all of the trophic period come into intimate relation with the cellular elements in the blood. There is always an alternation of hosts and of generations, an Invertebrate being the definitive host, in which sexual conjugation is undergone and which is to be regarded as the primary one, a Vertebrate being the intermediate or secondary one. The zygote or sporont is at first capable of movement and known as an ookinete. No resistant spores (chlamyospores) are formed, the ultimate germs or sporozoites always being free in the oocyst and not enclosed by sporocysts.

To Sir E. Ray Lankester is due the honour of discovering the first Haemosporidian, a discovery

which did not take place until after most of the other kinds of Sporozoa were known. In 1871 this author described the parasite of the frog, which he later termed *Drepanidium ranarum*. The next discovery was the great and far-reaching one of Laveran, who in 1883 described all the characteristic phases of the malarial parasite which are met with in human blood. While regarding the organism as the cause of the disease, Laveran did not at once recognize its animal and Sporozoan nature, but considered it rather as a vegetable, and termed it *Oscillaria malariae*. As in the case of the Trypanosomes, we owe to Danilewsky (1885-1889) the first serious attempts to study the comparative anatomy and life-history of these parasites, from a zoological point of view. Danilewsky first named them Haemosporidia, and distinguished between *Haemocytozoa* and *Leucocytozoa*. To the brilliant researches of R. Ross and Grassi in the closing years of the 19th century is due the realization of the essential part played by the gnat or mosquito in the life-cycle and transmission of the parasites; and to MacCallum belongs the credit of first observing the true sexual conjugation, in the case of a *Halteridium*. Since then, thanks to the labours of Argutinsky and Schaudinn, our knowledge of the malarial parasites has steadily increased. Until quite recently, however, very little was known about the Haemosporidia of cold-blooded Vertebrates; but in 1903 Siegel and Schaudinn demonstrated that the same rôle is performed in their case by a leech or a tick, and since then many new forms have been described.

The Haemosporidia are widely distributed and of very general occurrence among the chief classes of Vertebrates. Among Invertebrates they are apparently limited to bloodsucking insects, ticks and leeches.² As already stated, the universal habitat of the parasites in the

Occurrence:
habitat;
effects on
host.

Vertebrate is the blood; as a result, of course, they are to be met with in the capillaries of practically all the important organs of the body; and it is to be noted that while certain phases (*e.g.* growing trophozoites, mature gametocytes) are found in the peripheral circulation, others (*e.g.* schizogonous "rosettes," young gametocytes) occur in the internal organs, liver, kidneys, &c., where the

circulation is sluggish. The relation of the parasites to the blood-cells varies greatly. Most attack, probably exclusively, the red blood corpuscles (haematids); a few, however, select the leucocytes, and are therefore known as Leucocytozoa. In the case of Mammalian and Avian forms (malarial parasites) Schaudinn and Argutinsky have shown that the trophic and schizogonic phases are not really endoglobular but closely attached to the corpuscle, hollowing out a depression or space into which they nestle; the gametocytes, on the other hand, are actually intercellular. Forms parasitic in cold-blooded Vertebrates, on the contrary, are always, so far as is known, endoglobular when in relation with the corpuscles; and the same is apparently the case with the Mammalian parasite, *Piroplasma*. Although in no instance so far described is the parasite actually intranuclear (as certain Coccidia are), in one or two cases (*e.g.* *Karyolysus* of lizards and certain species of *Haemogregarina*) it reacts markedly upon the nucleus and soon causes its disintegration. While many Haemosporidia (*e.g.* malarial parasites, with the exception of *Halteridium*) remain in connexion with the same corpuscle throughout the whole period of growth and schizogony, the new generation of merozoites first being set free from the broken-down cell, others (the Haemogregarines, broadly speaking, and also *Halteridium*) leave one corpuscle after a short time, wander about free in the plasma, and then seek out another; and this may be repeated until the parasite is ready for schizogony, which generally occurs in the corpuscle.

As in the case of Trypanosomes (*q.v.*), normally—that is to say, when in an accustomed, tolerant host, and under natural conditions—Haemosporidia are non-pathogenic and do not give rise to any ill-effects in the animals harbouring them. When, however, the parasites gain an entry into the blood of man or other unadapted animals,³ they produce, as is well known, harmful and often very serious effects. There are three recognized types of malarial fever, each caused by a distinct form and characterized by the mode of manifestation. Two, the so-called benign fevers, are intermittent; namely, tertian and quartan fever, in which the fever recurs every second and third day respectively. This is due to the fact that schizogony takes different lengths of time in the two cases, 48 hours in the one, 72 in the other; the height of the fever-period coincides with the break-down of the corpuscle at the completion of the process, and the liberation of great numbers of merozoites in the blood. The third type is the dangerous aestivo-autumnal or pernicious malaria, in which the fever is irregular or continuous during long periods.

A very general symptom is anaemia, which is sometimes present to a marked extent, when it may lead to a fatal termination. This is the result of the very considerable destruction of the blood-corpuscles which takes place, the haemoglobin of which is absorbed by the parasites as nutriment. A universal feature connected with this mode of nutrition is the production, in the cytoplasm of the parasite, of a brown pigment, termed melanin; this does not represent reserve material, but is an excreted by-product derived from the haemoglobin. These pigment-grains are at length liberated into the blood-stream and become deposited in the various organs, spleen, liver, kidneys, brain, causing pronounced pigmentation.

Another type of fever, more acute and more generally fatal, is that produced by forms belonging to the genus *Piroplasma*, in cattle, dogs, horses and other domestic animals in different regions of the globe; and recently Wilson and Chowning have stated that the "spotted fever of the

Rockies" is a human piroplasmosis caused by *P. hominis*. The disease of cattle is known variously as Texas-fever, Tristeza, Red-water, Southern cattle-fever, &c. In this type of illness the endogenous multiplication of the parasites is very great and rapid, and brings about an enormous diminution in the number of healthy red blood corpuscles. Their sudden destruction results in the liberation of large quantities of haemoglobin in the plasma, which turns deep-red in colour; and hence haemoglobinuria, which occurs only rarely in malaria, is a constant symptom in piroplasmosis.

The parasite of pernicious malaria, here termed *Laverania malariae*, will serve very well as a type of the general life-cycle (fig. 1). Slight differences shown by the other malarial parasites

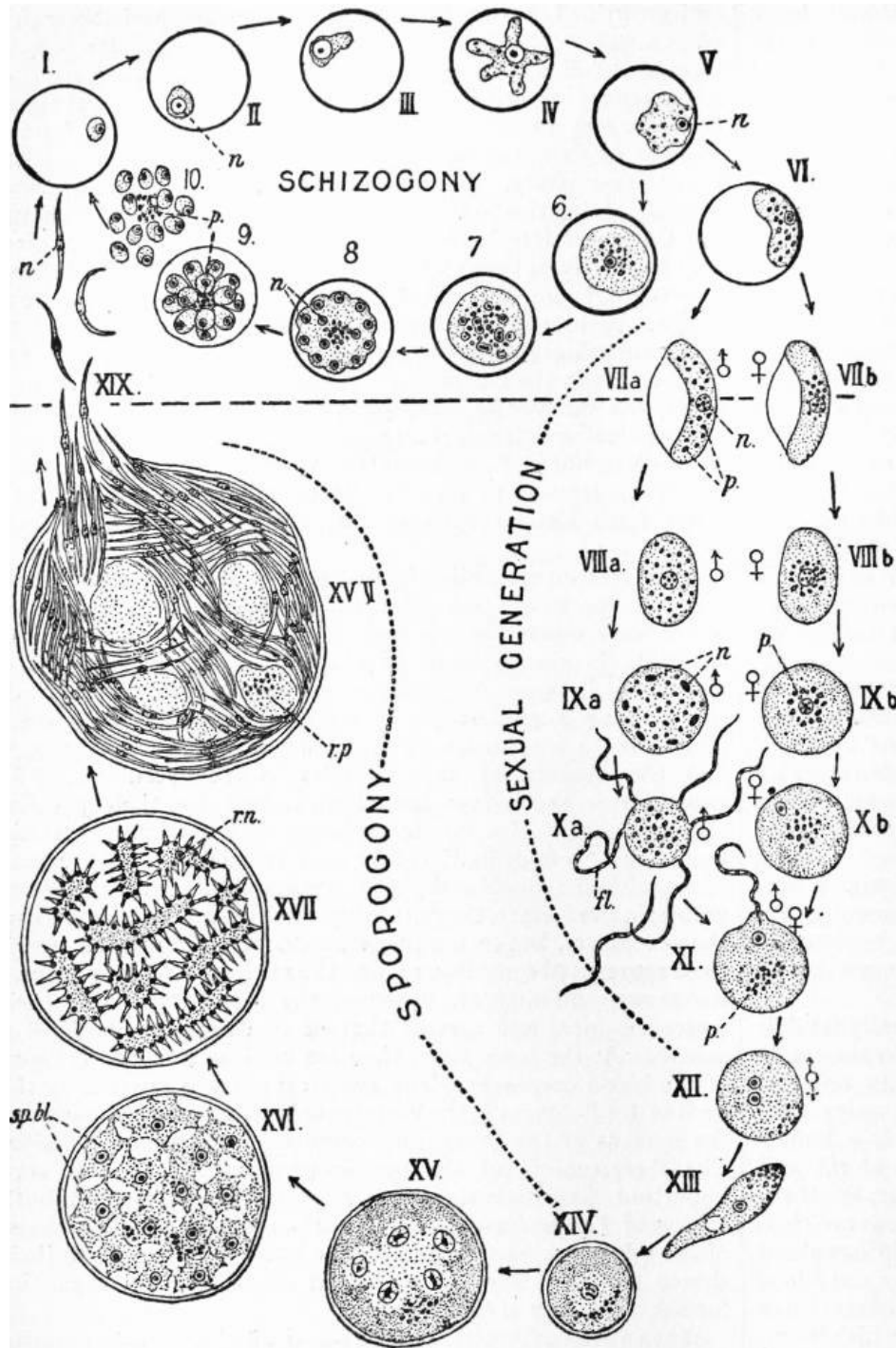
**Example of
the life-
history.**

(*Plasmodium*) will be mentioned in passing, but the main divergences which other Haemosporidian types exhibit are best considered separately. With the bite of an infected mosquito, the minute sickle-like sporozoites are injected into the blood. They rapidly penetrate into the blood corpuscles, in which they appear as small irregular, more or less amoeboid trophozoites. A vacuole next arises in the cytoplasm, which increases greatly in size, and gives rise to the well-known, much discussed ring-form of the parasite, in which it resembles a signet-ring, the nucleus forming a little thickening to one side. Some authorities (*e.g.* Argutinsky) have regarded this structure as being really a greatly distended vesicular nucleus, and, to a large extent, indeed, an artifact, resulting from imperfect fixation; but Schaudinn considers it is a true vacuole, and explains it on the ground of the rapid nutrition and growth. Later on this vacuole disappears, and the grains of pigment make their appearance. The trophozoite is now large and full-grown, and has become rounded and ready for schizogony. The nucleus of the schizont divides several times (more or less directly, by simple or multiple fission) to form a number of daughter-nuclei, which take up a regular position near the periphery. Around these the cytoplasm becomes segmented, giving rise to the well-known *corps en rosace*. Eventually the merozoites, in the form of little round uninuclear bodies, are liberated from the now broken-down corpuscle, leaving behind a certain amount of residual cytoplasm containing the pigment grains. Besides the difference in the time taken by the complete process of schizogony in the various species (see above), there are distinctions in the composition of the rosettes. Thus, in *Laverania*, the number of merozoites formed is very variable; in *Plasmodium vivax* (the tertian parasite) there are only few (9 to 12) merozoites, but in *P. malariae* (the quartan form) they are more numerous, from 12 to 24. The liberated merozoites proceed to infect fresh blood corpuscles and a new endogenous cycle is started.

After asexual multiplication has gone on for some time, sexual forms become developed. According to Schaudinn, the stimulus which determines the production of gametocytes instead of schizonts is the reaction of the host (at the height of a fever period) upon the parasites. A young trophozoite which is becoming a gametocyte is distinguished from one which gives rise to a schizont by its much slower rate of growth, and the absence of any vacuoles in its cytoplasm. The gametocytes themselves are characterized by their peculiar shape, like that of a sausage, whence they are very generally known as "crescents." Male and female gametocytes are distinguished (roughly) by the arrangement of the pigment-grains; in the former, they are fairly evenly scattered throughout the cytoplasm, but in the megagametocytes the pigment tends to be aggregated centrally, around the nucleus. As they become full-grown and mature, however, the gametocytes lose their crescentic form and assume that of an oval, and finally of a sphere. At the same time, they are set free from the remains of the blood corpuscle. The spherical stage is practically the limit of development in the Vertebrate host, although, sometimes, the nucleus of the microgametocyte may proceed to division. The "crescents" of the pernicious parasite afford a very important diagnostic difference from the gametocytes of both species of *Plasmodium*, which have the ordinary, rounded shape of the schizonts. In the case of the latter, points such as their slower growth, their less amoeboid character, and their size furnish the means of distinction.

When a gnat or mosquito sucks blood, all phases of the parasite in the peripheral circulation at that point may succeed in passing into the insect. If this occurs all trophic and schizogonic phases are forthwith digested, and the survival of the sexual phases depends entirely upon whether the insect is a gnat or mosquito. Only in the latter case can further development of the gametocytes go on; in other words, only the genus *Anopheles*, and not the genus *Culex*, furnishes specific hosts for the malarial parasites. This is a biological fact of considerable importance in connexion with the prophylactic measures against malaria. In the stomach of an *Anopheles*, the gametocytes quickly proceed to gamete-formation. The nucleus of the microgametocyte divides up, and the daughter-nuclei pass to the periphery. The surface of the body grows out into long, whip-like processes, of which there are usually 6 to 8 (probably the typical number is 8); each is very motile, in this respect strongly resembling a flagellum. This phase may also develop in drawn blood, which has, of course, become suddenly cooled by the exposure; and it seems evident that it is the change in temperature, from the warm to the cold-blooded host, which brings about the development of the actual sexual elements. Earlier observers regarded the phase just described as representing another parasite altogether, of a Flagellate nature—whence the well-known term, *Polymitus*-form; and even more recent workers, such as Labbé who

connected it with the malarial parasite, failed to appreciate its true significance, and considered it rather as a degeneration-appearance. The micro-gametes soon liberate themselves from the residual cytoplasm of the parent and swim away in search of a megagamete; each is a very slender, wavy filament, composed largely of chromatic substance. The finer details of structure of the microgamete of a malarial parasite cannot be said, however, to be thoroughly known, and it is by no means impossible that its structure is really trypaniform, as, according to Schaudinn's great work, is the case with the merozoites and sporozoites.



From Lankester's *Treatise on Zoology*.

FIG. 1.—Diagram of the complete life-cycle of the parasite of pernicious malaria, *Laverania malariae*, Gr. et Fel. The stages on the upper side of the dotted line are those found in human blood; below the dotted line are seen the phases through which the parasite passes in the intermediate host, the mosquito. Plan and arrangement chiefly after Neveu-Lemaire; details of the figures founded on those of Grassi, Schaudinn (*Leuckart's Zoologische Wandtafeln*), Ross and others.

I.-V. and 6-10 show the schizogony.

VI.-XII., The sexual generation.

XIII., The motile zygote.

XIV.-XIX., Sporogony.

I.-III., Young amoebulae in blood-corpules.

IV., Older, actively amoeboid trophozoite.

V., Still older, less amoeboid trophozoite.

6, Mature schizont.

7, Schizont, with nucleus dividing up.

XI., A male gamete penetrating a female gamete at a cone of reception formed near the nucleus.

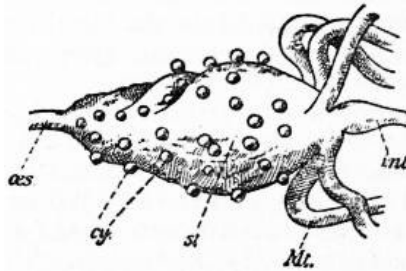
XII., Zygote with two pronuclei in proximity.

XIII., Zygote in the motile stage (vermicule or oökinete).

XIV., Encysted zygote (oöcyst).

XV., Commencing multiplication of the nuclei in the oöcyst.

- 8, Young rosette stage.
 9, Fully formed rosette stage.
 10, Merozoites free in the blood by breaking down of the corpuscle.
 VI., Young indifferent gametocyte.
 VII., *a*, Male crescent.
 VII., *b*, Female crescent.
 VIII., *a* and *b*, The gametocytes becoming oval.
 IX., *a* and *b*, Spherical gametocytes; in the male (IX. *a*) the nucleus has divided up.
 X., *a* and *b*, Formation of gametes; in the male (X. *a*) the so-called flagella or male gametes (*fl*) are thrown out, one of them is seen detached; in the female (X. *b*) a portion of the nucleus has been expelled.
- XVI., Oöcyst with numerous sporoblasts.
 XVII., Commencing formation of sporozoites.
 XVIII., Full-grown oocyst crammed with ripe sporozoites; on one side the cyst has burst and the sporozoites are escaping.
 XIX., Free sporozoites, showing their changes of form.
n, Nucleus of the parasite.
p, Melanin pigment.
fl, "Flagella."
sp. bl., Sporoblasts.
r. n., Residual nuclei.
r. p., Residual protoplasm.



From Lankester's *Treatise on Zoology*.

FIG. 2.—Stomach of a mosquito, with cysts of Haemosporidia. (After Ross.)

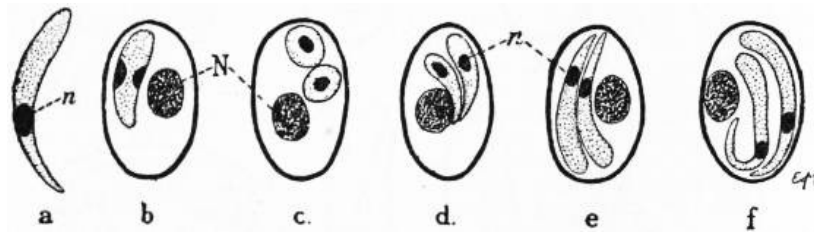
oes, Oesophagus. *Mt*, Malpighian
st, Stomach. tubules.
cy, Cysts. *int*, Intestine.

The megagametocyte becomes a megagamete directly after a process of maturation, which consists in the expulsion of a certain amount of nuclear substance. The actual conjugation is quite similar to the process in Coccidia, and the resulting zygote perfectly homologous. In the present case, however, the zygote does not at once secrete an oöcyst, with a thick resistant wall; on the contrary, it changes its shape, and becomes markedly gregariniform and active, and is known for this reason as an ookinete. The ookinete passes through the epithelial layer of the stomach, the thinner and more pointed end leading the way, and comes to rest in the connective tissue forming the outer layer of the stomach-wall (fig. 2). Here it becomes rounded and cyst-like, and grows considerably; for only a thin, delicate cyst-membrane is secreted, which does not impede the absorption of nutriment. Meanwhile, the nucleus has divided into several, around each of which the cytoplasm becomes segmented. Each of these segments ("blastophores," "zoidophores") is entirely comparable to a sporoblast in the Coccidian oocyst, the chief difference being that it never forms a spore; moreover the segments or sporoblasts in the oocyst of a malarial parasite are irregular in shape and do not become completely separated from one another, but remain connected by thin cytoplasmic strands. Repeated multiplication of the sporoblast-nuclei next takes place, with the result that a great number of little nuclei are found all round the periphery. A corresponding number of fine cytoplasmic processes grow out from the surface, each carrying a nucleus with it, and in this manner a huge number of slender, slightly sickle-shaped germs or sporozoites ("blasts," "zoids," &c.) are formed. Each oocyst may contain from hundreds to thousands of sporozoites.

When the sporogony (which lasts about 10 days) is completed, the oocyst ruptures and the sporozoites are set free into the body-cavity, leaving behind a large quantity of residual cytoplasm, including pigment grains, &c. The sporozoites are carried about by the blood-stream; ultimately, however, apparently by virtue of some chemotactic attraction, they practically all collect in the salivary glands, filling the secretory cells and also invading the ducts. When the mosquito next bites a man, numbers of them are injected, together with the minute drop of saliva, into his blood, where they begin a fresh endogenous cycle.

There is only one other point with regard to the life-history that need be mentioned. With the lapse of time all trophic and schizogonic (asexual) phases of the parasite in the blood die off. But it has long been known that malarial patients, apparently quite cured, may suddenly exhibit all the symptoms again, without having incurred a fresh infection. Schaudinn has investigated the cause of this recurrence, and finds that it is due to the power of the megagametocytes, which are very resistant and long-lived, to undergo a kind of parthenogenesis under favourable conditions

and give rise to the ordinary asexual schizonts, which in turn can repopulate the host with all the other phases. Microgametocytes, on the other hand, die off in time if they cannot pass into a mosquito.



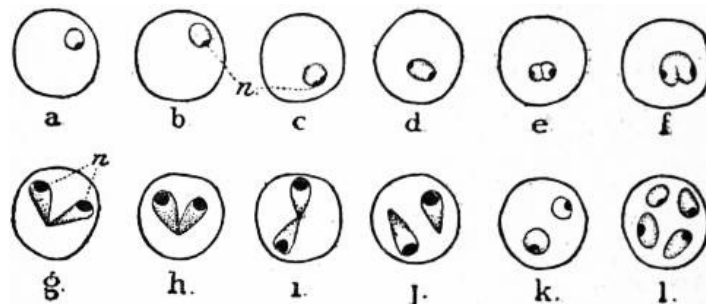
From Lankester's *Treatise on Zoology*.

FIG. 3.—*Haemogregarina bigemina*, Laveran, from the blood of blennies. (After Laveran, magnified about 1800 diameters.)

- | | |
|---|---|
| <p>a, The form of the parasite found free in the blood-plasma.</p> <p>b, Parasite within a blood-corpuscle, preparing for division; the nucleus has already divided.</p> <p>c, The parasite has divided into two rounded corpuscles, which assume the form of the free parasite, as seen in d, e and f.</p> | <p>N, Nucleus of the blood-corpuscle.</p> <p>n, Nucleus of the parasite. The outline of the blood-corpuscle is indicated by a thick black line.</p> |
|---|---|

Various types of form are to be met with among the Haemosporidia. In one, characteristic of most (though not of absolutely all) parasites of warm-blooded Vertebrates, the trophozoites are of irregular amoeboid shape; hence this section is generally known as the *Haemamoebidae*. In another type, characteristic of the parasites of cold-blooded Vertebrates, the body possesses a definite, vermiform, *i.e.* gregariniform shape, which is retained during the intracorpuseular as well as during the free condition; this section comprises the *Haemogregarinidae*. Allied to this latter type of form are the trophozoites of *Piroplasma*, which are normally pear-shaped; they differ, however, in being very minute, and, moreover, exhibit considerable polymorphism, rod-like (so-called bacillary) and ring-forms being of common occurrence. It is important to note that in a certain species of *Haemogregarina* (fig. 3) the young trophozoites markedly resemble *Piroplasma* in their pyriform appearance; and a further point of agreement between the two forms is mentioned below. Lastly there is the Avian genus *Halteridium*, the trophozoites of which are characteristically bean-shaped or reniform. True Haemogregarines also differ in other slight points from "Haemamoebae." Thus the young endoglobular trophozoite does not exhibit a ring (vacuolar) phase; and the cytoplasm never contains, at any period, the characteristic melanin pigment above noted. In some species of *Haemogregarina* the parasite, while intracorpuseular, becomes surrounded by a delicate membrane, the cytocyst; on entering upon an active, "free" period, the cytocyst is ruptured and left behind with the remains of the corpuscle. A very interesting cytological feature is the occurrence, in one or two Haemosporidia, of nuclear dimorphism, *i.e.* of a larger and smaller chromatic body, probably comparable to the trophic and kinetic nuclei of a Trypanosome, or of the "Leishman-Donovan" bodies. Schaudinn was the first to notice this character, in *Piroplasma canis*, and his observation has since been confirmed by Lühe.⁴ Moreover, Brumpt has also noticed nuclear dimorphism in the ookinete of a species of *Haemogregarina* in a leech (as the Invertebrate host)—a highly important observation.

As regards the life-history, the endogenous (schizogonous) cycle is known in many cases. Sometimes schizogony takes the primitive form of simple binary (probably) longitudinal fission; this is the case in *Piroplasma* (fig. 4) and also in *Haemogregarina bigemina* just referred to. From this result the pairs of individuals ("twins") so often found in the corpuscles. In addition, however, at any rate in *Piroplasma*, it is probable that multiple division (more allied to ordinary schizogony) also takes place; such is the case, according to Laveran, in *P. equi*, and the occurrence at times of four parasites in a corpuscle, arranged in a cruciform manner, is most likely to be thus explained. Labbé has described schizogony in *Halteridium danilewskyi* as taking place in a rather peculiar manner; the parasite becomes much drawn-out and halter-like, and the actual division is restricted to its two ends, two clumps of merozoites being formed, at first connected by a narrow strand of unused cytoplasm, which subsequently disappears. Some doubt, however, attaches to this account, as no one else appears to have seen the process. For the rest, schizogony takes place more or less in the customary way, allowing for variations in the mode of arrangement of the merozoites. It remains to be noted that in *Karyolysus lacertarum*, according to Labbé, two kinds of schizont are developed, which give rise, respectively, to micromerozoites and megamerozoites, in either case enclosed in a delicate cytocyst. This probably corresponds to an early sexual differentiation (such as is found among certain Coccidia (*q.v.*), the micromerozoites producing eventually micro-gametocytes, the others megagametocytes.



From Lankester's *Treatise on Zoology*.

FIG. 4.—Development and schizogony of *Piroplasma bigeminum* in the blood-corpuscles of the ox. (After Laveran and Nicolle.)

- | | |
|---|--|
| <p>a, Youngest form.
b, Slightly older.
c and d, Division of the nucleus.</p> | <p>e and f, Division of the body of the parasite.
g, h, i, j, Various forms of the twin parasite.
k and l, Doubly infected corpuscles.</p> |
|---|--|

It has now been recognized for some time that the sexual (exogenous) part of the life-cycle of all the *Haemamoebidae* takes place in an Invertebrate (Insectan) host, and is fundamentally similar to that above described in those cases where it has been followed. In contradistinction to the malarial parasites, this host, in the Avian forms (*Haemoproteus* and *Halteridium*)⁵ is a species of *Culex* and not of *Anopheles*; in other words, gamete-formation, conjugation and subsequent sporozoite-formation in these cases will only go on in the former. On the other hand, in the case of the Haemogregarines, it was thought until quite lately that the entire life-history, including conjugation and sporogony, went on in the Vertebrate host; and only in 1902 Hintze described what purported to be the complete life-history of *Lankesterella* (*Drepanidium*) *ranarum* undergone in the frog. This view was rendered obsolete by the work of Siegel and Schaudinn, who demonstrated the occurrence of an alternation of hosts and of generations in the case of *Haemogregarina stepanovi*, parasitic in a tortoise, and in *Karyolysus lacertarum*; the Invertebrate hosts, in which, in both cases, the sexual process is undergone, being respectively a leech (*Placobdella*) and a tick (*Ixodes*). With this discovery the main distinction (as supposed) between the Haemosporidia of warm and of cold-blooded Vertebrates vanished. It was further acknowledged by Schaudinn (under whom Hintze had worked) that the latter had been misled by Coccidian cysts and spores, which he took for those of *Lankesterella*. The gametogony and sporogony of *Haemogregarina stepanovi* in the leech agree in essential particulars with the process above described. The microgametes are extremely minute, and the sporozoites, which are developed in the salivary glands, where the motile ookinetes finally come to rest, are extremely "spirochaetiform"—the full significance of this latter fact being, perhaps, not appreciated.

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Christophers recently described some remarkable phases which he regarded as belonging to the cycle of *Haemogregarina gerbilli* (one of the few Mammalian Haemogregarines known) in a louse (*Haematopinus*). In a private communication, however, the author states that he has probably mistaken phases in the development of an ordinary gregarine parasite in the louse for part of the life-cycle of this Haemogregarine.

The Mammalian parasite *Piroplasma* is the one about whose life-history our knowledge is most vague. Besides the typical and generally occurring forms, others have also been observed in the blood, but it is doubtful how far these are to be looked upon as normal; for instance, Bowhill and Le Doux have described, in various species, a phase in which a long, slender pseudopodial-like outgrowth is present, with a swelling at the distal end. It is, moreover, quite uncertain which are the sexual forms, comparable to gametocytes. Doflein regards large pear-shaped forms as such (megagametocytes?), which become spherical when maturing; and Nocard and Motas have figured amoeboid, irregular forms, with the nucleus fragmented and possessing flagella-like processes (possibly microgametes?). The Invertebrate host is well known to be, in the case of all species, a tick; thus bovine piroplasmiasis (*P. bigeminum*) in America is conveyed by *Rhipicephalus annulatus* (*Boophilus bovis*), canine piroplasmiasis (*P. canis*) in South Africa by *Haemaphysalis leachi* (and perhaps *Dermacentor reticulatus*), and so on. The manner in which the infection is transmitted by the tick varies greatly. In some cases (e.g. *P. bigeminum* and *P. canis*) only the generation subsequent to that which receives the infection (by feeding on an infected ox) can transmit it back again to another ox; in other words, true hereditary infection of the ova in the mother-tick is found to occur. The actual period in the life of the daughter-tick at which it can convey the infection apparently varies. On the other hand, in the case of East African coast-fever, Theiler found that hereditary infection does not occur, the same generation transmitting the parasite (*P. parvum*) at different periods of life. Little is certainly known regarding the phases of the parasite which are passed through in the tick. Lignières has observed a kind of multiple fission in the stomach, several very minute bodies, consisting mostly of

chromatin, being formed, which may serve for endogenous reproduction. Koch has published an account of certain curious forms of *P. bigeminum*, in which the body is produced into many stiff, ray-like processes, giving the appearance of a star; according to him fusion of such forms takes place, and the resulting zygote becomes rounded, perhaps transitional to the pear-shaped forms.

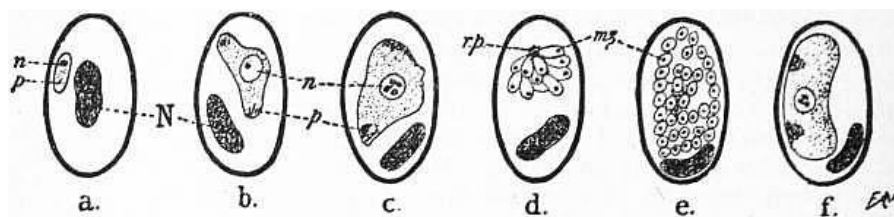
The classification and nomenclature of the Haemosporidia are in a very unsettled condition. For an account of the various systems and modifications hitherto adopted, the article of Minchin (see under **SPOROZOA: Bibliography**) should be consulted. With the realization that the life-history in the case of the "Haemamoebae" and the Haemogregarines is fundamentally similar in type, the chief reason for grouping them as distinct suborders has disappeared. It is most convenient to regard them as separate, but closely allied families, the *Plasmodidae* ("Haemamoebidae") and the *Haemogregarinidae*. The *Piroplasmata*, on the other hand, constitute another family, which is better placed in a distinct section or suborder. In addition there are, as already noted, two or three genera whose systematic position must be considered as quite uncertain. One is the well-known *Halteridium* of Labbé, parasitic in various birds; the type-species is *H. danilewskyi* (Gt. and Fel.). Another is the much-debated parasite of white blood-corpuses (leucocytes), originally described in birds by Danilewsky under the name of *Leucocytozoon*, a form of which has been recently observed in Mammals.

In conclusion, the chief members of the above-mentioned families may be enumerated.

Fam. *Plasmodidae* ("Haemamoebidae").

Genus *Laverania*, Gr. and Fel. (syn. *Haemamoenas*, Ross), for *L. malariae*, Gr. and Fel. (synn. *L. s. Plasmodium*, s. "Haemamoeba," &c., *praecox s. immaculatum*, &c.), the parasite of pernicious malaria. Genus *Plasmodium*, March. and Celli (syn. "Haemamoeba") for *P. vivax* and *P. malariae*, the tertian and quartan parasite, respectively. There is also a form known in apes, *P. kochi*. Genus *Haemoproteus*, Kruse (syn. *Proteosoma*), for *H. danilewskyi* (syn. *Proteosoma grassi*, *Plasmodium praecox*, &c.), parasitic in numerous birds. Recently, another form has been described, from reptiles, which Castellani and Willey have termed *Haemocystidium simondi*.

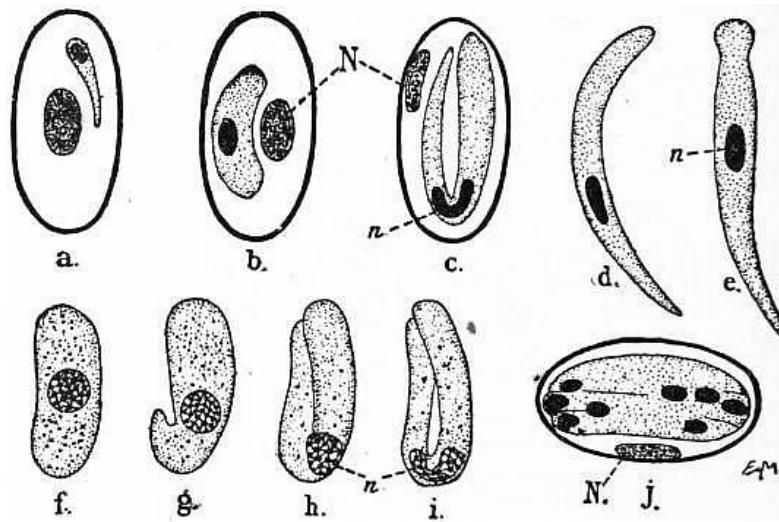
Remarks.—The distinguishing characters of the malarial parasites have been mentioned above. Some authorities would include *Laverania* in the genus *Plasmodium*, as differing only specifically from the other two forms. It has, moreover, been suggested by Sergent that all three are merely different phases of the same parasite, predominating at different seasons; this idea cannot be regarded, however, as in any way proved so far. From what is known of the morphology and mode of manifestation of these forms, the differences between *Laverania* and the two species of *Plasmodium* are considerably more pronounced than those between *P. vivax* and *P. malariae*; if the latter are to be considered as distinct species, the first-named is probably generically distinct. Lühe, it may be noted, in his recent comprehensive account of the Haematozoa, also takes this view. Lastly, whatever be the correct solution of the above problem, there is certainly not sufficient justification for including the Avian genus *Haemoproteus*, as also only a species of *Plasmodium*, which is done by some. Its different Vertebrate habitat, and also the fact that its Insectan definitive host is *Culex* and not *Anopheles*, differentiate it sharply from *Laverania* and *Plasmodium*.



From Lankester's *Treatise on Zoology*.

FIG. 5.—*Haemoproteus danilewskyi*, Kruse (parasite of various birds). × about 1200. *a*, *b*, *c* and *d* from the chaffinch; *d* and *e* from the lark. (After Labbé.)

- | | |
|---|---|
| <p><i>a</i>, Young trophozoite in a blood-corpusele,
 <i>b</i> and <i>c</i>, Older trophozoite.
 <i>d</i> and <i>e</i>, Sporulation.
 <i>d</i>, Precocious sporulation with few merozoites.
 <i>e</i>, Sporulation of a full-grown schizont, with numerous merozoites.
 <i>f</i>, Gametocyte.</p> | <p>N, Nucleus of blood-corpusele.
 <i>n</i>, Nucleus of parasite.
 <i>p</i>, Pigment.
 <i>mz</i>, Merozoites.
 <i>r.p</i>, Residual protoplasm.</p> |
|---|---|



From Lankester's *Treatise on Zoology*.

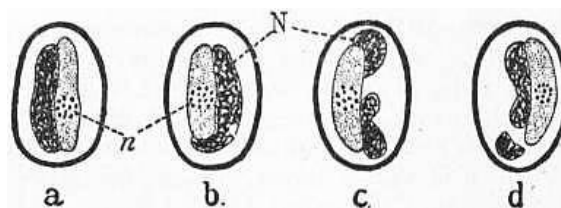
FIG. 6.—*Haemogregarina stepanovi*, Danilewsky (par. *Emys* and *Cistudo*), phases of the schizogony. (*a-e* and *j* after Laveran; *f-i* after Börner.) $\times 1000$ to 1200 diameters.

- a*, Blood-corpuscle with young trophozoite.
b, Older trophozoite.
c, Full-grown trophozoite, ready to leave the corpuscle.
d and *e*, Trophozoites free in the blood-plasma, showing changes of form.
f-i, Trophozoites, still within the blood-corpuscle (not drawn), showing the structure of the nucleus, the coarse chromatoid granules in the protoplasm and the manner in which the parasite grows into the U-shaped Haemogregarine without increase of body-mass.
j, Commencement of sporulation; the nucleus has divided into eight nuclei, and the body of the parasite is beginning to divide up into as many merozoites within a blood-corpuscle.
 N, Nucleus of the blood-corpuscle.
 n, Nucleus of the parasite.

Fam. *Haemogregarinidae*.—The different genera are characterized chiefly by their size relative to the blood-corpuscles, and their disposition in the latter. Here, again, it has been suggested to unite the various types all in one genus, *Haemogregarina*, but this seems at least premature when it is remembered how little is known in most cases of the life-cycle, which may prove to exhibit important divergences.

Genus *Haemogregarina*, Danilewsky (syn. *Danilewskyia*, Labbé). The body of the parasite exceeds the blood-corpuscle in length, when adult, and is bent upon itself, like a U. A very great number of species are known, mostly from reptiles and fishes; among them may be mentioned *H. stepanovi* (fig. 6), from *Emys* and *Cistudo*, whose sexual-cycle in a leech has been worked out by Siegel (see above), *H. delagei*, from *Raja*, *H. bigemina*, from blennies, and *H. simondi*, from soles. Recently one or two Mammalian forms have been observed, *H. gerbilli*, from an Indian rat (*Gerbillus*), and *H. jaculi*, from the jerboa.

Genus *Lankesterella*, Labbé (syn. *Drepanidium*, Lankester). The parasite is not more than three-quarters the length of the corpuscle. *L. ranarum* from *Rana* is the type-species; another, recently described by Fantham, is *L. tritonis*, from the newt.



From Lankester's *Treatise on Zoology*.

FIG. 7.—*Karyolysus lacertarum* (Danil.), in the blood-corpuscles of *Lacerta muralis*, showing the effects of the parasite upon the nucleus of the corpuscle. In *c* and *d* the nucleus is broken up. N, Nucleus of the corpuscle; n, nucleus of the parasite, seen as a number of masses of chromatin, not enclosed by a distinct membrane. (After Marceau.)

Genus *Karyolysus*, Labbé. The parasite does not exceed the corpuscle in length; the forms included in this genus, moreover, although not actually intranuclear, have a marked karyolytic and disintegrating action upon the nucleus of the corpuscle. The type-species is the well-known *K. lacertarum*, of lizards; another is *K. (Haemogregarina) viperini*, from *Tropidonotus*.

In the section of the *Piroplasmata* there is only the genus *Piroplasma*, Patton (synn. *Babesia*, Starcovici, *Pyrosoma*, Smith and Kilborne), the principal species of which are as follows: *P. bigeminum*, the cause of Texas cattle-fever, tick-fever (Rinder-malaria) of South Africa, and *P. bovis*, causing haemoglobinuria of cattle in Southern Europe; there is some uncertainty as to whether these two are really distinct; *P. canis*, *P. ovis* and *P. equi* associated, respectively, with those animals. Lately, a very small form, *P. parvum*, has been described by Theiler in Rhodesia, which causes East-African coast-fever; and another, *P. muris*, has been observed in white rats by Fantham.

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(H. M. Wo.)

- 1 Compare, for example, the flagellated granules of certain Coccidia, which point unmistakably to a Flagellate ancestry.
- 2 A possible exception is a doubtful species of *Haemogregarina*, which has been described from the walls of the blood-vessels of an Annelid.
- 3 For an interesting account of the biological relations between parasites and their hosts, and the penalty Man pays for his roving propensities, the reader should see Lankester's article in the *Quarterly Review*, July 1904.
- 4 This does away with one of the principal reasons on account of which some authorities consider *Piroplasma (Leishmania) donovani* as quite distinct from other *Piroplasmata* (see [TRYPANOSOMES](#)).
- 5 It must not be forgotten that one species of *Halteridium (H. [Trypanomorpha] noctuae)* is said to have well-marked trypaniform phases in its life-cycle; these are preferably considered under *Trypanosomes (q.v.)*, and therefore, to avoid repetition, are only thus alluded to here. Whether *H. danilewskyi* also becomes trypaniform in certain phases, and how far it really agrees with the criteria of a Haemosporidian above postulated, are matters which are not yet definitely known.

HAETZER, or HETZER, **LUDWIG** (d. 1529), Swiss divine, was born in Switzerland, at Bischofszell, in Thurgau. He studied at Freiburg-im-Breisgau, and began his career in a chaplaincy at Wadenswil, on the Lake of Zürich. At this time his attachment to the old faith was tempered by a mystical turn, and by a devotion to the prophetic writings of the Old Testament, which he studied in the original. By 1523 we find him in Zürich, where he published, at first anonymously and in Latin (*Judicium Dei*), later with his name and in German (Sept. 24, 1523), a small tract against the religious use of images, and bearing the motto attached to all his subsequent works, "O Got erlösz die (or dein) Gefangnen" ("O God, set the prisoners free"). An attempt to give effect to the teaching of this (frequently reprinted) tract was followed by a public religious disputation, of which Haetzer drew up the official account. In 1524 he brought out a tract on the conversion of the Jews, and published a German version of Johann Bugenhagen's brief exposition of the epistles of St Paul (Ephesians to Hebrews); in the dedication (dated Zürich, June 29, 1524) he undertakes to translate Bugenhagen's comment on the Psalter. He then went to Augsburg, bearing Zwingli's introduction to Johann Frosch. Here he came for a time under the influence of Urbanus Regius, and was for a short time the guest of Georg Regel. Returning to Zürich, he was in intercourse with leading Anabaptists (though his own position was simply the disuse of infant baptism) till their expulsion in January 1525. Again resorting to Augsburg, and resuming work as corrector of the press for his printer Silvan Ottmar, he pushed his views to the extreme of rejecting all sacraments, reaching something like the mystical standpoint of the early Quakers. He was expelled from Augsburg in the autumn of 1525, and made his way through Constance to Basel, where Oecolampadius received him kindly. He translated into German the first treatise of Oecolampadius on the Lord's Supper (in which the words of institution are taken figuratively), and proceeding to Zürich in November, published his version there in February 1526, with a preface disclaiming connexion with the Anabaptists. His relations with Zwingli were difficult; returning to Basel he published (July 18, 1526) his translation of Malachi, with Oecolampadius's exposition, and with a preface reflecting on Zwingli. This he followed by a version of Isaiah xxxvi.-xxxvii. He next went to Strassburg, and was received by Wolfgang Capito. At Strassburg in the late autumn of 1526 he fell in with Hans Dengk or Denck, who collaborated with him in the production of his *opus magnum*, the translation of the Hebrew Prophets, *Alle Propheten nach hebraischer Sprach vertuetscht*. The preface is dated Worms, 3 April 1527; and there are editions, Worms, 13 April 1527, folio; Augsburg, 22 June 1527, folio; Worms, 7 Sept. 1527, 16^o; and Augsburg, 1528, folio. It was the first Protestant version of the prophets in German, preceding Luther's by five years, and highly spoken of by him. Haetzer and Denck now entered on a propagandist mission from place to place, with some success, but of short duration. Denck died at Basel in November 1527. Haetzer was arrested at Constance in the summer of 1528. After long imprisonment and many examinations he was condemned on the 3rd of February 1529 to die by the sword, and the sentence was executed on the following day. His demeanour on the scaffold impressed impartial witnesses, Hans Zwick and Thomas Blaurer, who speak warmly of his fervour and courage. The Dutch Baptist Martyrology describes him as "a servant of Jesus Christ." The Moravian Chronicle says "he was condemned for the sake of divine truth." His papers included an unpublished treatise against the essential deity of Christ, which was suppressed by Zwingli; the only extant evidence of his anti-trinitarian views being contained in

eight quaint lines of German verse preserved in Sebastian Frank's *Chronica*. The discovery of his heterodox Christology (which has led modern Unitarians to regard him as their proto-martyr) was followed by charges of loose living, never heard of in his lifetime, and destitute of evidence or probability.

See Breiting, "Anecdota quaedam de L. H." in *Museum Helveticum* (1746), parts 21 and 23; Wallace, *Antitrinitarian Biography* (1850); *Dutch Martyrology* (Hanserd Knollys Society) (1856); Th. Keim, in Hauck's *Realencyklopädie* (1899).

