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THE ENCYCLOPÆDIA BRITANNICA

A DICTIONARY OF ARTS, SCIENCES, LITERATURE AND GENERAL INFORMATION

ELEVENTH EDITION

VOLUME XIV SLICE VI

Inscriptions to Ireland, William Henry

Articles in This Slice

INSCRIPTIONS (from Lat. *inscribere*, to write upon), the general term for writings cut on stone or metal, the subject matter of epigraphy. See generally WRITING and PALAEOGRAPHY. Under

this heading it is convenient here to deal more specifically with four groups of ancient inscriptions, Semitic, Indian, Greek and Latin, but further information will be found in numerous separate articles on philological subjects. See especially Cuneiform, Babylonia and Assyria, Sumer, Behistun, Egypt (*Language and Writing*), Ethiopia, Phoenicia, Arabia, Hittites, Sabaeans, Minaeans, Etruria, Aegean Civilization, Crete, Cyprus, Britain, Scandinavian Languages, Teutonic Languages, Central America: *Archaeology*, &c.

I. Semitic Inscriptions

Excluding cuneiform (*q.v.*), the inscriptions known as Semitic are usually classed under two main heads as North and South Semitic. The former class includes Hebrew (with Moabite), Phoenician (with Punic and neo-Punic), and Aramaic (with Nabataean and Palmyrene). The South Semitic class includes the Minaean and Sabaean inscriptions of South Arabia. In most of these departments there has been a very large increase of material during recent years, some of which is of the highest historical and palaeographical importance. The North Semitic monuments have received the greater share of attention because of their more general interest in connexion with the history of surrounding countries.

1. *North Semitic.*—The earliest authority for any North Semitic *language* is that of the Tel-el-Amarna tablets (15th century B.C.) which contain certain "Canaanite glosses,"[1] *i.e.* North Semitic words written in cuneiform characters. From these to the first inscription found in the North Semitic *alphabet*, there is an interval of about six centuries. The stele of Mesha, commonly called the Moabite Stone, was set up in the 9th century B.C. to commemorate the success of Moab in shaking off the Israelitish rule. It is of great value, both historically as relating to events indicated in 2 Kings i. 1, iii. 5, &c., and linguistically as exhibiting a language almost identical with Hebrew—that is to say, another form of the same Canaanitish language. It was discovered in 1868 by the German missionary, Klein, on the site of Dibon, intact, but was afterwards broken up by the Arabs. The fragments,[2] collected with great difficulty by Clermont-Ganneau and others, are now in the Louvre. Its genuineness was contested by A. Löwy (*Scottish Review*, 1887; republished, Berlin, 1903) and recently again by G. Jahn (appendix to *Das Buch Daniel*, Leipzig, 1904), but, although there are many difficulties connected with the text, its authenticity is generally admitted.

Early Hebrew inscriptions are at present few and meagre, although it cannot be doubted that others would be found by excavating suitable sites. The most important is that discovered in 1880 in the tunnel of the pool of Siloam, commemorating the piercing of the rock. It is generally believed to refer to Hezekiah's scheme for supplying Jerusalem with water (2 Kings xx. 20), and therefore to date from about 700 B.C. It consists of six lines in good Hebrew, and is the only early Hebrew inscription of any length. The character does not differ from that of the Moabite Stone, except in the slightly cursive tendency of its curved strokes, due no doubt to their having been traced for the stone-cutter by a scribe who was used to writing on parchment. There are also a few inscribed seals dating from before the Exile, some factory marks and an engraved capital at al-Amwās, which last may, however, be Samaritan. Otherwise this character is only found (as the result of an archaizing tendency) on coins of the Hasmoneans, and, still later, on those of the first and second (Bar Kokhba's) revolts.

The new Hebrew character, which developed into the modern square character, is first found in a name of five letters at 'Arāq-al-amīr, of the 2nd century B.C. Somewhat later, but probably of the 1st century B.C., is the tombstone of the B'nē Ḥeẓīr ("Tomb of St James") at Jerusalem. An inscription on a ruined synagogue at Kafr Bir'im, near Ṣafed, perhaps of about A.D. 300, or earlier, shows the fully developed square character.

Since the publication of the *Corpus Inscr. Sem.* it has been customary to treat papyri along with inscriptions, and for palaeographical reasons it is convenient to do so. Hebrew papyri are few, all in square character and not of great interest. The longest, and probably the earliest (6th century A.D.), is one now in the Bodleian Library at Oxford, containing a private letter[3] written in a character closely resembling that of the Kair Bir'im inscription. Other fragments were published by Steinschneider[4] (perhaps 8th century), and by D. H. Müller and Kaufmann.[5]

Hebrew inscriptions outside Palestine are the cursive graffiti in the catacombs at Venosa (2nd-5th century), the magical texts on Babylonian bowls (7th-8th century), and the numerous tombstones[6] in various parts of Europe, of all periods from the 6th century to the present time.

The few Samaritan inscriptions in existence are neither early nor interesting.

Closely related to the Hebrews, both politically and in language, were the Phoenicians in North Syria. Their monuments in Phoenicia itself are few and not earlier than the Persian period. The oldest yet found, dating probably from the 5th or 4th century B.C., is that of Yeḥaw-milk, king of Gebal (modern Jebel) or Byblus, where it was found. It records at some length the dedication of buildings, &c., to the goddess of Gebal. Of the 3rd century B.C. are the inscriptions on the

sarcophagi of Tabnith and his son Eshmun'azar, kings of Sidon, and some records of other members of the same family, Bod-'ashtart and his son Yathan-milk, found in 1902 a short distance north of Sidon.

Outside Phoenicia the inscriptions are numerous and widely scattered round the Mediterranean coasts, following the course of Phoenician trade. The earliest is that on some fragments of three bronze bowls, dedicated to Baal of Lebanon, found in Cyprus. The character is like that of the Moabite Stone, and the date is probably the 8th century B.C., though some scholars would put it nearer to 1000 B.C. In the latter case, the Hiram, king of Sidon, mentioned in the inscriptions would be the same as Hiram, king of Tyre, in Solomon's time. Similar bowls (of about 700 B.C.) found at Nimrud sometimes bear the maker's name in Phoenician characters.

Many monumental inscriptions have also been found in Cyprus, at Kition, Idalion, Tamassos, &c. They are chiefly votive, some dated in the 4th century, and some being perhaps as late as the 2nd century B.C., so that they afford valuable evidence as to the succession of the local kings. Several also are bilingual, and it was one of these which supplied George Smith with the clue to the Cypriote syllabic system of writing Greek. Similar memorials of Phoenician settlements were found at Athens (Piraeus), in Egypt, Sardinia, Malta and Gozo. Most interesting of all is the celebrated sacrificial tablet of Marseilles, giving an elaborate tariff of payments at or for the various offerings, and showing some striking analogies with the directions in the book of Leviticus. For the information it gives as to civil and priestly organization, it is the most important Phoenician text in existence. It was probably brought from Carthage, where similar tariffs have been found. On the site of that important colony, and indeed throughout the parts of North Africa once subject to its rule, Punic inscriptions are, as might be expected, very numerous. By far the majority are votive tablets, probably belonging to the period between the 4th and the 2nd centuries B.C., many of them in a wonderfully perfect state of preservation. One of the most interesting, recently discovered, mentions a high-priestess who was head of the college of priests, and whose husband's family had been *suffetes* for four generations. Later inscriptions, called neo-Punic, dating from the fall of Carthage to about the 1st century A.D., are written in a debased character and language differing in several respects from the earlier Punic, and presenting many difficulties.

In Aramaic the earliest inscriptions are three found in 1890-1891 at and near Zinjīrlī in North-west Syria, dating from the 8th century B.C. Of these, one was set up by Panammū, king of Ya'dī, in honour of the god Hadad, and is inscribed on a statue of him, the other two were set up by Bar-rekub, son of Panammū, one in honour of his father and on his statue, the second commemorating the erection of his new house. They are remarkable as being engraved in relief, a peculiarity which has been thought to be due to "Hittite" influence. Otherwise the character resembles that of the Moabite Stone. The texts consist of 77 lines (not all legible), giving a good deal of information about an obscure place and period hitherto known only from cuneiform sources. The ornamentation is Assyrian in style, as also is that of the inscriptions of Nerab (near Aleppo), commemorative texts engraved on statues of priests, of about the 7th century.