(A. Go.*)

HĀFĪZ. Shams-ud-din Mahommed, better known by his *takhallus* or *nom de plume* of Hāfiz, was one of the most celebrated writers of Persian lyrical poetry. He was born at Shiraz, the capital of Fars, in the early part of the 8th century of the Mahommedan era, that is to say, in the 14th of our own. The exact date of his birth is uncertain, but he attained a ripe old age and died in 791 A.H. (A.D. 1388). This is the date given in the chronogram which is engraved on his tomb, although several Persian biographers give a different year. Very little is actually known about his life, which appears to have been passed in retirement in Shiraz, of which he always speaks in terms of affectionate admiration. He was a subject of the Muzaffar princes, who ruled in Shiraz, Yazd, Kirman and Ispahan, until the dynasty was overthrown by Timur (Tamerlane). Of these princes his especial patrons were Shah Shujā' and Shah Mansūr. He early devoted himself to the study of poetry and theology, and also became learned in mystic philosophy, which he studied under Shaik Mahmūd 'Aṭṭār, chief of an order of dervishes. Hāfiz afterwards enrolled himself in the same order and became a professor of Koranic exegesis in a college which his friend and patron Haji Kiwam-ud-din, the vizier, specially founded for him. This was probably the reason of his adopting the sobriquet of Hāfiz ("one who remembers"), which is technically applied to any person who has learned the Koran by heart. The restraints of an ascetic life seem to have been very little to Hāfiz's taste, and his loose conduct and wine-bibbing propensities drew upon him the severe censure of his monastic colleagues. In revenge he satirizes them unmercifully in his verses, and seldom loses an opportunity of alluding to their hypocrisy. Hāfiz's fame as a poet was soon rapidly spread throughout the Mahommedan world, and several powerful monarchs sent him presents and pressing invitations to visit them. Amongst others he was invited by Mahmūd Shah Bahmani, who reigned in the south of India. After crossing the Indus and passing through Lahore he reached Hurmuz, and embarked on board a vessel sent for him by the Indian prince. He seems, however, to have been a bad sailor, and, having invented an excuse for being put ashore, made the best of his way back to Shiraz. Some biographies narrate a story of an interview between Hāfiz and the invader Timur. The latter sent for him and asked angrily, "Art thou he who was so bold as to offer my two great cities Samarkand and Bokhara for the black mole on thy mistress's cheek?" alluding to a well-known verse in one of his odes. "Yes, sire," replied Hāfiz, "and it is by such acts of generosity that I have brought myself to such a state of destitution that I have now to solicit your bounty." Timur was so pleased at his ready wit that he dismissed the poet with a handsome present. Unfortunately for the truth of this story Timur did not capture Shiraz till A.D. 1393, while the latest date that can be assigned to Hāfiz's death is 1391. Of his private life little or nothing is known. One of his poems is said to record the death of his wife, another that of a favourite unmarried son, and several others speak of his love for a girl called *Shākh i Nabat*, "Sugar-cane branch," and this is almost all of his personal history that can be gathered from his writings. He was, like most Persians, a Shi'ite by religion, believing in the transmission of the office of Imām (head of the Moslem Church) in the family of Ali, cousin of the prophet, and rejecting the *Hadith* (traditional sayings) of Mahomet, which form the Sunna or supplementary code of Mahommedan ceremonial law. One of his odes which contains a verse in praise of Ali is engraved on the poet's tomb, but is omitted by Sudi, the Turkish editor and commentator, who was himself a rigid Sunnite. Hāfiz's heretical opinions and dissipated life caused difficulties to be raised by the ecclesiastical authorities on his death as to his interment in consecrated ground. The question was at length settled by Hāfiz's own works, which had then already begun to be used, as they are now throughout the East, for the purposes of divination, in the same manner as Virgil was employed in the middle ages for the divination called *Sortes Virgilianae*. Opening the book at random after pronouncing the customary formula asking for inspiration, the objectors hit upon the following verse—"Turn not away thy foot from the bier of Hāfiz, for though immersed in sin, he will be admitted into Paradise." He was accordingly buried in the centre of a small cemetery at Shiraz, now included in an enclosure called the Hāfiziyyeh.

His principal work is the *Dīwān*, that is, a collection of short odes or sonnets called *ghazals*, and consisting of from five to sixteen *baits* or couplets each, all the couplets in each ode having the same rhyme in the last hemistich, and the last couplet always introducing the poet's own *nom de plume*. The whole of these are arranged in alphabetical order, an arrangement which certainly

facilitates reference but makes it absolutely impossible to ascertain their chronological order, and therefore detracts from their value as a means of throwing light upon the growth and development of his genius or the incidents of his career. They are often held together by a very slender thread of continuous thought, and few editions agree exactly in the order of the couplets. Still, a careful study of them, especially from the point of view indicated by the Sufiistic system of philosophy, will always show that a single idea does run throughout the whole. The nature of these poems has been the subject of much discussion in the West, some scholars seeing in their anacreontic utterances nothing but sensuality and materialism, while others, following the Oriental school, maintain that they are wholly and entirely mystic and philosophic. Something between the two would probably be nearer the truth. It must be remembered that Hāfiz was a professed dervish and Sūfi, and that his *ghazals* were in all probability published from a *takia*, and arranged with at least a view to Sufiistic interpretation. At the same time it is ridiculous to suppose that the glowing imagery, the gorgeous and often tender descriptions of natural beauties, the fervent love passages, and the roystering drinking songs were composed in cool blood or with deliberate ascetic purpose. The beauty of Hāfiz's poetry is that it is natural. It is the outcome of a fervent soul and a lofty genius delighting in nature and enjoying life; and it is the poet's misfortune that he lived in an age and amongst a people where rigid conventionality demanded that his free and spontaneous thoughts should be recast in an artificial mould.

Besides the *Dīwān*, Hāfiz wrote a number of other poems; the Leipzig edition of his works contains 573 *ghazals* (forming the *Dīwān*), 42 *kit'as* or fragments, 69 *ruba'iyāt* or tetrastics, 6 *masnaviyāt* or poems in rhyming couplets, 2 *kasāid*, idylls or panegyrics, and 1 *mukhammes* or poem in five-line strophes. Other editions contain several *tarji'-band* or poems with a refrain. The whole *Dīwān* was translated into English prose by H. Wilberforce Clarke in 1891, with introduction and exhaustive commentary and bibliography; a few rhyming versions of single poems by Sir William Jones, J. Nott, J. Hindley, Falconer, &c., are to be found scattered through the pages of the *Oriental Miscellany* and other periodicals, and a fine edition containing a verse rendering of the principal poems by H. Bicknell appeared in 1875. Other selections by S. Robinson (1875), A. Rogers (1889), J. H. M'Carthy (1893), and Gertrude L. Bell (1897). The principal German versions are by von Hammer Purgstall (1812), which gave the first impulse to Goethe's *Westöstlicher Diwan*; a rhyming and rhythmical translation of a large portion of Hāfiz's works by Vincenz von Rosenzweig of Vienna (Vienna, 1858), which contains also the Persian text and notes; *Der Diwan des Schemseddin Muhammed Hāfis*, by G. H. F. Nesselmann (Berlin, 1865), in which the rhyming system of the original is imitated. Besides these, the reader may consult d'Herbelot, *Bibliothèque orientale*, article "Hafiz"; Sir William Ouseley's *Oriental Collections* (1797-1798); *A Specimen of Persian Poetry, or Odes of Hafiz*, by John Richardson (London, 1802); *Biographical Notices of Persian Poets*, by Sir Gore Ouseley (Oriental Translation Fund, 1846); and an excellent article by Professor E. B. Cowell in *Macmillan's Magazine* (No. 177, July 1874); J. A. Vullers, *Vitae poëtarum Persicorum* (1839, translated from Daulatshah); S. Robinson, *Persian Poetry for English Readers* (1883). The best edition of the text is perhaps that edited by Hermann Brockhaus of Leipzig (1854-1856), which is based on the Turkish edition of the Turkish editor Sudi, and contains his commentary in Turkish on the first eighty *ghazals*. See also H. Ethé in *Grundriss der iranischen Philologie*, ii. (Strassburg, 1896); P. Horn, *Geschichte der persischen Literatur* (Leipzig, 1901).

(E. H. P.)

HAG. (1) (Probably a shortened form of the O. Eng. *hægtesse*, *hegtes*, cognate with Ger. *Hexe*, witch, Dutch *hecse*), a word common during the 16th and 17th centuries for a female demon or evil spirit, and so particularly applied to such supernatural beings as the harpies and fairies of classical mythology, and also to witches. In modern usage the word is generally used of a hideous old woman whose repulsive exterior is accompanied by malice or wickedness. The name is also used of an eel-like parasitic fish, *Myxine glutinosa*, allied to the lamprey.

(2) A word common in Scottish and northern English dialects for an enclosed piece of wood, a copse. This is the same word as "hedge" (see [HEDGES](#)) and "haw." "Hag" also means "to cut," and is used in Scotland of an extent of woodland marked out for felling, and of a quantity of felled wood. This word is also used of a cutting in the peat of a "moss" or "bog," and hence applied to the small plots of firm ground or heather in a bog; it is common in the form "moss-hags."

HAGEDORN, FRIEDRICH VON (1708-1754), German poet, was born on the 23rd of April

1708 at Hamburg, where his father, a man of scientific and literary taste, was Danish minister. He was educated at the gymnasium of Hamburg, and later (1726) became a student of law at Jena. Returning to Hamburg in 1729, he obtained the appointment of unpaid private secretary to the Danish ambassador in London, where he lived till 1731. Hagedorn's return to Hamburg was followed by a period of great poverty and hardship, but in 1733 he was appointed secretary to the so-called "English Court" (*Englischer Hof*) in Hamburg, a trading company founded in the 13th century. He shortly afterwards married, and from this time had sufficient leisure to pursue his literary occupations till his death on the 28th of October 1754. Hagedorn is the first German poet who bears unmistakable testimony to the nation's recovery from the devastation wrought by the Thirty Years' War. He is eminently a social poet. His light and graceful love-songs and anacreontics, with their undisguised *joie de vivre*, introduced a new note into the German lyric; his fables and tales in verse are hardly inferior in form and in delicate persiflage to those of his master La Fontaine, and his moralizing poetry re-echoes the philosophy of Horace. He exerted a dominant influence on the German lyric until late in the 18th century.

The first collection of Hagedorn's poems was published at Hamburg shortly after his return from Jena in 1729, under the title *Versuch einiger Gedichte* (reprinted by A. Sauer, Heilbronn, 1883). In 1738 appeared *Versuch in poetischen Fabeln und Erzählungen*; in 1742 a collection of his lyric poems, under the title *Sammlung neuer Oden und Lieder*; and his *Moralische Gedichte* in 1750. A collection of his entire works was published at Hamburg after his death in 1757. The best is J. J. Eschenburg's edition (5 vols., Hamburg, 1800). Selections of his poetry with an excellent introduction in F. Muncker's *Anakreontiker und preussisch-patriotische Lyriker* (Stuttgart, 1894). See also H. Schuster, *F. von Hagedorn und seine Bedeutung für die deutsche Literatur* (Leipzig, 1882); W. Eigenbrodt, *Hagedorn und die Erzählung in Reimversen* (Berlin, 1884).

HAGEN, FRIEDRICH HEINRICH VON DER (1780-1856), German philologist, chiefly distinguished for his researches in Old German literature, was born at Schmiedeberg in Brandenburg on the 19th of February 1780. After studying law at the university of Halle, he obtained a legal appointment in the state service at Berlin, but in 1806 resigned this office in order to devote himself exclusively to letters. In 1810 he was appointed *professor extraordinarius* of German literature in the university of Berlin; in the following year he was transferred in a similar capacity to Breslau, and in 1821 returned to Berlin as *professor ordinarius*. He died at Berlin on the 11th of June 1856. Although von der Hagen's critical work is now entirely out of date, the chief merit of awakening an interest in old German poetry belongs to him.

His principal publications are the *Nibelungenlied*, of which he issued four editions, the first in 1810 and the last in 1842; the *Minnesinger* (Leipzig, 1838-1856, 4 vols, in 5 parts); *Lieder der ältern Edda* (Berlin, 1812); *Gottfried von Strassburg* (Berlin, 1823); a collection of Old German tales under the title *Gesamtabenteuer* (Stuttgart, 1850, 3 vols.) and *Das Heldenbuch* (Leipzig, 1855). He also published *Über die ältesten Darstellungen der Faustsage* (Berlin, 1844); and from 1835 he edited *Das neue Jahrbuch der Berlinischen Gesellschaft für deutsche Sprache und Altertumskunde*. His correspondence with C. G. Heyne and G. F. Benecke was published by K. Dziatzko (Leipzig, 1893).

HAGEN, a town of Germany, in the Prussian province of Westphalia. Pop. (1905), 77,498. It lies amid well-wooded hills at the confluence of the Ennepe with the Volme, 15 m. N.E. of Elberfeld, on the main line to Brunswick and Berlin, and at the junction of important lines of railway, connecting it with the principal towns of the Westphalian iron district. It has five Evangelical churches, a Roman Catholic church, an Old Catholic church, a synagogue, a gymnasium, realgymnasium, and a technical school with special classes for machine-building. There are also a museum, a theatre, and a prettily arranged municipal park. Hagen is one of the most flourishing commercial towns in Westphalia, and possesses extensive iron and steel works, large cotton print works, woollen and cotton factories, manufactures of leather, paper, tobacco, and iron and steel wares, breweries and distilleries. There are large limestone quarries in the vicinity and also an alabaster quarry.

HAGENAU, a town of Germany, in the imperial province of Alsace-Lorraine, situated in the middle of the Hagenau Forest, on the Moder, and on the railway from Strassburg to Weissenburg, 10 m. N.N.E. of the former city. Pop. (1905), 18,500. It has two Evangelical and two ancient Catholic churches (one dating from the 12th, the other from the 13th century), a gymnasium, a public library, a hospital, and a theatre. The principal industries are wool and cotton spinning, and the manufacture of porcelain, earthenware, boots, soap, oil, sparkling wines and beer. There is also considerable trade in hops and vegetables. Hagenau is an important military centre and has a large garrison, including three artillery battalions.

Hagenau dates from the beginning of the 12th century, and owes its origin to the erection of a hunting lodge by the dukes of Swabia. The emperor Frederick I. surrounded it with walls and gave it town rights in 1154. On the site of the hunting lodge he founded an imperial palace, in which were preserved the jewelled imperial crown, sceptre, imperial globe, and sword of Charlemagne. Subsequently it became the seat of the *Landvogt* of Hagenau, the imperial *advocatus* in Lower Alsace. Richard of Cornwall, king of the Romans, made it an imperial city in 1257. In 1648 it came into the possession of France, and in 1673 Louis XIV. caused the fortifications to be razed. In 1675 it was captured by imperial troops, but in 1677 it was retaken by the French and nearly all destroyed by fire. In 1871 it fell, with the rest of Alsace-Lorraine, into the possession of Germany.

HAGENBACH, KARL RUDOLF (1801-1874). German church historian, was born on the 4th of March 1801 at Basel, where his father was a practising physician. His preliminary education was received at a Pestalozzian school, and afterwards at the gymnasium, whence in due course he passed to the newly reorganized local university. He early devoted himself to theological studies and the service of the church, while at the same time cherishing and developing broad "humanistic" tendencies which found expression in many ways and especially in an enthusiastic admiration for the writings of Herder. The years 1820-1823 were spent first at Bonn, where G. C. F. Lücke (1791-1855) exerted a powerful influence on his thought, and afterwards at Berlin, where Schleiermacher and Neander became his masters. Returning in 1823 to Basel, where W. M. L. de Wette had recently been appointed to a theological chair, he distinguished himself greatly by his trial-dissertation, *Observationes historico-hermeneuticae circa Origenis methodum interpretandae sacrae Scripturae*; in 1824 he became professor extraordinarius, and in 1829 professor ordinarius of theology. Apart from his academic labours in connexion with the history of dogma and of the church, he lived a life of great and varied usefulness as a theologian, a preacher and a citizen; and at his "jubilee" in 1873, not only the university and town of Basel but also the various churches of Switzerland united to do him honour. He died at Basel on the 7th of June 1874.

Hagenbach was a voluminous author in many departments, but he is specially distinguished as a writer on church history. Though neither so learned and condensed as the contributions of Gieseler, nor so original and profound as those of Neander, his lectures are clear, attractive and free from narrow sectarian prejudice. In dogmatics, while avowedly a champion of the "mediation theology" (*Vermittlungstheologie*), based upon the fundamental conceptions of Herder and Schleiermacher, he was much less revolutionary than were many others of his school. He sought to maintain the old confessional documents, and to make the objective prevail over the purely subjective manner of viewing theological questions. But he himself was aware that in the endeavour to do so he was not always successful, and that his delineations of Christian dogma often betrayed a vacillating and uncertain hand.

His works include *Tabellarische Übersicht der Dogmengeschichte* (1828); *Encyclopädie u. Methodologie der theol. Wissenschaften* (1833); *Vorlesungen über Wesen u. Geschichte der Reformation u. des Protestantismus* (1834-1843); *Lehrbuch der Dogmengeschichte* (1840-1841, 5th ed., 1867; English transl., 1850); *Vorlesungen über die Geschichte der alien Kirche* (1853-1855); *Vorlesungen über die Kirchengeschichte des Mittelalters* (1860-1861); *Grundlinien der Homiletik u. Liturgik* (1863); biographies of Johannes Ocolampadius (1482-1564) and Oswald Myconius (1488-1552) and a *Geschichte der theol. Schule Basels* (1860); his *Predigten* (1858-1875), two volumes of poems entitled *Luther u. seine Zeit* (1838), and *Gedichte* (1846). The lectures on church history under the general title *Vorlesungen über die Kirchengeschichte von der ältesten Zeit bis zum 19ten Jahrhundert* were reissued in seven volumes (1868-1872).

See especially the article in Herzog-Hauck, *Realencyklopädie*.

HAGENBECK, CARL (1844-), wild-animal collector and dealer, was born at Hamburg in 1844. In 1848 his father purchased some seals and a Polar bear brought to Hamburg by a whaler, and subsequently acquired many other wild animals. At the age of twenty-one Carl Hagenbeck was given the whole collection, and before long had greatly extended the business, so that in 1873 he had to erect large buildings in Hamburg to house his animals. In 1875 he began to exhibit a collection of the representative animals of many countries, accompanied by troupes of the natives of the respective countries, throughout all the large cities of Europe. The educational value of these exhibitions was officially recognized by the French government, which in 1891 awarded Hagenbeck the diploma of the Academy. Most of the wild animals exhibited in music-halls and other popular places of entertainment throughout the world have come from Hagenbeck's collection at Stellingen, near Hamburg.

HAGERSTOWN, a city and the county-seat of Washington county, Maryland, U.S.A., near Antietam Creek, about 86 m. by rail W.N.W. from Baltimore. Pop. (1890), 10,118; (1900), 13,591, of whom 1277 were negroes; (1910, census), 16,507. Hagerstown is served by the Baltimore & Ohio, the Western Maryland, the Norfolk & Western, and the Cumberland Valley railways, and by an interurban electric line. It lies in a fertile valley overlooked by South Mountain to the E. and North Mountain, more distant, to the W. The city is the seat of Kee Mar College (1852; non-sectarian) for women. Hagerstown is a business centre for the surrounding agricultural district, has good water power, and as a manufacturing centre ranked third in the state in 1905, its factory products being valued in that year at \$3,026,901, an increase of 66.3% over their value in 1900. Among the manufactures are flour, shirts, hosiery, gloves, bicycles, automobiles, agricultural implements, print paper, fertilizers, sash, doors and blinds, furniture, carriages, spokes and wheels. The municipality owns and operates its electric lighting plant. Hagerstown was laid out as a town in 1762 by Captain Jonathan Hager (who had received a patent to 200 acres here from Lord Baltimore in 1739), and was incorporated in 1791. It was an important station on the old National (or Cumberland) Road. General R. E. Lee concentrated his forces at Hagerstown before the battle of Gettysburg.

HAG-FISH, GLUTINOUS HAG, Or BORER (*Myxine*), a marine fish which forms with the lampreys one of the lowest orders of vertebrates (*Cyclostomata*). Similar in form to a lamprey, it is usually found within the body of dead cod or haddock, on the flesh of which it feeds after having buried itself in the abdomen. When caught, it secretes a thick glutinous slime in such quantity that it is commonly believed to have the power of converting water into glue. It is found in the North Atlantic and other temperate seas of the globe, being taken in some localities in large numbers, *e.g.* off the east coast of Scotland and the west coast of California (see [CYCLOSTOMATA](#)).

HAGGADA, or 'AGADA (literally "narrative"), includes the more homiletic elements of rabbinic teaching. It is not logically distinguishable from the halakha (*q.v.*), for the latter or forensic element makes up with the haggada the Midrash (*q.v.*), but, being more popular than the halakha, is often itself styled the Midrash. It may be described as the poetical and ethical element as contrasted with the legal element in the Talmud (*q.v.*), but the two elements are always closely connected. From one point of view the haggada, amplifying and developing the contents of Hebrew scripture in response to a popular religious need, may be termed a rabbinical commentary on the Old Testament, containing traditional stories and legends, sometimes amusing, sometimes trivial, and often beautiful. The haggada abounds in parables. The haggadic passages of the Talmud were collected in the *Eye of Jacob*, a very popular compilation completed by Jakob ibn Habib in the 16th century.

HAGGAI, in the Bible, the tenth in order of the “minor prophets,” whose writings are preserved in the Old Testament. The name Haggai (אג, Gr. Ἀγαῖος, whence Aggeus in the English version of the Apocrypha) perhaps means “born on the feast day,” “festive.” But Wellhausen¹ is probably right in taking the word as a contraction for Hagariah (“Yahweh hath girded”), just as Zaccai (Zacchaeus) is known to be a contraction of Zechariah.

The book of Haggai contains four short prophecies delivered between the first day of the sixth month and the twenty-fourth day of the ninth month—that is, between September and December—of the second year of Darius the king. The king in question must be Darius Hystaspis (521-485 B.C.). The language of the prophet in ii. 3 suggests the probability that he was himself one of those whose memories reached across the seventy years of the captivity, and that his prophetic work began in extreme old age. This supposition agrees well with the shortness of the period covered by his book, and with the fact that Zechariah, who began to prophesy in the same autumn and was associated with Haggai’s labours (Ezra v. 1), afterwards appears as the leading prophet in Jerusalem (Zech. vii. 1-4). We know nothing further of the personal history of Haggai from the Bible. Later traditions may be read in Carpzov’s *Introductio*, pars 3, cap. xvi. Epiphanius (*Vitae prophetarum*) says that he came up from Babylon while still young, prophesied the return, witnessed the building of the temple and received an honoured burial near the priests. Haggai’s name is mentioned in the titles of several psalms in the Septuagint (Psalms cxxxvii., cxlv.-cxlviii.) and other versions, but these titles are without value, and moreover vary in MSS. Eusebius did not find them in the Hexaplar Septuagint.²

In his first prophecy (i. 1-11) Haggai addresses Zerubbabel and Joshua, rebuking the people for leaving the temple unbuilt while they are busy in providing panelled houses for themselves. The prevalent famine and distress are due to Yahweh’s indignation at such remissness. Let them build the house, and Yahweh will take pleasure in it and acknowledge the honour paid to Him. The rebuke took effect, and the people began to work at the temple, strengthened by the prophet’s assurance that the Lord was with them (i. 12-15). In a second prophecy (ii. 1-9) delivered in the following month, Haggai forbids the people to be disheartened by the apparent meanness of the new temple. The silver and gold are the Lord’s. He will soon shake all nations and their choicest gifts will be brought to adorn His house. Its glory shall be greater than that of the former temple, and in this place He will give peace. A third prophecy (ii. 10-19) contains a promise, enforced by a figure drawn from the priestly ritual, that God will remove famine and bless the land from the day of the foundation of the temple onwards. Finally, in ii. 20-23, Zerubbabel is assured of God’s special love and protection in the impending catastrophe of kingdoms and nations to which the prophet had formerly pointed as preceding the glorification of God’s house on Zion. In thus looking forward to a shaking of all nations Haggai agrees with earlier prophecies, especially Isa. xxiv.-xxvii., while his picture of the glory and peace of the new Zion and its temple is drawn from the great anonymous prophet who penned Isa. lx and lxvi. The characteristic features of the book are the importance assigned to the personality of Zerubbabel, who, though a living contemporary, is marked out as the Messiah; and the almost sacramental significance attached to the temple. The hopes fixed on Zerubbabel, the chosen of the Lord, dear to Him as His signet ring (cf. Jer. xxii. 24), are a last echo in Old Testament prophecy of the theocratic importance of the house of David. In the book of Zechariah Zerubbabel has already fallen into the background and the high priest is the leading figure of the Judean community.³ The stem of David is superseded by the house of Zadok, the kingship has yielded to the priesthood, and the extinction of national hopes gives new importance to that strict organization of the hierarchy for which Ezekiel had prepared the way by his sentence of disfranchisement against the non-Zadokite priests.

The indifference of the Jews to the desolate conditions of their sanctuary opens up a problem of some difficulty. It is strange that neither Haggai nor his contemporary Zechariah mentions or implies any return of exiles from Babylon, and the suggestion has accordingly been made that the return under Cyrus described in Ezra i.-iv. is unhistorical, and that the community addressed by Haggai consisted of the remnant that had been left in Jerusalem and its neighbourhood after the majority had gone into exile or fled to Egypt (Jer. xliii.). Such a remnant, amongst whom might be members of the priestly and royal families, would gather strength and boldness as the troubles of Babylon increased and her vigilance was relaxed, and might receive from Babylon and other lands both refugees and some account at least of the writings of Ezekiel and the Second Isaiah. Stimulated by such causes and obtaining formal permission from the Persian government, they would arise as a new Israel and enter on a new phase of national life and divine revelation.

In spite, however, of the plausibility of this theory, it seems preferable to adhere to the story of Ezra i.-iv. Apart from the weighty objections that the Edomites would have frustrated such a recrudescence of the remnant Jews as has been described, it must be remembered that the main stream of Jewish life and thought had been diverted to Babylon. Thence, when the opportunity came under Cyrus, some 50,000 Jews, the spiritual heirs of the best elements of the old Israel, returned to found the new community. With them were all the resources, and the only people they found at Jerusalem were hostile gentiles and Samaritans. Full of enthusiasm, they set about

rebuilding the temple and realizing the glowing promises about the prosperity and dominance of Zion that had fallen from the lips of the Second Isaiah (xlix. 14-26, xlv. 14). Bitter disappointment, however, soon overcame them, the Samaritans were strong enough to thwart and hinder their temple-building, and it seemed as though the divine favour was withdrawn. Apathy took the place of enthusiasm, and sordid worries succeeded to high hopes. "The like collapse has often been experienced in history when bands of religious men, going forth, as they thought, to freedom and the immediate erection of a holy commonwealth, have found their unity wrecked and their enthusiasm dissipated by a few inclement seasons on a barren and hostile shore."⁴

From this torpor they were roused by tidings which might well be interpreted as the restoration of divine favour. Away in the East Cyrus had been succeeded in 529 B.C. by Cambyses, who had annexed Egypt and on whose death in 522 a Magian impostor, Gaumata, had seized the throne. The fraud was short-lived, and Darius I. became king and the founder of a new dynasty. These events shook the whole Persian empire; Babylon and other subject states rose in revolt, and to the Jews it seemed that Persia was tottering and that the Messianic era was nigh. It was therefore natural that Haggai and Zechariah should urge the speedy building of the temple, in order that the great king might be fittingly received.

It is sometimes levied as a reproach against Haggai that he makes no direct reference to moral duties. But it is hardly fair to contrast his practical counsel with the more ethical and spiritual teaching of the earlier Hebrew prophets. One thing was needful—the temple. "Without a sanctuary Yahweh would have seemed a foreigner to Israel. The Jews would have thought that He had returned to Sinai, the holy mountain; and that they were deprived of the temporal blessings which were the gifts of a God who literally dwelt in the midst of his people." Haggai argued that material prosperity was conditioned by zeal in worship; the prevailing distress was an indication of divine anger due to the people's religious apathy. Haggai's reproofs touched the conscience of the Jews, and the book of Zechariah enables us in some measure to follow the course of a religious revival which, starting with the restoration of the temple, did not confine itself to matters of ceremony and ritual worship. On the other hand, Haggai's treatment of his theme, practical and effective as it was for the purpose in hand, moves on a far lower level than the aspirations of the prophet who wrote the closing chapters of Isaiah. To the latter the material temple is no more than a detail in the picture of a work of restoration eminently ideal and spiritual, and he expressly warns his hearers against attaching intrinsic importance to it (Isa. lxvi. 1). To Haggai the temple appears so essential that he teaches that while it lay waste, the people and all their works and offerings were unclean (Hag. ii. 14). In this he betrays his affinity with Ezekiel, who taught that it is by the possession of the sanctuary that Israel is sanctified (Ezek. xxxvii. 28). In truth the new movement of religious thought and feeling which started from the fall of the Hebrew state took two distinct lines, of which Ezekiel and the anonymous authors of Isa. xl.-lxvi. are the respective representatives. While the latter developed their great picture of Israel the mediatorial nation, the systematic and priestly mind of Ezekiel had shaped a more material conception of the religious vocation of Israel in that picture of the new theocracy where the temple and its ritual occupy the largest place, with a sanctity which is set in express contrast to the older conception of the holiness of the city of Jerusalem (cf. Ezek. xliii. 7 seq. with Jer. xxxi. 40, Isa. iv. 5), and with a supreme significance for the religious life of the people which is expressed in the figure of the living waters issuing from under the threshold of the house (Ezek. xlvii.). It was the conception of Ezekiel which permanently influenced the citizens of the new Jerusalem, and took final shape in the institutions of Ezra. To this consummation, with its necessary accompaniment in the extinction of prophecy, the book of Haggai already points.

AUTHORITIES.—The elaborate and valuable German commentary of A. Köhler (Erlangen, 1860) forms the first part of his work on the *Nachexilische Propheten*. Reinke's *Commentary* (Münster, 1868) is the work of a scholarly Roman Catholic. Haggai has generally been treated in works on all the prophets, as by Ewald (2nd ed., 1868; Eng. trans., vol. iii., 1878); or along with the other minor prophets, as by Hitzig (3rd ed., by H. Steiner, Leipzig, 1881), Keil (1866, 3rd ed., 1888, Eng. trans., Edinburgh, 1868), and Pusey (1875), S. R. Driver (1906), W. Nowack (2nd ed., 1905), K. Marti (1904), J. Wellhausen (3rd ed., 1898); or with the other post-exile prophets, as by Köhler, Pressel (Gotha, 1870), Dods (1879) and others. The older literature will be found in books of introduction or in Rosenmüller's *Scholia*. The learned commentary of Marckius may be specially mentioned. On the place of Haggai in the history of Old Testament prophecy, see Duhm, *Theologie der Propheten* (Bonn, 1875); A. B. Davidson, *The Theology of the Old Testament* (1904); A. F. Kirkpatrick, *The Doctrine of the Prophets*; G. A. Smith, *The Book of the Twelve Prophets*, vol. 2 (1903); Tony Andrée, *Le Prophète Aggée*; Ed. Meyer, *Entstehung des Judentums* (1896).
(W. R. S.; A. J. G.)

¹ In Bleek's *Einleitung*, 4th ed., p. 434.

² See the note on Ps. cxlv. 1 in Field's *Hexapla*; Köhler, *Weissagungen Haggai's*, 32; Wright, *Zechariah and his Prophecies*, xix.

³ After the foundation of the temple Zerubbabel disappears from history and lives only in legend, which continued to busy itself with his story, as we see from the apocryphal book of Esdras (cf. Derenbourg,

HAGGARD, HENRY RIDER (1856-), English novelist, was born at Bradenham Hall, Norfolk, on the 22nd of June 1856. When he was nineteen he went to South Africa as secretary to Sir Henry Bulwer, governor of Natal. At the time of the first annexation of the Transvaal (1877), he was on the staff of the special commissioner, Sir Theophilus Shepstone; and he subsequently became a master of the high court of the Transvaal. He married in 1879 a Norfolk heiress, Miss Margitson, but returned to the Transvaal in time to witness its surrender to the Boers and the overthrow of the policy of his former chief. He returned to England and read for the bar, but soon took to literary work; he published *Cetywayo and his White Neighbours* (1882), written in defence of Sir T. Shepstone's policy. This was followed by the novels *Dawn* (1884), *The Witch's Head* (1885), which contains an account of the British defeat at Isandhlwana; and in 1886 *King Solomon's Mines*, suggested by the Zimbabwe ruins, which first made him popular. *She* (1887), another fantastic African story, was also very successful, a sequel, *Ayesha, or the Return of She*, being published in 1905. The scene of *Jess* (1887) and of *Allan Quatermain* (1888) was also laid in Africa. In 1895 he unsuccessfully contested the East Norfolk parliamentary division in the Unionist interest; he showed great interest in rural and agricultural questions, being a practical gardener and farmer on his estate in Norfolk. In his *Rural England* (2 vols., 1902) he exposed the evils of depopulation in country districts. In 1905 he was commissioned by the colonial office to inquire into the Salvation Army settlements at Fort Romie, S. California, and Fort Amity, Colorado, with a view to the establishment of similar colonies in South Africa. His report on the subject was first published as a blue book, and afterwards, in an enlarged form, as *The Poor and the Land* (1905), with suggestions for a scheme of national land settlement in Great Britain itself.

His other books include *Maiwa's Revenge* (1888), *Mr Meeson's Will* (1888), *Colonel Quaritch, V.C.* (1888), *Cleopatra* (1889), *Eric Brighteyes* (1891), *The World's Desire* (1890), a romance of Helen of Troy, written with Mr Andrew Lang; *Nada the Lily* (1892), *Montezuma's Daughter* (1894), *The People of the Mist* (1894), *Joan Haste* (1895), *Heart of the World* (1896), *Dr Therne* (1898), *A Farmer's Year* (1899), *The New South Africa* (1900), *Lysbeth, A Tale of the Dutch* (1901), *Stella Fregelius* (1903), *A Gardener's Year* (1905), *A Farmer's Year* (1899, revised ed., 1906), *The Way of the Spirit* (1906).

HAGGIS, a dish consisting of a calf's, sheep's or other animal's heart, liver and lungs, and also sometimes of the smaller intestines, boiled in the stomach of the animal with seasoning of pepper, salt, onions, &c., chopped fine with suet and oatmeal. It is considered peculiarly a Scottish dish, but was common in England till the 18th century. The derivation of the word is obscure. The Fr. *hachis*, English "hash," is of later appearance than "haggis." It may be connected with a verb "to hag," meaning to cut in small pieces, and would then be cognate ultimately with "hash."

HAGIOLOGY (from Gr. ἅγιος, saint, λόγος, discourse), that branch of the historical sciences which is concerned with the lives of the saints. If hagiology be considered merely in the sense in which the term has come to be understood in the later stages of its development, *i.e.* the critical study of hagiographic remains, there would be no such science before the 17th century. But the bases of hagiology may fairly be said to have been laid at the time when hagiographic documents, hitherto dispersed, were first brought together into collections. The oldest collection of this kind, the συναγωγή τῶν ἀρχαίων μαρτυρίων of Eusebius, to which the author refers in several passages in his writings (*Hist. Eccl.*, v. proem 2; v. 20, 5), and which has left more than one trace in Christian literature, is unfortunately lost in its entirety. The *Martyrs of Palestine*, as also the writings of Theodoret, Palladius and others, on the origins of the monastic life, and, similarly, the *Dialogues* of St Gregory (Pope Gregory I.), belong to the category of sources rather than to that of hagiologic collections. The *In gloria martyrum* and *In gloria confessorum* of Gregory of Tours

are valuable for the sources used in their compilation. The most important collections are those which comprise the Acts of the Martyrs and the lives of saints, arranged in the order of the calendar. In the Greek Church these are called menologies (from Gr. μήν, month, λόγος, discourse), and their existence can be traced back with certainty to the 9th century (Theodore of Studium, *Epist.* i. 2). One of them, the menology of Metaphrastes, compiled in the second half of the 10th century, enjoyed a universal vogue (see [SYMEON METAPHRASTES](#)). The corresponding works in the Western Church are the *passionaries* or *legendaries*, varieties of which are dispersed in libraries and have not been studied collectively. They generally draw from a common source, the Roman legendary, and the lives of the local saints, *i.e.* those specially honoured in a church, a province or a country. One of the best known is the Austrian legendary (*De magno legendario Austriaco* in the *Analecta Bollandiana*, xvii. 24-264). From the menologies and legendaries various compilations were made: in the Greek Church, the Synaxaria (see [SYNTAXARIUM](#)); in the Western Church, abridgments and extracts such as the *Speculum historiale* of Vincent de Beauvais; the *Legenda aurea* of Jacobus de Voragine; the *Sanctorale* of Bernard Guy [d. 1331] (see L. Delisle, *Notice sur les manuscrits de Bernard Guy*, Paris, 1879); the *Sanctilogium* of John of Tynemouth (*c.* 1366), utilized by John Capgrave, and published in 1516 under the name of *Nova legenda Angliae* (new edition by C. Horstman, Oxford, 1901); and the *Catalogus sanctorum* of Petrus de Natalibus (*c.* 1375), published at Vicenza in 1493, and many times reprinted. The *Sanctuarium* of B. Mombritius, published at Milan about 1480, is particularly valuable because it gives a faithful reproduction of the ancient texts according to the manuscripts. One of the most zealous collectors of lives of saints was John Gielemans of Brabant (d. 1487), whose work is of great value (Bollandists, *De codicibus hagiographicis Johannis Gielemans*, Brussels, 1895), and with him must be associated Anton Geens, or Gentius, of Groenendael, who died in 1543 (*Analecta Bollandiana*, vi. 31-34).

Hagiology entered on a new development with the publication of the *Sanctorum priscorum patrum vitae* (Venice and Rome, 1551-1560) of Aloysius Lippomanus (Lippomano), bishop of Verona. As a result of the co-operation of humanist scholars a great number of Greek hagiographic texts became for the first time accessible to the West in a Latin translation. The Carthusian, Laurentius Surius, carried on the work of Lippomano, completed it, and arranged the materials strictly in the order of the calendar (*De probatis sanctorum historiis*, Cologne, 1570-1575). What prevents the work of Surius from being regarded as an improvement upon Lippomano's is that Surius thought it necessary to retouch the style of those documents which appeared to him badly written, without troubling himself about the consequent loss of their documentary value.

The actual founder of hagiologic criticism was the Flemish Jesuit, Heribert Rosweyde (d. 1629), who, besides his important works on the martyrologies (see [MARTYROLOGY](#)), published the celebrated collection of the *Vitae patrum* (Antwerp, 1615), a veritable masterpiece for the time at which it appeared. It was he, too, who conceived the plan of a great collection of lives of saints, compiled from the manuscripts and augmented with notes, from which resulted the collection of the *Acta sanctorum* (see [BOLLANDISTS](#)). This last enterprise gave rise to others of a similar character but less extensive in scope.

Dom T. Ruinart collected the best *Acta* of the martyrs in his *Acta martyrum sincera* (Paris, 1689). The various religious orders collected the *Acta* of their saints, often increasing the lists beyond measure. The best publication of this kind, the *Acta sanctorum ordinis S. Benedicti* (Paris, 1668-1701) of d'Achery and Mabillon, does not entirely escape this reproach. Countries, provinces and dioceses also had their special hagiographic collections, conceived according to various plans and executed with more or less historical sense. Of these, the most important collections are those of O. Caietanus, *Vitae sanctorum Siculorum* (Palermo, 1657); G. A. Lobineau, *Vie des saints de Bretagne* (Rennes, 1725); and J. H. Ghesquière, *Acta sanctorum Belgii* (Brussels and Tongerlo, 1783-1794). The principal lives of the German saints are published in the *Monumenta Germaniae*, and a special section of the *Scriptores rerum Merovingicarum* is devoted to the lives of the saints. For Scotland and Ireland mention must be made of T. Messingham's *Florilegium insulae sanctorum* (Paris, 1624); I. Colgan's *Acta sanctorum veteris et maioris Scotiae seu Hiberniae* (Louvain, 1645-1647); John Pinkerton's *Vitae antiquae sanctorum ...* (London, 1789, of which a revised and enlarged edition was published by W. M. Metcalfe at Paisley in 1889, under the title of *Lives of the Scottish Saints*); W. J. Rees's *Lives of the Cambro-British Saints* (Llandoverly, 1853); *Acta sanctorum Hiberniae* (Edinburgh, 1888); Whitley Stokes's *Lives of Saints from the Book of Lismore* (Oxford, 1890); and J. O'Hanlon's *Lives of the Irish Saints* (Dublin, 1875-1904). Towards the 13th century vernacular collections of lives of saints began to increase. This literature is more interesting from the linguistic than from the hagiologic point of view, and comes rather within the domain of the philologist.

The hagiography of the Eastern and the Greek church also has been the subject of important publications. The Greek texts are very much scattered. Of them, however, may be mentioned J. B. Malou's "Symeonis Metaphrastae opera omnia" (*Patrologia Graeca*, 114, 115, 116) and Theophilus Ioannu, Μνημεῖα ἀγιολογικά (Venice, 1884). For Syriac, there are S. E. Assemani's *Acta sanctorum martyrum orientalium* (Rome, 1748) and P. Bedjan's *Acta martyrum et sanctorum* (Paris, 1890-1897); for Armenian, the acts of martyrs and lives of saints, published in two volumes

by the Mechitharist community of Venice in 1874; for Coptic, Hyvernat's *Les Actes des martyrs de l'Égypte* (Paris, 1886); for Ethiopian, K. Conti Rossini's *Scriptores Aethiopici, vitae sanctorum* (Paris, 1904 seq.); and for Georgian, Sabinin's *Paradise of the Georgian Church* (St Petersburg, 1882).

In addition to the principal collections must be mentioned the innumerable works in which the hagiographic texts have been subjected to detailed critical study.

To realize the present state of hagiology, the *Bibliotheca hagiographica*, both Latin and Greek, published by the Bollandists, and the *Bulletin hagiographique*, which appears in each number of the *Analecta Bollandiana* (see [BOLLANDISTS](#)), must be consulted. Thanks to the combined efforts of a great number of scholars, the classification of the hagiographic texts has in recent years made notable progress. The criticism of the sources, the study of literary styles, and the knowledge of local history now render it easier to discriminate in this literature between what is really historical and what is merely the invention of the genius of the people or of the imagination of pious writers (see H. Delehayé, *Les Légendes hagiographiques*, 2nd ed., pp. 121-141, Brussels, 1906). "Though the lives of saints," says a recent historian, "are filled with miracles and incredible stories, they form a rich mine of information concerning the life and customs of the people. Some of them are 'memorials of the best men of the time written by the best scholars of the time,'" (C. Gross, *The Sources and Literature of English History*, p. 34, London, 1900).

(H. DE.)

HAGIOSCOPE (from Gr. ἅγιος, holy, and σκοπεῖν, to see), in architecture, an opening through the wall of a church in an oblique direction, to enable the worshippers in the transepts or other parts of the church, from which the altar was not visible, to see the elevation of the Host. As a rule these hagioscopes, or "squints" as they are sometimes called, are found on one or both sides of the chancel arch. In some cases a series of openings has been cut in the walls in an oblique line to enable a person standing in the porch (as in Bridgewater church, Somerset) to see the altar; in this case and in other instances such openings were sometimes provided for an attendant, who had to ring the Sanctus bell when the Host was elevated. Though rarely met with on the continent of Europe, there are occasions where they are found, so as to enable a monk in one of the vestries to follow the service and communicate with the bell-ringers.

HAGONOY, a town of the province of Bulacan, Luzon, Philippine Islands, on Manila Bay and on the W. branch and the delta of the Pampanga Grande river, about 25 m. N.W. of Manila. Pop. (1903), 21,304. Hagonoy is situated in a rich agricultural region, producing rice, Indian corn, sugar and a little coffee. Alcohol is made in considerable quantities from the fermented juice of the nipa palm, which grows in the neighbouring swamps, and from the leaves of which the nipa thatch is manufactured. There is good fishing. The women of the town are very skilful in weaving the native fabrics. The language is Tagalog. Hagonoy was founded in 1581.

HAGUE, THE (in Dutch, 's Gravenhage, or, abbreviated, den Haag; in Fr. La Haye; and in Late Lat. *Haga Comitum*), the chief town of the province of South Holland, about 2½ m. from the sea, with a junction station 9½ m. by rail S.W. by S. of Leiden. Steam tramways connect it with the seaside villages of Scheveningen, Kykduin and 's Gravenzande, as well as with Delft, Wassenaar and Leiden, and it is situated on a branch of the main canal from Rotterdam to Amsterdam. Pop. (1900), 212,211. The Hague is the chief town of the province, the usual residence of the court and diplomatic bodies, and the seat of the government, the states-general, the high council of the Netherlands, the council of state, the chamber of accounts and various other administrative bodies. The characteristics of the town are quite in keeping with its political position; it is as handsome as it is fashionable, and was rightly described by de Amicis in his *Olanda* as half Dutch, half French. The Hague has grown very largely in modern times, especially on its western side, which is situated on the higher and more sandy soil, the south-eastern half of the town comprising the poorer and the business quarters. The main features in a plan of the town are its fine streets and houses and extensive avenues and well-planted squares; while, as a city, the

neighbourhood of an attractive seaside resort, combined with the advantages and importance of a large town, and the possession of beautiful and wooded surroundings, give it a distinction all its own.

The medieval-looking group of government buildings situated in the Binnenhof (or "inner court"), their backs reflected in the pretty sheet of water called the Vyver, represent both historically and topographically the centre of the Hague. On the opposite side of the Vyver lies the parallelogram formed by the fine houses and magnificent avenue of trees of the Lange Voorhout, the Kneuterdyk and the Vyverburg, representing the fashionable kernel of the city. Close by lies the entrance to the Haagsche Bosch, or the wood, on one side of which is situated the deer-park, and a little beyond on the other the zoological gardens (1862). Away from the Lange Voorhout the fine Park Straat stretches to the "1813 Plein" or square, in the centre of which rises the large monument (1869) by Jaquet commemorating the jubilee of the restoration of Dutch independence in 1813. Beyond this is the Alexander Veld, used as a military drill ground, and close by is the entrance to the beautiful road called the Scheveningsche Weg, which leads through the "little woods" to Scheveningen. Parallel to the Park Straat is the busy Noordeinde, in which is situated the royal palace. The palace was purchased by the States in 1595, rebuilt by the stadtholder William III., and extended by King William I. in the beginning of the 19th century. In front of the building is an equestrian statue of William I. of Orange by Count Nieuerkerke (1845), and behind are the gardens and extensive stables. The Binnenhof, which has been already mentioned, was once surrounded by a moat, and is still entered through ancient gateways. The oldest portion was founded in 1249 by William II., count of Holland, whose son, Florens V., enlarged it and made it his residence. Several centuries later the stadtholders also lived here. The fine old hall of the knights, built by Florens, and now containing the archives of the home office, is the historic chamber in which the states of the Netherlands abjured their allegiance to Philip II. of Spain, and in front of which the grey-headed statesman Johan van Oldenbarneveldt was executed in 1619. Close by on the one side are the courts of justice, and on the other the first and second chambers of the states-general, containing some richly painted ceilings and the portraits of various stadtholders. Government offices occupy the remainder of the buildings, and in the middle of the court is a fountain surmounted by a statuette of William II., count of Holland (1227-1256). In the adjoining Buitenhof, or "outer court," is a statue of King William II. (d. 1849), and the old Gevangen Poort, or prison gate (restored 1875), consisting of a tower and gateway. It was here that the brothers Cornelis and Jan de Witt were killed by the mob in 1672. On the opposite side of the Binnenhof is the busy square called the Plein, where all the tram-lines meet. Round about it are the buildings of the ministry of justice and other government buildings, including one to contain the state archives, the large club-house of the Witte Societeit, and the Mauritshuis. The Mauritshuis was built in 1633-1644 by Count John Maurice of Nassau, governor of Brazil, and contains the famous picture gallery of the Hague. The nucleus of this collection was formed by the princes of Orange, notably by the stadtholder William V. (1748-1806). King William I. did much to restore the losses caused by the removal of many of the pictures during the French occupation. Other artistic collections in the Hague are the municipal museum (*Gernsente* Museum), containing paintings by both ancient and modern Dutch artists, and some antiquities; the fine collection of pictures in the Steengracht gallery, belonging to Jonkheer Steengracht; the museum Meermanno-Westreenianum, named after Count Meermann and Baron Westreenen (d. 1850), containing some interesting MSS. and specimens of early typography and other curiosities; and the Mesdag Museum, containing the collection of the painter H. W. Mesdag (b. 1831) presented by him to the state. The royal library (1798) contains upwards of 500,000 volumes, including some early illuminated MSS., a valuable collection of coins and medals and some fine antique gems. In addition to the royal palace already mentioned, there are the palaces of the queen-dowager, of the prince of Orange (founded about 1720 by Count Unico of Wassenaar Twiekels) and of the prince von Wied, dating from 1825, and containing some good early Dutch and Flemish masters. There are numerous churches of various denominations in the Hague as well as an English church, a Russian chapel and two synagogues, one of which is Portuguese. The Groote Kerk of St James (15th and 16th centuries) has a fine vaulted interior, and contains some old stained glass, a carved wooden pulpit (1550), a large organ and interesting sepulchral monuments, and some escutcheons of the knights of the Golden Fleece, placed here after the chapter of 1456. The Nieuwe Kerk, or new church (first half 17th century), contains the tombs of the brothers De Witt and of the philosopher Spinoza. Spinoza is further commemorated by a monument in front of the house in which he died in 1677. The picturesque town hall (built in 1565 and restored and enlarged in 1882) contains a historical picture gallery. The principal other buildings are the provincial government offices, the royal school of music, the college of art, the large building (1874) of the society for arts and sciences, the ethnographical institute of the Netherlands Indies with fine library, the theatres, civil and military hospitals, orphanage, lunatic asylum and other charitable institutions; the fine modern railway station (1892), the cavalry and artillery and the infantry barracks, and the cannon foundry. The chief industries of the town are iron casting, copper and lead smelting, cannon founding, the manufacture of furniture and carriages, liqueur distilling, lithographing and printing.

The Hague wood has been described as the city's finest ornament. It is composed chiefly of oaks and alders and magnificent avenues of gigantic beech-trees. Together with the Haarlem wood it is thought to be a remnant of the immense forest which once extended along the coast. At the end of one of the avenues which penetrates into it from the town is the large summer clubhouse of the Witte Societeit, under whose auspices concerts are given here in summer. Farther into the wood are some pretty little lakes, and the famous royal villa called the Huis ten Bosch, or "house in the wood." This villa was built by Pieter Post for the Princess Amelia of Solms, in memory of her husband the stadtholder, Frederick Henry of Orange (d. 1647), and wings were added to it by Prince William IV. in 1748. The chief room is the Orange Saloon, an octagonal hall 50 ft. high, covered with paintings by Dutch and Flemish artists, chiefly of incidents in the life of Prince Frederick. In this room the International Peace Conference had its sittings in the summer of 1899. The collections in the Chinese and Japanese rooms, and the grisailles in the dining-room painted by Jacobus de Wit (1695-1754), are also noteworthy.

The history of the Hague is in some respects singular. In the 13th century it was no more than a hunting-lodge of the counts of Holland, and though Count Floris V. (b. 1254-1296) made it his residence and it thus became the seat of the supreme court of justice of Holland and the centre of the administration, and from the time of William of Orange onward the meeting-place of the states-general, it only received the status of a town, from King Louis Bonaparte, early in the 19th century.

In the latter part of the 17th and the first half of the 18th century the Hague was the centre of European diplomacy. Among the many treaties and conventions signed here may be mentioned the treaty of the Triple Alliance (January 23, 1688) between England, Sweden and the Netherlands; the concert of the Hague (March 31, 1710) between the Emperor, England and Holland, for the maintenance of the neutrality of the Swedish provinces in Germany during the war of the northern powers against Sweden; the Triple Alliance (January 4, 1717) between France, England and Holland for the guarantee of the treaty of Utrecht; the treaty of peace (Feb. 17, 1717) between Spain, Savoy and Austria, by which the first-named acceded to the principles of the Triple Alliance; the treaty of peace between Holland and France (May 16, 1795); the first "Hague Convention," the outcome of the "peace conference" assembled on the initiative of the emperor Nicholas II. of Russia (July 27, 1899), and the series of conventions, the results of the second peace conference (June 15-October 18, 1907). The International court of arbitration or Hague Tribunal was established in 1899 (see [EUROPE: History](#); [ARBITRATION, INTERNATIONAL](#)). The Palace of Peace designed to be completed in 1913 as the seat of the tribunal, on the Scheveningen avenue, is by a French architect, L. M. Cordonnier, and A. Carnegie contributed £300,000 towards its cost.

HAHN, AUGUST (1792-1863), German Protestant theologian, was born on the 27th of March 1792 at Grossosterhausen near Eisleben, and studied theology at the university of Leipzig. In 1819 he was nominated *professor extraordinarius* of theology and pastor of Altstadt in Königsberg, and in 1820 received a superintendency in that city. In 1822 he became *professor ordinarius*. In 1826 he removed as professor of theology to Leipzig, where, hitherto distinguished only as editor of Bardesanes, Marcion (*Marcion's Evangelium in seiner ursprünglichen Gestalt*, 1823), and Ephraem Syrus, and the joint editor of a *Syrische Chrestomathie* (1824), he came into great prominence as the author of a treatise, *De rationalismi qui dicitur vera indole et qua cum naturalismo contineatur ratione* (1827), and also of an *Offene Erklärung an die Evangelische Kirche zunächst in Sachsen u. Preussen* (1827), in which, as a member of the school of E. W. Hengstenberg, he endeavoured to convince the rationalists that it was their duty voluntarily and at once to withdraw from the national church. In 1833 Hahn's pamphlet against K. G. Bretschneider (*Über die Lage des Christenthums in unserer Zeit*, 1832) having attracted the notice of Friedrich Wilhelm III., he was called to Breslau as theological professor and consistorial councillor, and in 1843 became "general superintendent" of the province of Silesia. He died at Breslau on the 13th of May 1863. Though uncompromising in his "supra-naturalism," he did not altogether satisfy the men of his own school by his own doctrinal system. The first edition of his *Lehrbuch des christlichen Glaubens* (1828) was freely characterized as lacking in consistency and as detracting from the strength of the old positions in many important points. Many of these defects, however, he is considered to have remedied in his second edition (1857). Among his other works are his edition of the Hebrew Bible (1833), his *Bibliothek der Symbole und Glaubensregeln der apostolisch-katholischen Kirche* (1842; 2nd ed. 1877) and *Predigten* (1852).

His eldest son, HEINRICH AUGUST HAHN (1821-1861), after studying theology at Breslau and Berlin, became successively *Privatdozent* at Breslau (1845), professor *ad interim* (1846) at Königsberg on the death of Heinrich Hävernich, professor extraordinarius (1851) and professor

ordinarius (1860) at Greifswald. Amongst his published works were a commentary on the Book of Job (1850), a translation of the Song of Songs (1852), an exposition of Isaiah xl.-lxvi. (1857) and a commentary on the Book of Ecclesiastes (1860).

See the articles in Herzog-Hauck, *Realencyklopädie*, and the *Allgemeine deutsche Biographie*.

HAHNEMANN, SAMUEL CHRISTIAN FRIEDRICH (1755-1843), German physician and founder of "homoeopathy," was born at Meissen in Saxony on the 10th of April 1755. He was educated at the "elector's school" of Meissen, and studied medicine at Leipzig and Vienna, taking the degree of M.D. at Erlangen in 1779. After practising in various places, he settled in Dresden in 1784, and thence removed to Leipzig in 1789. In the following year, while translating W. Cullen's *Materia medica* into German, he was struck by the fact that the symptoms produced by quinine on the healthy body were similar to those of the disordered states it was used to cure. He had previously felt dissatisfied with the state of the science of medicine, and this observation led him to assert the truth of the "law of similars," *similia similibus curantur* or *curentur*—i.e. diseases are cured (or should be treated) by those drugs which produce symptoms similar to them in the healthy. He promulgated his new principle in a paper published in 1796 in C. W. Hufeland's *Journal*, and four years later, convinced that drugs in much smaller doses than were generally employed effectually exerted their curative powers, he advanced his doctrine of their potentization or dynamization. In 1810 he published his chief work, *Organon der rationellen Heilkunde*, containing an exposition of his system, which he called homoeopathy (*q. v.*), and in the following years appeared the six volumes of his *Reine Arzneimittellehre*, which detailed the symptoms produced by "proving" a large number of drugs, i.e. by systematically administering them to healthy subjects. In 1821 the hostility of established interests, and especially of the apothecaries, whose services were not required under his system, forced him to leave Leipzig, and at the invitation of the grand-duke of Anhalt-Cöthen he went to live at Cöthen. Fourteen years later he removed to Paris, where he practised with great success until his death on the 2nd of July 1843. Statues were erected to his memory at Leipzig in 1851 and at Cöthen in 1855. He also wrote, in addition to the works already mentioned, *Fragmenta de viribus medicamentorum positivis* (1805) and *Die chronischen Krankheiten* (1828-1830).

See the article [HOMOEOPATHY](#); also Albrecht, *Hahnemann's Leben und Werken* (Leipzig, 1875); Bradford, *Hahnemann's Life and Letters* (Philadelphia, 1895).

HAHN-HAHN, IDA, COUNTESS VON (1805-1880), German author, was born at Tressow, in Mecklenburg-Schwerin, on the 22nd of June 1805, daughter of Graf (Count) Karl Friedrich von Hahn (1782-1857), well known for his enthusiasm for the stage, upon which he squandered a large portion of his fortune. She married in 1826 her wealthy cousin Count Adolf von Hahn-Hahn. With him she had an extremely unhappy life, and in 1829 her husband's irregularities led to a divorce. The countess travelled, produced some volumes of poetry indicating true lyrical feeling, and in 1838 appeared as a novelist with *Aus der Gesellschaft*, a title which, proving equally applicable to her subsequent novels, was retained as that of a series, the book originally so entitled being renamed *Ida Schönholm*. For several years the countess continued to produce novels bearing a certain subjective resemblance to those of George Sand, but less hostile to social institutions, and dealing almost exclusively with aristocratic society. The author's patrician affectations at length drew upon her the merciless ridicule of Fanny Lewald in a parody of her style entitled *Diogena* (1847), and this and the revolution of 1848 together seem to have co-operated in inducing her to embrace the Roman Catholic religion in 1850. She justified her step in a polemical work entitled *Von Babylon nach Jerusalem* (1851), which elicited a vigorous reply from H. Abeken. In 1852 she retired into a convent at Angers, which she, however, soon left, taking up her residence at Mainz where she founded a nunnery, in which she lived without joining the order, and continued her literary labours. For many years her novels were the most popular works of fiction in aristocratic circles; many of her later publications, however, passed unnoticed as mere party manifestoes. Her earlier works do not deserve the neglect into which they have fallen. If their sentimentalism is sometimes wearisome, it is grounded on genuine feeling and expressed with passionate eloquence. *Ulrich* and *Gräfin Faustine*, both published in 1841, mark the culmination of her power; but *Sigismund Forster* (1843), *Cecil* (1844), *Sibylle* (1846) and *Maria Regina* (1860) also obtained considerable popularity. She died at Mainz on the 12th of January 1880.

Her collected works, *Gesammelte Werke*, with an introduction by O. von Schaching, were published in two series, 45 volumes in all (Regensburg, 1903-1904). See H. Keiter, *Gräfin Hahn-Hahn* (Würzburg, undated); P. Haffner, *Gräfin Ida Hahn-Hahn, eine psychologische Studie* (Frankfort, 1880); A. Jacoby, *Ida Gräfin Hahn-Hahn* (Mainz, 1894).

HAI (939-1038), Jewish Talmudical scholar, was born in 939. He was educated by his father Sherira, gaon of Pumbeditha (Pumbedita), whom he afterwards assisted in his work. They were cast into prison for a short time by the caliph Qadir, and subsequently on Sherira's death Hai was appointed gaon in his place (998). This office he held till his death on the 28th of March 1038. He is famous chiefly for his answers to problems of ritual and civil law. He composed important treatises on Talmudic law and the *Mishnah*; many poems are also attributed to him on doubtful authority. In his *responsa* he laid stress on custom and tradition provided no infringement of the law were involved, and was essentially conservative in theology. He had considerable knowledge not only of religious movements within the Jewish body, but also of Mahomedan theology and controversial method, and frequently consulted theologians of other beliefs.

See Steinschneider, *Hebr. Übersetz.* p. 910, and article in *Jewish Encyclopedia*, vi. 153.

HAIBAK, a town and khanate of Afghan Turkestan. The valley of Haibak, which is 3100 ft. above sea level, is fertile and richly cultivated. The town, which is famed in Persian legend, consists now of only a couple of streets, containing many Hindu shops and a small garrison. The inhabitants call themselves Jagatais, a Turki race, though now generally mixed with Tajiks and speaking Persian. In the neighbourhood of Haibak are some very typical Buddhist ruins. Haibak derives its importance from its position on the main line of communication between Kabul and Afghan Turkestan.

HAIDA, a tribe of North American Indians of Skittagetan stock. They still occupy their original home, the Queen Charlotte islands, British Columbia. They are skilful seamen, making long fishing expeditions in cedarwood canoes. They are noted for their carving and basket-work. They formerly made raids on the coast tribes. Slavery was hereditary, the slaves being prisoners of war. The population, some 7000 in the middle of the 19th century, is now reduced to a few hundreds.

See *Handbook of American Indians* (Washington, 1907). For "Haida Texts and Myths," see *Bull. 29 Smithsonian Institution Bureau Amer. Ethnol.* (1905).

HADINGER, WILHELM KARL, RITTER VON (1795-1871), Austrian mineralogist, geologist and physicist, was born at Vienna on the 5th of February 1795. His father, Karl Haidinger, contributed largely to the development of mineralogical science in the latter half of the 18th century. Having studied at the normal school of St Anne, and attended classes at the university, Wilhelm, at the age of seventeen, joined Professor F. Mohs at Gratz, and five years later accompanied the professor to Freiberg on the transfer of his labours to the mining academy of that town.

In 1822 Haidinger visited France and England with Count Breunner, and, journeying northward, took up his abode in Edinburgh. He translated into English, with additions of his own, Mohs's *Grundriss der Mineralogie*, published at Edinburgh in three volumes under the title *Treatise on Mineralogy* (1825). After a tour in northern Europe, including the Scandinavian mining districts, he undertook the scientific direction of the porcelain works at Elbogen,

belonging to his brothers. In 1840 he was appointed counsellor of mines (Bergrat) at Vienna in the place of Professor Mohs, a post which included the charge of the imperial cabinet of minerals. He devoted himself to the rearrangement and enrichment of the collections, and the museum became the first in Europe. Shortly after (1843) Haidinger commenced a series of lectures on mineralogy, which was given to the world under the title *Handbuch der bestimmenden Mineralogie* (Vienna, 1845; tables, 1846). On the establishment of the imperial geological institute, he was chosen director (1849); and this important position he occupied for seventeen years. He was elected a member of the imperial board of agriculture and mines, and a member of the imperial academy of sciences of Vienna. He organized the society of the Freunde der Naturwissenschaften. As a physicist Haidinger ranked high, and he was one of the most active promoters of scientific progress in Austria. He was the discoverer of the interesting optical appearances which have been called after him "Haidinger's brushes." Knighted in 1865, the following year he retired to his estate at Dornbach near Vienna, where he died on the 19th of March 1871.

In addition to the works already named, Haidinger published *Anfangsgründe der Mineralogie* (Leipzig, 1829); *Geognostische Übersichtskarte der österreich. Monarchie* (Vienna, 1847); *Bemerkungen über die Anordnung der kleinsten Theilchen in Christallen* (Vienna, 1853); *Interferenzlinien am Glimmer* (Vienna, 1855); *Vergleichungen von Augit und Amphibol* (Vienna, 1855). He also edited the *Naturwissenschaftliche Abhandlungen* (Vienna, 1847); the *Berichte über die Mittheilungen von Freunden der Naturwissenschaften in Wien* (Vienna, 1847-1851); and the *Jahrbuch* of the Vienna K. K. Geologische Reichsanstalt (1850), &c. Some of his papers will be found in the *Transactions* of the Royal Society of Edinburgh (vol. x.) and of the Wernerian Society (1822-1823), *Edinburgh Phil. Journal*, *Brewster's Journal of Science*, and *Poggendorff's Annalen*.
(H. B. Wo.)

HAIKUK (also written *Hayduk*, *Heiduc*, *Heyduke* and *Heyduque*), a term which appears originally to have meant "robber" or "brigand," a sense it retains in Servia and some other parts of the Balkan Peninsula. It is probably derived from the Turkish *haidūd*, "marauder," but its origin is not absolutely certain. Most of the European races with which the Turks came into close contact during the 15th and 16th centuries seem to have adopted it as a loan-word, and it appears in Magyar as *hajdú* (plural *hajduk*), in Serbo-Croatian, Rumanian, Polish and Čech as *hajduk*, in Bulgarian as *hajdutin* and in Greek as χαιντούτης. By the beginning of the 17th century its use had spread north and west as far as Sweden and Great Britain. In Hungary it was applied to a class of mercenary foot-soldiers of Magyar stock. In 1605 these haiduks were rewarded for their fidelity to the Protestant party (see [HUNGARY: History](#)) with titles of nobility and territorial rights over a district situated on the left bank of the river Theiss, known thenceforward as the Haiduk region. This was enlarged in 1876 and converted into the county of Hajdú (Ger. *Hajduken*). *Hajdú* is also a common prefix in Hungarian place-names, e.g. Hajdú-Szoboszló, Hajdú-Námás. In Austria-Hungary, Germany, Poland, Sweden and some other countries, *haiduk* came to mean an attendant in a court of law, or a male servant, dressed in Hungarian semi-military costume. It is also occasionally used as a synonym for "footman" or "lackey."

HAIFA, a town of Palestine at the foot of Mt. Carmel, on the south of the Bay of Acre. It represents the classical Sycaminum, but the present town is entirely modern. It has developed since about 1890 into an important port, and is connected by railway with Damascus. The population is estimated at 12,000 (Moslems 6000, Christians 4000, Jews 1500, Germans 500; the last belong for the greater part to the Unitarian sect of the "Templars," who have colonies also at Jaffa and Jerusalem). The exports (grain and oil) were valued at £178,738 in 1900. Much of the trade that formerly went to Acre has been attracted to Haifa. This port is the best natural harbour on the Palestine coast.

HAIK (an Arabic word, from *hak*, to weave), a piece of cloth, usually of coarse hand-woven wool, worn by Arabs, Moors and other Mahommedan peoples. It is generally 6 to 6½ yds. long,

and about 2 broad. It is either striped or plain, and is worn equally by both sexes, usually as an outer covering; but it is often the only garment of the poorer classes. By women the "haik" is arranged to cover the head and, in the presence of men, is held so as to conceal the face. A thin "haik" of silk, like a veil, is used by brides at their marriage.

HAIL (O. Eng. *hægl* and *hagol*,¹ cf. the cognate Teutonic *hagel*, as in German, Dutch, Swedish, &c.; the Gr. κάλλιξ, pebble, is probably allied), the name for rounded masses or single pellets of ice falling from the clouds in a shower. True hail has a concentric structure caused by the frozen particles of moisture first descending into a warm cloud, whence they are carried upwards on an ascending current of heated air into a cold stratum where the fresh coating of water vapour deposited in the cloud is frozen. The hailstone descends again, receives a fresh coating, is carried up once more, refrozen, and again descends. Thus the hailstone grows until the current is no longer strong enough to support it when it falls to the ground. At times masses of hail are frozen together, and a very sudden cooling will sometimes result in the formation of ragged masses of ice that fall with disastrous results. Hail must be distinguished from the frozen snow, "soft-hail" or "graupel," that often falls at the rear of a spring cyclone, since true hail is almost entirely a summer phenomenon, and falls most frequently in thunderstorms which are produced under the conditions that are favourable to the formation of hail, *i.e.* great heat, a still atmosphere, the production of strong local convection currents in consequence, and the passage of a cold upper drift.

1 "Hail," a call of greeting or salutation, a shout to attract attention, must, of course, be distinguished. This word represents the Old Norwegian *heill*, prosperity, cognate with O. Eng. *hāl*, whence "hale," "whole," and *hæl*, whence "health," "heal."

HAILES, DAVID DALRYMPLE, LORD (1726-1792), Scottish lawyer and historian, was born at Edinburgh on the 28th of October 1726. His father, Sir James Dalrymple, Bart., of Hailes, in the county of Haddington, auditor-general of the exchequer of Scotland, was a grandson of James, first Viscount Stair; and his mother, Lady Christian Hamilton, was a daughter of Thomas, 6th earl of Haddington. David was the eldest of sixteen children. He was educated at Eton, and studied law at Utrecht, being intended for the Scottish bar, to which he was admitted shortly after his return to Scotland in 1748. As a pleader he attained neither high distinction nor very extensive practice, but he rapidly established a well-deserved reputation for sound knowledge, unwearied application and strict probity; and in 1766 he was elevated to the bench, when he assumed the title of Lord Hailes. Ten years later he was appointed a lord of justiciary. He died on the 29th of November 1792. He was twice married, and had a daughter by each wife. The baronetcy to which he had succeeded passed to the son of his brother John, provost of Edinburgh. Another brother was Alexander Dalrymple (1737-1808), the first admiralty hydrographer, who distinguished himself in the East India Company's service and as a geographer. Lord Hailes's younger daughter married Sir James Fergusson; and their grandson, Sir Charles Dalrymple, 1st Bart. (cr. 1887), M.P. for Bute from 1868 to 1885, afterwards came into Lord Hailes's estate and took his family name.

Lord Hailes's most important contribution to literature was the *Annals of Scotland*, of which the first volume, "From the accession of Malcolm III., surnamed Canmore, to the accession of Robert I.," appeared in 1776, and the second, "From the accession of Robert I., surnamed Bruce, to the accession of the house of Stewart," in 1779. It is, as Dr Johnson justly described this work at the time of its appearance, a "Dictionary" of carefully sifted facts, which tells all that is wanted and all that is known, but without any laboured splendour of language or affected subtlety of conjecture. The other works of Lord Hailes include *Historical Memoirs concerning the Provincial Councils of the Scottish Clergy* (1769); *An Examination of some of the Arguments for the High Antiquity of Regiam Majestatem* (1769); three volumes entitled *Remains of Christian Antiquity* ("Account of the Martyrs of Smyrna and Lyons in the Second Century," 1776; "The Trials of Justin Martyr, Cyprian, &c.," 1778; "The History of the Martyrs of Palestine, translated from Eusebius," 1780); *Disquisitions concerning the Antiquities of the Christian Church* (1783); and editions or translations of portions of Lactantius, Tertullian and Minucius Felix. In 1786 he published *An Inquiry into the Secondary Causes which Mr Gibbon has assigned for the Rapid Growth of Christianity* (Dutch translation, Utrecht, 1793), one of the most respectable of the very many

replies which were made to the famous 15th and 16th chapters of the *Decline and Fall of the Roman Empire*.

A "Memoir" of Lord Hailes is prefixed to the 1808 reprint of his *Inquiry into the Secondary Causes*.

HAILSHAM, a market-town in the Eastbourne parliamentary division of Sussex, England, 54 m. S.S.E. from London by the London, Brighton & South Coast railway. Pop. (1901), 4197. The church of St Mary is Perpendicular. The picturesque Augustinian priory of Michelham lies 2 m. W. by the Cuckmere river; it is altered into a dwelling house, but retains a gate-house, crypt and other portions of Early English date. There was also a Premonstratensian house at Otham, 3 m. S., but the remains are scanty. Hailsham has a considerable agricultural trade, and manufactures of rope and matting are carried on.

HAINAN, or, as it is usually called in Chinese, *K'iung-chow-fu*, a large island belonging to the Chinese province of Kwang-tung, and situated between the Chinese Sea and the Gulf of Tongking from 20° 8' to 17° 52' N., and from 108° 32' to 111° 15' E. It measures 160 m. from N.E. to S.W., and the average breadth is about 90 m. The area is estimated at from 1200 to 1400 sq. m., or two-thirds the size of Sicily. From the peninsula of Lei-chow on the north it is separated by the straits of Hainan, which have a breadth of 15 or 20 m.

With the exception of a considerable area in the north, and broad tracts on the north-east and north-west sides, the whole island is occupied by jungle-covered mountains, with rich valleys between. The central range bears the name of Li-mou shan or Wu-tchi shan (the Five-Finger Mountain), and attains a height of 6000 or 7000 ft. Its praises are celebrated in a glowing ode by Ch'iu, a native poet. The island appears to be well watered, and some of its rivers are not without importance as possible highways of commerce; but the details of its hydrography are very partially ascertained. A navigable channel extends in an irregular curve from the bay of Hoi-how (Hai-K'ow) in the north to Tan-chow on the west coast. Being exposed to the winter monsoon, the northern parts of the island enjoy much the same sort of temperate climate as the neighbouring provinces of the mainland, but in the southern parts, protected from the monsoon by the mountain ranges, the climate is almost or entirely tropical. Snow falls so rarely that its appearance in 1684 is reported in the native chronicles as a remarkable event. Earthquakes are a much more familiar phenomenon, having occurred, according to the same authority, in 1523, 1526, 1605, 1652, 1677, 1681, 1684, 1702, 1704, 1725, 1742, 1816, 1817 and 1822. Excellent timber of various kinds—eagle-wood, rose-wood, liquidambar, &c.—is one of the principal products of the island, and has even been specially transported to Peking for imperial purposes. The coco palm flourishes freely even in the north, and is to be found growing in clumps with the *Pinus sinensis*. Rice, cotton, sugar, indigo, cinnamon, betel-nuts, sweet potatoes, ground-nuts and tobacco are all cultivated in varying quantities. The aboriginal inhabitants collect a kind of tea called t'ien ch'a, or celestial tea, which looks like the leaves of a wild camellia, and has an earthy taste when infused. Lead, silver, copper and iron occur in the Shi-lu shan or "stone-green-hill"; the silver at least was worked till 1850. Gold and lapis lazuli are found in other parts of the island.

The ordinary cattle of Hainan are apparently a cross between the little yellow cow of south China and the zebu of India. Buffaloes are common, and in the neighbourhood of Nanlu at least they are frequently albinos. Horses are numerous but small. Hogs and deer are both common wild animals, and of the latter there are three species, *Cervus Eldi*, *Cervus hippelaphus* and *Cervus vaginalis*. Among the birds, of which 172 species are described by Mr Swinhoe in his paper in *The Ibis* (1870), there are eagles, notably a new species *Spilornis Rutherfordi*, buzzards, harriers, kites, owls, goatsuckers and woodpeckers. The *Upupa ceylonensis* is familiar to the natives as the "bird of the Li matrons," and the *Palaeornis javanica* as the "sugar-cane bird."

Hainan forms a fu or department of the province of Kwang-tung, though strictly it is only a portion of the island that is under Chinese administration, the remainder being still occupied by unsubjected aborigines. The department contains three *chow* and ten *hien* districts. K'iung-chow-hien, in which the capital is situated; Ting-an-hien, the only inland district; Wen-ch'ang-hien, in the north-east of the island; Hui-t'ung-hien, Lo-hui-hien, Ling-shu-hien, Wan-chow, Yai-

chow (the southmost of all), Kan-ên-hien, Ch'ang-hwa-hien, Tan-chow, Lin-kaoh-hien and Ch'êng-mai-hien. The capital K'ung-chow-fu is situated in the north about 10 li (or 3 m.) from the coast on the river. It is a well-built compact city, and its temples and examination halls are in good preservation. Carved articles in coco-nuts and scented woods are its principal industrial product. In 1630 it was made the seat of a Roman Catholic mission by Benoit de Mathos, a Portuguese Jesuit, and the old cemetery still contains about 113 Christian graves. The port of K'ung-chow-fu at the mouth of the river, which is nearly dry at low water, is called simply Hoi-how, or in the court dialect Hai-K'ow, *i.e.* seaport. The two towns are united by a good road, along which a large traffic is maintained partly by coolie porters but more frequently by means of wheel-barrow, which serve the purpose of cabs and carts. The value of the trade of the port has risen from £670,600 in 1899 to £719,333 in 1904. In the same year 424 vessels, representing a tonnage of 312,554, visited the port. This trade is almost entirely with the British colony of Hong-Kong, with which the port is connected by small coasting steamers, but since 1893 it has had regular steamboat communication with Haiphong in Tongking. The population of K'ung-chow, including its shipping port of Hoi-how, is estimated at 52,000. The number of foreign residents in 1900 was about 30, most of them officials or missionaries.

The inhabitants of Hainan may be divided into three classes, the Chinese immigrants, the civilized aborigines or Shu-li and the wild aborigines or Sheng-li. The Chinese were for the most part originally from Kwang-si and the neighbouring provinces, and they speak a peculiar dialect, of which a detailed account by Mr Swinhoe was given in *The Phoenix, a Monthly Magazine for China, &c.* (1870). The Shu-li as described by Mr Taintor are almost of the same stature as the Chinese, but have a more decided copper colour, higher cheek-bones and more angular features, while their eyes are not oblique. Their hair is long, straight and black, and their beards, if they have any, are very scanty. They till the soil and bring rice, fuel, timber, grass-cloth, &c., to the Chinese markets. The Sheng-li or Li proper, called also La, Le or Lauy, are probably connected with the Laos of Siam and the Lolos of China. Though not gratuitously aggressive, they are highly intractable, and have given great trouble to the Chinese authorities. Among themselves they carry on deadly feuds, and revenge is a duty and an inheritance. Though they are mainly dependent on the chase for food, their weapons are still the spear and the bow, the latter being made of wood and strung with bamboo. In marriage no avoidance of similarity of name is required. The bride's face is tattooed according to a pattern furnished by the bridegroom. Their funeral mourning consists of abstaining from drink and eating raw beef, and they use a wooden log for a coffin. When sick they sacrifice oxen. In the spring-time there is a festival in which the men and women from neighbouring settlements move about in gay clothing hand in hand and singing songs. The whole population of the island is estimated at about 2½ millions. At its first conquest 23,000 families were introduced from the mainland. In 1300 the Chinese authorities assign 166,257 inhabitants; in 1370, 291,000; in 1617, 250,524; and in 1835, 1,350,000.

It was in 111 B.C. that Lu-Po-Teh, general of the emperor Wu-ti, first made the island of Hainan subject to the Chinese, who divided it into the two prefectures, Tan-urh or Drooping Ear in the south, so-called from the long ears of the native "king," and Chu-yai or Pearl Shore in the north. During the decadence of the elder branch of the Han dynasty the Chinese supremacy was weakened, but in A.D. 43 the natives were led by the success of Ma-yuan in Tong-king to make a new tender of their allegiance. About this time the whole island took the name of Chu-yai. In A.D. 627 the name of K'ung-chow came into use. On its conquest by the generals of Kublai Khan in 1278 the island was incorporated with the western part of the province of Kwang-tung in a new satrapy, Hai-peh Hai-nan Tao, *i.e.* the circuit north of the sea and south of the sea. It was thus that Hai-nan-Tao, or district south of the sea or strait, came into use as the name of the island, which, however, has borne the official title of K'ung-chow-fu, probably derived from the Kiung shan or Jade Mountains, ever since 1370, the date of its erection into a department of Kwang-tung. For a long time Hainan was the refuge of the turbulent classes of China and the place of deportation for delinquent officials. It was there, for example, that Su-She or Su-Tung-po was banished in 1097. From the 15th to the 19th century pirates made the intercourse with the mainland dangerous, and in the 17th they were considered so formidable that merchants were allowed to convey their goods only across the narrow Hainan Strait. Since 1863 the presence of English men-of-war has put an end to this evil. According to the treaty of Tientsin, the capital K'ung-chow and the harbour Hoi-how (Hai-Kow) were opened to European commerce; but it was not till 1876 that advantage was taken of the permission.

HAINAU (officially HAYNAU), a town of Germany, in the Prussian province of Silesia, on the Schnelle Deichsa and the railway from Breslau to Dresden, 12 m. N.W. of Liegnitz. Pop. 10,500. It has an Evangelical and a Roman Catholic church, manufactories of gloves, patent leather, paper, metal ware and artificial manures, and a considerable trade in cereals. Near Hainau the Prussian

HAINAUT (Flem. *Henegouwen*, Ger. *Hennegau*), a province of Belgium formed out of the ancient county of Hainaut. Modern Hainaut is famous as containing the chief coal and iron mines of Belgium. There are about 150,000 men and women employed in the mines, and about as many more in the iron and steel works of the province. About 1880 these numbers were not more than half their present totals. The principal towns of Hainaut are Mons, the capital, Charleroi, Tournai, Jumet and La Louvière. The province is watered by both the Scheldt and the Sambre, and is connected with Flanders by the Charleroi-Ghent canal. The area of the province is computed at 930,405 acres or 1453 sq. m. In 1904 the population was 1,192,967, showing an average of 821 per square mile.

Under the successors of Clovis Hainaut formed part, first of the kingdom of Metz, and then of that of Lotharingia. It afterwards became part of the duchy of Lorraine. The first to bear the title of count of Hainaut was Reginar "Long-Neck" (c. 875), who, later on, made himself master of the duchy of Lorraine and died in 916. His eldest son inherited Lower Lorraine, the younger, Reginar II., the countship of Hainaut, which remained in the male line of his descendants, all named Reginar, until the death of Reginar V. in 1036. His heiress, Richildis, married *en secondes noces* Baldwin VI. of Flanders, and, by him, became the ancestress of the Baldwin (VI. of Hainaut) who in 1204 was raised by the Crusaders to the empire of Constantinople. The emperor Baldwin's elder daughter Jeanne brought the countship of Hainaut to her husbands Ferdinand of Portugal (d. 1233) and Thomas of Savoy (d. 1259). On her death in 1244, however, it passed to her sister Margaret, on whose death in 1279 it was inherited by her grandson, John of Avesnes, count of Holland (d. 1304). The countship of Hainaut remained united with that of Holland during the 14th and 15th centuries. It was under the counts William I. "the Good" (1304-1337), whose daughter Philippa married Edward III. of England, and William II. (1337-1345) that the communes of Hainaut attained great political importance. Margaret, who succeeded her brother William II. in 1345, by her marriage with the emperor Louis IV. brought Hainaut with the rest of her dominions to the house of Wittelsbach. Finally, early in the 15th century, the countess Jacqueline was dispossessed by Philip the Good of Burgundy, and Hainaut henceforward shared the fate of the rest of the Netherlands.

AUTHORITIES.—The *Chronicon Hanoniense* or *Chronica Honnoniae* of Giselbert of Mons (d. 1223-1225), chancellor of Count Baldwin V., covering the period between 1040 and 1195, is published in Pertz, *Monum. Germ.* (Hanover, 1840, &c.). The *Chronicon Hanoniense*, ascribed to Baldwin, count of Avesnes (d. 1289), and written between 1278 and 1281, was published under the title *Hist. genealogica comitum Hannoniae*, &c., at Antwerp (1691 and 1693) and Brussels (1722). The Annals of Jacques de Guise (b. 1334; d. 1399) were published by de Fortia d'Urban under the title, *Histoire de Hainaut par Jacques de Guise*, in 19 vols. (Paris, 1826-1838); C. Delacourt, "Bibliographie de l'hist. du Hainaut," in the *Annales du cercle archéologique de Mons*, vol. v. (Mons, 1864); T. Bernier, *Dict. géograph. historique, &c., de Hainaut* (Mons, 1891). See also Ulysse Chevalier, *Répertoire des sources* s.v.

HAINBURG, or **HAIMBURG**, a town of Austria, in Lower Austria, 38 m. E.S.E of Vienna by rail. Pop. (1900), 5134. It is situated on the Danube, only 2½ m. from the Hungarian frontier, and since the fire of 1827 Hainburg has been much improved, being now a handsomely built town. It has one of the largest tobacco manufactories in Austria, employing about 2000 hands, and a large needle factory. It occupies part of the site of the old Celtic town Carnuntum (*q.v.*). It is still surrounded by ancient walls, and has a gate guarded by two old towers. There are numerous Roman remains, among which may be mentioned the altar and tower at the town-house, on the latter of which is a statue, said to be of Attila. A Roman aqueduct is still used to bring water to the town. On the neighbouring Hainberg is an old castle, built of Roman remains, which appears in German tradition under the name of Heimburc; it was wrested from the Hungarians in 1042 by the emperor Henry III. At the foot of the same hill is a castle of the 12th century, where Ottakar of Bohemia was married to Margaret of Austria in 1252; earlier it was the residence of the dukes of Babenberg. Outside the town, on an island in the Danube, is the ruined castle of Röthelstein or Rothenstein, held by the Knights Templars. Hainburg was besieged by the Hungarians in 1477, was captured by Matthias Corvinus in 1482, and was sacked and its inhabitants massacred by the Turks in 1683.

HAINICHEN, a town of Germany, in the kingdom of Saxony, on the Kleine Striegis, 15 m. N.E. of Chemnitz, on the railway to Rosswein. Pop. (1905), 7752. It has two Evangelical churches, a park, and commercial and technical schools. Hainichen is a place of considerable industry. Its chief manufacture is that of flannels, baize, and similar fabrics; indeed it may be called the centre of this industry in Germany. The special whiteness and excellence of the flannel made in Hainichen are due to the peculiar nature of the water used in the manufacture. There are also large dye-works and bleaching establishments. Hainichen is the birthplace of Gellert, to whose memory a bronze statue was erected in the market-place in 1865. The Gellert institution for the poor was erected in 1815.

HAI-PHONG, a seaport of Tongking, French Indo-China, on the Cua-Cam, a branch of the Song-koi (Red river) delta. The population numbers between 21,000 and 22,000, of whom 12,500 are Annamese, 7500 Chinese (attracted by the rice trade of the port) and 1200 Europeans. It is situated about 20 m. from the Gulf of Tongking and 58 m. E. by S. of Hanoi, with which it communicates by river and canal and by railway. It is the second commercial port of French Indo-China, is a naval station, and has government and private ship-building yards. The harbour is accessible at all times to vessels drawing 19 to 20 ft., but is obstructed by a bar. Hai-phong is the seat of a resident who performs the functions of mayor, and the residency is the chief building of the town. A civil tribunal, a tribunal of commerce and a branch of the Bank of Indo-China are also among its institutions. It is the headquarters of the river steamboat service (*Messageries fluviales*) of Tongking, which plies as far as Lao-kay on the Song-koi, to the other chief towns of Tongking and northern Annam, and also to Hong-kong. Cotton-spinning and the manufacture of cement are carried on.

HAIR (a word common to Teutonic languages), the general term for the characteristic outgrowth of the epidermis forming the coat of mammals. The word is also applied by analogy to the filamentous outgrowths from the body of insects, &c., plants, and metaphorically to anything of like appearance.

For anatomy, &c. of animal hair see [SKIN AND EXOSKELETON](#); [FIBRES](#) and allied articles; [FUR](#), and [LEATHER](#).

Anthropology.—The human hair has an important place among the physical criteria of race. While its general structure and quantity vary comparatively little, its length in individuals and relatively in the two sexes, its form, its colour, its general consistency and the appearance under the microscope of its transverse section show persistent differences in the various races. It is the persistence of these differences and specially in regard to its colour and texture, which has given to hair its ethnological importance. So obvious a racial differentiation had naturally long ago attracted the attention of anthropologists. But it was not until the 19th century that microscopic examination showed the profound difference in structure between the hair characteristic of the great divisions of mankind. It was in 1863 that Dr Pruner-Bey read a paper before the Paris Anthropological Society entitled "On the Human Hair as a Race Character, examined by aid of the Microscope." This address established the importance of hair as a racial criterion. He demonstrated that the structure of the hair is threefold:—

(1) Short and crisp, generally termed "woolly," elliptical or kidney-shaped in section, with no distinguishable medulla or pith. Its colour is almost always jet black, and it is characteristic of all the black races except the Australians and aborigines of India. This type of hair has two varieties. When the hairs are relatively long and the spiral of the curls large, the head has the appearance of being completely covered, as with some of the Melanesian races and most of the negroes. Haeckel has called this "*eriocomous*" or "woolly" proper. In some negroid peoples, however, such as the Hottentots and Bushmen, the hair grows in very short curls with narrow spirals and forms little tufts separated by spaces which appear bare. The head looks as if it were dotted over with pepper-seed, and thus this hair has gained the name of "peppercorn-growth." Haeckel has called

it "*Lophocomous*" or "crested." Most negroes have this type of hair in childhood and, even when fully grown, signs of it around the temples. The space between each tuft is not bald, as was at one time generally assumed. The hair grows uniformly over the head, as in all races.

2. Straight, lank, long and coarse, round or nearly so in section, with the medulla or pith easily distinguishable, and almost without exception black. This is the hair of the yellow races, the Chinese, Mongols and Indians of the Americas.

3. Wavy and curly, or smooth and silky, oval in section, with medullary tube but no pith. This is the hair of Europeans, and is mainly fair, though black, brown, red or towy varieties are found.

There is a fourth type of hair describable as "frizzy." It is easily distinguishable from the Asiatic and European types, but not from the negroid wool. It is always thick and black, and is characteristic of the Australians, Nubians, and certain of the Mulattos. Generally hair curls in proportion to its flatness. The rounder it is the stiffer and lanker. These extremes are respectively represented by the Papuans and the Japanese. Of all hair the woolly type is found to be the most persistent, as in the case of the Brazilian Cafusos, negro and native hybrids. Quatrefages quotes the case of a triple hybrid, "half negro, quarter Cherokee, quarter English," who had short crisp furry-looking hair.

Wavy types of hair vary most in colour: almost the deepest hue of black being found side by side with the most flaxen and towy. Colour varies less in the lank type, and scarcely at all in the woolly. The only important exception to the uniform blackness of the negroid wool is to be found among the Wochuas, a tribe of African pigmies whose hair is described by Wilhelm Junker (*Travels in Africa*, iii. p. 82) as "of a dark, rusty brown hue." Fair hair in all its shades is frequent among the populations of northern Europe, but much rarer in the south. According to Dr John Beddoe there are sixteen blonds out of every hundred Scotch, thirteen out of every hundred English, and two only out of a hundred Italians. The percentage of brown hair is 75% among Spaniards, 39 among French and 16 only in Scandinavia. Among the straight-haired races fair hair is far rarer; it is, however, found among the western Finns. Among those races with frizzy hair, red is almost as common as among those with wavy hair. Red hair, however, is an individual anomaly associated ordinarily with freckles. There are no red-haired races.

A certain correlation appears to exist between the nature of hair and its absolute or relative length in the two sexes. Thus straight hair is the longest (Chinese, Red Indians), while woolly is shortest. Wavy hair holds an intermediate position. In the two extremes the difference of length in man and woman is scarcely noticeable. In some lank-haired races, men's tresses are as long as women's, *e.g.* the Chinese pigtail, and the hair of Redskins which grows to the length sometimes of upwards of 9 ft. In the frizzy-haired peoples, men and women have equally short growths. Bushwomen, the female Hottentot and negresses have hair no longer than men's. It is only in the wavy, and now and again in the frizzy types, that the difference in the sexes is marked. Among European men the length rarely exceeds 12 to 16 in., while with women the mean length is between 25 and 30 in. and in some cases has been known to reach 6 ft. or more.

The growth of hair on the body corresponds in general with that on the head. The hairiest races are the Australians and Tasmanians, whose heads are veritable mops in the thickness and unkempt luxuriance of the locks. Next to them are the Todas, and other hill-tribesmen of India, and the Hairy Ainu of Japan. Traces, too, of the markedly hairy race, now extinct, supposed to be the ancestor of Toda and Ainu alike, are to be found here and there in Europe, especially among the Russian peasantry. The least hairy peoples are the yellow races, the men often scarcely having rudimentary beards, *e.g.* Indians of America and the Mongols. Negroid peoples may be said to be intermediate, but usually incline to hairlessness. The wavy-haired populations hold also an intermediate position, but somewhat incline to hairiness. Among negroes especially no rule can be formulated. Bare types such as the Bushmen and western negroes are found contiguous to hairy types such as the inhabitants of Ashantee. Neither is there any rule as to baldness. From statistics taken in America it would seem that it is ten times less frequent among negroes than among whites between the ages of thirty-three and forty-five years, and thirty times less between twenty-one and thirty-two years. Among Mulattos it is more frequent than among negroes but less than among whites. It is rarer among Redskins than among negroes. The *lanugo* or downy hairs, with which the human foetus is covered for some time before birth and which is mostly shed in the womb, and the minute hairs which cover nearly every part of the adult human body, may be regarded as rudimentary remains of a complete hairy covering in the ancestors of mankind. The Pliocene, or at all events Miocene precursor of man, was a furred creature. The discovery of Egyptian mummies six thousand years old or more has proved that this physical criterion remains unchanged, and that it is to-day what it was so many scores of centuries back. Perhaps, then, the primary divisions of mankind were distinguished by hair the same in texture and colour as that which characterizes to-day the great ethnical groups. The wavy type bridges the gulf between the lank and woolly types, all in turn derived from a common hair-covered being. In this connexion it is worth mention, as pointed out by P. Topinard, that though the regions occupied by the negroid races are the habitat of the anthropoid apes, the hair of the latter is real hair, not wool. Further in the eastern section of the dark domain, while the Papuan

is still black and dolichocephalic, his presumed progenitor, the orang-utan, is brachycephalic with decidedly red hair. Thus the white races are seen to come nearest the higher apes in this respect, yellow next, and black farthest removed.

No test has proved, on repeated examination, to be a safer one of racial purity than the quality of hair, and Pruner-Bey goes so far as to suggest that "a single hair presenting the average form characteristic of the race might serve to define it." At any rate a hair of an individual bears the stamp of his origin.

See Dr Pruner-Bey in *Mémoires de la société d'anthropologie*, ii. P. A. Brown, *Classification of Mankind by the Hair*; P. Topinard, *L'Homme dans la nature* (1891), chap. vi.