Of shorter inscriptions there is a long series from about the 8th century B.C., on bronze weights found at Nineveh (generally accompanied by an Assyrian version), and as "dockets"[7] to cuneiform contract-tablets, giving a brief indication of the contents. Aramaic, being the commercial language of the East, was naturally used for this purpose in business documents. For the same reason it is found in the 6th-4th centuries B.C. sporadically in various regions, as in Cilicia, in Lycia[8] (with a Greek version), at Abydos (on a weight). At Taimā also, in North Arabia, an important trading centre, besides shorter texts, a very interesting inscription of twenty-three lines was found, recording the foundation and endowment of a new temple, probably in the 5th century B.C. But by far the most extensive collection of early Aramaic texts comes from Egypt, where the language was used not only for trade purposes, as elsewhere, but also officially under the Persian rule. From Memphis there is a funeral inscription dated in the fourth year of Xerxes (482 B.C.), and a dedication on a bowl of about the same date. A stele recently published by de Vogüé[9] is dated 458 B.C. Another which is now at Carpentras in France (place of origin unknown) is probably not much later. At Elephantine and Assuān in Upper Egypt, a number of ostraka have been dug up, dating from the 5th century B.C. and onward, all difficult to read and explain, but interesting for the popular character of their contents, style and writing. There was a Jewish (or Israelitish[10]) settlement there in the 5th century from which emanated most, if not all, of the papyrus documents edited in the *C.I.S.* Since the appearance of this part of the *Corpus*, more papyri have come to light. One published by Euting[11] is dated 411 B.C. and is of historical interest, eleven others,[12] containing legal documents, mostly dated, were written between 471 and 411 B.C.; another (408 B.C.) is a petition to the governor of Jerusalem.[13] The fragments in the *C.I.S.* are in the same character and clearly belong to the same period. The language continued to be used in Egypt even in Ptolemaic times, as shown by a papyrus[14] (accounts) and ostrakon[15] containing Greek names, and belonging, to judge from the style of the writing, to the 3rd century B.C. The latest fragments[16] are of the 6th-8th century A.D., written in a fully developed square character. They are Jewish private letters, and do not prove anything as to the use of Aramaic in

Egypt at that time.

Nabataean inscriptions are very numerous. They are written in a peculiar, somewhat cursive character, derived from the square, and date from the 2nd century B.C. The earliest *dated* is of the year 40 B.C., the latest dated is of A.D. 95. The Nabataean kingdom proper had its centre at Petra (= Sela in 2 Kings xiv. 7), which attained great importance as the emporium on the trade route between Arabia and the Persian Gulf on the one side and Syria and Egypt on the other. The commercial activity of the people, however, was widely extended, and their monuments are found not only round Petra and in N. Arabia, but as far north as Damascus, and even in Italy, where there was a trading settlement at Puteoli. The inscriptions are mostly votive or sepulchral, and are often dated, but give little historical information except in so far as they fix the dates of Nabataean kings.

A distinct subdivision of Nabataean is found in the Sinaitic peninsula, chiefly in the Wādī Firān and Wādī Mukattib, which lay on the caravan route. The inscriptions are rudely scratched or punched on the rough rock, without any sort of order, and some of them are accompanied by rude drawings. A few only are dated, but, as shown by de Vogüé in the *C.I.S.* (ii. 1, p. 353), they must all belong to the 2nd and 3rd centuries A.D. This accounts for the fact that already in the 6th century Cosmas Indicopleustes[17] has no correct account of their origin, and ascribes them to the Israelites during their wanderings in the wilderness.[18] They were first correctly deciphered as Nabataean by Beer in 1848, when they proved to consist chiefly of proper names (many of them of Arabic formation), accompanied by ejaculations or blessings. It is clear that they are not the work of pilgrims either Jewish or Christian,[19] nor are they of a religious character. The frequent recurrence of certain names shows that only a few generations of a few families are represented, and these must have belonged to a small body of Nabataeans temporarily settled in the particular Wādīs, no doubt for purposes connected with the caravan-traffic. The form of the Nabataean character in which they are written is interesting as being the probable progenitor of the Kufic Arabic alphabet.

Another important trading centre was Tadmor or Palmyra in northern Syria. Numerous inscriptions found there, and hence called Palmyrene, were copied by Waddington in 1861 and published by de Vogüé in his great work *Syrie Centrale* (1868, &c.), which is still the most extensive collection of them. The difficulties of exploration have hitherto prevented any further increase of the material, but much more would undoubtedly be found if excavation were possible. The texts are mostly sepulchral and dedicatory, some of them being accompanied by a Greek version. The language is a form of western Aramaic, and the character, which is derived from the Hebrew and Aramaic square, is closely related to the Syriac estrangelo alphabet. The inscriptions are mostly dated, and belong to the period between 9 B.C. and A.D. 271. The most important is the tariff of taxes on imports, dated A.D. 137. Nearly all were found on the surface at or round Palmyra and remain *in situ*. Of the very few in other places, one (with a Latin version) was found at South Shields, the tombstone of *Regina liberta et conjux* of a native of Palmyra.