Commerce.—Hair enters into a considerable variety of manufactures. Bristles are the stout elastic hairs obtained from the backs of certain breeds of pigs. The finest qualities, and the greatest quantities as well, are obtained from Russia, where a variety of pig is reared principally on account of its bristles. The best and most costly bristles are used by shoemakers, secondary qualities being employed for toilet and clothes-brushes, while inferior qualities are worked up into the commoner kinds of brushes used by painters and for many mechanical purposes. For artists' use and for decorative painting, brushes or pencils of hair from the sable, camel, badger, polecat, &c., are prepared. The hair of various animals which is too short for spinning into yarn is utilized for the manufacture of felt. For this use the hair of rabbits, hares, beavers and of several other rodents is largely employed, especially in France, in making the finer qualities of felt hats. Cow hair, obtained from tanneries, is used in the preparation of roofing felts, and felt for covering boilers or steam-pipes, and for other similar purposes. It is also largely used by plasterers for binding the mortar of the walls and roofs of houses; and it is to some extent being woven up into coarse friezes, horse-cloths, railway rugs and inferior blankets. The tail hair of oxen is also of value for stuffing cushions and other upholstery work, for which purpose, as well as for making the official wigs of law officers, barristers, &c., the tail and body hair of the yak or Tibet ox is also sometimes imported into Europe. The tail and mane hair of horses is in great demand for various purposes. The long tail hair is especially valuable for weaving into hair-cloth, mane hair and the short tail hair being, on the other hand, principally prepared and curled for stuffing the chairs, sofas and couches which are covered with the cloth manufactured from the long hair. The horse hair used in Great Britain is principally obtained from South America, Germany and Russia, and its sorting, cleaning and working up into the various manufactures dependent on the material are industries of some importance. In addition to the purposes already alluded to, horse hair is woven into crinoline for ladies' bonnets, plaited into fishing lines, woven into bags for oil and cider pressers, and into straining cloths for brewers, &c., and for numerous other minor uses. The manufactures which arise in connexion with human hair are more peculiar than important, although occasionally fashions arise which cause a large demand for human hair. The fluctuations of such fashions determine the value of hair; but at all times long tresses are of considerable value. Grey, light, pale and auburn hair are distinguished as extra colours, and command much higher prices than the common shades. The light-coloured hair is chiefly obtained in Germany and Austria, and the south of France is the principal source of the darker shades. In the south of France the cultivation and sale of heads of hair by peasant girls is a common practice; and hawkers attend fairs for the special purpose of engaging in this traffic. Hair 5 and even 6 ft. long is sometimes obtained. Scarcely any of the "raw material" is obtained in the United Kingdom except in the form of ladies' "combing." Bleaching of hair by means of peroxide of hydrogen is extensively practised, with the view of obtaining a supply of golden locks, or of preparing white hair for mixing to match grey shades; but in neither case is the result very successful. Human hair is worked up into a great variety of wigs, scalps, artificial fronts, frizzets and curls, all for supplementing the scanty or failing resources of nature. The plaiting of human hair into articles of jewellery, watch-guards, &c., forms a distinct branch of trade.

HAIR-TAIL (*Trichiurus*), a marine fish belonging to the *Acanthopterygii scombriformes*, with a long band-like body terminating in a thread-like tail, and with strong prominent teeth in both jaws. Several species are known, of which one, common in the tropical Atlantic, not rarely reaches the British Islands.

HAITI [HAÏTI, HAYTI, SAN DOMINGO, or *Hispaniola*], an island in the West Indies. It lies almost in the centre of the chain and, with the exception of Cuba, is the largest of the group. Its greatest length between Cape Engano on the east and Cape des Irois on the west is 407 m., and its

greatest breadth between Cape Beata on the south and Cape Isabella on the north 160 m. The area is 28,000 sq. m., being rather less than that of Ireland. From Cuba, 70 m. W.N.W., and from Jamaica, 130 m. W.S.W., it is separated by the Windward Passage; and from Porto Rico, 60 m. E., by the Mona Passage. It lies between 17° 37' and 20° 0' N. and 68° 20' and 74° 28' W. From the west coast project two peninsulas. The south-western, of which Cape Tiburon forms the extremity, is the larger. It is 150 m. long and its width varies from 20 to 40 m. Columbus landed at Mole St Nicholas at the point of the north-western peninsula, which is 50 m. long, with an average breadth of 40 m. Between these lies the Gulf of Gonaïve, a triangular bay, at the apex of which stands the city of Port-au-Prince. The island of Gonaïve, opposite the city at a distance of 27 m., divides the entrance to Port-au-Prince into two fine channels, and forms an excellent harbour, 200 sq. m. In extent, the coral reefs along the coast being its only defect. On the north-east coast is the magnificent Bay of Samana, formed by the peninsula of that name, a mountain range projecting into the sea; its mouth is protected by a coral reef stretching 8½m. from the south coast. There is however, a good passage for ships, and within lies a safe and beautiful expanse of water 300 sq. m. in extent. Beyond Samana, with the exception of the poor harbour of Santo Domingo, there are no inlets on the east and south coasts until the Bays of Ocoa and Neyba are reached. The south coast of the Tiburon peninsula has good harbours at Jacmel, Bainet, Aquin and Les Cayes or Aux Cayes. The only inlets of any importance between Aux Cayes and Port-au-Prince are Jeremie and the Bay of Baraderes. The coast line is estimated at 1250 m.



Haiti is essentially a mountainous island. Steep escarpments, leading to the rugged uplands of the interior, reach almost everywhere down to the shores, leaving only here and there a few strips of beach. There are three fairly distinct mountain ranges, the northern, central and southern, with parallel axes from E. to W.; while extensive and fertile plains lie between them. The northern range usually called the Sierra de Monti Cristi, extends from Cape Samana on the east to Cape Fragata on the west. It has a mean elevation of 3000 ft., culminating in the Loma Diego Campo (3855 ft.), near the centre of the range. The central range runs from Cape Engano to Cape St Nicholas, some 400 m. in an oblique direction from E. to W. Towards the centre of the island it broadens and forms two distinct chains; the northern, the Sierra del Cibao, constituting the backbone of Haiti; the southern curving first S.W., then N.W., and reaching the sea near St Marc. In addition to these there are a number of secondary crests, difficult to trace to the backbone of the system, since the loftiest peaks are usually on some lateral ridge. Such for instance is Loma Tina (10,300 ft.) the highest elevation on the island, which rises as a spur N.W. of the city of Santo Domingo. In the Sierra del Cibao, the highest summit is the Pico del Yaqui (9700 ft.). The southern range runs from the Bay of Neyba due W. to Cape Tiburon. Its highest points are La Selle (8900 ft.) and La Hotte (7400 ft.). The plain of Seybo or Los Llanos is the largest of the Haitian plains. It stretches eastwards from the river Ozama for 95 m. and has an average width of 16 m. It is perfectly level, abundantly watered, and admirably adapted for the rearing of cattle. But perhaps the grandest is the Vega Real, or Royal Plain, as it was called by Columbus, which lies between the Cibao and Monti Cristi ranges. It stretches from Samana Bay to Manzanillo Bay, a distance of 140 m., but is interrupted in the centre by a range of hills in which rise the rivers which drain it. The northern part of this plain, however, is usually known as the Valley of Santiago. Most of the large valleys are in a state of nature, in part savanna, in part wooded, and all very fertile.

There are four large rivers. The Yaqui, rising in the Pico del Yaqui, falls, after a tortuous north-westerly course through the valley of Santiago, into Manzanillo Bay; its mouth is obstructed by shallows, and it is navigable only for canoes. The Neyba, or South Yaqui, also rises in the Pico del Yaqui and flows S. into the Bay of Neyba. In the mountains within a few miles from the sources of these rivers, rise the Yuna and the Artibonite. The Yuna drains the Vega Real, flows into Samana Bay, and is navigable by light-draught vessels for some distance from its mouth. The Artibonite flows through the valley of its name into the Gulf of Gonaïve. Of the smaller rivers the Ozama, on which the city of Santo Domingo stands, is the most important. The greatest lake is that of

Enriquillo or Xaragua, at a height of 300 ft. above sea-level. It is 27 m. long by 8 m. broad and very deep. Though 25 m. from the sea its waters are salt, and the Haitian negroes call it Etang Salé. After heavy rains it occasionally forms a continuous sheet of water with another lake called Azuey, or Etang Saumatre, which is 16 m. long by 4 m. broad; on these occasions the united lake has a total length of 60 m. and is larger than the Lake of Geneva. Farther S. is the Icoten de Limon, 5 m. long by 2 m. broad, a fresh-water lake with no visible outlet. Smaller lakes are Rincon and Miragoane. There are no active volcanoes, but earthquakes are not infrequent.

Geology.—The geology of Haiti is still very imperfectly known, and large tracts of the island have never been examined by a geologist. It is possible that the schists that have been observed in some parts of the island may be of Pre-cretaceous age, but the oldest rocks in which fossils have yet been found belong to the Cretaceous System, and the geological sequence is very similar to that of Jamaica. Excluding the schists of doubtful age, the series begins with sandstones and conglomerates, containing pebbles of syenite, granite, diorite, &c.; and these are overlaid by marls, clays and limestones containing *Hippurites*. Then follows a series of sandstones, clays and limestones with occasional seams of lignite, evidently of shallow-water origin. These are referred by R. T. Hill to the Eocene, and they are succeeded by chalky beds which were laid down in a deeper sea and which probably correspond with the Montpelier beds of Jamaica (Oligocene). Finally, there are limestones and marls composed largely of corals and molluscs, which are probably of very late Tertiary or Post-tertiary age. Until, however, the island has been more thoroughly examined, the correlation of the various Tertiary and Post-tertiary deposits must remain doubtful. Some of the beds which Hill has placed in the Eocene have been referred by earlier writers to the Miocene. Tippenhauer describes extensive eruptions of basalt of Post-pliocene age.

Fauna and Flora.—The fauna is not extensive. The agouti is the largest wild mammal. Birds are few, excepting water-fowl and pigeons. Snakes abound, though few are venomous. Lizards are numerous, and insects swarm in the low parts, with tarantulas, scorpions and centipedes. Caymans are found in the lakes and rivers, and the waters teem with fish and other sea food. Wild cattle, hogs and dogs, descendants of those brought from Europe, roam at large on the plains and in the forests. The wild hogs furnish much sport to the natives, who hunt them with dogs trained for the purpose.

In richness and variety of vegetable products Haiti is not excelled by any other country in the world. All tropical plants and trees grow in perfection, and nearly all the vegetables and fruits of temperate climates may be successfully cultivated in the highlands. Among indigenous products are cotton, rice, maize, tobacco, cocoa, ginger, native indigo (*indigo marron* or *sauvage*), arrowroot, manioc or cassava, pimento, banana, plantain, pine-apple, artichoke, yam and sweet potato. Among the important plants and fruits are sugarcane, coffee, indigo (called *indigo franc*, to distinguish it from the native), melons, cabbage, lucerne, guinea grass and the bread-fruit, mango, caimite, orange, almond, apple, grape, mulberry and fig. Most of the imported fruits have degenerated from want of care, but the mango, now spread over nearly the whole island, has become almost a necessary article of food; the bread-fruit has likewise become common, but is not so much esteemed. Haiti is also rich in woods, especially in cabinet and dye woods; among the former are mahogany, manchineel, satinwood, rosewood, cinnamon wood (*Canella alba*), yellow acoma (*Sideroxylon mastichodendron*) and gri-gri; and among the latter are Brazil wood, logwood, fustic and sassafras. On the mountains are extensive forests of pine and a species of oak; and in various parts occur the locust, ironwood, cypress or Bermuda cedar, palmetto and many kinds of palms.

Climate.—Owing to the great diversity of its relief Haiti presents a wider range of climate than any other part of the Antilles. The yearly rainfall is abundant, averaging about 120 in., but the wet and dry seasons are clearly divided. At Port-au-Prince the rainy season lasts from April to October, but varies in other parts of the island, so that there is never a season when rain is general. The mountain districts are constantly bathed in dense mists and heavy dews, while other districts are almost rainless. Owing to its sheltered position the heat at Port-au-Prince is greater than elsewhere. In summer the temperature there ranges between 80° and 95° F. and in winter between 70° and 80° F. Even in the highlands the mercury never falls below 45° F. Hurricanes are not so frequent as in the Windward Isles, but violent gales often occur. The prevailing winds are from the east.

The Republic of Haiti.—Haiti is divided into two parts, the negro republic of Haiti owning the western third of the island, while the remainder belongs to Santo Domingo (*q.v.*) or the Dominican Republic. Between these two governments there exists the strongest political antipathy.

Although but a small state, with an area of only 10,204 sq. m., the republic of Haiti is, in many respects, one of the most interesting communities in the world, as it is the earliest and most successful example of a state peopled, and governed on a constitutional model, by negroes. At its head is a president assisted by two chambers, the members of which are elected and hold office under a constitution of 1889. This constitution, thoroughly republican in form, is French in origin, as are also the laws, language, traditions and customs of Haiti. In practice, however, the government resolves itself into a military despotism, the power being concentrated in the hands

of the president. The Haitians seem to possess everything that a progressive and civilized nation can desire, but corruption is spread through every portion and branch of the government. Justice is venal, and the police are brutal and inefficient. Since 1869 the Roman Catholic has been the state religion, but all classes of society seem to be permeated with a thinly disguised adherence to the horrid rites of Voodoo (*q.v.*), although this has been strenuously denied. The country is divided into 5 *départements*, 23 *arrondissements* and 67 *communes*. Each *département* and *arrondissement* is governed by a general in the army. The army numbers about 7000 men, and the navy consists of a few small vessels. Elementary education is free, and there are some 400 primary schools; secondary education is mainly in the hands of the church. The Sisters of Charity and the Christian Brothers have schools at Port-au-Prince, where there is also a lyceum, a medical and a law school. The children of the wealthier classes are usually sent to France for their education. The unit of money is the *gourde*, the nominal value of which is the same as the American dollar, but it is subject to great fluctuations. The revenue is almost entirely derived from customs, paid both on imports and exports. There being a lack of capital and enterprise, the excessive customs dues produce a very depressed condition of trade. Imports are consequently confined to bare necessaries, the cheapest sorts of dry and fancy goods, matches, flour, salt beef and pork, codfish, lard, butter and similar provisions. The exports are coffee, cocoa, logwood, cotton, gum, honey, tobacco and sugar. The island is one of the most fertile in the world, and if it had an enlightened and stable government, an energetic people, and a little capital, its agricultural possibilities would seem to be endless. Communications are bad; the roads constructed during the French occupation have degenerated into mere bridle tracks. There is a coast service of steamers, maintained since 1863, and 26 ports are regularly visited every ten days. Foreign communication is excellent, more foreign steamships visiting this island than any other in the West Indies. A railway from Port-au-Prince runs through the Plain of Cul de Sac for 28 m. to Manneville on the Etang Saumatre, another runs from Cap Haitien to La Grande Rivière, 15 m. distant.

The people are almost entirely pure-blooded negroes, the mulattoes, who form about 10% of the population, being a rapidly diminishing and much-hated class. The negroes are a kindly, hospitable people, but ignorant and lazy. They have a passion for dancing weird African dances to the accompaniment of the tom-tom. Marriage is neither frequent nor legally prescribed, since children of looser unions are regarded by the state as legitimate. In the interior polygamy is frequent. The people generally speak a curious but not unattractive *patois* of French origin, known as Creole. French is the official language, and by a few of the educated natives it is written and spoken in its purity. On the whole it must be owned that, after a century of independence and self-government, the Haitian people have made no progress, if they have not actually shown signs of retrogression. The chief towns are Port-au-Prince (pop. 75,000), Cap Haitien (29,000), Les Cayes (25,000), Gonaïve (18,000), and Port de Paix (10,000). Jeremie was the birthplace of the elder Dumas. The ruins of the wonderful palace of Sans-Souci and of the fortress of La Ferrière, built by King Henri Christophe (1807-1825), can be seen near Millot, a town 9 m. inland from Cap Haitien. Plaisance (25,000), Gros Morne (22,000) and La Croix des Bouquets (20,000) are the largest towns in the interior. The entire population of the republic is about 1,500,000.

History.—The history of Haiti begins with its discovery by Columbus, who landed from Cuba at Mole St Nicholas on the 6th of December 1492. The natives called the country Haiti (mountainous country), and Quisquica (vast country). Columbus named it Espagnola (Little Spain), which was latinized into Hispaniola. At the time of its discovery, the island was inhabited by about 2,000,000 Indians, who are described by the Spaniards as feeble in intellect and physically defective. They were, however, soon exterminated, and their place was supplied (as early as 1512) by slaves imported from Africa, the descendants of whom now possess the land. Six years after its discovery Columbus had explored the interior of the island, founded the present capital, and had established flourishing settlements at Isabella, Santiago, La Vega, Porto Plata and Bonao. Mines had been opened up, and advances made in agriculture. Sugar was introduced in 1506, and in a few years became the staple product. About 1630, a mixed company of French and English, driven by the Spaniards from St Kitts, settled on the island of Tortuga, where they became formidable under the name of Buccaneers. They soon obtained a footing on the mainland of Haiti, and by the treaty of Ryswick, 1697, the part they occupied was ceded to France. This new colony, named Saint Dominique, subsequently attained a high degree of prosperity, and was in a flourishing state when the French Revolution broke out in 1789. The population was then composed of whites, free coloured people (mostly mulattoes) and negro slaves. The mulattoes demanded civil rights, up to that time enjoyed only by the whites; and in 1791 the National Convention conferred on them all the privileges of French citizens. The whites at once adopted the most violent measures, and petitioned the home government to reverse the decree, which was accordingly revoked. In August 1791, the plantation slaves broke out into insurrection, and the mulattoes threw in their lot with them. A period of turmoil followed, lasting for several years, during which both parties were responsible for acts of the most revolting cruelty. Commissioners were sent out from France with full powers to settle the dispute, but although in 1793 they proclaimed the abolition of slavery, they could effect nothing. To add

further to the troubles of the colony, it was invaded by a British force, which, in spite of the climate and the opposition of the colonists, succeeded in maintaining itself until driven out in 1798 by Toussaint l'Ouverture. By treaty with Spain, in 1795, France had acquired the title to the entire island.

By 1801, Toussaint l'Ouverture, an accomplished negro of remarkable military genius, had succeeded in restoring order. He then published, subject to the approval of France, a form of constitutional government, under which he was to be governor for life. This step, however, roused the suspicions of Bonaparte, then first consul, who determined to reduce the colony and restore slavery. He sent out his brother-in-law, General Leclerc, with 25,000 troops; but the colonists offered a determined, and often ferocious, resistance. At length, wearied of the struggle, Leclerc proposed terms, and Toussaint, induced by the most solemn guarantees on the part of the French, laid down his arms. He was seized and sent to France, where he died in prison in 1803. The blacks, infuriated by this act of treachery, renewed the struggle, under Jean Jacques Dessalines (1758-1806), with a barbarity unequalled in previous contests. The French, further embarrassed by the appearance of a British fleet, were only too glad to evacuate the island in November 1803.

The opening of the following year saw the declaration of independence, and the restoration of the aboriginal name of Haiti. Dessalines, made governor for life, inaugurated his rule with a bloodthirsty massacre of all the whites. In October 1804, he proclaimed himself emperor and was crowned with great pomp; but in 1806 his subjects, growing tired of his tyranny, assassinated him. His position was now contended for by several chiefs, one of whom, Henri Christophe (1767-1820), established himself in the north, while Alexandre Sabes Pétion (1770-1818) took possession of the southern part. The Spaniards re-established themselves in the eastern part of the island, retaining the French name, modified to Santo Domingo. Civil war now raged between the adherents of Christophe and Pétion, but in 1810 hostilities were suspended. Christophe declared himself king of Haiti under the title of Henry I.; but his cruelty caused an insurrection, and in 1820 he committed suicide. Pétion was succeeded in 1818 by General Jean Pierre Boyer (1776-1850), who, after Christophe's death, made himself master of all the French part of the island. In 1821 the eastern end of the island proclaimed its independence of Spain, and Boyer, taking advantage of dissensions there, invaded it, and in 1822 the dominion of the whole island fell into his hands. Boyer held the presidency of the new government, which was called the republic of Haiti, until 1843, when he was driven from the island by a revolution. In 1844 the people at the eastern end of the island again asserted their independence. The republic of Santo Domingo was established, and from that time the two political divisions have been maintained. Meanwhile in Haiti revolution followed revolution, and president succeeded president, in rapid succession. Order, however, was established in 1849, when Soulouque, who had previously obtained the presidency, proclaimed himself emperor, under the title of Faustin I. After a reign of nine years he was deposed and exiled, the republic being restored under the mulatto president Fabre Geffrard. His firm and enlightened rule rendered him so unpopular that in 1867 he was forced to flee to Jamaica. He was succeeded by Sylvestre Salnave, who, after a presidency of two years, was shot. Nissage-Saget (1870), Dominique (1874), and Boisrond-Canal (1876) followed, each to be driven into exile by revolution. The next president, Salomon, maintained himself in office for ten years, but he too was driven from the country and died in exile. Civil war raged in 1888-1889 between Generals Légitime and Hippolyte, and the latter succeeded in obtaining the vacant presidency. He ruled with the most absolute authority till his death in 1896. General Tiresias Simon Sam followed and ruled till his flight to Paris in 1902. The usual civil war ensued, and after nine months of turmoil, order was restored by the election of Nord Alexis in December 1902.

Alexis' administration was unsuccessful, and was marked by many disturbances, culminating in his expulsion. In 1904 there was an attack by native soldiery on the French and German representatives, and punishment was exacted by these powers. In December 1904 ex-president Sam, his wife and members of his ministry were sentenced to long terms of imprisonment for fraudulently issuing bonds. In December 1907 a conspiracy against the government was reported and the ringleaders were sentenced to death. But in January 1908 the revolution spread, and Gonaïve and St Marc and other places were reported to be in the hands of the insurgents. Prompt measures were taken, the rising was checked, and Alexis announced the pardon of the revolutionaries. In March, however, this pacific policy was reversed by a new ministry; some suspects were summarily executed, and the attitude of the government was only modified when the powers sent war-ships to Port-au-Prince. In September the criminal court at the capital sentenced to death, by default, a large number of persons implicated in the risings earlier in the year, and in November revolution broke out again. General Antoine Simon raised his standard at Aux Cayes. Disaffection was rife among the government troops, who deserted to him in great numbers. On the 2nd of December Port-au-Prince was occupied without bloodshed by the revolutionaries, and Alexis took to flight, escaping violence with some difficulty, and finding refuge on a French ship. General Simon then assumed the presidency. At the end of April 1910 Alexis died in Jamaica, in circumstances of some obscurity; it had just been discovered that a plot

was on foot to depose Simon, and further trouble was threatened.

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HAIJIPUR, a town of British India, in the Muzaffarpur district of Bengal, on the Gandak, just above its confluence with the Ganges opposite Patna. Pop. (1901), 21,398. Hajipur figures conspicuously in the history of the struggles between Akbar and his rebellious Afghan governors of Bengal, being twice besieged and captured by the imperial troops, in 1572 and 1574. Within the limits of the old fort is a small stone mosque, very plain, but of peculiar architecture, and attributed to Hājī Ilyās, its traditional founder (*c.* 1350). Its command of water traffic in three directions makes the town a place of considerable commercial importance. Hajipur has a station on the main line of the Bengal and North-western railway.

HAIJ or **HADJ**, the Arabic word, meaning literally a "setting out," for the greater pilgrimage of Mahommedans to Mecca, which takes place from the 8th to the 10th of the twelfth month of the Mahommedan year; the lesser pilgrimage, called *umrah* or *omra*, may be made to the mosque at Mecca at any time other than that of the hajj proper, and is also a meritorious act. The term *hajji* or *hadji* is given to those who have performed the greater pilgrimage. The word *hajj* is sometimes loosely used of any Mahommedan pilgrimage to a sacred place or shrine, and is also applied to the pilgrimages of Christians of the East to the Holy Sepulchre at Jerusalem (see [MECCA](#); [MAHOMMEDAN RELIGION](#)).

HĀJJĪ KHALĪFA [in full Muṣṭafā ibn 'Abdallāh Kātib Chelebī Hājī Khalīfa] (*ca.* 1599-1658), Arabic and Turkish author, was born at Constantinople. He became secretary to the commissariat department of the Turkish army in Anatolia, was with the army in Bagdad in 1625, was present at the siege of Erzerum, and returned to Constantinople in 1628. In the following year he was again in Bagdad and Hamadān, and in 1633 at Aleppo, whence he made the pilgrimage to Mecca (hence his title Hājī). The following year he was in Erivān and then returned to Constantinople. Here he obtained a post in the head office of the commissariat department, which afforded him time for study. He seems to have attended the lectures of great teachers up to the time of his death, and made a practice of visiting bookshops and noting the titles and contents of all books he found there. His largest work is the *Bibliographical Encyclopaedia* written in Arabic. In this work, after five chapters dealing with the sciences generally, the titles of Arabian, Persian and Turkish books written up to his own time are arranged in alphabetical order. With the titles are given, where possible, short notes on the author, his date, and sometimes the introductory words of his work. It was edited by G. Flügel with Latin translation and a useful appendix (7 vols. Leipzig, 1835-1858). The text alone of this edition has been reproduced at Constantinople (1893).

Hājī Khalīfa also wrote in Turkish: a chronological conspectus of general history (translated into Italian by G. R. Carli, Venice, 1697); a history of the Turkish empire from 1594 to 1655 (Constantinople, 1870); a history of the naval wars of the Turks (Constantinople, 1729; chapters 1-4 translated by J. Mitchell, London, 1831); a general geography published at Constantinople,

1732 (Latin trans. by M. Norberg, London and Gotha, 1818; German trans. of part by J. von Hammer, Vienna, 1812; French trans. of part by V. de St Martin in his *Geography of Asia Minor*, vol. I).

For his life see the preface to Flügel's edition; list of his works in C. Brockelmann's *Gesch. d. arabischen Literatur* (Berlin, 1902), vol. ii., pp. 428-429.

(G. W. T.)

HAKE, EDWARD (fl. 1579), English satirist, was educated under John Hopkins, the part-author of the metrical version of the Psalms. He resided in Gray's Inn and Barnard's Inn, London. In the address "To the Gentle Reader" prefixed to his *Newes out of Powles Churchyard ... Otherwise entitled Syr Nummus* (2nd ed., 1579) he mentions the "first three yeeres which I spent in the Innes of Channcery, being now about a dosen of yeeres passed." In 1585 and 1586 he was mayor of New Windsor, and in 1588 he represented the borough in parliament. His last work was published in 1604. He was protected by the earl of Leicester, whose policy it was to support the Puritan party, and who no doubt found a valuable ally in so vigorous a satirist of error in clerical places as was Hake. *Newes out of Paules Churchyarde, A Trappe for Syr Monye*, first appeared in 1567, but no copy of this impression is known, and it was re-issued in 1579 with the title quoted above. The book takes the form of a dialogue between Bertulph and Paul, who meet in the aisles of the cathedral, and is divided into eight "satyrs," dealing with the corruption of the higher clergy and of judges, the greed of attorneys, the tricks of physicians and apothecaries, the sumptuary laws, extravagant living, Sunday sports, the abuse of St Paul's cathedral as a meeting-place for business and conversation, usury, &c. It is written in rhymed fourteen-syllable metre, which is often more comic than the author intended. It contains, amid much prefatory matter, a note to the "carping and scornefull Sicophant," in which he attacks his enemies with small courtesy and much alliteration. One is described as a "carping careless cankerd churle."

He also wrote a translation from Thomas à Kempis, *The Imitation, or Following of Christ* (1567, 1568); *A Touchstone for this Time Present* (1574), a scurrilous attack on the Roman Catholic Church, followed by a treatise on education; *A Commemoration of the ... Raigne of ... Elizabeth* (1575), enlarged in 1578 to *A Joyfull Continuance of the Commemoration, &c.*; and of *Gold's Kingdom, and this Unhelping Age* (1604), a collection of pieces in prose and verse, in which the author inveighs against the power of gold. A bibliography of these and of Hake's other works was compiled by Mr Charles Edmonds for his edition in 1872 of the *Newes* (Isham Reprints, No. 2, 1872).

HAKE, THOMAS GORDON (1800-1895), English poet, was born at Leeds, of an old Devonshire family, on the 10th of March 1809. His mother was a Gordon of the Huntly branch. He studied medicine at St George's hospital and at Edinburgh and Glasgow, but had given up practice for many years before his death, and had devoted himself to a literary life. In 1839 he published a prose epic *Vates*, republished in Ainsworth's magazine as *Valdarno*, which attracted the attention of D. G. Rossetti. In after years he became an intimate member of the circle of friends and followers gathered round Rossetti, who so far departed from his usual custom as to review Hake's poems in the *Academy* and in the *Fortnightly Review*. In 1871 he published *Madeline*; 1872, *Parables and Tales*; 1883, *The Serpent Play*; 1890, *New Day Sonnets*; and in 1892 his *Memoirs of Eighty Years*. Dr Hake's works had much subtlety and felicity of expression, and were warmly appreciated in a somewhat restricted literary circle. In his last published verse, the sonnets, he shows an advance in facility on the occasional harshness of his earlier work. He was given a Civil List literary pension in 1893, and died on the 11th of January 1895.

HAKE (*Merluccius vulgaris*), a fish which differs from the cod in having only two dorsal fins, and one anal. It is very common on the coasts of Europe and eastern North America, but its flesh is much less esteemed than that of the true *Gadi*. Specimens 4 ft. in length are not scarce. There are local variations in the use of "hake" as a name; in America the "silver hake" (*Merluccius*

bilinearis), sometimes called "whiting," and "Pacific hake" (*Merluccius productus*) are also food-fishes of inferior quality.

HAKKAS ("Guests," or "Strangers"), a people of S.W. China, chiefly found in Kwang-Tung, Fu-Kien and Formosa. Their origin is doubtful, but there is some ground for believing that they may be a cross between the aboriginal Mongolic element of northern China and the Chinese proper. According to their tradition, they were in Shantung and northern China as early as the 3rd century B.C. In disposition, appearance and customs they differ from the true Chinese. They speak a distinct dialect. Their women, who are prettier than the pure Chinese, do not compress their feet, and move freely about in public. The Hakkas are a most industrious people and furnish at Canton nearly all the coolie labour employed by Europeans. Their intelligence is great, and many noted scholars have been of Hakka birth. Hung Sin-tsuan, the leader in the Taiping rebellion, was a Hakka. In Formosa they serve as intermediaries between the Chinese and European traders and the natives. From time immemorial they seem to have been persecuted by the Chinese, whom they regard as "foreigners," and with whom their means of communication is usually "pidgin English." The earliest persecution occurred under the "first universal emperor" of China, Shi-Hwang-ti (246-210 B.C.). From this time the Hakkas appear to have become wanderers. Sometimes for generations they were permitted to live unmolested, as under the Han dynasty, when some of them held high official posts. During the Tang dynasty (7th, 8th, and 9th centuries) they settled in the mountains of Fu-kien and on the frontiers of Kwang-Tung. On the invasion of Kublai Khan, the Hakkas distinguished themselves by their bravery on the Chinese side. In the 14th century further persecutions drove them into Kwang-Tung.

See "An Outline History of the Hakkas," *China Review* (London, 1873-1874), vol. ii.; Pitou, "On the Origin and History of the Hakkas," *ib.*; Dyer Ball, *Easy Lessons in the Hakka Dialect* (1884), *Things Chinese* (London, 1893); Schaub, "Proverbs in Daily Use among the Hakkas," in *China Review* (London, 1894-1895), vol. xxi.; Rev. J. Edkins, *China's Place in Philology*; Girard de Rialle, *Rev. d. anthrop.* (Jan. and April, 1885); G. Taylor, "The Aborigines of Formosa," *China Review*, xiv. p. 198 seq., also xvi. No. 3, "A Ramble through Southern Formosa."

HAKLUYT, RICHARD (c. 1553-1616), British geographer, was born of good family in or near London about 1553. The Hakluyts were of Welsh extraction, not Dutch as has been supposed. They appear to have settled in Herefordshire as early as the 13th century. The family seat was Eaton, 2 m. S.E. of Leominster. Hugo Hakelute was returned M.P. for that borough in 1304/5. Richard went to school at Westminster, where he was a queen's scholar; while there his future bent was determined by a visit to his cousin and namesake, Richard Hakluyt of the Middle Temple. His cousin's discourse, illustrated by "certain bookes of cosmographie, an universall mape, and the Bible," made young Hakluyt resolve to "prosecute that knowledge and kind of literature." Entering Christ Church, Oxford, in 1570, "his exercises of duty first performed," he fell to his intended course of reading, and by degrees perused all the printed or written voyages and discoveries that he could find. He took his B.A. in 1573/4. It is probable that, shortly after taking his M.A. (1577), he began at Oxford the first public lectures in geography that "shewed both the old imperfectly composed and the new lately reformed mappes, globes, spheares, and other instruments of this art." That this was not in London is certain, as we know that the first lecture of the kind was delivered in the metropolis on the 4th of November 1588 by Thomas Hood.

Hakluyt's first published work was his *Divers Voyages touching the Discoverie of America* (London, 1582, 4to.). This brought him to the notice of Lord Howard of Effingham, and so to that of Sir Edward Stafford, Lord Howard's brother-in-law; accordingly at the age of thirty, being acquainted with "the chieftest captaines at sea, the greatest merchants, and the best mariners of our nation," he was selected as chaplain to accompany Stafford, now English ambassador at the French court, to Paris (1583). In accordance with the instructions of Secretary Walsingham, he occupied himself chiefly in collecting information of the Spanish and French movements, and "making diligent inquirie of such things as might yield any light unto our westerne discoverie in America." The first fruits of Hakluyt's labours in Paris are embodied in his important work entitled *A particuler discourse concerning Westerne discoveries written in the yere 1584, by Richarde Hackluyt of Oxforde, at the requeste and direction of the righte worshipfull Mr Walter Raghly before the comynge home of his twoo barkes*. This long-lost MS. was at last printed in

1877. Its object was to recommend the enterprise of planting the English race in the unsettled parts of North America. Hakluyt's other works consist mainly of translations and compilations, relieved by his dedications and prefaces, which last, with a few letters, are the only material we possess out of which a biography of him can be framed. Hakluyt revisited England in 1584, laid before Queen Elizabeth a copy of the *Discourse* "along with one in Latin upon Aristotle's *Politicks*," and obtained, two days before his return to Paris, the grant of the next vacant prebend at Bristol, to which he was admitted in 1586 and held with his other preferments till his death.

While in Paris Hakluyt interested himself in the publication of the MS. journal of Laudonnière, the *Histoire notable de la Florida*, edited by Bassanier (Paris, 1586, 8vo.). This was translated by Hakluyt and published in London under the title of *A notable historie containing foure voyages made by certayne French captaynes into Florida* (London, 1587, 4to.). The same year *De orbe novo Petri Martyris Anglerii decades octo illustratae labore et industria Richardi Hackluyti* saw the light at Paris. This work contains the exceedingly rare copperplate map dedicated to Hakluyt and signed F. G. (supposed to be Francis Gualle); it is the first on which the name of "Virginia" appears.

In 1588 Hakluyt finally returned to England with Lady Stafford, after a residence in France of nearly five years. In 1589 he published the first edition of his chief work, *The Principall Navigations, Voiages and Discoveries of the English Nation* (fol., London, 1 vol.). In the preface to this we have the announcement of the intended publication of the first terrestrial globe made in England by Molyneux. In 1598-1600 appeared the final, reconstructed and greatly enlarged edition of *The Principall Navigations, Voyages, Traffiques and Discoveries of the English Nation* (fol., 3 vols.). Some few copies contain an exceedingly rare map, the first on the Mercator projection made in England according to the true principles laid down by Edward Wright. Hakluyt's great collection, though but little read, has been truly called the "prose epic of the modern English nation." It is an invaluable treasure of material for the history of geographical discovery and colonization, which has secured for its editor a lasting reputation. In 1601 Hakluyt edited a translation from the Portuguese of Antonio Galvano, *The Discoveries of the World* (4to., London). In the same year his name occurs as an adviser to the East India Company, supplying them with maps, and informing them as to markets. Meantime in 1590 (April 20th) he had been instituted to the rectory of Withering-sett-cum-Brockford, Suffolk. In 1602, on the 4th of May, he was installed prebendary of Westminster, and in the following year he was elected archdeacon of Westminster. In the licence of his second marriage (30th of March 1604) he is also described as one of the chaplains of the Savoy, and his will contains a reference to chambers occupied by him there up to the time of his death; in another official document he is styled D.D. In 1605 he secured the prospective living of James Town, the intended capital of the intended colony of Virginia. This benefice he supplied, when the colony was at last established in 1607, by a curate, one Robert Hunt. In 1606 he appears as one of the chief promoters of the petition to the king for patents to colonize Virginia. He was also a leading adventurer in the London or South Virginia Company. His last publication was a translation of Fernando de Soto's discoveries in Florida, entitled *Virginia richly valued by the description of Florida her next neighbour* (London, 1609, 4to). This work was intended to encourage the young colony of Virginia; to Hakluyt, it has been said, "England is more indebted for its American possession than to any man of that age." We may notice that it was at Hakluyt's suggestion that Robert Parke translated Mendoza's *History of China* (London, 1588-1589) and John Pory made his version of *Leo Africanus* (*A Geographical History of Africa*, London, 1600). Hakluyt died in 1616 (November 23rd) and was buried in Westminster Abbey (November 26th); by an error in the abbey register his burial is recorded under the year 1626. Out of his various emoluments and preferments (of which the last was Gedney rectory, Lincolnshire, in 1612) he amassed a small fortune, which was squandered by a son. A number of his MSS., sufficient to form a fourth volume of his collections of 1598-1600, fell into the hands of Samuel Purchas, who inserted them in an abridged form in his *Pilgrimes* (1625-1626, fol.). Others are preserved at Oxford (Bib. Bod. MS. Seld. B. 8). which consist chiefly of notes gathered from contemporary authors.

Besides the MSS. or editions noticed in the text (*Divers Voyages* (1582); *Particuler Discourse* (1584); Laudonnière's *Florida* (1587); Peter Martyr, *Decades* (1587); *Principall Navigations* (1589 and 1598-1600); Galvano's *Discoveries* (1601); De Soto's Florida record, the *Virginia richly valued* (1609, &c.), we may notice the Hakluyt Society's London edition of the *Divers Voyages* in 1850, the edition of the *Particuler Discourse*, by Charles Deane in the *Collections of the Maine Historical Society* (Cambridge, Mass., 1870, with an introduction by Leonard Woods); also, among modern issues of the *Principall Navigations*, those of 1809 (5 vols., with much additional matter), and of 1903-1905 (Glasgow, 12 vols.). The new title-page issued for the first volume of the final edition of the *Principall Navigations*, in 1599, merely cancelled the former 1598 title with its reference to the Cadiz expedition of 1596; but from this has arisen the mistaken supposition that a new *edition* was then (1599) published. Hakluyt's Galvano was edited for the Hakluyt Society by Admiral C. R. D. Bethune in 1862. This Society, which was founded in 1846 for printing rare and unpublished voyages and travels, includes the Glasgow edition of the *Principall Navigations* in its *extra series*, as well as C. R. Beazley's edition of *Carpini, Rubruquis*, and other medieval texts from Hakluyt (Cambridge, 1903, 1 vol.). Reckoning in these and an issue of Purchas's *Pilgrimes*

by the Glasgow publisher of the Hakluyt of 1903-1905, the society has now published or "fathered" 150 vols. See also *Voyages of the Elizabethan Seamen to America, being Select Narratives from the Principal Navigations*, by E. J. Payne (Oxford, 1880; 1893; new edition by C. R. Beazley, 1907).

For Hakluyt's life the dedications of the 1589 and 1598 editions of the *Principal Navigations* should be especially consulted; also Winter Jones's introduction to the Hakluyt Society edition of the *Divers Voyages*; Fuller's *Worthies of England, "Herefordshire"*; *Oxford Univ. Reg.* (Oxford Hist. Soc), ii., iii. 39; *Historical MSS. Commission, 4th report, appendix*, p. 614, the last giving us the Towneley MSS. referring to payments (prizes?) awarded to Hakluyt when at Oxford, May 12th and June 4th, 1575.

(C. H. C; C. R. B.)

HAKODATE, a town on the south of the island of Yezo, Japan, for many years regarded as the capital of the island until Sapporo was officially raised to that rank. Pop. (1903) 84,746. Its position, as has been frequently remarked, is not unlike that of Gibraltar, as the town is built along the north-western base of a rocky promontory (1157 ft. in height) which forms the eastern boundary of a spacious bay, and is united to the mainland by a narrow sandy isthmus. The summit of the rock, called the Peak, is crowned by a fort. Hakodate is one of the ports originally opened to foreign trade. The Bay of Hakodate, an inlet of Tsugaru Strait, is completely land-locked, easy of access and spacious, with deep water almost up to the shore, and good holding-ground. The Russians formerly used Hakodate as a winter port. The staple exports are beans, pulse and peas, marine products, sulphur, furs and timber; the staple imports, comestibles (especially salted fish), kerosene and oil-cake. The town is not situated so as to profit largely by the development of the resources of Yezo, and as a port of foreign trade its outlook is indifferent. Frequent steamers connect Hakodate and Yokohama and other ports, and there is daily communication with Aomori, 56 m. distant, whence there is rail-connexion with Tokyo. Hakodate was opened to American commerce in 1854. In the civil war of 1868 the town was taken by the rebel fleet, but it was recovered by the mikado in 1869.

HAL, a town of Brabant, Belgium, about 9 m. S.W. of Brussels, situated on the river Senne and the Charleroi canal. Pop. (1904) 13,541. The place is interesting chiefly on account of its fine church of Notre Dame, formerly dedicated to St Martin. This church, a good example of pure Gothic, was begun in 1341 and finished in 1409. Its principal ornament is the alabaster altar, by J. Mone, completed in 1533. The bronze font dates from 1446. Among the monuments is one in black marble to the dauphin Joachim, son of Louis XI., who died in 1460. In the treasury of the church are many costly objects presented by illustrious personages, among others by the emperor Charles V., King Henry VIII. of England, Charles the Bold of Burgundy, and several popes. The church is chiefly celebrated, however, for its miraculous image of the Virgin. Legend says that during a siege the bullets fired into the town were caught by her in the folds of her dress. Some of these are still shown in a chest that stands in a side chapel. In consequence of this belief a great pilgrimage, attended by many thousands from all parts of Belgium, is paid annually to this church. The hôtel de ville dates from 1616 and has been restored with more than ordinary good taste.

HALA, or HALLA (formerly known as Murtazabad), a town of British India in Hyderabad district, Sind. Pop. (1901) 4985. It has long been famous for its glazed pottery and tiles, made from a fine clay obtained from the Indus, mixed with powdered flints. The town has also a manufacture of susis or striped trouser-cloths.

HALAESA, an ancient town on the north coast of Sicily, about 14 m. E. of Cephaloedium [Cefalu], to the east of the modern Castel di Tusa, founded in 403 B.C. by Archonides, tyrant of Herbita, whose name it sometimes bore: we find, *e.g. Halaisa Archonida* on a coin of the time of Augustus (*Corp. inscrip. Lat. x.*, Berlin, 1883, p. 768). It was the first town to surrender to the Romans in the First Punic War, and was granted freedom and immunity from tithe. It became a place of some importance in Roman days, especially as a port, and entirely outstripped its mother city. Halaesa is the only place in Sicily where an inscription dedicated to a Roman governor of the republican period (perhaps in 93 B.C.) has come to light.

(T. As.)

HALAKHA, or HALACHA (literally "rule of conduct"), the rabbinical development of the Mosaic law; with the haggada it makes up the Talmud and Midrash (*q.v.*). As the haggada is the poetic, so the halakha is the legal element of the Talmud (*q.v.*), and arose out of the faction between the Sadducees, who disputed the traditions, and the Pharisees, who strove to prove their derivation from scripture. Among the chief attempts to codify the halakha were the *Great Rules (Halakhoth Gedoloth)* of Simon Kayyara (9th century), based on the letters written by the Gaonim, the heads of the Babylonian schools, to Jewish inquirers in many lands, the work of Jacob Alfassi (1013-1103), the *Strong Hand of Maimonides* (1180), and the *Table Prepared (Shulhan Aruch)* of Joseph Qaro (1565), which from its practical scope and its clarity as a work of general reference became the universal handbook of Jewish life in many of its phases.

(I. A.)

HALBERSTADT, a town of Germany, in the Prussian province of Saxony, 56 m. by rail N.W. of Halle, and 29 S.W. of Magdeburg. It lies in a fertile country to the north of the Harz Mountains, on the Holzemme, at the junction of railways to Halle, Goslar and Thale. Pop. (1905) 45,534. The town has a medieval appearance, many old houses decorated with beautiful wood-carving still surviving. The Gothic cathedral (now Protestant), dating from the 13th and 14th centuries, is remarkable for the majestic impression made by the great height of the interior, with its slender columns and lofty, narrow aisles. The treasure, preserved in the former chapter-house, is rich in reliquaries, vestments and other objects of medieval church art. The beautiful spires, which had become unsafe, were rebuilt in 1890-1895. Among the other churches the only one of special interest is the Liebfrauenkirche (Church of Our Lady), a basilica, with four towers, in the later Romanesque style, dating from the 12th and 13th centuries and restored in 1848, containing old mural frescoes and carved figures. Remarkable among the other old buildings are the town-hall, of the 14th century and restored in the 17th century, with a crypt, and the Petershof, formerly the episcopal palace, but now utilized as law courts and a prison. The principal educational establishment is the gymnasium, with a library of 40,000 volumes. Close to the cathedral lies the house of the poet Gleim (*q.v.*), since 1899 the property of the municipality and converted into a museum. It contains a collection of the portraits of the friends of the poet-scholar and some valuable manuscripts. The principal manufactures of the town are sugar, cigars, paper, gloves, chemical products, beer and machinery. About a mile and a half distant are the Spiegelsberge, from which a fine view of the surrounding country is obtained, and the Klusberge, with prehistoric cave-dwellings cut out in the sandstone rocks.

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The history of Halberstadt begins with the transfer to it, by Bishop Hildegrim I., in 820 of the see founded by Charlemagne at Seligenstadt. At the end of the 10th century the bishops were granted by the emperors the right to exercise temporal jurisdiction over their see, which became one of the most considerable of the ecclesiastical principalities of the Empire. As such it survived the introduction of the Reformation in 1542; but in 1566, on the death of Sigismund of Brandenburg (also archbishop of Madgeburg from 1552 to 1566), the last Catholic bishop, the chapter from motives of economy elected the infant Henry Julius of Brunswick-Lüneburg. In 1589 he became duke of Brunswick, and two years later he abolished the Catholic rites in Halberstadt. The see was governed by lay bishops until 1648, when it was formally converted by the treaty of Westphalia into a secular principality for the elector of Brandenburg. By the treaty of Tilsit in 1807 it was annexed to the kingdom of Westphalia, but came again to Prussia on the downfall of Napoleon.

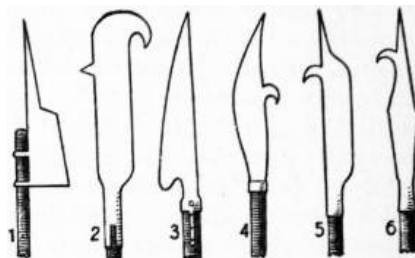
The town received a charter from Bishop Arnulf in 998. In 1113 it was burnt by the emperor Henry V., and in 1179 by Henry the Lion. During the Thirty Years' War it was occupied alternately by the Imperialists and the Swedes, the latter of whom handed it over to

See Lucanus, *Der Dom zu Halberstadt* (1837), *Wegweiser durch Halberstadt* (2nd ed., 1866) and *Die Liebfrauenkirche zu Halberstadt* (1872); Scheffer, *Inschriften und Legenden halberstädtischer Bauten* (1864); Schmidt, *Urkundenbuch der Stadt Halberstadt* (Halle, 1878); and Zschiesche, *Halberstadt, sonst und jetzi* (1882).

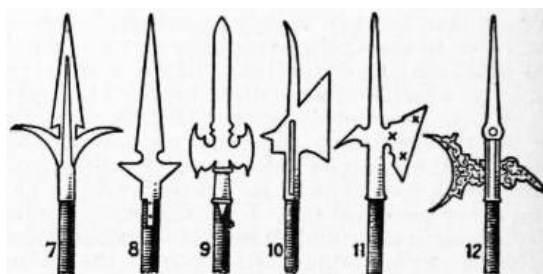
HALBERT, HALBERD or HALBARD, a weapon consisting of an axe-blade balanced by a pick and having an elongated pike-head at the end of the staff, which was usually about 5 or 6 ft. in length. The utility of such a weapon in the wars of the later middle ages lay in this, that it gave the foot soldier the means of dealing with an armoured man on horseback. The pike could do no more than keep the horseman at a distance. This ensured security for the foot soldier but did not enable him to strike a mortal blow, for which firstly a long-handled and secondly a powerful weapon, capable of striking a heavy cleaving blow, was required. Several different forms of weapon responding to these requirements are described and illustrated below; it will be noticed that the thrusting pike is almost always combined with the cutting-bill hook or axe-head, so that the individual billman or halberdier should not be at a disadvantage if caught alone by a mounted opponent, or if his first descending blow missed its object. It will be noticed further that, concurrently with the disuse of complete armour and the development of firearms, the pike or thrusting element gradually displaces the axe or cleaving element in these weapons, till at last we arrive at the court halberts and partizans of the late 16th and early 17th centuries and the so-called "halbert" of the infantry officer and sergeant in the 18th, which can scarcely be classed even as partizans.

Figs. 1-6 represent types of these long cutting, cut and thrust weapons of the middle ages, details being omitted for the sake of clearness. The most primitive is the *voulge* (fig. 1), which is simply a heavy cleaver on a pole, with a point added. The next form, the *gisarme* or *guisarme* (fig. 2), appears in infinite variety but is always distinguished from voulges, &c. by the hook, which was used to pull down mounted men, and generally resembles the agricultural bill-hook of to-day. The *glaive* (fig. 3 is late German) is a broad, heavy, slightly curved sword-blade on a stave; it is often combined with the hooked *gisarme* as a *glaive-gisarme* (fig. 4, Burgundian, about 1480). A *gisarme-voulge* is shown in fig. 5 (Swiss, 14th century).

The weapon best known to Englishmen is the *bill*, which was originally a sort of scythe-blade, sharp on the concave side (whereas the glaive has the cutting edge on the convex side), but in its best-known form it should be called a bill-gisarme (fig. 6). The *partizans*, *ranseurs* and *halberts* proper developed naturally from the earlier types. The feature common to all, as has been said, is the combination of spear and axe. In the halberts the axe predominates, as the examples (fig. 10, Swiss, early 15th century; fig. 11, Swiss, middle 16th century; and fig. 12, German court halbert of the same period as fig. 11) show. In the *partizan* the pike is the more important, the axe-heads being reduced to little more than an ornamental feature. A south German specimen (fig. 9, 1615) shows how this was compensated by the broadening of the spear-head, the edges of which in such weapons were sharpened. Fig. 8, a service weapon of simple form, merely has projections on either side, and from this developed the *ranseur* (fig. 7), a partizan with a very long and narrow point, like the blade of a rapier, and with fork-like projections intended to act as "sword-breakers," instead of the atrophied axe-heads of the partizan proper.



FIGS. 1-6.



FIGS. 7-12.

The halbert played almost as conspicuous a part in the military history of Middle Europe during the 15th and early 16th centuries as the pike. But, even in a form distinguishable from the voulge and the glaive, it dates from the early part of the 13th century, and for many generations thereafter it was the special weapon of the Swiss. Fauchet, in his *Origines des dignitez*, printed in 1600, states that Louis XI. of France ordered certain new weapons of war called *hallebardes* to be made at Angers and other places in 1475. The Swiss had a mixed armament of pikes and

halberts at the battle of Morat in 1476. In the 15th and 16th centuries the halberts became larger, and the blades were formed in many varieties of shape, often engraved, inlaid, or pierced in open work, and exquisitely finished as works of art. This weapon was in use in England from the reign of Henry VII. to the reign of George III., when it was still carried (though in shape it had certainly lost its original characteristics, and had become half partizan and half pike) by sergeants in the guards and other infantry regiments. It is still retained as the symbol of authority borne before the magistrates on public occasions in some of the burghs of Scotland. The Lochaber axe may be called a species of halbert furnished with a hook on the end of the staff at the back of the blade. The *godendag* (Fr. *godendart*) is the Flemish name of the halbert in its original form.

The derivation of the word is as follows. The O. Fr. *hallebarde*, of which the English "halberd," "halbert," is an adaptation, was itself adapted from the M.H.G. *helmbarde*, mod. *Hellebarde*; the second part is the O.H.G. *barta* or *parta*, broad-axe, probably the same word as *Bart*, beard, and so called from its shape; the first part is either *helm*, handle, cf. "helm," tiller of a ship, the word meaning "hafted axe," or else *helm*, helmet, an axe for smiting the helmet. A common derivation was to take the word as representing a Ger. *halb-barde*, half-axe; the early German form shows this to be an erroneous guess.

HALDANE, JAMES ALEXANDER (1768-1851), Scottish divine, the younger son of Captain James Haldane of Airthrey House, Stirlingshire, was born at Dundee on the 14th of July 1768. Educated first at Dundee and afterwards at the high school and university of Edinburgh, at the age of seventeen he joined the "Duke of Montrose" East Indiaman as a midshipman. After four voyages to India he was nominated to the command of the "Melville Castle" in the summer of 1793; but having during a long and unexpected detention of his ship begun a careful study of the Bible, and also come under the evangelical influence of David Bogue of Gosport, one of the founders of the London Missionary Society, he abruptly resolved to quit the naval profession for a religious life, and returned to Scotland before his ship had sailed. About the year 1796 he became acquainted with the celebrated evangelical divine, Charles Simeon of Cambridge, in whose society he made several tours through Scotland, endeavouring by tract-distribution and other means to awaken others to some of that interest in religious subjects which he himself so strongly felt. In May 1797 he preached his first sermon, at Gilmerton near Edinburgh, with encouraging success. In the same year he established a non-sectarian organization for tract distribution and lay preaching called the "Society for the Propagation of the Gospel at Home." During the next few years he made repeated missionary journeys, preaching wherever he could obtain hearers, and generally in the open air. Not originally disloyal to the Church of Scotland, he was gradually driven by the hostility of the Assembly and the exigencies of his position into separation. In 1799 he was ordained as pastor of a large Independent congregation in Edinburgh. This was the first congregational church known by that name in Scotland. In 1801 a permanent building replaced the circus in which the congregation had at first met. To this church he continued to minister gratuitously for more than fifty years. In 1808 he made public avowal of his conversion to Baptist views. As advancing years compelled him to withdraw from the more exhausting labours of itineracy and open-air preaching, he sought more and more to influence the discussion of current religious and theological questions by means of the press. He died on the 8th of February 1851.

His son, DANIEL RUTHERFORD HALDANE (1824-1887), by his second wife, a daughter of Professor Daniel Rutherford, was a prominent Scottish physician, who became president of the Edinburgh College of Physicians.

Among J. A. Haldane's numerous contributions to current theological discussions were: *The Duty of Christian Forbearance in Regard to Points of Church Order* (1811); *Strictures on a Publication upon Primitive Christianity by Mr John Walker* (1819); *Refutation of Edward Irving's Heretical Doctrines respecting the Person and Atonement of Jesus Christ*. His *Observations on Universal Pardon, &c.*, was a contribution to the controversy regarding the views of Thomas Erskine of Linlathen and Campbell of Row; *Man's Responsibility* (1842) is a reply to Howard Hinton on the nature and extent of the Atonement. He also published: *Journal of a Tour in the North*; *Early Instruction Commended* (1801); *Views of the Social Worship of the First Churches* (1805); *The Doctrine and Duty of Self-Examination* (1806); *The Doctrine of the Atonement* (1845); *Exposition of the Epistle to the Galatians* (1848).

HALDANE, RICHARD BURDON (1856-), British statesman and philosopher, was the third son of Robert Haldane of Cloanden, Perthshire, a writer to the signet, and nephew of J. S. Burdon-Sanderson. He was a grand-nephew of the Scottish divines J. A. and Robert Haldane. He was educated at Edinburgh Academy and the universities of Edinburgh and Göttingen, where he studied philosophy under Lotze. He took first-class honours in philosophy at Edinburgh, and was Gray scholar and Ferguson scholar in philosophy of the four Scottish Universities (1876). He was called to the bar in 1879, and so early as 1890 became a queen's counsel. In 1885 he entered parliament as liberal member for Haddingtonshire, for which he was re-elected continuously up to and including 1910. He was included in 1905 in Sir H. Campbell-Bannerman's cabinet as secretary for war, and was the author of the important scheme for the reorganization of the British army, by which the militia and the volunteer forces were replaced by a single territorial force. Though always known as one of the ablest men of the Liberal party and conspicuous during the Boer War of 1899-1902 as a Liberal Imperialist, the choice of Mr Haldane for the task of thinking out a new army organization on business lines had struck many people as curious. Besides being a chancery lawyer, he was more particularly a philosopher, conspicuous for his knowledge of Hegelian metaphysics. But with German philosophy he had also the German sense of thoroughness and system, and his scheme, while it was much criticized, was recognized as the best that could be done with a voluntary army. Mr Haldane's chief literary publications were: *Life of Adam Smith* (1887); *Education and Empire* (1902); *The Pathway to Reality* (1903). He also translated, jointly with J. Kemp, Schopenhauer's *Die Welt als Wille und Vorstellung* (*The World as Will and Idea*, 3 vols., 1883-1886).

HALDANE, ROBERT (1764-1842), Scottish divine, elder brother of J. A. Haldane (*q.v.*), was born in London on the 28th of February 1764. After attending classes in the Dundee grammar school and in the high school and university of Edinburgh in 1780, he joined H.M.S. "Monarch," of which his uncle Lord Duncan was at that time in command, and in the following year was transferred to the "Foudroyant," on board of which, during the night engagement with the "Pegase," he greatly distinguished himself. Haldane was afterwards present at the relief of Gibraltar, but at the peace of 1783 he finally left the navy, and soon afterwards settled on his estate of Airthrey, near Stirling. He put himself under the tuition of David Bogue of Gosport and carried away deep impressions from his academy. The earlier phases of the French Revolution excited his deepest sympathy, a sympathy which induced him to avow his strong disapproval of the war with France. As his over-sanguine visions of a new order of things to be ushered in by political change disappeared, he began to direct his thoughts to religious subjects. Resolving to devote himself and his means wholly to the advancement of Christianity, his first proposal for that end, made in 1796, was to organize a vast mission to Bengal, of which he was to provide the entire expense; with this view the greater part of his estate was sold, but the East India Company refused to sanction the scheme, which therefore had to be abandoned. In December 1797 he joined his brother and some others in the formation of the "Society for the Propagation of the Gospel at Home," in building chapels or "tabernacles" for congregations, in supporting missionaries, and in maintaining institutions for the education of young men to carry on the work of evangelization. He is said to have spent more than £70,000 in the course of the following twelve years (1798-1810). He also initiated a plan for evangelizing Africa by bringing over native children to be trained as Christian teachers to their own countrymen. In 1816 he visited the continent, and first at Geneva and afterwards in Montauban (1817) he lectured and interviewed large numbers of theological students with remarkable effect; among them were Malan, Monod and Merle d'Aubigné. Returning to Scotland in 1819, he lived partly on his estate of Auchengray and partly in Edinburgh, and like his brother took an active part, chiefly through the press, in many of the religious controversies of the time. He died on the 12th of December 1842.

In 1816 he published a work on the *Evidences and Authority of Divine Revelation*, and in 1819 the substance of his theological prelections in a *Commentaire sur l'Épître aux Romains*. Among his later writings, besides numerous pamphlets on what was known as "the Apocrypha controversy," are a treatise *On the Inspiration of Scripture* (1828), which has passed through many editions, and a later *Exposition of the Epistle to the Romans* (1835), which has been frequently reprinted, and has been translated into French and German.

See *Memoirs of R. and J. A. Haldane*, by Alexander Haldane (1852).

HALDEMAN, SAMUEL STEHMAN (1812-1880), American naturalist and philologist, was born on the 12th of August 1812 at Locust Grove, Pa. He was educated at Dickinson College, and in 1851 was appointed professor of the natural sciences in the university of Pennsylvania. In 1855 he went to Delaware College, where he filled the same position, but in 1869 he returned to the university of Pennsylvania as professor of comparative philology and remained there till his death, which occurred at Chickies, Pa., on the 10th of September 1880. His writings include *Freshwater Univalve Mollusca of the United States* (1840); *Zoological Contributions* (1842-1843); *Analytic Orthography* (1860); *Tours of a Chess Knight* (1864); *Pennsylvania Dutch, a Dialect of South German with an Infusion of English* (1872); *Outlines of Etymology* (1877); and *Word-Building* (1881).

HALDIMAND, SIR FREDERICK (1718-1791), British general and administrator, was born at Yverdun, Neuchâtel, Switzerland, on the 11th of August 1718, of Huguenot descent. After serving in the armies of Sardinia, Russia and Holland, he entered British service in 1754, and subsequently naturalized as an English citizen. During the Seven Years' War he served in America, was wounded at Ticonderoga (1758) and was present at the taking of Montreal (1760). After filling with credit several administrative positions in Canada, Florida and New York, in 1778 he succeeded Sir Guy Carleton (afterwards Lord Dorchester) as governor-general of Canada. His measures against French sympathizers with the Americans have incurred extravagant strictures from French-Canadian historians, but he really showed moderation as well as energy. In 1785 he returned to London. He died at his birthplace on the 5th of June 1791.

His life has been well written by Jean McIlwraith in the "Makers of Canada" series (Toronto, 1904). His Correspondence and Diary fill 262 volumes in the Canadian Archives, and are catalogued in the Annual Reports (1884-1889).

HALE, EDWARD EVERETT (1822-1909), American author, was born in Boston on the 3rd of April 1822, son of Nathan Hale (1784-1863), proprietor and editor of the Boston *Daily Advertiser*, nephew of Edward Everett, the orator and statesman, and grand-nephew of Nathan Hale, the martyr spy. He graduated from Harvard in 1839; was pastor of the church of the Unity, Worcester, Massachusetts, in 1846-1856, and of the South Congregational (Unitarian) church, Boston, in 1856-1899; and in 1903 became chaplain of the United States Senate. He died at Roxbury (Boston), Massachusetts, on the 10th of June 1909. His forceful personality, organizing genius, and liberal practical theology, together with his deep interest in the anti-slavery movement (especially in Kansas), popular education (especially Chautauqua work), and the working-man's home, were active in raising the tone of American life for half a century. He was a constant and voluminous contributor to the newspapers and magazines. He was an assistant editor of the Boston *Daily Advertiser*, and edited the *Christian Examiner, Old and New* (which he assisted in founding in 1869; in 1875 it was merged in *Scribner's Magazine*), *Lend a Hand* (founded by him in 1886 and merged in the *Charities Review* in 1897), and the *Lend a Hand Record*; and he was the author or editor of more than sixty books—fiction, travel, sermons, biography and history.

He first came into notice as a writer in 1859, when he contributed the short story "My Double and How He Undid Me" to the *Atlantic Monthly*. He soon published in the same periodical other stories, the best known of which was "The Man Without a Country" (1863), which did much to strengthen the Union cause in the North, and in which, as in some of his other non-romantic tales, he employed a minute realism which has led his readers to suppose the narrative a record of fact. The two stories mentioned, and such others as "The Rag-Man and the Rag-Woman" and "The Skeleton in the Closet," gave him a prominent position among the short-story writers of America. The story *Ten Times One is Ten* (1870), with its hero Harry Wadsworth, and its motto, first enunciated in 1869 in his Lowell Institute lectures, "Look up and not down, look forward and not back, look out and not in, and lend a hand," led to the formation among young people of "Lend-a-Hand Clubs," "Look-up Legions" and "Harry Wadsworth Clubs." Out of the romantic Waldensian story *In His Name* (1873) there similarly grew several other organizations for religious work, such as "King's Daughters," and "King's Sons."

Among his other books are *Kansas and Nebraska* (1854); *The Ingham Papers* (1869); *His Level Best, and Other Stories* (1870); *Sybaris and Other Homes* (1871); *Philip Nolan's Friends* (1876),

his best-known novel, and a sequel to *The Man Without a Country*; *The Kingdom of God* (1880); *Christmas at Narragansett* (1885); *East and West*, a novel (1892); *For Fifty Years* (poems, 1893); *Ralph Waldo Emerson* (1899); *We, the People* (1903); *Prayers Offered in the Senate of the United States* (1904), and *Tarry-at-Home Travels* (1906). He edited Lingard's *History of England* (1853), and contributed to Winsor's *Memorial History of Boston* (1880-1881), and to his *Narrative and Critical History of America* (1886-1889). With his son, Edward Everett Hale, Jr., he published *Franklin in France* (2 vols., 1887-1888), based largely on original research. The most charming books of his later years were *A New England Boyhood* (1893), *James Russell Lowell and His Friends* (1899), and *Memories of a Hundred Years* (1902).

A uniform and revised edition of his principal writings, in ten volumes, appeared in 1899-1901.

HALE, HORATIO (1817-1896), American ethnologist, was born in Newport, New Hampshire, on the 3rd of May 1817. He was the son of David Hale, a lawyer, and of Sarah Josepha Hale (1790-1879), a popular poet, who, besides editing *Godey's Lady's Magazine* for many years and publishing some ephemeral books, is supposed to have written the verses "Mary had a little lamb," and to have been the first to suggest the national observance of Thanksgiving Day. The son graduated in 1837 at Harvard, and during 1838-1842 was philologist to the United States Exploring Expedition, which under Captain Charles Wilkes sailed around the world. Of the reports of that expedition Hale prepared the sixth volume, *Ethnography and Philology* (1846), which is said to have "laid the foundations of the ethnography of Polynesia." He was admitted to the Chicago bar in 1855, and in the following year removed to Clinton, Ontario, Canada, where he practised his profession, and where on the 28th of December 1896 he died. He made many valuable contributions to the science of ethnology, attracting attention particularly by his theory of the origin of the diversities of human languages and dialects—a theory suggested by his study of "child-languages," or the languages invented by little children. He also emphasized the importance of languages as tests of mental capacity and as "criteria for the classification of human groups." He was, moreover, the first to discover that the Tutelos of Virginia belonged to the Siouan family, and to identify the Cherokee as a member of the Iroquoian family of speech. Besides writing numerous magazine articles, he read a number of valuable papers before learned societies. These include: *Indian Migrations as Evidenced by Language* (1882); *The Origin of Languages and the Antiquity of Speaking Man* (1886); *The Development of Language* (1888); and *Language as a Test of Mental Capacity: Being an Attempt to Demonstrate the True Basis of Anthropology* (1891). He also edited for Brinton's "Library of Aboriginal Literature," the *Iroquois Book of Rites* (1883).

HALE, JOHN PARKER (1806-1873), American statesman, was born at Rochester, New Hampshire, on the 31st of March 1806. He graduated at Bowdoin College in 1827, was admitted to the New Hampshire bar in 1830, was a member of the state House of Representatives in 1832, and from 1834 to 1841 was United States district attorney for New Hampshire. In 1843-1845 he was a Democratic member of the national House of Representatives, and, though his earnest cooperation with John Quincy Adams in securing the repeal of the "gag rule" directed against the presentation to Congress of anti-slavery petitions estranged him from the leaders of his party, he was renominated without opposition. In January 1845, however, he refused in a public statement to obey a resolution (28th of December 1844) of the state legislature directing him and his New Hampshire associates in Congress to support the cause of the annexation of Texas, a Democratic measure which Hale regarded as being distinctively in the interest of slavery. The Democratic State convention was at once reassembled, Hale was denounced, and his nomination withdrawn. In the election which followed Hale ran independently, and, although the Democratic candidates were elected in the other three congressional districts of the state, his vote was large enough to prevent any choice (for which a majority was necessary) in his own. Hale then set out in the face of apparently hopeless odds to win over his state to the anti-slavery cause. The remarkable canvass which he conducted is known in the history of New Hampshire as the "Hale Storm of 1845." The election resulted in the choice of a legislature controlled by the Whigs and the independent Democrats, he himself being chosen as a member of the state House of Representatives, of which in 1846 he was speaker. He is remembered, however, chiefly for his long service in the United States Senate, of which he was a member from 1847 to 1853 and again from 1855 to 1865. At first he was the only out-and-out anti-slavery senator,—he alone prevented the vote of thanks to General Taylor and General Scott for their Mexican war victories from being

made unanimous in the Senate (February 1848)—but in 1849 Salmon P. Chase and William H. Seward, and in 1851 Charles Sumner joined him, and the anti-slavery cause became for the first time a force to be reckoned with in that body. In October 1847 he had been nominated for president by the Liberty party, but he withdrew in favour of Martin Van Buren, the Free Soil candidate, in 1848. In 1851 he was senior counsel for the rescuers of the slave Shadrach in Boston. In 1852 he was the Free Soil candidate for the presidency, but received only 156,149 votes. In 1850 he secured the abolition of flogging in the U.S. navy, and through his efforts in 1862 the spirit ration in the navy was abolished. He was one of the organizers of the Republican party, and during the Civil War was an eloquent supporter of the Union and chairman of the Senate naval committee. From 1865 to 1869 he was United States minister to Spain. He died at Dover, New Hampshire, on the 19th of December 1873. A statue of Hale, presented by his son-in-law William Eaton Chandler (b. 1835), U.S. senator from New Hampshire in 1887-1901, was erected in front of the Capitol in Concord, New Hampshire, in 1892.

HALE, SIR MATTHEW (1609-1676), lord chief justice of England, was born on the 1st of November 1609 at Alderley in Gloucestershire, where his father, a retired barrister, had a small estate. His paternal grandfather was a rich clothier of Wotton-under-Edge; on his mother's side he was connected with the noble family of the Poyntzes of Acton. Left an orphan when five years old, he was placed by his guardian under the care of the Puritan vicar of Wotton-under-Edge, with whom he remained till he attained his sixteenth year, when he entered Magdalen Hall, Oxford. At Oxford, Hale studied for several terms with a view to holy orders, but suddenly there came a change. The diligent student, at first attracted by a company of strolling players, threw aside his studies, and plunged carelessly into gay society. He soon decided to change his profession; and resolved to trail a pike as a soldier under the prince of Orange in the Low Countries. Before going abroad, however, Hale found himself obliged to proceed to London in order to give instructions for his defence in a legal action which threatened to deprive him of his patrimony. His leading counsel was the celebrated Serjeant Glanville (1586-1661), who, perceiving in the acuteness and sagacity of his youthful client a peculiar fitness for the legal profession, succeeded, with much difficulty, in inducing him to renounce his military for a legal career, and on the 8th of November 1629 Hale became a member of the honourable society of Lincoln's Inn.

He immediately resumed his habits of intense application. The rules which he laid down for himself, and which are still extant in his handwriting, prescribe sixteen hours a day of close application, and prove, not only the great mental power, but also the extraordinary physical strength he must have possessed, and for which indeed, during his residence at the university, he had been remarkable. During the period allotted to his preliminary studies, he read over and over again all the yearbooks, reports, and law treatises in print, and at the Tower of London and other antiquarian repositories examined and carefully studied the records from the foundation of the English monarchy down to his own time. But Hale did not confine himself to law. He dedicated no small portion of his time to the study of pure mathematics, to investigations in physics and chemistry, and even to anatomy and architecture; and there can be no doubt that this varied learning enhanced considerably the value of many of his judicial decisions.

Hale was called to the bar in 1637, and almost at once found himself in full practice. Though neither a fluent speaker nor bold pleader, in a very few years he was at the head of his profession. He entered public life at perhaps the most critical period of English history. Two parties were contending in the state, and their obstinacy could not fail to produce a most direful collision. But amidst the confusion Hale steered a middle course, rising in reputation, and an object of solicitation from both parties. Taking Pomponius Atticus as his political model, he was persuaded that a man, a lawyer and a judge could best serve his country and benefit his countrymen by holding aloof from partisanship and its violent prejudices, which are so apt to distort and confuse the judgment. But he is best vindicated from the charges of selfishness and cowardice by the thoughts and meditations contained in his private diaries and papers, where the purity and honour of his motives are clearly seen. It has been said, but without certainty, that Hale was engaged as counsel for the earl of Strafford; he certainly acted for Archbishop Laud, Lord Maguire, Christopher Love, the duke of Hamilton and others. It is also said that he was ready to plead on the side of Charles I. had that monarch submitted to the court. The parliament having gained the ascendancy, Hale signed the Solemn League and Covenant, and was a member of the famous assembly of divines at Westminster in 1644; but although he would undoubtedly have preferred a Presbyterian form of church government, he had no serious objection to the system of modified Episcopacy, proposed by Usher. Consistently with his desire to remain neutral, Hale took the engagement to the Commonwealth as he had done to the king, and in 1653, already serjeant, he became a judge in the court of common pleas. Two years afterwards

he sat in Cromwell's parliament as one of the members for Gloucestershire. After the death of the protector, however, he declined to act as a judge under Richard Cromwell, although he represented Oxford in Richard's parliament. At the Restoration in 1660 Hale was very graciously received by Charles II., and in the same year was appointed chief baron of the exchequer, and accepted, with extreme reluctance, the honour of knighthood. After holding the office of chief baron for eleven years he was raised to the higher dignity of lord chief justice, which he held till February 1676, when his failing health compelled him to resign. He retired to his native Alderley, where he died on the 25th of December of the same year. He was twice married and survived all his ten children save two.

As a judge Sir Matthew Hale discharged his duties with resolute independence and careful diligence. His sincere piety made him the intimate friend of Isaac Barrow, Archbishop Tillotson, Bishop Wilkins and Bishop Stillingfleet, as well as of the Nonconformist leader, Richard Baxter. He is chargeable, however, with the condemnation and execution of two poor women tried before him for witchcraft in 1664, a kind of judicial murder then falling under disuse. He is also reproached with having hastened the execution of a soldier for whom he had reason to believe a pardon was preparing.

Of Hale's legal works the only two of importance are his *Historia placitorum coronae, or History of the Pleas of the Crown* (1736); and the *History of the Common Law of England, with an Analysis of the Law, &c.* (1713). Among his numerous religious writings the *Contemplations, Moral and Divine*, occupy the first place. Others are *The Primitive Origination of Man* (1677); *Of the Nature of True Religion, &c.* (1684); *A Brief Abstract of the Christian Religion* (1688). One of his most popular works is the collection of *Letters of Advice to his Children and Grandchildren*. He also wrote an *Essay touching the Gravitation or Nongravitation of Fluid Bodies* (1673); *Difficiles Nugae, or Observations touching the Torricellian Experiment, &c.* (1675); and a translation of the *Life of Pomponius Atticus*, by Cornelius Nepos (1677). His efforts in poetry were inauspicious. He left his valuable collection of MSS. and records to the library of Lincoln's Inn. His life has been written by G. Burnet (1682); by J. B. Williams (1835); by H. Roscoe, in his *Lives of Eminent Lawyers*, in 1838; by Lord Campbell, in his *Lives of the Chief Justices*, in 1849; and by E. Foss in his *Lives of the Judges* (1848-1870).

HALE, NATHAN (1756-1776). American hero of the War of Independence, was born at Coventry, Conn., and educated at Yale, then becoming a school teacher. He joined a Connecticut regiment after the breaking out of the war, and served in the siege of Boston, being commissioned a captain at the opening of 1776. When Heath's brigade departed for New York he went with them, and the tradition is that he was one of a small and daring band who captured an English provision sloop from under the very guns of a man-of-war. But on the 21st of September, having volunteered to enter the British lines to obtain information concerning the enemy, he was captured in his disguise of a Dutch school-teacher and on the 22nd was hanged. The penalty was in accordance with military law, but young Hale's act was a brave one, and he has always been glorified as a martyr. Tradition attributes to him the saying that he only regretted that he had but one life to lose for his country; and it is said that his request for a Bible and the services of a minister was refused by his captors. There is a fine statue of Hale by Macmonnies in New York.

See H. P. Johnston, *Nathan Hale* (1901).

HALE, WILLIAM GARDNER (1849-), American classical scholar, was born on the 9th of February 1849 in Savannah, Georgia. He graduated at Harvard University in 1870, and took a post-graduate course in philosophy there in 1874-1876; studied classical philology at Leipzig and Göttingen in 1876-1877; was tutor in Latin at Harvard from 1877 to 1880, and professor of Latin in Cornell University from 1880 to 1892, when he became professor of Latin and head of the Latin department of the University of Chicago. From 1894 to 1899 he was chairman and in 1895-1896 first director of the American School of Classical Studies at Rome. He is best known as an original teacher on questions of syntax. In *The Cum-Constructions: Their History and Functions*, which appeared in *Cornell University Studies in Classical Philology* (1888-1889; and in German version by Neizert in 1891), he attacked Hoffmann's distinction between absolute and relative temporal clauses as published in *Lateinische Zeitpartikeln* (1874); Hoffmann replied in 1891, and the best summary of the controversy is in Wetzel's *Der Streit zwischen Hoffmann und Hale* (1892). Hale wrote also *The Sequence of Tenses in Latin* (1887-1888), *The Anticipatory*

Subjunctive in Greek and Latin (1894), and a *Latin Grammar* (1903), to which the parts on sounds, inflection and word-formation were contributed by Carl Darling Buck.

HALEBID, a village in Mysore state, southern India; pop. (1901), 1524. The name means "old capital," being the site of Dorasamudra, the capital of the Hoysala dynasty founded early in the 11th century. In 1310 and again in 1326 it was taken and plundered by the first Mahomedan invader of southern India. Two temples, still standing, though never completed and greatly ruined, are regarded as the finest examples of the elaborately carved Chalukyan style of architecture.

HALES, or HAYLES, **JOHN** (d. 1571), English writer and politician, was a son of Thomas Hales of Hales Place, Halden, Kent. He wrote his *Highway to Nobility* about 1543, and was the founder of a free school at Coventry for which he wrote *Introductiones ad grammaticam*. In political life Hales, who was member of parliament for Preston, was specially concerned with opposing the enclosure of land, being the most active of the commissioners appointed in 1548 to redress this evil; but he failed to carry several remedial measures through parliament. When the protector, the duke of Somerset, was deprived of his authority in 1550, Hales left England and lived for some time at Strassburg and Frankfort, returning to his own country on the accession of Elizabeth. However he soon lost the royal favour by writing a pamphlet, *A Declaration of the Succession of the Crowne Imperiall of Inglande*, which declared that the recent marriage between Lady Catherine Grey and Edward Seymour, earl of Hertford, was legitimate, and asserted that, failing direct heirs to Elizabeth, the English crown should come to Lady Catherine as the descendant of Mary, daughter of Henry VII. The author was imprisoned, but was quickly released, and died on the 28th of December 1571. The *Discourse of the Common Weal*, described as "one of the most informing documents of the age," and written about 1549, has been attributed to Hales. This has been edited by E. Lamond (Cambridge, 1893).

Hales is often confused with another John Hales, who was clerk of the hanaper under Henry VIII. and his three immediate successors.

HALES, JOHN (1584-1656), English scholar, frequently referred to as "the ever memorable," was born at Bath on the 19th of April 1584, and was educated at Corpus Christi College, Oxford. He was elected a fellow of Merton in 1605, and in 1612 he was appointed public lecturer on Greek. In 1613 he was made a fellow of Eton. Five years later he went to Holland, as chaplain to the English ambassador, Sir Dudley Carleton, who despatched him to Dort to report upon the proceedings of the synod then sitting. In 1619 he returned to Eton and spent his time among his books and in the company of literary men, among whom he was highly reputed for his common sense, his erudition and his genial charity. Andrew Marvell called him "one of the clearest heads and best-prepared breasts in Christendom." His eirenical tract entitled *Schism and Schismatics* (1636) fell into the hands of Archbishop Laud, and Hales, hearing that he had disapproved of it, is said to have written to the prelate a vindication of his position. This led to a meeting, and in 1639 Hales was made one of Laud's chaplains and also a canon of Windsor. In 1642 he was deprived of his canonry by the parliamentary committee, and two years later was obliged to hide in Eton with the college documents and keys. In 1649 he refused to take the "Engagement" and was ejected from his fellowship. He then retired to Buckinghamshire, where he found a home with Mrs Salter, the sister of the bishop of Salisbury (Brian Duppa), and acted as tutor to her son. The issue of the order against harbouring malignants led him to return to Eton. Here, having sold his valuable library at great sacrifice, he lived in poverty until his death on the 19th of May 1656.

His collected works (3 vols.) were edited by Lord Hailes, and published in 1765.

HALES, STEPHEN (1677-1761), English physiologist, chemist and inventor, was born at Bekesbourne in Kent on the 7th or 17th of September 1677, the fifth (or sixth) son of Thomas Hales, whose father, Sir Robert Hales, was created a baronet by Charles II. in 1670. In June 1696 he was entered as a pensioner of Benet (now Corpus Christi) College, Cambridge, with the view of taking holy orders, and in February 1703 was admitted to a fellowship. He received the degree of master of arts in 1703 and of bachelor of divinity in 1711. One of his most intimate friends was William Stukeley (1687-1765) with whom he studied anatomy, chemistry, &c. In 1708-1709 Hales was presented to the perpetual curacy of Teddington in Middlesex, where he remained all his life, notwithstanding that he was subsequently appointed rector of Porlock in Somerset, and later of Faringdon in Hampshire. In 1717 he was elected fellow of the Royal Society, which awarded him the Copley medal in 1739. In 1732 he was named one of a committee for establishing a colony in Georgia, and the next year he received the degree of doctor of divinity from Oxford. He was appointed almoner to the princess-dowager of Wales in 1750. On the death of Sir Hans Sloane in 1753, Hales was chosen foreign associate of the French Academy of Sciences. He died at Teddington on the 4th of January 1761.

Hales is best known for his *Statical Essays*. The first volume, *Vegetable Staticks* (1727), contains an account of numerous experiments in plant-physiology—the loss of water in plants by evaporation, the rate of growth of shoots and leaves, variations in root-force at different times of the day, &c. Considering it very probable that plants draw “through their leaves some part of their nourishment from the air,” he undertook experiments to show in “how great a proportion air is wrought into the composition of animal, vegetable and mineral substances”; though this “analysis of the air” did not lead him to any very clear ideas about the composition of the atmosphere, in the course of his inquiries he collected gases over water in vessels separate from those in which they were generated, and thus used what was to all intents and purposes a “pneumatic trough.” The second volume (1733) on *Haemostaticks*, containing experiments on the “force of the blood” in various animals, its rate of flow, the capacity of the different vessels, &c., entitles him to be regarded as one of the originators of experimental physiology. But he did not confine his attention to abstract inquiries. The quest of a solvent for calculus in the bladder and kidneys was pursued by him as by others at the period, and he devised a form of forceps which, on the testimony of John Ranby (1703-1773), sergeant-surgeon to George II., extracted stones with “great ease and readiness.” His observations of the evil effect of vitiated air caused him to devise a “ventilator” (a modified organ-bellows) by which fresh air could be conveyed into gaols, hospitals, ships’-holds, &c.; this apparatus was successful in reducing the mortality in the Savoy prison, and it was introduced into France by the aid of H. L. Duhamel du Monceau. Among other things Hales invented a “sea-gauge” for sounding, and processes for distilling fresh from sea water, for preserving corn from weevils by fumigation with brimstone, and for salting animals whole by passing brine into their arteries. His *Admonition to the Drinkers of Gin, Brandy, &c.*, published anonymously in 1734, has been several times reprinted.

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HALESOWEN, a market town in the Oldbury parliamentary division of Worcestershire, England, on a branch line of the Great Western and Midland railways, 6½ m. W.S.W. of Birmingham. Pop. (1901), 4057. It lies in a pleasant country among the eastern foothills of the Lickey Hills. There are extensive iron and steel manufactures. The church of SS Mary and John the Baptist has rude Norman portions; and the poet William Shenstone, buried in 1763 in the churchyard, has a memorial in the church. His delight in landscape gardening is exemplified in the neighbouring estate of the Leasowes, which was his property. There is a grammar school founded in 1652, and in the neighbourhood is the Methodist foundation of Bourne College (1883). Close to the town, on the river Stour, which rises in the vicinity, are slight ruins of a Premonstratensian abbey of Early English date. Within the parish and 2 m. N.W. of Halesowen is Cradley, with iron and steel works, fire-clay works and a large nail and chain industry.

HALEVI, JUDAH BEN SAMUEL (c. 1085-c. 1140), the greatest Hebrew poet of the middle ages, was born in Toledo c. 1085, and died in Palestine after 1140. In his youth he wrote Hebrew love poems of exquisite fancy, and several of his Wedding Odes are included in the liturgy of the Synagogue. The mystical connexion between marital affection and the love of God had, in the view of older exegesis, already expressed itself in the scriptural *Song of Songs* and Judah Halevi used this book as his model. In this aspect of his work he found inspiration also in Arabic

predecessors. The second period of his literary career was devoted to more serious pursuits. He wrote a philosophical dialogue in five books, called the *Cuzari*, which has been translated into English by Hirschfeld. This book bases itself on the historical fact that the Crimean Kingdom of the Khazars adopted Judaism, and the Hebrew poet-philosopher describes what he conceives to be the steps by which the Khazar king satisfied himself as to the claims of Judaism. Like many other medieval Jewish authors, Judah Halevi was a physician. His real fame depends on his liturgical hymns, which are the finest written in Hebrew since the Psalter, and are extensively used in the Septardic rite. A striking feature of his thought was his devotion to Jerusalem. To the love of the Holy City he devoted his noblest genius, and he wrote some memorable Odes to Zion, which have been commemorated by Heine, and doubly appreciated recently under the impulse of Zionism (*q.v.*). He started for Jerusalem, was in Damascus in 1140, and soon afterwards died. Legend has it that he was slain by an Arab horseman just as he arrived within sight of what Heine called his "Woebegone poor darling, Desolation's very image,—Jerusalem."

Excellent English renderings of some of Judah Halevi's poems may be read in Mrs H. Lucas's *The Jewish Year*, and Mrs R. N. Solomon's *Songs of Exile*.

(I. A.)

HALÉVY, JACQUES FRANÇOIS FROMENTAL ÉLIE (1799-1862), French composer, was born on the 27th of May 1799, at Paris, of a Jewish family. He studied at the Paris Conservatoire under Berton and Cherubini, and in 1819 gained the grand prix de Rome with his cantata *Herminie*. In accordance with the conditions of his scholarship he started for Rome, where he devoted himself to the study of Italian music, and wrote an opera and various minor works. In 1827 his opera *L'Artisan* was performed at the Théâtre Feydeau in Paris, apparently without much success. Other works of minor importance, and now forgotten, followed, amongst which *Manon Lescaut*, a ballet, produced in 1830, deserves mention. In 1834 the Opéra-Comique produced *Ludovic*, the score of which had been begun by Hérold and had been completed by Halévy. In 1835 Halévy composed the tragic opera *La Juive* and the comic opera *L'Éclair*, and on these works his fame is mainly founded. The famous air of Eléazar and the anathema of the cardinal in *La Juive* soon became popular all over France. *L'Éclair* is a curiosity of musical literature. It is written for two tenors and two soprani, without a chorus, and displays the composer's mastery over the most refined effects of instrumentation and vocalization in a favourable light. After these two works he wrote numerous operas of various genres, amongst which only *La Reine de Chypre*, a spectacular piece analyzed by Wagner in one of his Paris letters (1841), and *La Tempesta*, in three acts, written for Her Majesty's theatre, London (1850), need be mentioned. In addition to his productive work Halévy also rendered valuable services as a teacher. He was professor at the Conservatoire from 1827 till his death—some of the most successful amongst the younger composers in France, such as Gounod, Victor Massé and Georges Bizet, the author of *Carmen*, being amongst his pupils. He was *maestro al cembalo* at the Théâtre Italien from 1827 to 1829; then director of singing at the Opera House in Paris until 1845, and in 1836 he succeeded Reicha at the Institut de France. Halévy also tried his hand at literature. In 1857 he became permanent secretary to the Académie des Beaux Arts, and there exists an agreeable volume of *Souvenirs et portraits* from his pen. He died at Nice, on the 17th of March 1862.

HALÉVY, LUDOVIC (1834-1908), French author, was born in Paris on the 1st of January 1834. His father, Léon Halévy (1802-1883), was a clever and versatile writer, who tried almost every branch of literature—prose and verse, vaudeville, drama, history—without, however, achieving decisive success in any. His uncle, J. F. Fromental E. Halévy (*q.v.*), was for many years associated with the opéra; hence the double and early connexion of Ludovic Halévy with the Parisian stage. At the age of six he might have been seen playing in that *Foyer de la danse* with which he was to make his readers so familiar, and, when a boy of twelve, he would often, of a Sunday night, on his way back to the College Louis le Grand, look in at the Odéon, where he had free admittance, and see the first act of the new play. At eighteen he joined the ranks of the French administration and occupied various posts, the last being that of secrétaire-rédacteur to the Corps Législatif. In that capacity he enjoyed the special favour and friendship of the famous duke of Morny, then president of that assembly. In 1865 Ludovic Halévy's increasing popularity as an author enabled him to retire from the public service. Ten years earlier he had become acquainted with the

musician Offenbach, who was about to start a small theatre of his own in the Champs Élysées, and he wrote a sort of prologue, *Entrez, messieurs, mesdames*, for the opening night. Other little productions followed, *Ba-ta-clan* being the most noticeable among them. They were produced under the pseudonym of Jules Servières. The name of Ludovic Halévy appeared for the first time on the bills on the 1st of January 1856. Soon afterwards the unprecedented run of *Orphée aux enfers*, a musical parody, written in collaboration with Hector Crémieux, made his name famous. In the spring of 1860 he was commissioned to write a play for the manager of the Variétés in conjunction with another vaudevillist, Lambert Thiboust. The latter having abruptly retired from the collaboration, Halévy was at a loss how to carry out the contract, when on the steps of the theatre he met Henri Meilhac (1831-1897), then comparatively a stranger to him. He proposed to Meilhac the task rejected by Lambert Thiboust, and the proposal was immediately accepted. Thus began a connexion which was to last over twenty years, and which proved most fruitful both for the reputation of the two authors and the prosperity of the minor Paris theatres. Their joint works may be divided into three classes: the *opérettes*, the farces, the comedies. The *opérettes* afforded excellent opportunities to a gifted musician for the display of his peculiar humour. They were broad and lively libels against the society of the time, but savoured strongly of the vices and follies they were supposed to satirize. Amongst the most celebrated works of the joint authors were *La Belle Hélène* (1864), *Barbe Bleue* (1866), *La Grande Duchesse de Gerolstein* (1867), and *La Périchole* (1868). After 1870 the vogue of Parody rapidly declined. The decadence became still more apparent when Offenbach was no longer at hand to assist the two authors with his quaint musical irony, and when they had to deal with interpreters almost destitute of singing powers. They wrote farces of the old type, consisting of complicated intrigues, with which they cleverly interwove the representation of contemporary whims and social oddities. They generally failed when they attempted comedies of a more serious character and tried to introduce a higher sort of emotion. A solitary exception must be made in the case of *Frou-frou* (1869), which, owing perhaps to the admirable talent of Aimée Desclée, remains their unique *succès de larmes*.

Meilhac and Halévy will be found at their best in light sketches of Parisian life, *Les Sonnettes*, *Le Roi Candaule*, *Madame attend Monsieur*, *Toto chez Tata*. In that intimate association between the two men who had met so opportunely on the *perron des variétés*, it was often asked who was the leading partner. The question was not answered until the connexion was finally severed and they stood before the public, each to answer for his own work. It was then apparent that they had many gifts in common. Both had wit, humour, observation of character. Meilhac had a ready imagination, a rich and whimsical fancy; Halévy had taste, refinement and pathos of a certain kind. Not less clever than his brilliant comrade, he was more human. Of this he gave evidence in two delightful books, *Monsieur et Madame Cardinal* (1873) and *Les Petites Cardinal*, in which the lowest orders of the Parisian middle class are faithfully described. The pompous, pedantic, venomous Monsieur Cardinal will long survive as the true image of sententious and self-glorifying immorality. M. Halévy's peculiar qualities are even more visible in the simple and striking scenes of the *Invasion*, published soon after the conclusion of the Franco-German War, in *Criquette* (1883) and *L'Abbé Constantin* (1882), two novels, the latter of which went through innumerable editions. Zola had presented to the public an almost exclusive combination of bad men and women; in *L'Abbé Constantin* all are kind and good, and the change was eagerly welcomed by the public. Some enthusiasts still maintain that the *Abbé* will rank permanently in literature by the side of the equally chimerical *Vicar of Wakefield*. At any rate, it opened for M. Ludovic Halévy the doors of the French Academy, to which he was elected in 1884.

Halévy remained an assiduous frequenter of the Academy, the Conservatoire, the Comédie Française, and the Society of Dramatic Authors, but, when he died in Paris on the 8th of May 1908, he had produced practically nothing new for many years. His last romance, *Kari Kari*, appeared in 1892.

The *Théâtre* of MM. Meilhac and Halévy was published in 8 vols. (1900-1902).

HALFPENNY, WILLIAM, English 18th-century architectural designer—he described himself as “architect and carpenter.” He was also known as Michael Hoare; but whether his real name was William Halfpenny or Michael Hoare is uncertain. His books, of which he published a score, deal almost entirely with domestic architecture, and especially with country houses in those Gothic and Chinese fashions which were so greatly in vogue in the middle of the 18th century. His most important publications, from the point of view of their effect upon taste, were *New Designs for Chinese Temples*, in four parts (1750-1752); *Rural Architecture in the Gothic Taste* (1752); *Chinese and Gothic Architecture Properly Ornamented* (1752); and *Rural Architecture in the Chinese Taste* (1750-1752). These four books were produced in collaboration with John Halfpenny, who is said to have been his son. *New Designs for Chinese Temples* is a volume of

some significance in the history of furniture, since, having been published some years before the books of Thomas Chippendale and Sir Thomas Chambers, it disproves the statement so often made that those designers introduced the Chinese taste into this country. Halfpenny states distinctly that "the Chinese manner" had been "already introduced here with success." The work of the Halfpennys was by no means all contemptible. It is sometimes distinctly graceful, but is marked by little originality.

HALF-TIMBER WORK, an architectural term given to those buildings in which the framework is of timber with vertical studs and cross pieces filled in between with brickwork, rubble masonry or plaster work on oak laths; in the first two, brick nogging or nogging are the terms occasionally employed (see [CARPENTRY](#)). Sometimes the timber structure is raised on a stone or brick foundation, as at Ledbury town hall in Herefordshire, where the lower storey is open on all sides; but more often it is raised on a ground storey, either in brick or stone, and in order to give additional size to the upper rooms projects forward, being carried on the floor joists. Sometimes the masonry or brickwork rises through two or three storeys and the half-brick work is confined to the gables. There seems to be some difference of opinion as to whether the term applies to the mixture of solid walling with the timber structure or to the alternation of wood posts and the filling in, but the latter definition is that which is generally understood. The half-timber throughout England is of the most picturesque description, and the earliest examples date from towards the close of the 15th century. In the earliest example, Newgate House, York (*c.* 1450), the timber framing is raised over the ground floor. The finest specimen is perhaps that of Moreton Old Hall, Cheshire (1570), where there is only a stone foundation about 12 in. high, and the same applies to Bramall Hall, near Manchester, portions of which are very early. Among other examples are Speke Hall, Lancashire; Park Hall, Shropshire (1553-1558); Hall i' th' Wood, Lancashire (1591); St Peter's Hospital, Bristol (1607); the Ludlow Feather's Inn (1610); many of the streets at Chester and Shrewsbury; the Sparrowe's Home, Ipswich; and Staple Inn, Holborn, from which in recent years the plaster coat which was put on many years ago has been removed, displaying the ancient woodwork. A similar fate has overtaken a very large number of half-timber buildings to keep out the driving winds; thus in Lewes nearly all the half-timbered houses have had slates hung on the timbers, others tiles, the greater number having been covered with plaster or stucco. Although there are probably many more half-timber houses in England than on the continent of Europe, in the north of France and in Germany are examples in many of the principal towns, and in some cases in better preservation than in England. They are also enriched with carving of a purer and better type, especially in France; thus at Chartres, Angers, Rouen, Caen, Lisieux, Bayeux, St Lô and Beauvais, are many extremely fine examples of late Flamboyant and early Transitional examples. Again on the borders of the Rhine in all the small towns most of the houses are in half-timber work, the best examples being at Bacharach, Rhense and Boppard. Far more elaborate examples, however, are found in the vicinity of the Harz Mountains; the supply of timber from the forests there being very abundant; thus at Goslar, Wernigerode and Quedlingburg there is an endless variety, as also farther on at Gelnhausen and Hameln, the finest series of all being at Hildesheim. In Bavaria at Nuremberg, Rothenburg and Dinkelsbühl, half-timber houses dating from the 16th century are still well preserved; and throughout Switzerland the houses constructed in timber and plaster are the most characteristic features of the country.

HALFWAY COVENANT, an expedient adopted in the Congregational churches of New England between 1657 and 1662. Under its terms baptized persons of moral life and orthodox belief might receive the privilege of baptism for their children and other church benefits, without the full enrolment in membership which admitted them to the communion of the Lord's Supper.

See [CONGREGATIONALISM](#): *American*.

HALHED, NATHANIEL BRASSEY (1751-1830), English Orientalist and philologist, was born at Westminster on the 25th of May 1751. He was educated at Harrow, where he began his

intimacy with Richard Brinsley Sheridan (see [SHERIDAN FAMILY](#)) continued after he entered Christ Church, Oxford, where, also, he made the acquaintance of Sir William Jones, the famous Orientalist, who induced him to study Arabic. Accepting a writership in the service of the East India Company, Halhed went out to India, and here, at the suggestion of Warren Hastings, by whose orders it had been compiled, translated the Gentoo code from a Persian version of the original Sanskrit. This translation was published in 1776 under the title *A Code of Gentoo Laws*. In 1778 he published a Bengali grammar, to print which he set up, at Hugli, the first press in India. It is claimed for him that he was the first writer to call attention to the philological connexion of Sanskrit with Persian, Arabic, Greek and Latin. In 1785 he returned to England, and from 1790-1795 was M.P. for Lymington, Hants. For some time he was a disciple of Richard Brothers (*q.v.*), and his unwise speech in parliament in defence of Brothers made it impossible for him to remain in the House, from which he resigned in 1795. He subsequently obtained a home appointment under the East India Company. He died in London on the 18th of February 1830.

His collection of Oriental manuscripts was purchased by the British Museum, and there is an unfinished translation by him of the *Mahābhārata* in the library of the Asiatic Society of Bengal.

HALIBURTON, THOMAS CHANDLER (1796-1865), British writer, long a judge of Nova Scotia, was born at Windsor, Nova Scotia, in 1796, and received his education there, at King's College. He was called to the bar in 1820, and became a member of the House of Assembly. He distinguished himself as a barrister, and in 1828 was promoted to the bench as a chief-justice of the common pleas. In 1829 he published *An Historical and Statistical Account of Nova Scotia*. But it is as a brilliant humourist and satirist that he is remembered, in connexion with his fictitious character "Sam Slick." In 1835 he contributed anonymously to a local paper a series of letters professedly depicting the peculiarities of the genuine Yankee. These sketches, which abounded in clever picturings of national and individual character, drawn with great satirical humour, were collected in 1837, and published under the title of *The Clockmaker, or Sayings and Doings of Samuel Slick of Slickville*. A second series followed in 1838, and a third in 1840. *The Attaché, or Sam Slick in England* (1843-1844), was the result of a visit there in 1841. His other works include: *The Old Judge, or Life in a Colony* (1843); *The Letter Bag of the Great Western* (1839); *Rule and Misrule of the English in America* (1851); *Traits of American Humour* (1852); and *Nature and Human Nature* (1855).

Meanwhile he continued to secure popular esteem in his judicial capacity. In 1840 he was promoted to be a judge of the supreme court; but within two years he resigned his seat on the bench, removed to England, and in 1859 entered parliament as the representative of Launceston, in the Conservative interest. But the tenure of his seat for Launceston was brought to an end by the dissolution of the parliament in 1865, and he did not again offer himself to the constituency. He died on the 27th of August of the same year, at Gordon House, Isleworth, Middlesex.

A memoir of Haliburton, by F. Blake Crofton, appeared in 1889.

HALIBUT, or **HOLIBUT** (*Hippoglossus vulgaris*), the largest of all flat-fishes, growing to a length of 10 ft. or more, specimens of 5 ft. in length and of 100 lb in weight being frequently exposed for sale in the markets. Indeed, specimens under 2 ft. in length are very rarely caught, and singularly enough, no instance is known of a very young specimen having been obtained. Small ones are commonly called "chicken halibut." The halibut is much more frequent in the higher latitudes of the temperate zone than in its southern portion; it is a circumpolar species, being found on the northern coasts of America, Europe and Asia, extending in the Pacific southwards to California. On the British coasts it keeps at some distance from the shore, and is generally caught in from 50 to 150 fathoms. Its flesh is generally considered coarse, but it is white and firm, and when properly served is excellent for the table. The name is derived from "holy" (M.E. *haly*), and recalls its use for food on holy days.

HALICARNASSUS (mod. *Budrum*), an ancient Greek city on the S.W. coast of Caria, Asia Minor, on a picturesque and advantageous site on the Ceramic Gulf or Gulf of Cos. It originally occupied only the small island of Zephyria close to the shore, now occupied by the great castle of St Peter, built by the Knights of Rhodes in 1404; but in course of time this island was united to the mainland and the city extended so as to incorporate Salmacis, an older town of the Leleges and Carians.

About the foundation of Halicarnassus various traditions were current; but they agree in the main point as to its being a Dorian colony, and the figures on its coins, such as the head of Medusa, Athena and Poseidon, or the trident, support the statement that the mother cities were Troezen and Argos. The inhabitants appear to have accepted as their legendary founder Anthes, mentioned by Strabo, and were proud of the title of Antheadæ. At an early period Halicarnassus was a member of the Doric Hexapolis, which included Cos, Cnidus, Lindus, Camirus and Ialysus; but one of the citizens, Agasicles, having taken home the prize tripod which he had won in the Triopian games instead of dedicating it according to custom to the Triopian Apollo, the city was cut off from the league. In the early 5th century Halicarnassus was under the sway of Artemisia, who made herself famous at the battle of Salamis. Of Pisindalis, her son and successor, little is known; but Lygdamis, who next attained to power, is notorious for having put to death the poet Panyasis and caused Herodotus, the greatest of Halicarnassians, to leave his native city (c. 457 B.C.). In the 5th century B.C. Halicarnassus and other Dorian cities of Asia were to some extent absorbed by the Delian League, but the peace of Antalcidas in 387 made them subservient to Persia; and it was under Mausolus, a Persian satrap who assumed independent authority, that Halicarnassus attained its highest prosperity. Struck by the natural strength and beauty of its position, Mausolus removed to Halicarnassus from Mylasa, increasing the population of the city by the inhabitants of six towns of the Leleges. He was succeeded by Artemisia, whose military ability was shown in the stratagem by which she captured the Rhodian vessels attacking her city, and whose magnificence and taste have been perpetuated by the "Mausoleum," the monument she erected to her husband's memory (see [MAUSOLUS](#)). One of her successors, Pixodarus, tried to ally himself with the rising power of Macedon, and is said to have gained the momentary consent of the young Alexander to wed his daughter. The marriage, however, was forbidden by Philip. Alexander, as soon as he had reduced Ionia, summoned Halicarnassus, where Memnon, the paramount satrap of Asia Minor, had taken refuge with the Persian fleet, to surrender; and on its refusal took the city after hard fighting and devastated it, but not being able to reduce the citadel, was forced to leave it blockaded. He handed the government of the city back to the family of Mausolus, as represented by Ada, sister of the latter. Not long afterwards we find the citizens receiving the present of a gymnasium from Ptolemy, and building in his honour a stoa or portico; but the city never recovered altogether from the disasters of the siege, and Cicero describes it as almost deserted. The site is now occupied in part by the town of Budrum; but the ancient walls can still be traced round nearly all their circuit, and the position of several of the temples, the theatre, and other public buildings can be fixed with certainty.

From the ruins of the Mausoleum sufficient has been recovered by the excavations carried out in 1857 by C. T. Newton to enable a fairly complete restoration of its design to be made. The building consisted of five parts—a basement or podium, a pteron or enclosure of columns, a pyramid, a pedestal and a chariot group. The basement, covering an area of 114 ft. by 92, was built of blocks of greenstone and cased with marble. Round the base of it were probably disposed groups of statuary. The pteron consisted (according to Pliny) of thirty-six columns of the Ionic order, enclosing a square *cella*. Between the columns probably stood single statues. From the portions that have been recovered, it appears that the principal frieze of the pteron represented combats of Greeks and Amazons. In addition to these, there are also many life-size fragments of animals, horsemen, &c., belonging probably to pedimental sculptures, but formerly supposed to be parts of minor friezes. Above the pteron rose the pyramid, mounting by 24 steps to an apex or pedestal. On this apex stood the chariot with the figure of Mausolus himself and an attendant. The height of the statue of Mausolus in the British Museum is 9 ft. 9½ in. without the plinth. The hair rising from the forehead falls in thick waves on each side of the face and descends nearly to the shoulder; the beard is short and close, the face square and massive, the eyes deep set under overhanging brows, the mouth well formed with settled calm about the lips. The drapery is grandly composed. All sorts of restorations of this famous monument have been proposed. The original one, made by Newton and Pullan, is obviously in error in many respects; and that of Oldfield, though to be preferred for its lightness (the Mausoleum was said anciently to be "suspended in mid-air"), does not satisfy the conditions postulated by the remains. The best on the whole is that of the veteran German architect, F. Adler, published in 1900; but fresh studies have since been made (see below).

See C. T. Newton and R. P. Pullan, *History of Discoveries at Halicarnassus* (1862-1863); J. Fergusson, *The Mausoleum at Halicarnassus* restored (1862); E. Oldfield, "The Mausoleum," in *Archaeologia* (1895); F. Adler, *Mausoleum zu Halikarnass* (1900); J. P. Six in *Journ. Hell. Studies* (1905); W. B. Dinsmoor, in *Amer. Journ. of Arch.* (1908); J. J. Stevenson, *A Restoration of the Mausoleum of Halicarnassus* (1909); J. B. K. Preedy, "The Chariot Group of the Mausoleum," in

HALICZ, a town of Austria, in Galicia, 70 m. by rail S.S.E. of Lemberg. Pop. (1900), 4809. It is situated at the confluence of the Luckow with the Dniester and its principal resources are the recovery of salt from the neighbouring brine wells, soap-making and the trade in timber. In the neighbourhood are the ruins of the old castle, the seat of the ruler of the former kingdom from which Galicia derived its Polish name. Halicz, which is mentioned in annals as early as 1113, was from 1141 to 1255 the residence of the princes of that name, one of the principalities into which western Russia was then divided. The town was then much larger, as is shown by excavations in the neighbourhood made during the 19th century, and probably met its doom during the Mongol invasion of 1240. In 1349 it was incorporated in the kingdom of Poland.

HALIFAX, CHARLES MONTAGUE, EARL OF (1661-1715), English statesman and poet, fourth son of the Hon. George Montague, fifth son of the first earl of Manchester, was born at Horton, Northamptonshire, on the 16th of April 1661. In his fourteenth year he was sent to Westminster school, where he was chosen king's scholar in 1677, and distinguished himself in the composition of extempore epigrams made according to custom upon theses appointed for king's scholars at the time of election. In 1679 he entered Trinity College, Cambridge, where he acquired a solid knowledge of the classics and surpassed all his contemporaries at the university in logic and ethics. Latterly, however, he preferred to the abstractions of Descartes the practical philosophy of Sir Isaac Newton; and he was one of the small band of students who assisted Newton in forming the Philosophical Society of Cambridge. But it was his facility in verse-writing, and neither his scholarship nor his practical ability, that first opened up to him the way to fortune. His clever but absurdly panegyric poem on the death of Charles II. secured for him the notice of the earl of Dorset, who invited him to town and introduced him to the principal wits of the time; and in 1687 his joint authorship with Prior of the *Hind and Panther transversed to the Story of the Country Mouse and the City Mouse*, a parody of Dryden's political poem, not only increased his literary reputation but directly helped him to political influence.

In 1689, through the patronage of the earl of Dorset, he entered parliament as member for Maldon, and sat in the convention which resolved that William and Mary should be declared king and queen of England. About this time he married the countess-dowager of Manchester, and it would appear, according to Johnson, that it was still his intention to take orders; but after the coronation he purchased a clerkship to the council. On being introduced by Earl Dorset to King William, after the publication of his poetical *Epistle occasioned by his Majesty's Victory in Ireland*, he was ordered to receive an immediate pension of £500 per annum, until an opportunity should present itself of "making a man of him." In 1691 he was chosen chairman of the committee of the House of Commons appointed to confer with a committee of the Lords in regard to the bill for regulating trials in cases of high treason; and he displayed in these conferences such tact and debating power that he was made one of the commissioners of the treasury and called to the privy council. But his success as a politician was less due to his oratorical gifts than to his skill in finance, and in this respect he soon began to manifest such brilliant talents as completely eclipsed the painstaking abilities of Godolphin. Indeed it may be affirmed that no other statesman has initiated schemes which have left a more permanent mark on the financial history of England. Although perhaps it was inevitable that England should sooner or later adopt the continental custom of lightening the annual taxation in times of war by contracting a national debt, the actual introduction of the expedient was due to Montague, who on the 15th of December 1692 proposed to raise a million of money by way of loan. Previous to this the Scotsman William Paterson (*q.v.*) had submitted to the government his plan of a national bank, and when in the spring of 1694 the prolonged contest with France had rendered another large loan absolutely necessary, Montague introduced a bill for the incorporation of the Bank of England. The bill after some opposition passed the House of Lords in May, and immediately after the prorogation of parliament Montague was rewarded by the chancellorship of the exchequer. In 1695 he was triumphantly returned for the borough of Westminster to the new parliament, and succeeded in passing his celebrated measure to remedy the depreciation which had taken place in the currency on account of dishonest manipulations. To provide for the expense of recoinage, Montague, instead of reviving the old tax of hearth money, introduced the window tax, and the

difficulties caused by the temporary absence of a metallic currency were avoided by the issue for the first time of exchequer bills. His other expedients for meeting the emergencies of the financial crisis were equally successful, and the rapid restoration of public credit secured him a commanding influence both in the House of Commons and at the board of the treasury; but although Godolphin resigned office in October 1696, the king hesitated for some time between Montague and Sir Stephen Fox as his successor, and it was not till 1697 that the former was appointed first lord. In 1697 he was accused by Charles Duncombe, and in 1698 by a Col. Granville, of fraud, but both charges broke down, and Duncombe was shown to have been guilty of extreme dishonesty himself. In 1698 and 1699 he acted as one of the council of regency during the king's absence from England. With the accumulation of his political successes his vanity and arrogance became, however, so offensive that latterly they utterly lost him the influence he had acquired by his administrative ability and his masterly eloquence; and when his power began to be on the wane he set the seal to his political overthrow by conferring the lucrative sinecure office of auditor of the exchequer on his brother in trust for himself should he be compelled to retire from power. This action earned him the offensive nickname of "Filcher," and for some time afterwards, in attempting to lead the House of Commons, he had to submit to constant mortifications, often verging on personal insults. After the return of the king in 1699 he resigned his offices in the government and succeeded his brother in the auditorship.

On the accession of the Tories to power he was removed in 1701 to the House of Lords by the title of Lord Halifax. In the same year he was impeached for malpractices along with Lord Somers and the earls of Portland and Oxford, but all the charges were dismissed by the Lords; and in 1703 a second attempt to impeach him was still more unsuccessful. He continued out of office during the reign of Queen Anne, but in 1706 he was named one of the commissioners to negotiate the union with Scotland; and after the passing of the Act of Settlement in favour of the house of Hanover, he was appointed ambassador to the elector's court to convey the insignia of order of the garter to George I. On the death of Anne (1714) he was appointed one of the council of regency until the arrival of the king from Hanover; and after the coronation he received the office of first lord of the treasury in the new ministry, being at the same time created earl of Halifax and Viscount Sunbury. He died on the 19th of May 1715 and left no issue. He was buried in the vault of the Albemarle family in Westminster Abbey. His nephew George (d. 1739) succeeded to the barony, and was created Viscount Sunbury and earl of Halifax in 1715.

Montague's association with Prior in the travesty of Dryden's *Hind and Panther* has no doubt largely aided in preserving his literary reputation; but he is perhaps indebted for it chiefly to his subsequent influential position and to the fulsome flattery of the men of letters who enjoyed his friendship, and who, in return for his liberal donations and the splendid banqueting which they occasionally enjoyed at his villa on the Thames, "fed him," as Pope says, "all day long with dedications." Swift says he gave them nothing but "good words, and good dinners." That, however, his beneficence to needy talent, if sometimes attributable to an itching ear for adulation, was at others prompted by a sincere appreciation of intellectual merit, is sufficiently attested by the manner in which he procured from Godolphin a commissionership for Addison, and also by his life-long intimacy with Newton, for whom he obtained the mastership of the mint. The small fragments of poetry which he left behind him, and which were almost solely the composition of his early years, display a certain facility and vigour of diction, but their thought and fancy are never more than commonplace, and not unfrequently in striving to be eloquent and impressive he is only grotesquely and extravagantly absurd. In administrative talent he was the superior of all his contemporaries, and his only rival in parliamentary eloquence was Somers; but the skill with which he managed measures was superior to his tact in dealing with men, and the effect of his brilliant financial successes on his reputation was gradually almost nullified by the affected arrogance of his manner and by the eccentricities of his sensitive vanity. So eager latterly was his thirst for fame and power that perhaps Marlborough did not exaggerate when he said that "he had no other principle but his ambition, so that he would put all in distraction rather than not gain his point."

Among the numerous notices of Halifax by contemporaries may be mentioned the eulogistic reference which concludes Addison's account of the "greatest of English poets"; the dedications by Steel to the second volume of the *Spectator* and to the fourth of the *Tatler*; Pope's laudatory mention of him in the epilogue to his *Satires* and in the preface to the *Iliad*, and his portrait of him as "Full-blown Bufo" in the *Epistle to Arbuthnot*. Various allusions to him are to be found in Swift's works and in Marlborough's *Letters*. See also Burnet's *History of his Own Times*; *The Parliamentary History*; Howell's *State Trials*; Johnson's *Lives of the Poets*; and Macaulay's *History of England*. His *Miscellaneous Works* were published at London in 1704; his *Life and Miscellaneous Works* in 1715; and his *Poetical Works*, to which also his "Life" is attached, in 1716. His poems were reprinted in the 9th volume of Johnson's *English Poets*.

HALIFAX, GEORGE MONTAGU DUNK, 2ND EARL OF (1716-1771), son of George Montagu, 1st earl of Halifax (of the second creation), was born on the 5th or 6th of October 1716, becoming earl of Halifax on his father's death in 1739. Educated at Eton and at Trinity College, Cambridge, he was married in 1741 to Anne Richards (d. 1753), a lady who had inherited a great fortune from Sir Thomas Dunk, whose name was taken by Halifax. After having been an official in the household of Frederick, prince of Wales, the earl was made master of the buckhounds, and in 1748 he became president of the Board of Trade. While filling this position he helped to found Halifax, the capital of Nova Scotia, which was named after him, and in several ways he rendered good service to trade, especially with North America. About this time he sought to become a secretary of state, but in vain, although he was allowed to enter the cabinet in 1757. In March 1761 Halifax was appointed lord-lieutenant of Ireland, and during part of the time which he held this office he was also first lord of the admiralty. He became secretary of state for the northern department under the earl of Bute in October 1762, retaining this post under George Grenville and being one of the three ministers to whom George III. entrusted the direction of affairs. He signed the general warrant under which Wilkes was arrested in 1763, for which action he was mulcted in damages by the courts of law in 1769, and he was mainly responsible for the exclusion of the name of the king's mother, Augusta, princess of Wales, from the Regency Bill of 1765. With his colleagues the earl left office in July 1765, returning to the cabinet as lord privy seal under his nephew, Lord North, in January 1770. He had just been transferred to his former position of secretary of state when he died on the 8th of June 1771. Halifax, who was lord-lieutenant of Northamptonshire and a lieutenant-general in the army, showed some disinterestedness in money matters, but was very extravagant. He left no children, and his titles became extinct on his death. Horace Walpole speaks slightly of the earl, and says he and his mistress, Mary Anne Faulkner, "had sold every employment in his gift."

See the *Memoirs* of his secretary, Richard Cumberland (1807).

HALIFAX, GEORGE SAVILE, 1ST MARQUESS OF (1633-1695), English statesman and writer, great-grandson of Sir George Savile of Lupset and Thornhill in Yorkshire (created baronet in 1611), was the eldest son of Sir William Savile, 3rd baronet, who distinguished himself in the civil war in the royalist cause and who died in 1644, and of Anne, eldest daughter of Lord Keeper Coventry. He was thus nephew of Sir William Coventry, who is said to have influenced his political opinions, and of Lord Shaftesbury, afterwards his most bitter opponent, and great-nephew of the earl of Strafford; by his marriage with the Lady Dorothy Spencer, he was brother-in-law to Lord Sunderland. He entered public life with all the advantages of lineage, political connexions, great wealth and estates, and uncommon abilities. He was elected member of the Convention parliament for Pontefract in 1660, and this was his only appearance in the Lower House. A peerage was sought for him by the duke of York in 1665, but was successfully opposed by Clarendon, on the ground of his "ill-reputation amongst men of piety and religion," the real motives of the chancellor's hostile attitude being probably Savile's connexion with Buckingham and Coventry. The honours were, however, only deferred for a short time and were obtained after the fall of Clarendon on the 31st of December 1667,¹ when Savile was created Baron Savile of Eland and Viscount Halifax.

He supported zealously the anti-French policy formulated in the Triple Alliance of January 1668. He was at this time in favour at court, was created a privy councillor in 1672, and, while ignorant of the disgraceful secret clauses in the treaty of Dover, was chosen envoy to negotiate terms of peace with Louis XIV. and the Dutch at Utrecht. His mission was still further deprived of importance by Arlington and Buckingham, who were in the king's counsels, and who anticipated his arrival and took the negotiations out of his hands; and though he signed the compact, he had no share in the harsh terms imposed upon the Dutch, and henceforth became a bitter opponent of the policy of subservience to French interests and of the Roman Catholic claims.

He took an active part in passing through parliament the great Test Act of 1673² and forfeited in consequence his friendship with James. In 1674 he brought forward a motion for disarming "popish recusants," and supported one by Lord Carlisle for restricting the marriages in the royal family to Protestants; but he opposed the bill introduced by Lord Danby (see [LEEDS, 1ST DUKE OF](#)) in 1675, which imposed a test oath on officials and members of parliament, speaking "with that quickness, learning and elegance that are inseparable from all his discourses," and ridiculing the multiplication of oaths, since "no man would ever sleep with open doors ... should all the town be sworn not to rob." He was now on bad terms with Danby, and a witty sally at that minister's expense caused his dismissal from the council in January 1676. In 1678 he took an active part in the investigation of the "Popish Plot," to which he appears to have given excessive credence, but opposed the bill which was passed on the 30th of October 1678, to exclude Roman Catholics from

the House of Lords.

In 1679, as a consequence of the fall of Danby, he became a member of the newly constituted privy council. With Charles, who had at first “kicked at his appointment,” he quickly became a favourite, his lively and “libertine” (*i.e.* free or sceptical) conversation being named by Bishop Burnet as his chief attraction for the king. His dislike of the duke of York and of the Romanist tendencies of the court did not induce him to support the rash attempt of Lord Shaftesbury to substitute the illegitimate duke of Monmouth for James in the succession. He feared Shaftesbury’s ascendancy in the national councils and foresaw nothing but civil war and confusion as a result of his scheme. He declared against the exclusion of James, was made an earl in 1679, and was one of the “Triumvirate” which now directed public affairs. He assisted in passing into law the Habeas Corpus Bill. According to Sir W. Temple he showed great severity in putting into force the laws against the Roman Catholics, but this statement is considered a misrepresentation.³ In 1680 he voted against the execution of Lord Stafford.

Meanwhile (1679) his whole policy had been successfully directed towards uniting all parties with the object of frustrating Shaftesbury’s plans. Communications were opened with the prince of Orange, and the illness of the king was made the occasion for summoning James from Brussels. Monmouth was compelled to retire to Holland, and Shaftesbury was dismissed. On the other hand, while Halifax was so far successful, James was given an opportunity of establishing a new influence at the court. It was with great difficulty that his retirement to Scotland was at last effected; the ministers lost the confidence and support of the “country party,” and Halifax, fatigued and ill, at the close of this year, retired to Rufford Abbey, the country home of the Saviles since the destruction of Thornhill Hall in 1648, and for some time took little part in affairs. He returned in September 1680 on the occasion of the introduction of the Exclusion Bill in the Lords. The debate which followed, one of the most famous in the whole annals of parliament, became a duel of oratory between Halifax and his uncle Shaftesbury, the finest two speakers of the day, watched by the Lords, the Commons at the bar, and the king, who was present. It lasted seven hours. Halifax spoke sixteen times, and at last, regardless of the menaces of the more violent supporters of the bill, who closed round him, vanquished his opponent. The rejection of the bill by a majority of 33 was attributed by all parties entirely to the eloquence of Halifax. His conduct transformed the allegiance to him of the Whigs into bitter hostility, the Commons immediately petitioning the king to remove him from his councils for ever, while any favour which he might have regained with James was forfeited by his subsequent approval of the regency scheme.

He retired to Rufford again in January 1681, but was present at the Oxford parliament, and in May returned suddenly to public life and held for a year the chief control of affairs. The arrest of Shaftesbury on the 2nd of July was attributed to his influence, but in general, during the period of Tory reaction, he seems to have urged a policy of conciliation and moderation upon the king. He opposed James’s return from Scotland and, about this time (Sept.), made a characteristic but futile attempt to persuade the duke to attend the services of the Church of England and thus to end all difficulties. He renewed relations with the prince of Orange, who in July paid a visit to England to seek support against the French designs upon Luxemburg. The influence of Halifax procured for the Dutch a formal assurance from Charles of his support; but the king informed the French ambassador that he had no intention of fulfilling his engagements, and made another secret treaty with Louis. Halifax opposed in 1682 James’s vindictive prosecution of the earl of Argyll, arousing further hostility in the duke, while the same year he was challenged to a duel by Monmouth, who attributed to him his disgrace.

His short tenure of power ended with the return of James in May. Outwardly he still retained the king’s favour and was advanced to a marquisate (Aug. 17) and to the office of lord privy seal (Oct. 25). Being still a member of the administration he must share responsibility for the attack now made upon the municipal franchises, a violation of the whole system of representative government, especially as the new charters passed his office. In January 1684 he was one of the commissioners “who supervise all things concerning the city and have turned out those persons who are whiggishly inclined” (N. Luttrell’s *Diary*, i. 295). He made honourable but vain endeavours to save Algernon Sidney and Lord Russell. “My Lord Halifax,” declared Tillotson in his evidence before the later inquiry, “showed a very compassionate concern for my Lord Russell and all the readiness to serve them that could be wished.”⁴ The Rye-House Plot, in which it was sought to implicate them, was a disastrous blow to his policy, and in order to counteract its consequences he entered into somewhat perilous negotiations with Monmouth, and endeavoured to effect his reconciliation with the king. On the 12th of February 1684, he procured the release of his old antagonist, Lord Danby. Shortly afterwards his influence at the court revived. Charles was no longer in receipt of his French pension and was beginning to tire of James and Rochester. The latter, instead of becoming lord treasurer, was, according to the epigram of Halifax which has become proverbial, “kicked upstairs,” to the office of lord president of the council. Halifax now worked to establish intimate relations between Charles and the prince of Orange and opposed the abrogation of the recusancy laws. In a debate in the cabinet of November 1684, on the question of the grant of a fresh constitution to the New England colonies, he urged with great

warmth "that there could be no doubt whatever but that the same laws which are in force in England should also be established in a country inhabited by Englishmen and that an absolute government is neither so happy nor so safe as that which is tempered by laws and which sets bounds to the authority of the prince," and declared that he could not "live under a king who should have it in his power to take, whenever he thought proper, the money he has in his pocket." The opinions thus expressed were opposed by all the other ministers and highly censured by Louis XIV., James and Judge Jeffreys.

At the accession of James he was immediately deprived of all power and relegated to the presidency of the council. He showed no compliance, like other Lords, with James's Roman Catholic preferences. He was opposed to the parliamentary grant to the king of a revenue for life; he promoted the treaty of alliance with the Dutch in August 1685; he expostulated with the king on the subject of the illegal commissions in the army given to Roman Catholics; and finally, on his firm refusal to support the repeal of the Test and Habeas Corpus Acts, he was dismissed, and his name was struck out of the list of the privy council (Oct. 1685). He corresponded with the prince of Orange, conferred with Dykveldt, the latter's envoy, but held aloof from plans which aimed at the prince's personal interference in English affairs. In 1687 he published the famous *Letter to a Dissenter*, in which he warns the Nonconformists against being beguiled by the "Indulgence" into joining the court party, sets in a clear light the fatal results of such a step, and reminds them that under their next sovereign their grievances would in all probability be satisfied by the law. The tract, which has received general and unqualified admiration, must be classed amongst the few known writings which have actually and immediately altered the course of history. Copies to the number of 20,000 were circulated through the kingdom, and a great party was convinced of the wisdom of remaining faithful to the national traditions and liberties. He took the popular side on the occasion of the trial of the bishops in June 1688, visited them in the Tower, and led the cheers with which the verdict of "not guilty" was received in court; but the same month he refrained from signing the invitation to William, and publicly repudiated any share in the prince's plans. On the contrary he attended the court and refused any credence to the report that the prince born to James was supposititious. After the landing of William he was present at the council called by James on the 27th of November. He urged the king to grant large concessions, but his speech, in contrast to the harsh and overbearing attitude of the Hydes, was "the most tender and obliging ... that ever was heard." He accepted the mission with Nottingham and Godolphin to treat with William at Hungerford, and succeeded in obtaining moderate terms from the prince. The negotiations, however, were abortive, for James had from the first resolved on flight. In the crisis which ensued, when the country was left without a government, Halifax took the lead. He presided over the council of Lords which assembled and took immediate measures to maintain public order. On the return of James to London on the 16th of November, after his capture at Faversham, Halifax repaired to William's camp and henceforth attached himself unremittingly to his cause. On the 17th he carried with Lords Delamere and Shrewsbury a message from William to the king advising his departure from London, and, after the king's second flight, directed the proceedings of the executive. On the meeting of the convention on the 22nd of January 1689, he was formally elected speaker of the House of Lords. He voted against the motion for a regency (Jan. 20), which was only defeated by two votes. The moderate and comprehensive character of the settlement at the revolution plainly shows his guiding hand, and it was finally through his persuasion that the Lords yielded to the Commons and agreed to the compromise whereby William and Mary were declared joint sovereigns. On the 13th of February in the Banqueting House at Whitehall, he tendered the crown to them in the name of the nation, and conducted the proclamation of their accession in the city.

At the opening of the new reign he had considerable influence, was made lord privy seal, while Danby his rival was obliged to content himself with the presidency of the council, and controlled the appointments to the new cabinet which were made on a "trimming" or comprehensive basis. His views on religious toleration were as wide as those of the new king. He championed the claims of the Nonconformists as against the high or rigid Church party, and he was bitterly disappointed at the miscarriage of the Comprehension Bill. He thoroughly approved also at first of William's foreign policy; but, having excited the hostility of both the Whig and Tory parties, he now became exposed to a series of attacks in parliament which finally drove him from power. He was severely censured, as it seems quite unjustly, for the disorder in Ireland, and an attempt was made to impeach him for his conduct with regard to the sentences on the Whig leaders. The inquiry resulted in his favour; but notwithstanding, and in spite of the king's continued support, he determined to retire. He had already resigned the speakership of the House of Lords, and he now (Feb. 8, 1690) quitted his place in the cabinet. He still nominally retained his seat in the privy council, but in parliament he became a bitter critic of the administration; and the rivalry of Halifax (the Black Marquess) with Danby, now marquess of Carmarthen (the White Marquess) threw the former at this time into determined opposition. He disapproved of William's total absorption in European politics, and his open partiality for his countrymen. In January 1691 Halifax had an interview with Henry Bulkeley, the Jacobite agent, and is said to have promised "to do everything that lay in his power to serve the king." This was probably merely a measure of precaution, for he had no serious Jacobite leanings. He entered bail for Lord Marlborough,

accused wrongfully of complicity in a Jacobite plot in May 1692, and in June, during the absence of the king from England, his name was struck off the privy council.

He spoke in favour of the Triennial Bill (Jan. 12, 1693) which passed the legislature but was vetoed by William, suggested a proviso in the Licensing Act, which restricted its operation to anonymous works, approved the Place Bill (1694), but opposed, probably on account of the large sums he had engaged in the traffic of annuities, the establishment of the bank of England in 1694. Early in 1695 he delivered a strong attack on the administration in the House of Lords, and, after a short illness arising from a neglected complaint, he died on the 5th of April at the age of sixty-one. He was buried in Henry VII.'s chapel in Westminster Abbey.

The influence of Halifax, both as orator and as writer, on the public opinion of his day was probably unrivalled. His intellectual powers, his high character, his urbanity, vivacity and satirical humour made a great impression on his contemporaries, and many of his witty sayings have been recorded. But the superiority of his statesmanship could not be appreciated till later times. Maintaining throughout his career a complete detachment from party, he never acted permanently or continuously with either of the two great factions, and exasperated both in turn by deserting their cause at the moment when their hopes seemed on the point of realization. To them he appeared weak, inconstant, untrustworthy. They could not see what to us now is plain and clear, that Halifax was as consistent in his principles as the most rabid Whig or Tory. But the principle which chiefly influenced his political action, that of compromise, differed essentially from those of both parties, and his attitude with regard to the Whigs or Tories was thus by necessity continually changing. Measures, too, which in certain circumstances appeared to him advisable, when the political scene had changed became unwise or dangerous. Thus the regency scheme, which Halifax had supported while Charles still reigned, was opposed by him with perfect consistency at the revolution. He readily accepted for himself the character of a "trimmer," desiring, he said, to keep the boat steady, while others attempted to weigh it down perilously on one side or the other; and he concluded his tract with these assertions: "that our climate is a Trimmer between that part of the world where men are roasted and the other where they are frozen; that our Church is a Trimmer between the frenzy of fanatic visions and the lethargic ignorance of Popish dreams; that our laws are Trimmers between the excesses of unbounded power and the extravagance of liberty not enough restrained; that true virtue hath ever been thought a Trimmer, and to have its dwelling in the middle between two extremes; that even God Almighty Himself is divided between His two great attributes, His Mercy and His Justice. In such company, our Trimmer is not ashamed of his name...."⁵

His powerful mind enabled him to regard the various political problems of his time from a height and from a point of view similar to that from which distance from the events enables us to consider them at the present day; and the superiority of his vision appears sufficiently from the fact that his opinions and judgments on the political questions of his time are those which for the most part have ultimately triumphed and found general acceptance. His attitude of mind was curiously modern.⁶ Reading, writing and arithmetic, he thinks, should be taught to all and at the expense of the state. His opinions again on the constitutional relations of the colonies to the mother country, already cited, were completely opposed to those of his own period. For that view of his character which while allowing him the merit of a brilliant political theorist denies him the qualities of a man of action and of a practical politician, there is no solid basis. The truth is that while his political ideas are founded upon great moral or philosophical generalizations, often vividly recalling and sometimes anticipating the broad conceptions of Burke, they are at the same time imbued with precisely those practical qualities which have ever been characteristic of English statesmanship, and were always capable of application to actual conditions. He was no star-gazing philosopher, with thoughts superior to the contemplation of mundane affairs. He had no taste for abstract political dogma. He seems to venture no further than to think that "men should live in some competent state of freedom," and that the limited monarchical and aristocratic government was the best adapted for his country. "Circumstances," he writes in the *Rough Draft of a New Model at Sea*, "must come in and are to be made a part of the matter of which we are to judge; positive decisions are always dangerous, more especially in politics." Nor was he the mere literary student buried in books and in contemplative ease. He had none of the "indecisiveness which commonly renders literary men of no use in the world" (Sir John Dalrymple). The incidents of his career show that there was no backwardness or hesitation in acting when occasion required. The constant tendency of his mind towards antithesis and the balancing of opinions did not lead to paralysis in time of action. He did not shrink from responsibility, nor show on any occasion lack of courage. At various times of crisis he proved himself a great leader. He returned to public life to defeat the Exclusion Bill. At the revolution it was Halifax who seized the reins of government, flung away by James, and maintained public security. His subsequent failure in collaborating with William is, it is true, disappointing. But the cause was one that has not perhaps received sufficient attention. Party government had come to the birth during the struggles over the Exclusion Bill, and there had been unconsciously introduced into politics a novel element of which the nature and importance were not understood or suspected. Halifax had consistently ignored and neglected party; and it now had its revenge.

Detested by the Whigs and by the Tories alike, and defended by neither, the favour alone of the king and his own transcendent abilities proved insufficient to withstand the constant and violent attacks made upon him in parliament, and he yielded to the superior force. He seems indeed himself to have been at last convinced of the necessity in English political life of party government, for though in his *Cautions to electors* he warns them against men "tied to a party," yet in his last words he declares "If there are two parties a man ought to adhere to that which he disliked least though in the whole he doth not approve it; for whilst he doth not list himself in one or the other party, he is looked upon as such a straggler that he is fallen upon by both.... Happy those that are convinced so as to be of the general opinions" (*Political Thoughts and Reflections of Parties*).

The private character of Lord Halifax was in harmony with the greatness of his public career. He was by no means the "voluptuary" described by Macaulay. He was on the contrary free from self-indulgence; his manner of life was decent and frugal, and his dress proverbially simple. He was an affectionate father and husband. "His heart," says Burnet (i. 492-493, ed. 1833), "was much set on raising his family"—his last concern even while on his deathbed was the remarriage of his son Lord Eland to perpetuate his name; and this is probably the cause of his acceptance of so many titles for which he himself affected a philosophical indifference. He was estimable in his social relations and habits. He showed throughout his career an honourable independence, and was never seen to worship the rising sun. In a period when even great men stooped to accept bribes, Halifax was known to be incorruptible; at a time when animosities were especially bitter, he was too great a man to harbour resentments. "Not only from policy," says Reresby (*Mem.* p. 231), "(which teaches that we ought to let no man be our enemy when we can help it), but from his disposition I never saw any man more ready to forgive than himself." Few were insensible to his personal charm and gaiety. He excelled especially in quick repartee, in "exquisite nonsense," and in spontaneous humour. When quite a young man, just entering upon political life he is described by Evelyn as "a witty gentleman, if not a little too prompt and daring." The latter characteristic was not moderated by time but remained through life. He was incapable of controlling his spirit of raillery, from jests on Siamese missionaries to sarcasms at the expense of the heir to the throne and ridicule of hereditary monarchy, and his brilliant paradoxes, his pungent and often profane epigrams were received by graver persons as his real opinions and as evidences of atheism. This latter charge he repudiated, assuring Burnet that he was "a Christian in submission," but that he could not digest iron like an ostrich nor swallow all that the divines sought to impose upon the world.

The speeches of Halifax have not been preserved, and his political writings on this account have all the greater value. *The Character of a Trimmer* (1684 or 1685), the authorship of which, long doubtful, is now established,⁷ was his most ambitious production, written seemingly as advice to the king and as a manifesto of his own opinions. In it he discusses the political problems of the time and their solution on broad principles. He supports the Test Act and, while opposing the Indulgence, is not hostile to the repeal of the penal laws against the Roman Catholics by parliament. Turning to foreign affairs he contemplates with consternation the growing power of France and the humiliation of England, exclaiming indignantly at the sight of the "Roses blasted and discoloured while lilies triumph and grow insolent upon the comparison." The whole is a masterly and comprehensive summary of the actual political situation and its exigencies; while, when he treats such themes as liberty, or discusses the balance to be maintained between freedom and government in the constitution, he rises to the political idealism of Bolingbroke and Burke. *The Character of King Charles II.* (printed 1750), to be compared with his earlier sketch of the king in the *Character of a Trimmer*, is perhaps from the literary point of view the most admirable of his writings. The famous *Letter to a Dissenter* (1687) was thought by Sir James Mackintosh to be unrivalled as a political pamphlet. *The Lady's New Year's Gift: or Advice to a Daughter*, refers to his daughter Elizabeth, afterwards wife of the 3rd and mother of the celebrated 4th earl of Chesterfield (1688). In *The Anatomy of an Equivalent* (1688) he treats with keen wit and power of analysis the proposal to grant a "perpetual edict" in favour of the Established Church in return for the repeal of the test and penal laws. *Maxims of State* appeared about 1692. *The Rough Draft of a New Model at Sea* (c. 1694), though apparently only a fragment, is one of the most interesting and characteristic of his writings. It opens with the question: "'What shall we do to be saved in this world?' There is no other answer but this, 'Look to your moat.' The first article of an Englishman's political creed must be that he believeth in the sea." He discusses the naval establishment, not from the naval point of view alone, but from the general aspect of the constitution of which it is a detail, and is thus led on to consider the nature of the constitution itself, and to show that it is not an artificial structure but a growth and product of the natural character. We may also mention *Some Cautions* to the electors of the parliament (1694), and *Political, Moral and Miscellaneous Thoughts and Reflections* (n.d.), a collection of aphorisms in the style of the maxims of La Rochefoucauld, inferior in style—but greatly excelling the French author in breadth of view and in moderation. (For other writings attributed to Halifax, see Foxcroft, *Life of Sir G. Savile*, ii. 529 sqq.).

Halifax was twice married, first in 1656 to the Lady Dorothy Spencer—daughter of the 1st earl

of Sunderland and of Dorothy Sidney, "Sacharissa"—who died in 1670, leaving a family; and secondly, in 1672, to Gertrude, daughter of William Pierrepont of Thoresby, who survived him, and by whom he had one daughter, Elizabeth, Lady Chesterfield, who seems to have inherited a considerable portion of her father's intellectual abilities. On the death of his son William, 2nd marquess of Halifax, in August 1700 without male issue, the peerage became extinct, and the baronetcy passed to the Saviles of Lupset, the whole male line of the Savile family ending in the person of Sir George Savile, 8th baronet, in 1784. Henry Savile, British envoy at Versailles, who died unmarried in 1687, was a younger brother of the first marquess. Halifax has been generally supposed to have been the father of the illegitimate Henry Carey, the poet, but this is doubtful.

See *Life and Letters of Sir George Savile, 1st Marquis of Halifax* (2 vols., 1898), by Miss H. C. Foxcroft, who has collected and made excellent use of all the material available at that date, including hitherto unexplored Savile MSS., at Devonshire House, in the Spencer Archives, in the Longleat and other collections, and who has edited the works of Halifax and printed a memorandum of conversations with King William of 1688-1690, left in MS. by Halifax. Macaulay, in his *History of England*, misjudged Halifax on some points, but nevertheless understood and did justice to the greatness of his statesmanship, and pronounced on him a well-merited and eloquent eulogy (iv. 545). Contemporary characters of Halifax which must be accepted with caution are Burnet's in the *History of His Own Times* (ed. 1833, vol. i. pp. 491-493, and iv. 268), that by the author of "Saviliana," identified as William Mompesson, and "Sacellum Apollinare," a panegyric in verse by Elkanah Settle (1695).

(P. C. Y.)

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- 1 *Cal. State Papers, Dom.* (Nov. 1667-Sep. 1668). p. 106.
 - 2 *Lords' Journals*, 12, p. 567; *Savile Correspondence*, ed. by W. D. Cooper, p. 136; "Character of a Trimmer," in *Life of Sir G. Savile*, by H. C. Foxcroft, ii. 316.
 - 3 Foxcroft i. 160, where Hallam is quoted to this effect.
 - 4 *Hist. MSS. Comm. House of Lords MSS.* 1689-1690, p. 287.
 - 5 *Character of a Trimmer*, conclusion.
 - 6 Saviliana quoted by Foxcroft i. 115.
 - 7 Foxcroft, ii. 273 et seq., and *Hist. MSS. Comm. MSS.* of F. W. Leyborne-Popham, p. 264.
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HALIFAX, a city and port of entry, capital of the province of Nova Scotia, Canada. It is situated in 44° 59' N. and 63° 35' W., on the south-east coast of the province, on a fortified hill, 225 ft. in height, which slopes down to the waters of Chebucto Bay, now known as Halifax Harbour. The harbour, which is open all the year, is about 6 m. long by 1 m. in width, and has excellent anchorage in all parts; to the north a narrow passage connects it with Bedford Basin, 6 m. in length by 4 m., and deep enough for the largest men-of-war. At the harbour mouth lies McNab's Island, thus forming two entrances; the eastern passage is only employed by small vessels, though in 1862 the Confederate cruiser, "Tallahassee," slipped through by night, and escaped the northern vessels which were watching off the western entrance. The population in 1901 was 40,832.

The town was originally built of wood, plastered or stuccoed, but though the wooden houses largely remain, the public buildings are of stone. Inferior in natural strength to Quebec alone, the city and its approaches have been fortified till it has become the strongest position in Canada, and one of the strongest in the British Empire. Till 1906 it was garrisoned by British troops, but in that year, with Esquimalt, on the Pacific coast, it was taken over by the Canadian government, an operation necessitating a large increase in the Canadian permanent military force. At the same time, the royal dockyard, containing a dry-dock 610 ft. in length, and the residences in connexion, were also taken over for the use of the department of marine and fisheries. Till 1905 Halifax was the summer station of the British North American squadron. In that year, in consequence of a redistribution of the fleet, the permanent North American squadron was withdrawn; but Halifax is still visited periodically by powerful squadrons of cruisers.

Though, owing to the growth of Sydney and other outports, it no longer monopolizes the foreign trade of the province, Halifax is still a thriving town, and has the largest export trade of the Dominion in fish and fish products, the export of fish alone, in 1904, amounting to over three-fifths that of the entire Dominion. Lumber (chiefly spruce deals) and agricultural products (especially apples) are also exported in large quantities. The chief imports are manufactures from Great Britain and the United States, and sugar, molasses, rum and fruit from the West Indies. Its industrial establishments include foundries, sugar refineries, manufactures of furniture and other

articles of wood, a skate factory and rope and cordage works, the produce of which are all exported. It is the Atlantic terminus of the Intercolonial, Canadian Pacific and several provincial railways, and the chief winter port of Canada, numerous steamship lines connecting it with Great Britain, Europe, the West Indies and the United States. The public gardens, covering 14 acres, and Point Pleasant Park, left to a great extent in its natural state, are extremely beautiful. Behind the city is an arm of the sea (known as the North-West Arm), 5 m. in length and 1 m. in breadth, with high, well-wooded shores, and covered in summer with canoes and sailing craft. The educational institutions include a ladies' college, several convents, a Presbyterian theological college and Dalhousie University, with faculties of arts, law, medicine and science. Established by charter in 1818 by the earl of Dalhousie, then lieutenant governor, and reorganized in 1863, it has since become much the most important seat of learning in the maritime provinces. Other prominent buildings are Government House, the provincial parliament and library, and the Roman Catholic cathedral. St Paul's church (Anglican) dates from 1750, and though not striking architecturally, is interesting from the memorial tablets and the graves of celebrated Nova Scotians which it contains. The city is the seat of the Anglican bishop of Nova Scotia and Prince Edward Island, and of the Roman Catholic bishop of Halifax.

Founded in 1749 by the Hon. Edward Cornwallis as a rival to the French town of Louisburg in Cape Breton, it was named after the 2nd earl of Halifax, president of the board of trade and plantations. In the following year it superseded Annapolis as capital of the province. Its privateers played a prominent part in the war of 1812-15 with the United States, and during the American Civil War it was a favourite base of operations for Confederate blockade-runners. The federation of the North American provinces in 1867 lessened its relative importance, but its merchants have gradually adapted themselves to the altered conditions.

HALIFAX, a municipal, county and parliamentary borough in the West Riding of Yorkshire, England, 194 m. N.N.W. from London and 7 m. S.W. from Bradford, on the Great Northern and the Lancashire & Yorkshire railways. Pop. (1891), 97,714; (1901) 104,936. It lies in a bare hilly district on and above the small river Hebble near its junction with the Calder. Its appearance is in the main modern, though a few picturesque old houses remain. The North Bridge, a fine iron structure, spans the valley, giving connexion between the opposite higher parts of the town. The principal public building is the town hall, completed in 1863 after the designs of Sir Charles Barry; it is a handsome Palladian building with a tower. Of churches the most noteworthy is that of St John the Baptist, the parish church, a Perpendicular building with lofty western tower. Two earlier churches are traceable on this side, the first perhaps pre-Norman, the second of the Early English period. The old woodwork is fine, part being Perpendicular, but the greater portion dates from 1621. All Souls' church was built in 1859 from the designs of Sir Gilbert Scott, of whose work it is a good example, at the expense of Mr Edward Akroyd. The style is early Decorated, and a rich ornamentation is carried out in Italian marble, serpentine and alabaster. A graceful tower and spire 236 ft. high rise at the north-west angle. The Square chapel, erected by the Congregationalists in 1857, is a striking cruciform building with a tower and elaborate crocketed spire. Both the central library and museum and the Akroyd museum and art gallery occupy buildings which were formerly residences, the one of Sir Francis Crossley (1817-1872) and the other of Mr Edward Akroyd. Among charitable institutions the principal is the handsome royal infirmary, a Renaissance building. The Heath grammar school was founded in 1585 under royal charter for instruction in classical languages. It possesses close scholarships at Oxford and Cambridge universities. The Waterhouse charity school occupies a handsome set of buildings forming three sides of a quadrangle, erected in 1855. The Crossley almshouses were erected and endowed by Sir Francis and Mr Joseph Crossley, who also endowed the Crossley orphan home and school. Technical schools are maintained by the corporation. Among other public buildings may be noted the Piece-Hall, erected in 1799 for the lodgment and sale of piece goods, now used as a market, a great quadrangular structure occupying more than two acres; the bonding warehouse, court-house, and mechanics' institute. There are six parks, of which the People's Park of 12½ acres, presented by Sir Francis Crossley in 1858, is laid out in ornate style from designs by Sir Joseph Paxton.

Halifax ranks with Leeds, Bradford and Huddersfield as a seat of the woollen and worsted manufacture. The manufacture of carpets is a large industry, one establishment employing some 5000 hands. The worsted, woollen and cotton industries, and the iron, steel and machinery manufactures are very extensive. There are collieries and freestone quarries in the neighbourhood.

The parliamentary borough returns two members. The county borough was created in 1888. The municipal borough is under a mayor, 15 aldermen and 45 councillors. Area, 13,967 acres.

At the time of the Conquest Halifax formed part of the extensive manor of Wakefield, which belonged to the king, but in the 13th century was in the hands of John, earl Warrenne (c. 1245-1305). The prosperity of the town began with the introduction of the cloth trade in the 15th century, when there are said to have been only thirteen houses, which before the end of the 16th century had increased to 520. Camden, about the end of the 17th century, wrote that "the people are very industrious, so that though the soil about it be barren and unprofitable, not fit to live on, they have so flourished ... by the clothing trade that they are very rich and have gained a reputation for it above their neighbours." The trade is said to have been increased by the arrival of certain merchants driven from the Netherlands by the persecution of the duke of Alva. Among the curious customs of Halifax was the Gibbet Law, which was probably established by a prescriptive right to protect the wool trade, and gave the inhabitants the power of executing any one taken within their liberty, who, when tried by a jury of sixteen of the frith-burgesses, was found guilty of the theft of any goods of the value of more than 13d. The executions took place on market days on a hill outside the town, the gibbet somewhat resembling a guillotine. The first execution recorded under this law took place in 1541, and the right was exercised in Halifax longer than in any other town, the last execution taking place in 1650. In 1635 the king granted the inhabitants of Halifax licence to found a workhouse in a large house given to them for that purpose by Nathaniel Waterhouse, and incorporated them under the name of the master and governors. Nathaniel Waterhouse was appointed the first master, his successors being elected every year by the twelve governors from among themselves. Halifax was a borough by prescription, its privileges growing up with the increased prosperity brought by the cloth trade, but it was not incorporated until 1848. Since the Reform Act of 1832 the burgesses have returned two members to parliament. In 1607 David Waterhouse, lord of the manor of Halifax, obtained a grant of two markets there every week on Friday and Saturday and two fairs every year, each lasting three days, one beginning on the 24th of June, the other on the 11th of November. Later these fairs and markets were confirmed with the addition of an extra market on Thursday to Sir William Aylofffe, baronet, who had succeeded David Waterhouse as lord of the manor. The market rights were sold to the Markets Company in 1810 and purchased from them by the corporation in 1853.

During the Civil War Halifax was garrisoned by parliament, and a field near it is still called the Bloody Field on account of an engagement which took place there between the forces of parliament and the Royalists.

See *Victoria County History, "Yorkshire"*; T. Wright, *The Antiquities of the Town of Halifax* (Leeds, 1738); John Watson, *The History and Antiquities of the Parish of Halifax* (London, 1775); John Crabtree, *A Concise History of the Parish and Vicarage of Halifax* (Halifax and London, 1836).

ḤALIṢAH (Hebrew, חליצה "untying"), the ceremony by which a Jewish widow releases her brother-in-law from the obligation to marry her in accordance with Deuteronomy xxv. 5-10, and obtains her own freedom to remarry. By the law of Moses it became obligatory upon the brother of a man dying childless to take his widow as wife. If he refused, "then shall his brother's wife come unto him in the presence of the elders and loose his shoe from off his foot, and spit in his face, and shall answer and say, So shall it be done unto that man that will not build up his brother's house." By Rabbinical law the ceremony was later made more complex. The parties appear before a court of three elders with two assessors. The place is usually the synagogue house, or that of the Rabbi, sometimes that of the widow. After inquiry as to the relationship of the parties and their status (for if either be a minor or deformed, ḥaliṣah cannot take place), the shoe is produced. It is usually the property of the community and made entirely of leather from the skin of a "clean" animal. It is of two pieces, the upper part and the sole, sewn together with leathern threads. It has three small straps in front, and two white straps to bind it on the leg. After it is strapped on, the man must walk four cubits in the presence of the court. The widow then loosens and removes the shoe, throwing it some distance, and spits on the ground, repeating thrice the Biblical formula "So shall it be done," &c. Ḥaliṣah, which is still common among orthodox Jews, must not take place on the Sabbath, a holiday, or the eve of either, or in the evening. To prevent brothers-in-law from extorting money from a widow as a price for releasing her from perpetual widowhood, Jewish law obliges all brothers at the time of a marriage to sign a document pledging themselves to submit to ḥaliṣah without payment. (Compare [LEVIRATE](#)).

HALKETT, HUGH, FREIHERR VON (1783-1863), British soldier and general of infantry in the Hanoverian service, was the second son of Major-General F. G. Halkett, who had served many years in the army, and whose ancestors had for several generations distinguished themselves in foreign services. With the "Scotch Brigade" which his father had been largely instrumental in raising, Hugh Halkett served in India from 1798 to 1801. In 1803 his elder brother Colin was appointed to command a battalion of the newly formed King's German Legion, and in this he became senior captain and then major. Under his brother's command he served with Cathcart's expeditions to Hanover, Rügen and Copenhagen, where his bold initiative on outpost duty won commendation. He was in the Peninsula in 1808-1809, and at Walcheren. At Albuera, Salamanca, &c., he commanded the 2nd Light Infantry Battalion, K.G.L., in succession to his brother, and at Venta del Pozo in the Burgos retreat he greatly distinguished himself. In 1813 he left the Peninsula and was subsequently employed in the organization of the new Hanoverian army. He led a brigade of these troops in Count Wallmoden's army, and bore a marked part in the battle of Gohrde and the action of Schestedt, where he took with his own hand a Danish standard. In the Waterloo campaign he commanded two brigades of Hanoverian militia which were sent to the front with the regulars, and during the fight with the Old Guard captured General Cambronne. After the fall of Napoleon he elected to stay in the Hanoverian service, though he retained his half-pay lieutenant-colonelcy in the English army. He rose to be general and inspector-general of infantry. In his old age he led the Xth Federal Army Corps in the Danish War of 1848, and defeated the Danes at Oversee. He had the G.C.H., the C.B. and many foreign orders, including the Prussian order of the Black Eagle and *pour le Mérite* and the Russian St Anne.

See Knesebeck, *Leben des Freiherrn Hugh von Halkett* (Stuttgart, 1865).

His brother, SIR COLIN HALKETT (1774-1856), British soldier, began his military career in the Dutch Guards and served in various "companies" for three years, leaving as a captain in 1795. From 1800 to the peace of Amiens he served with the Dutch troops in English pay in Guernsey. In August 1803 Halkett was one of the first officers assigned to the service of raising the King's German Legion, and he became major, and later lieutenant-colonel, commanding the 2nd Light Infantry Battalion. His battalion was employed in the various expeditions mentioned above, from Hanover to Walcheren, and in 1811 Colin Halkett succeeded Charles Alten in the command of the Light Brigade, K.G.L., which he held throughout the Peninsula War from Albuera to Toulouse. In 1815 Major-General Sir Colin Halkett commanded the 5th British Brigade of Alten's division, and at Waterloo he received four wounds. Unlike his brother, he remained in the British service, in which he rose to general. At the time of his death he was governor of Chelsea hospital. He had honorary general's rank in the Hanoverian service, the G.C.B. and G.C.H., as well as numerous foreign orders.

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For information about both the Halketts, see Beamish, *History of the King's German Legion* (1832).

HALL, BASIL (1788-1844), British naval officer, traveller and miscellaneous writer, was born at Edinburgh on the 31st of December 1788. His father was Sir James Hall of Dunglass, the geologist. Basil Hall was educated at the High School, Edinburgh, and in 1802 entered the navy, where he rose to the rank of post-captain in 1817, after seeing active service in several fields. By observing the ethnological as well as the physical peculiarities of the countries he visited, he collected the materials for a very large number of scientific papers. In 1816 he commanded the sloop "Lyra," which accompanied Lord Amherst's embassy to China; and he described his cruise in *An Account of a Voyage of Discovery to the West Coast of Corea and the Great Loo-choo Island in the Japan Sea* (London, 1818). In 1820 he held a command on the Pacific coast of America, and in 1824 published two volumes of *Extracts from a Journal written on the Coasts of Chili, Peru and Mexico in the Years 1820-21-22*. Retiring on half-pay in 1824, Hall in 1825 married Margaret, daughter of Sir John Hunter, and in her company travelled (1827-1828) through the United States. In 1829 he published his *Travels in North America in the Years 1827 and 1828*, which was assailed by the American press for its views of American society. *Schloss Hainfeld, or a Winter in Lower Styria* (1836), is partly a romance, partly a description of a visit paid by the author to the castle of the countess Purgstall. *Spain and the Seat of War in Spain* appeared in 1837. *The Fragments of Voyages and Travels* (9 vols.) were issued in three detachments between 1831 and 1840. Captain Hall was a fellow of the Royal Societies of London and Edinburgh, and of the Royal Astronomical, Royal Geographical and Geological Societies. His last work, a collection of sketches and tales under the name of *Patchwork* (1841), had not been long published before its author became insane, and he died in Haslar hospital, Portsmouth, on the 11th of September 1844.

HALL, CARL CHRISTIAN (1812-1888), Danish statesman, son of the highly respected artisan and train-band colonel Mads Hall, was born at Christianshavn on the 25th of February 1812. After a distinguished career at school and college, he adopted the law as his profession, and in 1837 married the highly gifted but eccentric Augusta Marie, daughter of the philologist Peter Oluf Brøndsted. A natural conservatism indisposed Hall at first to take any part in the popular movement of 1848, to which almost all his friends had already adhered; but the moment he was convinced of the inevitability of popular government, he resolutely and sympathetically followed in the new paths. Sent to the *Rigsforsamling* of 1848 as member for the first district of Copenhagen, a constituency he continued to represent in the *Folketing* till 1881, he immediately took his place in the front rank of Danish politicians. From the first he displayed rare ability as a debater, his inspiring and yet amiable personality attracted hosts of admirers, while his extraordinary tact and temper disarmed opposition and enabled him to mediate between extremes without ever sacrificing principles.

Hall was not altogether satisfied with the fundamental law of June; but he considered it expedient to make the best use possible of the existing constitution and to unite the best conservative elements of the nation in its defence. The aloofness and sulkiness of the aristocrats and landed proprietors he deeply deplored. Failing to rally them to the good cause he determined anyhow to organize the great cultivated middle class into a political party. Hence the "June Union," whose programme was progress and reform in the spirit of the constitution, and at the same time opposition to the one-sided democratism and party-tyranny of the *Bondevenner* or peasant party. The "Union" exercised an essential influence on the elections of 1852, and was, in fact, the beginning of the national Liberal party, which found its natural leader in Hall. During the years 1852-1854 the burning question of the day was the connexion between the various parts of the monarchy. Hall was "eiderdansk" by conviction. He saw in the closest possible union between the kingdom and a Schleswig freed from all risk of German interference the essential condition for Denmark's independence; but he did not think that Denmark was strong enough to carry such a policy through unsupported, and he was therefore inclined to promote it by diplomatic means and international combinations, and strongly opposed to the Conventions of 1851-1852 (See [DENMARK: History](#)), though he was among the first, subsequently, to accept them as an established fact and the future basis for Denmark's policy.

Hall first took office in the Bang administration (12th of December 1854) as minister of public worship. In May 1857 he became president of the council after Andrae, Bang's successor, had retired, and in July 1858 he exchanged the ministry of public worship for the ministry of foreign affairs, while still retaining the premiership.

Hall's programme, "den Konstitutionelle Helstat," *i.e.* a single state with a common constitution, was difficult enough in a monarchy which included two nationalities, one of which, to a great extent, belonged to a foreign and hostile jurisdiction. But as this political monstrosity had already been guaranteed by the Conventions of 1851-1852, Hall could not rid himself of it, and the attempt to establish this "Helstat" was made accordingly by the Constitution of the 13th of November 1863. The failure of the attempt and its disastrous consequences for Denmark are described elsewhere. Here it need only be said that Hall himself soon became aware of the impossibility of the "Helstat," and his whole policy aimed at making its absurdity patent to Europe, and substituting for it a constitutional Denmark to the Eider which would be in a position to come to terms with an independent Holstein. That this was the best thing possible for Denmark is absolutely indisputable, and "the diplomatic Seven Years' War" which Hall in the meantime conducted with all the powers interested in the question is the most striking proof of his superior statesmanship. Hall knew that in the last resort the question must be decided not by the pen but by the sword. But he relied, ultimately, on the protection of the powers which had guaranteed the integrity of Denmark by the treaty of London, and if words have any meaning at all he had the right to expect at the very least the armed support of Great Britain.¹ But the great German powers and the force of circumstances proved too strong for him. On the accession of the new king, Christian IX., Hall resigned rather than repeal the November Constitution, which gave Denmark something to negotiate upon in case of need. But he made matters as easy as he could for his successors in the Monrad administration, and the ultimate catastrophe need not have been as serious as it was had his advice, frankly given, been intelligently followed.

After 1864 Hall bore more than his fair share of the odium and condemnation which weighed so heavily upon the national Liberal party, making no attempt to repudiate responsibility and refraining altogether from attacking patently unscrupulous opponents. But his personal popularity suffered not the slightest diminution, while his clear, almost intuitive, outlook and his unconquerable faith in the future of his country made him, during those difficult years, a factor of incalculable importance in the public life of Denmark. In 1870 he joined the Holstein-Holsteinborg ministry as minister of public worship, and in that capacity passed many useful educational reforms, but on the fall of the administration, in 1873, he retired altogether from public life. In the summer of 1879 Hall was struck down by apoplexy, and for the remaining nine years of his life he was practically bedridden. He died on the 14th of August 1888. In politics Hall was a practical, sagacious "opportunist," in the best sense of that much abused word, with an eye

rather for things than for persons. Moreover, he had no very pronounced political ambition, and was an utter stranger to that longing for power, which drives so many men of talent to adopt extreme expedients. His urbanity and perfect equilibrium at the very outset incited sympathy, while his wit and humour made him the centre of every circle within which he moved.

See Vilhelm Christian Sigurd Topsøe, *Polit. Portraetstudier* (Copenhagen, 1878); Schøller Parelius Vilhelm Birkedal, *Personlige Oplevelser* (Copenhagen, 1890-1891).

(R. N. B.)

1 On this head see the 3rd marquess of Salisbury's *Political Essays*, reprinted from the *Quarterly Review*.

HALL, CHARLES FRANCIS (1821-1871), American Arctic explorer, was born at Rochester, New Hampshire. After following the trade of blacksmith he became a journalist in Cincinnati; but his enthusiasm for Arctic exploration led him in 1859 to volunteer to the American Geographical Society to "go in search for the bones of Franklin." With the proceeds of a public subscription he was equipped for his expedition and sailed in May 1860 on board a whaling vessel. The whaler being ice-bound, Hall took up his abode in the regions to the north of Hudson Bay, where he found relics of Frobisher's 16th-century voyages, and living with the Eskimo for two years he acquired a considerable knowledge of their habits and language. He published an account of these experiences under the title of *Arctic Researches, and Life among the Esquimaux* (1864). Determined, however, to learn more about the fate of the Franklin expedition he returned to the same regions in 1864, and passing five years among the Eskimo was successful in obtaining a number of Franklin relics, as well as information pointing to the exact fate of 76 of the crew, whilst also performing some geographical work of interest. In 1871 he was given command of the North Polar expedition fitted out by the United States Government in the "Polaris." Making a remarkably rapid passage up Smith Sound at the head of Baffin Bay, which was found to be ice-free, the "Polaris" reached on the 30th of August the lat. of 82° 11', at that time, and until the English expedition of 1876 the highest northern latitude attained by vessel. The expedition went into winter quarters in a sheltered cove on the Greenland coast. On the 24th of October, Hall on his return from a successful sledge expedition to the north was suddenly seized by an illness of which he died on the 8th of November. Capt. S. O. Buddington (1823-1888) assumed command, and although the "Polaris" was subsequently lost after breaking out of the ice, with only part of the crew aboard, the whole were ultimately rescued, and the scientific results of the expedition proved to be of considerable importance.

HALL, CHRISTOPHER NEWMAN (1816-1902), English Nonconformist divine, was born at Maidstone on the 22nd of May 1816. His father was John Vine Hall, proprietor and printer of the *Maidstone Journal*, and the author of a popular evangelical work called *The Sinner's Friend*. Christopher was educated at University College, London, and took the London B.A. degree. His theological training was gained at Highbury College, whence he was called in 1842 to his first pastorate at the Albion Congregational Church, Hull. During the twelve years of his ministry there the membership was greatly increased, and a branch chapel and school were opened. At Hull Newman Hall first began his active work in temperance reform, and in defence of his position wrote *The Scriptural Claims of Teetotalism*. In 1854 he accepted a call to Surrey chapel, London, founded in 1783 by the Rev. Rowland Hill. A considerable sum had been bequeathed by Hill for the perpetuation of his work on the expiration of the lease; but, owing to some legal flaw in the will, the money was not available, and Newman Hall undertook to raise the necessary funds for a new church. By weekly offertories and donations the money for the beautiful building called Christ Church at the junction of the Kennington and Westminster Bridge Roads was collected, and within four years of opening (1876) the total cost (£63,000) was cleared. In 1892 Newman Hall resigned his charge and devoted himself to general evangelical work. Most of his writings are small booklets or tracts of a distinctly evangelical character. The best known of these is *Come to Jesus*, of which over four million copies have been circulated in forty different languages. Newman Hall visited the United States during the Civil War, and did much to promote a friendly understanding between England and America. A Liberal in politics, and a keen admirer of John Bright, few preachers of any denomination have exercised so far-reaching an influence as the "Dissenters' Bishop," as he came to be termed. He died on the 18th of February 1902.

HALL, EDWARD (c. 1498-1547), English chronicler and lawyer, was born about the end of the 15th century, being a son of John Hall of Northall, Shropshire. Educated at Eton and King's College, Cambridge, he became a barrister and afterwards filled the offices of common serjeant of the city of London and judge of the sheriff's court. He was also member of parliament for Bridgnorth. Hall's great work, *The Union of the Noble and Illustre Famelies of Lancastre and York*, commonly called *Hall's Chronicle*, was first published in 1542. Another edition was issued by Richard Grafton in 1548, the year after Hall's death, and another in 1550; these include a continuation from 1532 compiled by Grafton from the author's notes. In 1809 an edition was published under the supervision of Sir Henry Ellis, and in 1904 the part dealing with the reign of Henry VIII. was edited by C. Whibley. The *Chronicle* begins with the accession of Henry IV. to the English throne in 1399; it follows the strife between the houses of Lancaster and York, and with Grafton's continuation carries the story down to the death of Henry VIII. in 1547. Hall presents the policy of this king in a very favourable light and shows his own sympathy with the Protestants. For all kinds of ceremonial he has all a lawyer's respect, and his pages are often adorned and encumbered with the pageantry and material garniture of the story. The value of the *Chronicle* in its early stages is not great, but this increases when dealing with the reign of Henry VII. and is very considerable for the reign of Henry VIII. Moreover, the work is not only valuable, it is attractive. To the historian it furnishes what is evidently the testimony of an eye-witness on several matters of importance which are neglected by other narrators; and to the student of literature it has the exceptional interest of being one of the prime sources of Shakespeare's historical plays.

See J. Gairdner, *Early Chroniclers of Europe; England* (1879).

HALL, FITZEDWARD (1825-1901), American Orientalist, was born in Troy, New York, on the 21st of March 1825. He graduated with the degree of civil engineer from the Rensselaer Polytechnic Institute at Troy in 1842, and entered Harvard in the class of 1846; just before his class graduated he left college and went to India in search of a runaway brother. In January 1850 he was appointed tutor, and in 1853 professor of Sanskrit and English, in the government college at Benares; and in 1855 was made inspector of public instruction in Ajmere-Merwara and in 1856 in the Central Provinces. He settled in England in 1862 and received the appointment to the chair of Sanskrit, Hindustani and Indian jurisprudence in King's College, London, and to the librarianship of the India Office. He died at Marlesford, Suffolk, on the 1st of February 1901. Hall was the first American to edit a Sanskrit text, the *Vishnupurāna*; his library of a thousand Oriental MSS. he gave to Harvard University.

His works include: in Sanskrit, *Atmabodha* (1852), *Sāṅkhyaprāvachana* (1856), *Sāryasiddhānta* (1859), *Vāsavadattū* (1859), *Sāṅkhyasāra* (1862) and *Dasarūpa* (1865); in Hindi, Ballantynes' *Hindi Grammar* (1868) and a *Reader* (1870); on English philology, *Recent Exemplifications of False Philology* (1872), attacking Richard Grant White, *Modern English* (1873), "On English Adjectives in -able, with Special Reference to Reliable" (*Am. Jour. Philology*, 1877), *Doctor Indoctus* (1880).

HALL, ISAAC HOLLISTER (1837-1896), American Orientalist, was born in Norwalk, Connecticut, on the 12th of December 1837. He graduated at Hamilton College in 1859, was a tutor there in 1859-1863, graduated at the Columbia Law School in 1865, practised law in New York City until 1875, and in 1875-1877 taught in the Syrian Protestant College at Beirut, where he discovered a valuable Syriac manuscript of the Philoxenian version of a large part of the New Testament, which he published in part in facsimile in 1884. He worked with General di Cesnola in classifying the famous Cypriote collection in the Metropolitan Museum of New York City, and was a curator of that museum from 1885 until his death in Mount Vernon, New York, on the 2nd of July 1896. He was an eminent authority on Oriental inscriptions. Following the scanty clues given

by George Smith and Samuel Birch, and working on the data furnished by the di Cesnola collection, he succeeded about 1874 in deciphering an entire Cypriote inscription, and in establishing the Hellenic character of the dialect and the syllabic nature of the script.

His work in Cypriote epigraphy is described in his articles in *Scribner's Magazine*, vol. 20 (June, 1880), pp. 205-211 and in the *Journal of the American Oriental Society*, vol. 10, No. 2 (1880), pp. 201-218. He published in facsimile the Antilegomena epistles (1886), which he deciphered from the W. F. Williams manuscript, and edited *A Critical Bibliography of the Greek New Testament as Published in America* (1884).

HALL, SIR JAMES (1761-1832), Scottish geologist and physicist, eldest son of Sir John Hall, Bart., was born at Dunglass on the 17th of January 1761; and became distinguished as the first to establish experimental research as an aid to geological investigation. He was intimately acquainted with James Hutton and John Playfair, and having studied rocks in various parts of Europe he was eventually led to accept and to demonstrate the truth of Hutton's views with regard to intrusive rocks. He commenced a series of experiments to illustrate the fusion of rocks, their vitreous and crystalline characters, and the influence of molten rocks in altering adjacent strata. He thus assisted in proving that granitic veins had been injected into overlying deposits after their consolidation. He studied the volcanic rocks in Italy and recognized that the old lava flows and the numerous dikes in Scotland must have had a similar origin. He made further experiments to illustrate the contortions of rocks. The results were brought before the Royal Society of Edinburgh. He died at Edinburgh on the 23rd of June 1832. He represented in parliament (1807-1812) the old borough of Michael in Cornwall; he also wrote an *Essay on the Origin, History and Principles of Gothic Architecture* (1813).

His eldest son, John Hall (1787-1860), who succeeded him, was a Fellow of the Royal Society; the second son, Captain Basil Hall (*q.v.*), was the distinguished traveller; the third son, James Hall (1800-1854), was a painter, art-patron, and a friend of Sir David Wilkie.

HALL, JAMES (1793-1868), American judge and man of letters, was born at Philadelphia on the 19th of August 1793. After for some time prosecuting the study of law, he in 1812 joined the army, and in the war with Great Britain distinguished himself in engagements at Lundy's Lane, Niagara and Fort Erie. On the conclusion of the war he accompanied an expedition against Algiers, but in 1818 he resigned his commission, and continued the study of law at Pittsburg. In 1820 he removed to Shawneetown, Illinois, where he commenced practice at the bar and also edited the *Illinois Gazette*. Soon after he was appointed public prosecutor of the circuit, and in 1824 state circuit judge. In 1827 he became state treasurer, and held that office till 1831, but he continued at the same time his legal practice and also edited the *Illinois Intelligencer*. Subsequently he became editor of the *Western Souvenir*, an annual publication, and of the *Illinois Monthly Magazine*, afterwards the *Western Monthly Magazine*. He died near Cincinnati on the 5th of July 1868.

The following are his principal works:—*Letters from the West*, originally contributed to the *Portfolio*, and collected and published in London in 1828; *Legends of the West* (1832); *The Soldier's Bride and other Tales* (1832); *The Harpe's Head, a Legend of Kentucky* (1833); *Sketches of the West* (2 vols., 1835); *Tales of the Border* (1835); *Notes on the Western States* (1838); *History of the Indian Tribes*, in conjunction with T. L. M'Keeney (3 vols., 1838-1844); *The Wilderness and the War-Path* (1845); *Romance of Western History* (1857).

HALL, JAMES (1811-1898). American geologist and palaeontologist, was born at Hingham, Massachusetts, on the 12th of September 1811. In early life he became attached to the study of natural history, and he completed his education at the polytechnic institute at Troy in New York, where he graduated in 1832, and afterwards became professor of chemistry and natural science, and subsequently of geology. In 1836 he was appointed one of the geologists on the Geological

Survey of the state of New York, and he was before long charged with the palaeontological work. Eventually he became state geologist and director of the museum of natural history at Albany. His published papers date from 1836, and include numerous reports on the geology and palaeontology of various portions of the United States and Canada. He dealt likewise with physical geology, and in 1859 discussed the connexion between the accumulation of sedimentary deposits and the elevation of mountain-chains. His chief work was the description of the invertebrate fossils of New York—in which he dealt with the graptolites, brachiopods, mollusca, trilobites, echini and crinoids of the Palaeozoic formations. The results were published in a series of quarto volumes entitled *Palaeontology of New York* (1847-1894), in which he was assisted in course of time by R. P. Whitfield and J. M. Clarke. He published also reports on the geology of Oregon and California (1845), Utah (1852), Iowa (1859) and Wisconsin (1862). He received the Wollaston medal from the Geological Society of London in 1858. He was a man of great energy and untiring industry, and in 1897, when in his eighty-sixth year, he journeyed to St Petersburg to take part in the International Geological Congress, and then joined the excursion to the Ural mountains. He died at Albany on the 7th of August 1898.

See *Life and Work of James Hall*, by H. C. Hovey, *Amer. Geol.* xxiii., 1899, p. 137 (portraits).

HALL, JOSEPH (1574-1656), English bishop and satirist, was born at Bristow park, near Ashby de la Zouch, Leicestershire, on the 1st of July 1574. His father, John Hall, was agent in the town for Henry, earl of Huntingdon, and his mother, Winifred Bambridge, was a pious lady, whom her son compared to St Monica. Joseph Hall received his early education at the local school, and was sent (1589) to Emmanuel College, Cambridge. Hall was chosen for two years in succession to read the public lecture on rhetoric in the schools, and in 1595 became fellow of his college. During his residence at Cambridge he wrote his *Virgidemiarum* (1597), satires written after Latin models. The claim he put forward in the prologue to be the earliest English satirist:—

“I first adventure, follow me who list
And be the second English satirist”—

gave bitter offence to John Marston, who attacks him in the satires published in 1598. The archbishop of Canterbury gave an order (1599) that Hall's satires should be burnt with works of John Marston, Marlowe, Sir John Davies and others on the ground of licentiousness, but shortly afterwards Hall's book, certainly unjustly condemned, was ordered to be “staied at the press,” which may be interpreted as reprieved (see *Notes and Queries*, 3rd series, xii. 436). Having taken holy orders, Hall was offered the mastership of Blundell's school, Tiverton, but he refused it in favour of the living of Halsted, Essex, to which he was presented (1601) by Sir Robert Drury. In his parish he had an opponent in a Mr Lilly, whom he describes as “a witty and bold atheist.” In 1603 he married; and in 1605 he accompanied Sir Edmund Bacon to Spa, with the special aim, he says, of acquainting himself with the state and practice of the Romish Church. At Brussels he disputed at the Jesuit College on the authentic character of modern miracles, and his inquiring and argumentative disposition more than once threatened to produce serious results, so that his patron at length requested him to abstain from further discussion. His devotional writings had attracted the notice of Henry, prince of Wales, who made him one of his chaplains (1608). In 1612 Lord Denny, afterwards earl of Norwich, gave him the curacy of Waltham-Holy-Cross, Essex, and in the same year he received the degree of D.D. Later he received the prebend of Willenhall in the collegiate church of Wolverhampton, and in 1616 he accompanied James Hay, Lord Doncaster, afterwards earl of Carlisle, to France, where he was sent to congratulate Louis XIII. on his marriage, but Hall was compelled by illness to return. In his absence the king nominated him dean of Worcester, and in 1617 he accompanied James to Scotland, where he defended the five points of ceremonial which the king desired to impose upon the Scots. In the next year he was one of the English deputies at the synod of Dort. In 1624 he refused the see of Gloucester, but in 1627 became bishop of Exeter.

He took an active part in the Arminian and Calvinist controversy in the English church. He did his best in his *Via media, The Way of Peace*, to persuade the two parties to accept a compromise. In spite of his Calvinistic opinions he maintained that to acknowledge the errors which had arisen in the Catholic Church did not necessarily imply disbelief in her catholicity, and that the Church of England having repudiated these errors should not deny the claims of the Roman Catholic Church on that account. This view commended itself to Charles I. and his episcopal advisers, but at the same time Archbishop Laud sent spies into Hall's diocese to report on the Calvinistic tendencies of the bishop and his lenience to the Puritan and low-church clergy. Hall says he was thrice down on his knees to the King to answer Laud's accusations and at length threatened to

“cast up his rochet” rather than submit to them. He was, however, amenable to criticism, and his defence of the English Church, entitled *Episcopacy by Divine Right* (1640), was twice revised at Laud’s dictation. This was followed by *An Humble Remonstrance to the High Court of Parliament* (1640 and 1641), an eloquent and forceful defence of his order, which produced a retort from the syndicate of Puritan divines, who wrote under the name of “Smectymnuus,” and was followed by a long controversy to which Milton contributed five pamphlets, virulently attacking Hall and his early satires.

In 1641 Hall was translated to the see of Norwich, and in the same year sat on the Lords’ Committee on religion. On the 30th of December he was, with other bishops, brought before the bar of the House of Lords to answer a charge of high treason of which the Commons had voted them guilty. They were finally convicted of an offence against the Statute of Praemunire, and condemned to forfeit their estates, receiving a small maintenance from the parliament. They were immured in the Tower from New Year to Whitsuntide, when they were released on finding bail for £5000 each. On his release Hall proceeded to his new diocese at Norwich, the revenues of which he seems for a time to have received, but in 1643, when the property of the “malignants” was sequestrated, Hall was mentioned by name. Mrs Hall had difficulty in securing a fifth of the maintenance (£400) assigned to the bishop by the parliament; they were eventually ejected from the palace, and the cathedral was dismantled. Hall retired to the village of Higham, near Norwich, where he spent the time preaching and writing until “he was first forbidden by man, and at last disabled by God.” He bore his many troubles and the additional burden of much bodily suffering with sweetness and patience, dying on the 8th of September 1656. Thomas Fuller says: “He was commonly called our English Seneca, for the purenesse, plainnesse, and fulnesse of his style. Not unhappy at *Controversies*, more happy at *Comments*, very good in his *Characters*, better in his *Sermons*, best of all in his *Meditations*.”

Bishop Hall’s polemical writings, although vigorous and effective, were chiefly of ephemeral interest, but many of his devotional writings have been often reprinted. It is by his early work as the censor of morals and the unsparing critic of contemporary literary extravagance and affectations that he is best known. *Virgidemiarum. Sixe Bookes. First three Bookes. Of Toothlesse Satyrs.* (1) *Poeticall*, (2) *Academicall*, (3) *Morall* (1597) was followed by an amended edition in 1598, and in the same year by *Virgidemiarum. The three last bookes. Of byting Satyres* (reprinted 1599). His claim to be reckoned the earliest English satirist, even in the formal sense, cannot be justified. Thomas Lodge, in his *Fig for Momus* (1593), had written four satires in the manner of Horace, and John Marston and John Donne both wrote satires about the same time, although the publication was in both cases later than that of *Virgidemiae*. But if he was not the earliest, Hall was certainly one of the best. He writes in the heroic couplet, which he manœuvres with great ease and smoothness. In the first book of his satires (*Poeticall*) he attacks the writers whose verses were devoted to licentious subjects, the bombast of *Tamburlaine* and tragedies built on similar lines, the laments of the ghosts of the *Mirror for Magistrates*, the metrical eccentricities of Gabriel Harvey and Richard Stanyhurst, the extravagances of the sonneteers, and the sacred poets (Southwell is aimed at in “Now good St Peter weeps pure Helicon, And both the Mary’s make a music moan”). In Book II. Satire 6 occurs the well-known description of the trencher-chaplain, who is tutor and hanger-on in a country manor. Among his other satirical portraits is that of the famished gallant, the guest of “Duke Humfray.”¹ Book VI. consists of one long satire on the various vices and follies dealt with in the earlier books. If his prose is sometimes antithetical and obscure, his verse is remarkably free from the quips and conceits which mar so much contemporary poetry.

He also wrote *The King’s Prophecie; or Weeping Joy* (1603), a gratulatory poem on the accession of James I.; *Epistles*, both the first and second volumes of which appeared in 1608 and a third in 1611; *Characters of Virtues and Vices* (1608), versified by Nahum Tate (1691); *Solomons Divine Arts ...* (1609); and, probably *Mundus alter et idem sive Terra Australis antehac semper incognita ... lustrata* (1605? and 1607), by “Mercurius Britannicus,” translated into English by John Healy (1608) as *The Discovery of a New World or A Description of the South Indies ... by an English Mercury*. *Mundus alter* is an excuse for a satirical description of London, with some criticism of the Romish church, its manners and customs, and is said to have furnished Swift with hints for *Gulliver’s Travels*. It was not ascribed to him by name until 1674, when Thomas Hyde, the librarian of the Bodleian, identified “Mercurius Britannicus” with Joseph Hall. For the question of the authorship of this pamphlet, and the arguments that may be advanced in favour of the suggestion that it was written by Alberico Gentili, see E. A. Petherick, *Mundus alter et idem*, reprinted from the *Gentleman’s Magazine* (July 1896). His controversial writings, not already mentioned, include:—*A Common Apology ... against the Brownists* (1610), in answer to John Robinson’s *Censorious Epistle; The Olde Religion: A treatise, wherein is laid downe the true state of the difference betwixt the Reformed and the Romane Church; and the blame of this schisme is cast upon the true Authors ...* (1628); *Columba Noae olivam adferens ...*, a sermon preached at St Paul’s in 1623; *Episcopacie by Divine Right* (1640); *A Short Answer to the Vindication of Smectymnuus* (1641); *A Modest Confutation of ... (Milton’s) Animadversions* (1642).

His devotional works include:—*Holy Observations Lib. I. Some few of David’s Psalmes Metaphrased* (1607 and 1609); three centuries of *Meditations and Vowes, Divine and Morall*

(1606, 1607, 1609), edited by Charles Sayle (1901); *The Arte of Divine Meditation* (1607); *Heaven upon Earth, or of True Peace and Tranquillitie of Mind* (1606), reprinted with some of his letters in John Wesley's *Christian Library*, vol. iv. (1819); *Occasional Meditations ...* (1630), edited by his son Robert Hall; *Henoichisme; or a Treatise showing how to walk with God* (1639), translated from Bishop Hall's Latin by Moses Wall; *The Devout Soul; or Rules of Heavenly Devotion* (1644), often since reprinted; *The Balm of Gilead ...* (1646, 1752); *Christ Mysticall; or the blessed union of Christ and his Members* (1647), of which General Gordon was a student (reprinted from Gordon's copy, 1893); *Susurrium cum Deo* (1659); *The Great Myserie of Godliness* (1650); *Resolutions and Decisions of Divers Practicall cases of Conscience* (1649, 1650, 1654).

AUTHORITIES.—The chief authority for Hall's biography is to be found in his autobiographical tracts: *Observations of some Specialities of Divine Providence in the Life of Joseph Hall, Bishop of Norwich, Written with his own hand*; and his *Hard Measure*, a reprint of which may be consulted in Dr Christopher Wordsworth's *Ecclesiastical Biography*. The best criticism of his satires is to be found in Thomas Warton's *History of English Poetry*, vol. iv. pp. 363-409 (ed. Hazlitt, 1871), where a comparison is instituted between Marston and Hall. In 1615 Hall published *A Recollection of such treatises as have been ... published ...* (1615, 1617, 1621); in 1625 appeared his *Works* (reprinted 1627, 1628, 1634, 1662). The first complete *Works* appeared in 1808, edited by the Rev. Josiah Pratt. Other editions are by Peter Hall (1837) and by Philip Wynter (1863). See also *Bishop Hall, his Life and Times* (1826), by Rev. John Jones; *Life of Joseph Hall*, by Rev. George Lewis (1886); A. B. Grosart, *The Complete Poems of Joseph Hall ... with introductions, &c.* (1879); *Satires, &c. (Early English Poets, ed. S. W. Singer, 1824)*. Many of Hall's works were translated into French, and some into Dutch, and there have been numerous selections from his devotional works.

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- 1 The tomb of Sir John Beauchamp (d. 1358) in old St Paul's was commonly known, in error, as that of Duke Humphrey of Gloucester. "To dine with Duke Humphrey" was to go hungry among the debtors and beggars who frequented "Duke Humphrey's Walk" in the cathedral.

HALL, MARSHALL (1790-1857). English physiologist, was born on the 18th of February 1790, at Basford, near Nottingham, where his father, Robert Hall, was a cotton manufacturer. Having attended the Rev. J. Blanchard's academy at Nottingham, he entered a chemist's shop at Newark, and in 1809 began to study medicine at Edinburgh University. In 1811 he was elected senior president of the Royal Medical Society; the following year he took the M.D. degree, and was immediately appointed resident house physician to the Royal Infirmary, Edinburgh. This appointment he resigned after two years, when he visited Paris and its medical schools, and, on a walking tour, those also of Berlin and Göttingen. In 1817, when he settled at Nottingham, he published his *Diagnosis*, and in 1818 he wrote the *Mimoses*, a work on the affections denominated bilious, nervous, &c. The next year he was elected a fellow of the Royal Society of Edinburgh, and in 1825 he became physician to the Nottingham general hospital. In 1826 he removed to London, and in the following year he published his *Commentaries* on the more important diseases of females. In 1830 he issued his *Observations on Blood-letting, founded on researches on the morbid and curative effects of loss of blood*, which were acknowledged by the medical profession to be of vast practical value, and in 1831 his *Experimental Essay on the Circulation of the Blood in the Capillary Vessels*, in which he showed that the blood-channels intermediate between arteries and veins serve the office of bringing the fluid blood into contact with the material tissues of the system. In the following year he read before the Royal Society a paper "On the inverse ratio which subsists between Respiration and Irritability in the Animal Kingdom." His most important work in physiology was concerned with the theory of reflex action, embodied in a paper "On the reflex Function of the Medulla Oblongata and the Medulla Spinalis" (1832), which was supplemented in 1837 by another "On the True Spinal Marrow, and the Excitomotor System of Nerves." The "reflex function" excited great attention on the continent of Europe, though in England some of his papers were refused publication by the Royal Society. Hall thus became the authority on the multiform deranged states of health referable to an abnormal condition of the nervous system, and he gained a large practice. His "ready method" for resuscitation in drowning and other forms of suspended respiration has been the means of saving innumerable lives. He died at Brighton of a throat affection, aggravated by lecturing, on the 11th of August 1857.

A list of his works and details of his "ready method," &c., are given in his *Memoirs* by his widow (London, 1861).

HALL, ROBERT (1764-1831), English Baptist divine, was born on the 2nd of May 1764, at Arnesby near Leicester, where his father, Robert Hall (1728-1791), a man whose cast of mind in some respects resembled closely that of the son, was pastor of a Baptist congregation. Robert was the youngest of a family of fourteen. While still at the dame's school his passion for books absorbed the greater part of his time, and in the summer it was his custom after school hours to retire to the churchyard with a volume, which he continued to peruse there till nightfall, making out the meaning of the more difficult words with the help of a pocket dictionary. From his sixth to his eleventh year he attended the school of Mr Simmons at Wigston, a village four miles from Arnesby. There his precocity assumed the exceptional form of an intense interest in metaphysics, partly perhaps on account of the restricted character of his father's library; and before he was nine years of age he had read and re-read Jonathan Edwards's *Treatise on the Will* and Butler's *Analogy*. This incessant study at such an early period of life seems, however, to have had an injurious influence on his health. After he left Mr Simmons's school his appearance was so sickly as to awaken fears of the presence of phthisis. In order, therefore, to obtain the benefit of a change of air, he stayed for some time in the house of a gentleman near Kettering, who with an impropriety which Hall himself afterwards referred to as "egregious," prevailed upon the boy of eleven to give occasional addresses at prayer meetings. As his health seemed rapidly to recover, he was sent to a school at Northampton conducted by the Rev. John Ryland, where he remained a year and a half, and "made great progress in Latin and Greek." On leaving school he for some time studied divinity under the direction of his father, and in October 1778 he entered the Bristol academy for the preparation of students for the Baptist ministry. Here the self-possession which had enabled him in his twelfth year to address unfalteringly various audiences of grown-up people seems to have strangely forsaken him; for when, in accordance with the arrangements of the academy, his turn came to deliver an address in the vestry of Broadmead chapel, he broke down on two separate occasions and was unable to finish his discourse. On the 13th of August 1780 he was set apart to the ministry, but he still continued his studies at the academy; and in 1781, in accordance with the provisions of an exhibition which he held, he entered King's College, Aberdeen, where he took the degree of master of arts in March 1785. At the university he was without a rival of his own standing in any of the classes, distinguishing himself alike in classics, philosophy and mathematics. He there formed the acquaintance of Mackintosh (afterwards Sir James), who, though a year his junior in age, was a year his senior as a student. While they remained at Aberdeen the two were inseparable, reading together the best Greek authors, especially Plato, and discussing, either during their walks by the sea-shore and the banks of the Don or in their rooms until early morning, the most perplexed questions in philosophy and religion.

During the vacation between his last two sessions at Aberdeen, Hall acted as assistant pastor to Dr Evans at Broadmead chapel, Bristol, and three months after leaving the university he was appointed classical tutor in the Bristol academy, an office which he held for more than five years. Even at this period his extraordinary eloquence had excited an interest beyond the bounds of the denomination to which he belonged, and when he preached the chapel was generally crowded to excess, the audience including many persons of intellectual tastes. Suspicions in regard to his orthodoxy having in 1789 led to a misunderstanding with his colleague and a part of the congregation, he in July 1790 accepted an invitation to make trial of a congregation at Cambridge, of which he became pastor in July of the following year. From a statement of his opinions contained in a letter to the congregation which he left, it would appear that, while a firm believer in the proper divinity of Christ, he had at this time disowned the cardinal principles of Calvinism—the federal headship of Adam, and the doctrine of absolute election and reprobation; and that he was so far a materialist as to "hold that man's thinking powers and faculties are the result of a certain organization of matter, and that after death he ceases to be conscious till the resurrection." It was during his Cambridge ministry, which extended over a period of fifteen years, that his oratory was most brilliant and most immediately powerful. At Cambridge the intellectual character of a large part of the audience supplied a stimulus which was wanting at Leicester and Bristol.

His first published compositions had a political origin. In 1791 appeared *Christianity consistent with the Love of Freedom*, in which he defended the political conduct of dissenters against the attacks of the Rev. John Clayton, minister of Weighhouse, and gave eloquent expression to his hopes of great political and social ameliorations as destined to result nearly or remotely from the subversion of old ideas and institutions in the maelstrom of the French Revolution. In 1793 he expounded his political sentiments in a powerful and more extended pamphlet entitled an *Apology for the Freedom of the Press*. On account, however, of certain asperities into which the warmth of his feelings had betrayed him, and his conviction that he had treated his subject in too superficial a manner, he refused to permit the publication of the pamphlet beyond the third edition, until the references of political opponents and the circulation of copies without his sanction induced him in 1821 to prepare a new edition, from which he omitted the attack on Bishop Horsley, and to which he prefixed an advertisement stating that his political opinions had undergone no substantial change. His other publications while at Cambridge were three sermons—*On Modern Infidelity* (1801), *Reflections on War* (1802), and *Sentiments proper to the present*

Crisis (1803). He began, however, to suffer from mental derangement in November 1804. He recovered so speedily that he was able to resume his duties in April 1805, but a recurrence of the malady rendered it advisable for him on his second recovery to resign his pastoral office in March 1806.

On leaving Cambridge he paid a visit to his relatives in Leicestershire, and then for some time resided at Enderby, preaching occasionally in some of the neighbouring villages. Latterly he ministered to a small congregation in Harvey Lane, Leicester, from whom at the close of 1806 he accepted a call to be their stated pastor. In the autumn of 1807 he changed his residence from Enderby to Leicester, and in 1808 he married the servant of a brother minister. His proposal of marriage had been made after an almost momentary acquaintance, and, according to the traditional account, in very abrupt and peculiar terms; but, judging from his subsequent domestic life, his choice did sufficient credit to his penetration and sagacity. His writings at Leicester embraced various tracts printed for private circulation; a number of contributions to the *Eclectic Review*, among which may be mentioned his articles on "Foster's Essays" and on "Zeal without Innovation"; several sermons, including those *On the Advantages of Knowledge to the Lower Classes* (1810), *On the Death of the Princess Charlotte* (1817), and *On the Death of Dr Ryland* (1825); and his pamphlet on *Terms of Communion*, in which he advocated intercommunion with all those who acknowledged the "essentials" of Christianity. In 1819 he published an edition in one volume of his sermons formerly printed. On the death of Dr Ryland, Hall was invited to return to the pastorate of Broadmead chapel, Bristol, and as the peace of the congregation at Leicester had been to some degree disturbed by a controversy regarding several cases of discipline, he resolved to accept the invitation, and removed there in April 1826. The malady of renal calculus had for many years rendered his life an almost continual martyrdom, and henceforth increasing infirmities and sufferings afflicted him. Gradually the inability to take proper exercise, by inducing a plethoric habit of body and impeding the circulation, led to a diseased condition of the heart, which resulted in his death on the 21st of February 1831. He is remembered as a great pulpit orator, of a somewhat laboured, rhetorical style in his written works, but of undeniable vigour in his spoken sermons.

See *Works of Robert Hall, A.M., with a Brief Memoir of his Life, by Olinthus Gregory, LL.D., and Observations on his Character as Preacher by John Foster*, originally published in 6 vols. (London, 1832); *Reminiscences of the Rev. Robert Hall, A.M., by John Greene*, (London, 1832); *Biographical Recollections of the Rev. Robert Hall*, by J. W. Morris (1848); *Fifty Sermons of Robert Hall from Notes taken at the time of their Delivery*, by the Rev. Thomas Grinfield, M.A. (1843); *Reminiscences of College Life in Bristol during the Ministry of the Rev. Robert Hall, A.M., by Frederick Trestrail* (1879).

HALL, SAMUEL CARTER (1800-1889), English journalist, was born at Waterford on the 9th of May 1800, the son of an army officer. In 1821 he went to London, and in 1823 became a parliamentary reporter. From 1826 to 1837 he was editor of a great number and variety of public prints, and in 1839 he founded and edited *The Art Journal*. His exposure of the trade in bogus "Old Masters" earned for this publication a considerable reputation. Hall resigned the editorship in 1880, and was granted a Civil List pension "for his long and valuable services to literature and art." He died in London on the 16th of March 1889. His wife, Anna Maria Fielding (1800-1881), became well known as Mrs S. C. Hall, for her numerous novels, sketches of Irish life, and plays. Two of the last, *The Groves of Blarney* and *The French Refugee*, were produced in London with success. She also wrote a number of children's books, and was practically interested in various London charities, several of which she helped to found.

HALL, WILLIAM EDWARD (1835-1894), English writer on international law, was the only child of William Hall, M.D., a descendant of a junior branch of the Halls of Dunglass, and of Charlotte, daughter of William Cotton, F.S.A. He was born on the 22nd of August 1835, at Leatherhead, Surrey, but passed his childhood abroad, Dr Hall having acted as physician to the king of Hanover, and subsequently to the British legation at Naples. Hence, perhaps, the son's taste in after life for art and modern languages. He was educated privately till, at the early age of seventeen, he matriculated at Oxford, where in 1856 he took his degree with a first class in the then recently instituted school of law and history, gaining, three years afterwards, the chancellor's prize for an essay upon "the effect upon Spain of the discovery of the precious

metals in America." In 1861 he was called to the bar at Lincoln's Inn, but devoted his time less to any serious attempt to obtain practice than to the study of Italian art, and to travelling over a great part of Europe, always bringing home admirable water-colour drawings of buildings and scenery. He was an early and enthusiastic member of the Alpine Club, making several first ascents, notably that of the Lyskamm. He was always much interested in military matters, and was under fire, on the Danish side, in the war of 1864. In 1867 he published a pamphlet entitled "A Plan for the Reorganization of the Army," and, many years afterwards, he saw as much as he was permitted to see of the expedition sent for the rescue of Gordon. He would undoubtedly have made his mark in the army, but in later life his ideal, which he realized, with much success, first at Llanfihangel in Monmouthshire, and then at Coker Court in Somersetshire, was, as has been said, "the English country gentleman, with cosmopolitan experiences, encyclopaedic knowledge, and artistic feeling." His travels took him to Lapland, Egypt, South America and India. He had done good work for several government offices, in 1871 as inspector of returns under the Elementary Education Act, in 1877 by reports to the Board of Trade upon Oyster Fisheries, in France as well as in England; and all the time was amassing materials for ambitious undertakings upon the history of civilization, and of the colonies. His title to lasting remembrance rests, however, upon his labours in the realm of international law, recognized by his election as *associé* in 1875, and as *membre* in 1882, of the *Institut de Droit International*. In 1874 he published a thin 8vo upon the *Rights and Duties of Neutrals*, and followed it up in 1880 by his *magnum opus*, the *Treatise on International Law*, unquestionably the best book upon the subject in the English language. It is well planned, free from the rhetorical vagueness which has been the besetting vice of older books of a similar character, full of information, and everywhere bearing traces of the sound judgment and statesmanlike views of its author. In 1894 Hall published a useful monograph upon a little-explored topic, "the Foreign Jurisdictions of the British Crown," but on the 30th of November of the same year, while apparently in the fullest enjoyment of bodily as well as mental vigour, he suddenly died. He married, in 1866, Imogen, daughter of Mr (afterwards Mr Justice) Grove, who died in 1886; and in 1891, Alice, daughter of Colonel Hill of Court Hill, Shropshire, but left no issue.

See T. E. Holland in *Law Quarterly Review*, vol. xi. p. 113; and in *Studies in International Law*, p. 302.

(T. E. H.)

HALL, or BAD-HALL, a market-place and spa of Austria, in Upper Austria, 25 m. S. of Linz by rail. Pop. (1900) 984. It is renowned for its saline springs, strongly impregnated with iodine and bromine, which are considered very efficacious in scrofulous affections and venereal skin diseases. Although the springs are known since the 8th century, Hall attained its actual importance only since 1855, when the springs became the property of the government. The number of visitors in 1901 was 4300.

HALL (generally known as SCHWÄBISCH-HALL, to distinguish it from the small town of Hall in Tirol and Bad-Hall, a health resort in Upper Austria), a town of Germany, in the kingdom of Württemberg, situated in a deep valley on both sides of the Kocher, and on the railway from Heilbronn to Krailsheim, 35 m. N.E. of Stuttgart. Pop. (1905) 9400. It possesses four Evangelical churches (of which the Michaeliskirche dates from the 15th century and has fine medieval carving), a Roman Catholic church, a handsome town hall and classical and modern schools. A short distance south from the town is the royal castle of Komburg, formerly a Benedictine abbey and now used as a garrison for invalid soldiers, with a church dating from the 12th century. The town is chiefly known for its production of salt, which is converted into brine and piped from Wilhelmglück mine, 5 m. distant. Connected with the salt-works there is a salt-bath and whey-diet establishment. The industries of the town also include cotton-spinning, iron founding, tanning, and the manufacture of soap, starch, brushes, machines, carriages and metal ware.

Hall was early of importance on account of its salt-mines, which were held as a fief of the Empire by the so-called Salzgrafen (Salt-graves), of whom the earliest known, the counts of Westheim, had their seat in the castle of Hall. Later the town belonged to the Knights Templars. It was made a free imperial city in 1276 by Rudolph of Habsburg. In 1802 it came into the possession of Württemberg.

HALL (O. E. *heall*, a common Teutonic word, cf. Ger. *Halle*), a term which has two significations in England and is applied sometimes to the manor house, the residence of the lord of the manor, which implied a territorial possession, but more often to the entrance hall of a mansion. In the latter case it was the one large room in the feudal castle up to the middle of the 15th century, when it served as audience chamber, dining-room, and dormitory. The hall was generally a parallelogram on plan, with a raised daïs at the farther end, a large bow window on one side, and in one or two cases on both sides. At the entrance end was a passage, which was separated from the hall by a partition screen often elaborately decorated, and over which was provided a minstrels' gallery; on the opposite side of the passage were the hatches communicating with the serveries. This arrangement is still found in some of the colleges at Oxford and Cambridge, such as those of New College, Christchurch, Wadham and Magdalen, Oxford, and in Trinity College, Cambridge. In private mansions, however, the kitchen and offices have been removed to a greater distance, and the great hall is only used for banquets. Among the more remarkable examples are the halls of Audley End; Hatfield; Brougham Castle; Hardwick; Knole Stanway in Gloucestershire; Wollaton, where it is situated in the centre of the mansion and lighted by clerestory windows; Burton Agnes in Yorkshire; Canons Ashley, Northamptonshire; Westwood Park, Worcestershire; Fountains, Yorkshire; Sydenham House, Devonshire; Cobham, Kent; Montacute, Somersetshire; Bolsover Castle, Derbyshire (vaulted and with two columns in the centre of the hall to carry the vault); Longford Castle, Wiltshire; Barlborough, Derbyshire; Rushton Hall, Northamptonshire, with a bow window at each end of the daïs and a third bow window at the other end; Knole, Kent; and at Mayfield, Sussex (with stone arches across to carry the roof), now converted into a Roman Catholic chapel. Many of these halls have hammer-beam roofs, the most remarkable of which is found in the Middle Temple Hall, London, where both the tie and collar beams have hammer-beams. Of other halls, Westminster is the largest, being 238 ft. long; followed by the Banqueting Hall, Whitehall, 110 ft.; Wolsey's Hall, Hampton Court, 106 ft.; the Egyptian Hall at the Mansion House; the hall at Lambeth, now the library; Crosby Hall; Gray's Inn Hall; the Guildhall; Charterhouse; and the following halls of the London City Companies—Clothworkers, Brewers, Goldsmiths, Fishmongers. The term hall is also given to the following English mansions:—Haddon, Hardwick, Apethorpe, Aston, Blickling, Brereton, Burton Agnes, Cobham, Dingley, Rushton, Kirby, Litford and Wollaton; and it was the name of some of the earlier colleges at Oxford and Cambridge, most of which have now been absorbed in other colleges, so that there remain only St Edmund's Hall, Oxford, and Trinity Hall, Cambridge.

HALLAM, HENRY (1777-1859), English historian, was the only son of John Hallam, canon of Windsor and dean of Bristol, and was born on the 9th of July 1777. He was educated at Eton and Christ Church, Oxford, where he graduated in 1799. Called to the bar, he practised for some years on the Oxford circuit; but his tastes were literary, and when, on the death of his father in 1812, he inherited a small estate in Lincolnshire, he gave himself up wholly to the studies of his life. He had early become connected with the brilliant band of authors and politicians who then led the Whig party, a connexion to which he owed his appointment to the well-paid and easy post of commissioner of stamps; but in practical politics, for which he was by nature unsuited, he took no active share. But he was an active supporter of many popular movements—particularly of that which ended in the abolition of the slave trade; and he was throughout his entire life sincerely and profoundly attached to the political principles of the Whigs, both in their popular and in their aristocratic aspect.

Hallam's earliest literary work was undertaken in connexion with the great organ of the Whig party, the *Edinburgh Review*, where his review of Scott's *Dryden* attracted much notice. His first great work, *The View of the State of Europe during the Middle Ages*, was produced in 1818, and was followed nine years later by the *Constitutional History of England*. In 1838-1839 appeared the *Introduction to the Literature of Europe in the 15th, 16th and 17th Centuries*. These are the three works on which the fame of Hallam rests. They at once took a place in English literature which has never been seriously challenged. A volume of supplemental notes to his *Middle Ages* was published in 1848. These facts and dates represent nearly all the events of Hallam's career. The strongest personal interest in his life was the affliction which befell him in the loss of his children, one after another. His eldest son, Arthur Henry Hallam,—the "A.H.H." of Tennyson's *In Memoriam*, and by the testimony of his contemporaries a man of the most brilliant promise,—died in 1833 at the age of twenty-two. Seventeen years later, his second son, Henry Fitzmaurice Hallam, was cut off like his brother at the very threshold of what might have been a great career.

The premature death and high talents of these young men, and the association of one of them with the most popular poem of the age, have made Hallam's family afflictions better known than any other incidents of his life. He survived wife, daughter and sons by many years. In 1834 Hallam published *The Remains in Prose and Verse of Arthur Henry Hallam, with a Sketch of his Life*. In 1852 a selection of *Literary Essays and Characters* from the *Literature of Europe* was published. Hallam was a fellow of the Royal Society, and a trustee of the British Museum, and enjoyed many other appropriate distinctions. In 1830 he received the gold medal for history, founded by George IV. He died on the 21st of January 1859.

The *Middle Ages* is described by Hallam himself as a series of historical dissertations, a comprehensive survey of the chief circumstances that can interest a philosophical inquirer during the period from the 5th to the 15th century. The work consists of nine long chapters, each of which is a complete treatise in itself. The history of France, of Italy, of Spain, of Germany, and of the Greek and Saracenic empires, sketched in rapid and general terms, is the subject of five separate chapters. Others deal with the great institutional features of medieval society—the development of the feudal system, of the ecclesiastical system, and of the free political system of England. The last chapter sketches the general state of society, the growth of commerce, manners, and literature in the middle ages. The book may be regarded as a general view of early modern history, preparatory to the more detailed treatment of special lines of inquiry carried out in his subsequent works, although Hallam's original intention was to continue the work on the scale on which it had been begun.

The *Constitutional History of England* takes up the subject at the point at which it had been dropped in the *View of the Middle Ages*, viz. the accession of Henry VII.,¹ and carries it down to the accession of George III. Hallam stopped here for a characteristic reason, which it is impossible not to respect and to regret. He was unwilling to excite the prejudices of modern politics which seemed to him to run back through the whole period of the reign of George III. As a matter of fact they ran back much farther, as Hallam soon found. The sensitive impartiality which withheld him from touching perhaps the most interesting period in the history of the constitution did not save him from the charge of partisanship. The *Quarterly Review* for 1828 contains an article on the *Constitutional History*, written by Southey, full of railing and reproach. The work, he says, is the "production of a decided partisan," who "rakes in the ashes of long-forgotten and a thousand times buried slanders, for the means of heaping obloquy on all who supported the established institutions of the country." No accusation made by a critic ever fell so wide of the mark. Absolute justice is the standard which Hallam set himself and maintained. His view of constitutional history was that it should contain only so much of the political and general history of the time as bears directly on specific changes in the organization of the state, including therein judicial as well as ecclesiastical institutions. But while abstaining from irrelevant historical discussions, Hallam dealt with statesmen and policies with the calm and fearless impartiality of a judge. It was his cool treatment of such sanctified names as Charles, Cranmer and Laud that provoked the indignation of Southey and the *Quarterly*, who forgot that the same impartial measure was extended to statesmen on the other side. If Hallam can ever be said to have deviated from perfect fairness, it was in the tacit assumption that the 19th-century theory of the constitution was the right theory in previous centuries, and that those who departed from it on one side or the other were in the wrong. He did unconsciously antedate the constitution, and it is clear from incidental allusions in his last work that he did not regard with favour the democratic changes which he thought to be impending. Hallam, like Macaulay, ultimately referred all political questions to the standard of Whig constitutionalism. But though his work is thus, like that of many historians, coloured by his opinions, this was not the outcome of a conscious purpose, and he was scrupulously conscientious in collecting and weighing his materials. In this he was helped by his legal training, and it was doubtless this fact which made the *Constitutional History* one of the text-books of English politics, to which men of all parties appealed, and which, in spite of all the work of later writers, still leaves it a standard authority.

Like the *Constitutional History*, the *Introduction to the Literature of Europe* continues one of the branches of inquiry which had been opened in the *View of the Middle Ages*. In the first chapter of the *Literature*, which is to a great extent supplementary to the last chapter of the *Middle Ages*, Hallam sketches the state of literature in Europe down to the end of the 14th century: the extinction of ancient learning which followed the fall of the Roman empire and the rise of Christianity; the preservation of the Latin language in the services of the church; and the slow revival of letters, which began to show itself soon after the 7th century—"the *nadir* of the human mind"—had been passed. For the first century and a half of his special period he is mainly occupied with a review of classical learning, and he adopts the plan of taking short decennial periods and noticing the most remarkable works which they produced. The rapid growth of literature in the 16th century compels him to resort to a classification of subjects. Thus in the period 1520-1550 we have separate chapters on ancient literature, theology, speculative philosophy and jurisprudence, the literature of taste, and scientific and miscellaneous literature; and the subdivisions of subjects is carried further of course in the later periods. Thus poetry, the drama and polite literature form the subjects of separate chapters. One inconvenient result of

this arrangement is that the same author is scattered over many chapters, according as his works fall within this category or that period of time. Names like Shakespeare, Grotius, Bacon, Hobbes appear in half a dozen different places. The individuality of great authors is thus dissipated except when it has been preserved by an occasional sacrifice of the arrangement—and this defect, if it is to be esteemed a defect, is increased by the very sparing references to personal history and character with which Hallam was obliged to content himself. His plan excluded biographical history, nor is the work, he tells us, to be regarded as one of reference. It is rigidly an account of the books which would make a complete library of the period,² arranged according to the date of their publication and the nature of their subjects. The history of institutions like universities and academies, and that of great popular movements like the Reformation, are of course noticed in their immediate connexion with literary results; but Hallam had little taste for the spacious generalization which such subjects suggest. The great qualities displayed in this work have been universally acknowledged—conscientiousness, accuracy, judgment and enormous reading. Not the least striking testimony to Hallam’s powers is his mastery over so many diverse forms of intellectual activity. In science and theology, mathematics and poetry, metaphysics and law, he is a competent and always a fair if not a profound critic. The bent of his own mind is manifest in his treatment of pure literature and of political speculation—which seems to be inspired with stronger personal interest and a higher sense of power than other parts of his work display. Not less worthy of notice in a literary history is the good sense by which both his learning and his tastes have been held in control. Probably no writer ever possessed a juster view of the relative importance of men and things. The labour devoted to an investigation is with Hallam no excuse for dwelling on the result, unless that is in itself important. He turns away contemptuously from the mere curiosities of literature, and is never tempted to make a display of trivial erudition. Nor do we find that his interest in special studies leads him to assign them a disproportionate place in his general view of the literature of a period.

Hallam is generally described as a “philosophical historian.” The description is justified not so much by any philosophical quality in his method as by the nature of his subject and his own temper. Hallam is a philosopher to this extent that both in political and in literary history he fixed his attention on results rather than on persons. His conception of history embraced the whole movement of society. Beside that conception the issue of battles and the fate of kings fall into comparative insignificance. “We can trace the pedigree of princes,” he reflects, “fill up the catalogue of towns besieged and provinces desolated, describe even the whole pageantry of coronations and festivals, but we cannot recover the genuine history of mankind.” But, on the other hand, there is no trace in Hallam of anything like a philosophy of history or society. Wise and generally melancholy reflections on human nature and political society are not infrequent in his writings, and they arise naturally and incidentally out of the subject he is discussing. His object is the attainment of truth in matters of fact. Sweeping theories of the movement of society, and broad characterizations of particular periods of history seem to have no attraction for him. The view of mankind on which such generalizations are usually based, taking little account of individual character, was highly distasteful to him. Thus he objects to the use of statistics because they favour that tendency to regard all men as mentally and morally equal which is so unhappily strong in modern times. At the same time Hallam by no means assumes the tone of the mere scholar. He is even solicitous to show that his point of view is that of the cultivated gentleman and not of the specialist of any order. Thus he tells us that Montaigne is the first French author whom an English gentleman is ashamed not to have read. In fact, allusions to the necessary studies of a gentleman meet us constantly, reminding us of the unlikely erudition of the schoolboy in Macaulay. Hallam’s prejudices, so far as he had any, belong to the same character. His criticism is apt to assume a tone of moral censure when he has to deal with certain extremes of human thought—scepticism in philosophy, atheism in religion and democracy in politics.

Hallam’s style is singularly uniform throughout all his writings. It is sincere and straightforward, and obviously innocent of any motive beyond that of clearly expressing the writer’s meaning. In the *Literature of Europe* there are many passages of great imaginative beauty.

(E. R.)

1 Lord Brougham, overlooking the constitutional chapter in the *Middle Ages*, censured Hallam for making an arbitrary beginning at this point, and proposed to write a more complete history himself.

2 Technical subjects like painting or English law have been excluded by Hallam, and history and theology only partially treated.

Constance, was educated at Oxford, and was chancellor of the university from 1403 to 1405. In the latter year the pope nominated him to be archbishop of York, but the king objected. However, in 1407 he was consecrated by Gregory XII. at Siena as bishop of Salisbury. At the council of Pisa in 1409 he was one of the English representatives. On the 6th of June 1411 Pope John XXIII. made Hallam a cardinal, but there was some irregularity, and his title was not recognized. At the council of Constance (*q.v.*), which met in November 1414, Hallam was the chief English envoy. There he at once took a prominent position, as an advocate of the cause of Church reform, and of the superiority of the council to the pope. In the discussions which led up to the deposition of John XXIII. on the 29th of May 1415 he had a leading share. With the trials of John Hus and Jerome of Prague he had less concern. The emperor Sigismund, through whose influence the council had been assembled, was absent during the whole of 1416 on a diplomatic mission in France and England; but when he returned to Constance in January 1417, as the open ally of the English king, Hallam as Henry's trusted representative obtained increased importance. Hallam contrived skilfully to emphasize English prestige by delivering the address of welcome to Sigismund on his formal reception. Afterwards, under his master's direction, he gave the emperor vigorous support in the endeavour to secure a reform of the Church, before the council proceeded to the election of a new pope. This matter was still undecided when Hallam died suddenly, on the 4th of September 1417. After his death the direction of the English nation fell into less skilful hands, with the result that the cardinals were able to secure the immediate election of a new pope (Martin V., elected on the 11th of November). It has been supposed that the abandonment of the reformers by the English was due entirely to Hallam's death; but it is more likely that Henry V., foreseeing the possible need for a change of front, had given Hallam discretionary powers which the bishop's successors used with too little judgment. Hallam himself, who had the confidence of Sigismund and was generally respected for his straightforward independence, might have achieved a better result. Hallam was buried in the cathedral at Constance, where his tomb near the high altar is marked by a brass of English workmanship.

For the acts of the council of Constance see H. von der Hardt's *Concilium Constantiense*, and H. Finke's *Acta concilii Constanciensis*. For a modern account see Mandell Creighton's *History of the Papacy* (6 vols., London, 1897).

(C. L. K.)

HALLÉ, SIR CHARLES (originally KARL HALLE) (1819-1895), English pianist and conductor, German by nationality, was born at Hagen, in Westphalia, on the 11th of April 1819. He studied under Rink at Darmstadt in 1835, and as early as 1836 went to Paris, where for twelve years he lived in constant intercourse with Cherubini, Chopin, Liszt and other musicians, and enjoyed the friendship of such great literary figures as Alfred de Musset and George Sand. He had started a set of chamber concerts with Alard and Franchomme with great success, and had completed one series of them when the revolution of 1848 drove him from Paris, and he settled, with his wife and two children, in London. His pianoforte recitals, given at first from 1850 in his own house, and from 1861 in St James's Hall, were an important feature of London musical life, and it was due in great measure to them that a knowledge of Beethoven's pianoforte sonatas became general in English society. At the Musical Union founded by John Ella, and at the Popular Concerts from their beginning, Hallé was a frequent performer, and from 1853 was director of the Gentlemen's Concerts in Manchester, where, in 1857, he started a series of concerts of his own, raising the orchestra to a pitch of perfection quite unknown at that time in England. In 1888 he married Madame Norman Neruda (b. 1839), the violinist, widow of Ludwig Norman, and daughter of Josef Neruda, members of whose family had long been famous for musical talent. In the same year he was knighted; and in 1890 and 1891 he toured with his wife in Australia and elsewhere. He died at Manchester on the 25th of October 1895. Hallé exercised an important influence in the musical education of England; if his pianoforte-playing, by which he was mainly known to the public in London, seemed remarkable rather for precision than for depth, for crystal clearness rather than for warmth, and for perfect realization of the written text rather than for strong individuality, it was at least of immense value as giving the composer's idea with the utmost fidelity. Those who were privileged to hear him play in private, like those who could appreciate the power, beauty and imaginative warmth of his conducting, would have given a very different verdict; and they were not wrong in judging Hallé to be a man of the widest and keenest artistic sympathies, with an extraordinary gift of insight into music of every school, as well as a strong sense of humour. He fought a long and arduous battle for the best music, and never forgot the dignity of his art. In spite of the fact that his technique was that of his youth, of the period before Liszt, the ease and certainty he attained in the most modern music was not the less wonderful because he concealed the mechanical means so completely.

Lady Hallé, who from 1864 onwards had been one of the leading solo violinists of the time, was constantly associated with her husband on the concert stage till his death; and in 1896 a public subscription was organized in her behalf, under royal patronage. She continued to appear occasionally in public, notably as late as 1907, when she played at the Joachim memorial concert. In 1901 she was given by Queen Alexandra the title of "violinist to the queen." A fine classical player and artist, frequently associated with Joachim, Lady Hallé was the first of the women violinists who could stand comparison with men.

HALLE (known as HALLE-AN-DER-SAALE, to distinguish it from the small town of Halle in Westphalia), a town of Germany, in the Prussian province of Saxony, situated in a sandy plain on the right bank of the Saale, which here divides into several arms, 21 m. N.W. from Leipzig by the railway to Magdeburg. Pop. (1875), 60,503; (1885) 81,982; (1895) 116,304; (1905) 160,031. Owing to its situation at the junction of six important lines of railway, bringing it into direct communication with Berlin, Breslau, Leipzig, Frankfort-on-Main, the Harz country and Hanover, it has greatly developed in size and in commercial and industrial importance. It consists of the old, or inner, town surrounded by promenades, which occupy the site of the former fortifications, and beyond these of two small towns, Glaucha in the south and Neumarkt in the north, and five rapidly increasing suburbs. The inner town is irregularly built and presents a somewhat unattractive appearance, but it has been much improved and modernized by the laying out of new streets.

The centre of the town proper is occupied by the imposing market square, on which stand the fine medieval town hall (restored in 1883) and the handsome Gothic Marienkirche, dating mainly from the 16th century, with two towers connected by a bridge. In the middle of the square are a clock-tower (*Der rote Turm*) 276 ft. in height, and a bronze statue of Handel, the composer, a native of Halle. West of the market-square lies the Halle, or the Tal, where the brine springs (see below) issue. Among the eleven churches, nine Protestant and two Roman Catholic, may also be mentioned the St Moritzkirche, dating from the 12th century, with fine wood carvings and sculptures, and the cathedral (belonging since 1689 to the Reformed or Calvinistic church), built in the 16th century and containing an altar-piece representing Duke Augustus of Saxony and his family. Of secular buildings the most noticeable are the ruins of the castle of Moritzburg, formerly a citadel and the residence of the archbishops of Magdeburg, destroyed by fire in the Thirty Years' War, with the exception of the left wing now used for military purposes, the university buildings, the theatre and the new railway station. The famous university was founded by the elector Frederick III. of Brandenburg (afterwards king of Prussia), in 1694, on behalf of the jurist, Christian Thomasius (1655-1728), whom many students followed to Halle, when he was expelled from Leipzig through the enmity of his fellow professors. It was closed by Napoleon in 1806 and again in 1813, but in 1815 was re-established and augmented by the removal to it of the university of Wittenberg, with which it thus became united. It has faculties of theology, law, medicine and philosophy. From the first it has been recognized as one of the principal seats of Protestant theology, originally of the pietistic and latterly of the rationalistic and critical school. In connexion with the university there are a botanical garden, a theological seminary, anatomical, pathological and physical institutes, hospitals, an agricultural institute—one of the foremost institutions of the kind in Germany—a meteorological institute, an observatory and a library of 180,000 printed volumes and 800 manuscripts. Among other educational establishments must be mentioned the Francke'sche Stiftungen, founded in 1691 by August Hermann Francke (1663-1727), a bronze statue of whom by Rauch was erected in 1829 in the inner court of the building. They embrace an orphanage, a laboratory where medicines are prepared and distributed, a Bible press from which Bibles are issued at a cheap rate, and eight schools of various grades, attended in all by over 3000 pupils. The other principal institutions are the city gymnasium, the provincial lunatic asylum, the prison, the town hospital and infirmary, and the deaf and dumb institute. The salt-springs of Halle have been known from a very early period. Some rise within the town and others on an island in the Saale; and together their annual yield of salt is about 8500 tons.

The workmen employed at the salt-works are of a peculiar race and are known as the *Halloren*. They have been usually regarded as descendants of the original Wendish inhabitants, or as Celtic immigrants, with an admixture of Frankish elements. They wear a distinct dress, the ordinary costume of about 1700, observe several ancient customs, and enjoy certain exemptions and privileges derived from those of the ancient *Pfannerschaft* (community of the salt-panners).

Among the other industries of Halle are sugar refining, machine building, the manufacture of spirits, malt, chocolate, cocoa, confectionery, cement, paper, chicory, lubricating and illuminating oil, wagon grease, carriages and playing cards, printing, dyeing and coal mining (soft brown coal). The trade, which is supervised by a chamber of commerce, is very considerable, the

principal exports being machinery, raw sugar and petroleum. Halle is also noted as the seat of several important publishing firms. The Bibelanstalt (Bible institution) of von Castein is the central authority for the revision of Luther's Bible, of which it sells annually from 60,000 to 70,000 copies.

Halle is first mentioned as a fortress erected on the Saale in 806 by Charles, son of Charlemagne, during his expedition against the Sorbs. The place was, however, known long before, and owes its origin as well as its name to the salt springs (*Halis*). In 968 Halle, with the valuable salt works, was given by the emperor Otto I. to the newly founded archdiocese of Magdeburg, and in 981 Otto II. gave it a charter as a town. The interests of the archbishop were watched over by a *Vogt* (*advocatus*) and a burgrave, and from the first there were separate jurisdictions for the Halloren and the German settlers in the town, the former being under that of the *Salzgraf* (comes salis), the latter of a *Schultheiss* or bailiff, both subordinate to the burgrave. The conflict of interests and jurisdictions led to the usual internecine strife during the middle ages. The panners (*Pfänner*) of the Tal, feudatories or officials, became a close hereditary aristocracy in perpetual rivalry with the gilds in the town; and both resisted the pretensions of the archbishops. At the beginning of the 12th century Halle had attained considerable importance, and in the 13th and 14th centuries as a member of the Hanseatic League it carried on successful wars with the archbishops of Magdeburg; and in 1435 it resisted an army of 30,000 men under the elector of Saxony. Its liberty perished, however, as a result of the internal feud between the democratic gilds and the patrician panners. On the 20th of September 1478 a demagogue and cobbler named Jakob Weissak, a member of the town council, with his confederates opened the gates to the soldiers of the archbishop. The townsmen were subdued, and to hold them in check the archbishop, Ernest of Saxony, built the castle of Moritzburg. Notwithstanding the efforts of the archbishops of Mainz and Magdeburg, the Reformation found an entrance into the city in 1522; and in 1541 a Lutheran superintendent was appointed. After the peace of Westphalia in 1648 the city came into the possession of the house of Brandenburg. In 1806 it was stormed and taken by the French, after which, at the peace of Tilsit, it was united to the new kingdom of Westphalia. After the battle between the Prussians and French, in May 1813, it was taken by the Prussians. The rise of Leipzig was for a long time hurtful to the prosperity of Halle, and its present rapid increase in population and trade is principally due to its position as the centre of a network of railways.

See Dreyhaupt, *Ausführliche Beschreibung des Saalkreises* (Halle, 2 vols., 1755; 3rd edition, 1842-1844); Hoffbauer, *Geschichte der Universität zu Halle* (1806); *Halle in Vorzeit und Gegenwart* (1851); Knauth, *Kurze Geschichte und Beschreibung der Stadt Halle* (3rd ed., 1861); vom Hagen, *Die Stadt Halle* (1866-1867); Hertzberg, *Geschichte der Vereinigung der Universitäten von Wittenberg und Halle* (1867); Voss, *Zur Geschichte der Autonomie der Stadt Halle* (1874); Schrader, *Geschichte der Friedrichs-Universität zu Halle* (Berlin, 1894); Karl Hegel, *Städte und Gilden der germanischen Völker* (Leipzig, 1891), ii. 444-449.

HALLECK, FITZ-GREENE (1790-1867), American poet, was born at Guilford, Connecticut, on the 8th of July 1790. By his mother he was descended from John Eliot, the "Apostle to the Indians." At an early age he became clerk in a store at Guilford, and in 1811 he entered a banking-house in New York. Having made the acquaintance of Joseph Rodman Drake, in 1819 he assisted him under the signature of "Croaker junior" in contributing to the New York *Evening Post* the humorous series of "Croaker Papers." In 1821 he published his longest poem, *Fanny*, a satire on local politics and fashions in the measure of Byron's *Don Juan*. He visited Europe in 1822-1823, and after his return published anonymously in 1827 *Alnwick Castle, with other Poems*. From 1832 to 1841 he was confidential agent of John Jacob Astor, who named him one of the trustees of the Astor library. In 1864 he published in the *New York Ledger* a poem of 300 lines entitled "Young America." He died at Guilford, on the 19th of November 1867. The poems of Halleck are written with great care and finish, and manifest the possession of a fine sense of harmony and of genial and elevated sentiments.

His *Life and Letters*, by James Grant Wilson, appeared in 1869. His *Poetical Writings*, together with extracts from those of Joseph Rodman Drake, were edited by Wilson in the same year.

HALLECK, HENRY WAGER (1815-1872), American general and jurist, was born at Westernville, Oneida county, N.Y., in 1815, entered the West Point military academy at the age of twenty, and on graduating in 1839 was appointed to the engineers, becoming at the same time

assistant professor of engineering at the academy. In the following year he was made an assistant to the Board of Engineers at Washington, from 1841 to 1846 he was employed on the defence works at New York, and in 1845 he was sent by the government to visit the principal military establishments of Europe. After his return, Halleck delivered a course of lectures on the science of war, published in 1846 under the title *Elements of Military Art and Science*. A later edition of this work was widely used as a text-book by volunteer officers during the Civil War. On the outbreak of the Mexican War in 1846, he served with the expedition to California and the Pacific coast, in which he distinguished himself not only as an engineer, but by his skill in civil administration and by his good conduct before the enemy. He served for several years in California as a staff officer, and as secretary of state under the military government, and in 1849 he helped to frame the state constitution of California, on its being admitted into the Union. In 1852 he was appointed inspector and engineer of lighthouses, and in 1853 was employed in the fortification of the Pacific coast. In 1854 Captain Halleck resigned his commission and took up the practice of law with great success. He was also director of a quicksilver mine, and in 1855 he became president of the Pacific & Atlantic railway. On the outbreak of the Civil War he returned to the army as a major-general, and in November 1861 he was charged with the supreme command in the western theatre of war. There can be no question that his administrative skill was mainly instrumental in bringing order out of chaos in the hurried formation of large volunteer armies in 1861, but the strategical and tactical successes of the following spring were due rather to the skill and activity of his subordinate generals Grant, Buell and Pope, than to the plans of the supreme commander, and when he assumed command of the united forces of these three generals before Corinth, the methodical slowness of his advance aroused much criticism. In July, however, he was called to Washington as general-in-chief of the armies. At headquarters his administrative powers were conspicuous, but he proved to be utterly wanting in any large grasp of the military problem; the successive reverses of Generals McClellan, Pope, Burnside and Hooker in Virginia were not infrequently traceable to the defects of the general-in-chief. No co-ordination of the military efforts of the Union was seriously undertaken by Halleck, and eventually in March 1864 Grant was appointed to replace him, Major-General Halleck becoming chief of staff at Washington. This post he occupied with credit until the end of the war. In April 1865 he held the command of the military division of the James and in August of the same year of the military division of the Pacific, which he retained till June 1869, when he was transferred to that of the South, a position he held till his death at Louisville, Ky., on the 9th of January 1872. Halleck's position as a soldier is easily defined by his uniform success as an administrative official, his equally uniform want of success as an officer at the head of large armies in the field, and the popularity of his theoretical writings on war. His influence, for good or evil, on the course of the greatest war of modern times was greater than that of any soldier on either side save Grant and Lee, and whilst his interference with the dispositions of the commanders in the field was often disastrous, his services in organizing and instructing the Union forces were always of the highest value, and in this respect he was indispensable.

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Besides *Military Art and Science*, Halleck wrote *Bitumen, its Varieties, Properties and Uses* (1841); *The Mining Laws of Spain and Mexico* (1859); *International Law* (1861; new edition, 1908); and *Treatise on International Law and the Laws of War, prepared for the use of Schools and Colleges*, abridged from the larger work. He translated Jomini's *Vie politique et militaire de Napoléon* (1864) and de Fozz *On the Law of Mines* (1860). The works on international law mentioned above entitle General Halleck to be considered as one of the great jurists of the 19th century.

HÄLLEFLINTA (a Swedish word meaning rock-flint), a white, grey, yellow, greenish or pink, fine-grained rock consisting of an intimate mixture of quartz and felspar. Many examples are banded or striated; others contain porphyritic crystals of quartz which resemble those of the felsites and porphyries. Mica, iron oxides, apatite, zircon, epidote and hornblende may also be present in small amount. The more micaceous varieties form transitions to granulite and gneiss. Hälleflinta under the microscope is very finely crystalline, or even cryptocrystalline, resembling the felsitic matrix of many acid rocks. It is essentially metamorphic and occurs with gneisses, schists and granulites, especially in the Scandinavian peninsula, where it is regarded as being very characteristic of certain horizons. Of its original nature there is some doubt, but its chemical composition and the occasional presence of porphyritic crystals indicate that it has affinities to the fine-grained acid intrusive rocks. In this group there may also have been placed metamorphosed acid tuffs and a certain number of adinoles (shales, contact altered by intrusions of diabase). The assemblage is not a perfectly homogeneous one but includes both igneous and sedimentary rocks, but the former preponderate. Rocks very similar to the typical Swedish hälleflintas occur in Tirol, in Galicia and eastern Bohemia.

HALLEL (Heb. הללה a Mishnic derivative from הללה hillēl, “to praise”), a term in synagogal liturgy for (a) Psalms cxiii.-cxviii., often called “the Egyptian Hallel” because of its recitation during the paschal meal on the night of the Passover, (b) Psalm cxxxvi. “the Great Hallel.” C. A. Briggs¹ points out that the term “Hallelujah” (Praise ye Yah) is found at the close of Pss. civ., cv., cxv., cxvi., cxvii., at the beginning of Pss. cxi., cxii. and at both ends of Pss. cvi., cxiii., cxxxv., cxlvi. to cl. The Septuagint also gives it at the beginning of Pss. cv., cvii., cxiv., cxvi. to cxix., cxxxvi. There are thus four groups of Hallel psalms:—civ.-cvii. (a tetralogy on creation, the patriarchal age, the Exodus, and the Restoration); cxi.-cxvii. which includes most of the “Egyptian Hallel”; cxxxv.-cxxxvi.; cxlvi.-cl. All of these Hallels (except cxlvii. and cxlix. which are Maccabean) belong to the Greek period, forming a collection of sixteen psalms composed for public use by the choirs, especially at the great feasts. Their distribution into four groups was the work of the final editor of the psalter. Later liturgical use regarded Pss. cxviii. and even cxix. as Hallels, as well as Pss. cxx. to cxxxiv.

It will be observed that the extent of the official Hallel varied from time to time. It would appear that in the time of Gamaliel (*Pesahim* x. 5) the custom of its recitation at the paschal meal was still of recent innovation. While the school of Shammai advised only Ps. cxiii., the school of Hillel favoured Pss. cxiii. and cxiv.² The further extension so as to include Pss. cxv. to cxviii. probably dates from the first half of the 2nd century A.D., and these four psalms were recited after the pouring out of the fourth cup, the two earlier ones being taken at the beginning of the meal. From the 3rd century the use of the Hallel was extended to other occasions, and was gradually incorporated into the liturgy of eighteen festal days.

The “Great Hallel” (Ps. cxxxvi. and its later extension to cxx.-cxxxvi.) always served the wider purpose of a more general thanksgiving. According to Rabbi Johanan it derived its name from the allusion in v. 25 to the Holy One who sits in heaven and thence distributes food to all his creatures.

1 *International Critical Commentary*, “Psalms,” Intro. lxxviii.

2 The reference to a hymn at the institution of the Eucharist (Matt. xxvi. 30, Mark xiv. 26) must be interpreted in the light of this inceptive stage of the Hallel.

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