Syriac inscriptions are few. The earliest is that on the sarcophagus of Queen Ṣaddan (in the Hebrew version, Ṣadda), perhaps of about A.D. 40, found at Jerusalem. Others were found by Sachau[20] at Edessa, of the 2nd and 3rd centuries, and by Pognon.[21]

2. *South Semitic.*—The South Semitic class of inscriptions comprises the Minaean, Sabaean, Himyaritic and Liḥyanitic in South Arabia, the Thamudic and Safaitic in the north and the Abyssinian. A great deal of material has been collected by Halévy, Glaser and Euting, and much valuable work has been done by them and by D. H. Müller, Hommel and Littmann. Many of the texts, however, are still unpublished and the rest is not very accessible (except so far as it has appeared in the *C.I.S.*), so that South Semitic has been less widely studied than North Semitic.

The successive kingdoms of South Arabia (Yemen) were essentially commercial. Their country was the natural intermediary between Asia (India), Africa and Syria, and this position, combined with its natural fertility, made the south far more prosperous than the north. In language, the two most important peoples, the Minaeans and Sabaeans, differ only dialectically, both writing forms of southern Arabic. The Minaean capital was at Ma'īn, about 300 m. N. of Aden and 200 m. from the west coast. Here and in the neighbourhood numerous inscriptions were found, as well as in the north at al-'Öla.[22] Their chronology is much disputed. D. H. Müller makes the Minaean power contemporary with the Sabaean, but Glaser (with whom Hommel and D. S. Margoliouth agree) contends that the Sabaeans followed the Minaeans, whom they conquered in 820 B.C. Mention is made in a cuneiform text (Annals of Sargon, 715 B.C.) of Ithamar the Sabaean, who must be identical with one (it is not certain which) of the kings of that name mentioned in the Sabaean inscriptions. Their capital was Marib, a little south of Ma'īn, and here they appear to have flourished for about a thousand years. In the 1st century A.D., with the establishment of the Roman power in the north, their trade, and consequently their prosperity, began to decline. The rival kingdom of the Himyarites, with its capital at Zafar, then rose to importance, and this in turn was conquered by the Abyssinians in the 6th century A.D. With the spread of Islām the old Arabic language was supplanted by the northern dialects from which

classical Arabic was developed. A peculiarity of the South Arabian inscriptions is that many of them are engraved on bronze tablets. Besides being historically important, they are of great value for the study of early Semitic religion. The gods most often named in Sabaean are ʻAthtār Wadd and Nakraḥ, the first being the male counterpart of the Syrian Ashtoreth. The term denoting the priests and priestesses who are devoted to the temple-service is identified by Hommel and others with the Hebrew "Levite."

Closely connected with South Arabia is Abyssinia. Indeed a considerable number of Sabaean inscriptions have been found at Yeha and Aksum, showing that merchants from Arabia must at some time have formed settlements there. D. H. Müller[23] thinks that some of these belong to the earliest and others to the latest period of Sabaean power. The inscriptions hitherto found in Ethiopic (the alphabet of which is derived from the Sabaean) date from the 4th century A.D. onward. They are few in number, but long and of great historical importance. There can be no doubt that exploration, if it were possible, would bring many more to light.

From time to time emigrants from the southern tribes settled in the north of Arabia. Mention has already been made of Minaean inscriptions found at al-'Öla, which is on the great pilgrim road, about 70 m. south of Taimā. In recent years a number of others has been collected belonging to the people of Liḥyān and dating from about A.D. 250. Nearly related to the Liḥyānitic are the Thamudic (so called from the tribe of the Thamūd mentioned in them), and the Safaitic, both of which, though found in the north, belong in character to south Arabia and no doubt owe their origin to emigrants from the south. The Thamudic inscriptions, collected by Euting (called Proto-Arabian by Halévy),[24] are carelessly scrawled graffiti very like those of the Sinai peninsula. Their date is uncertain, but they cannot be much earlier than the Safaitic, which resemble them in most respects. These last are called after the mountainous district about 20 m. S.E. of Damascus. The inscriptions are, however, found not in Mount Ṣafā itself but in the desert of al-Ḥarrah to the west and south and in the fertile plain of ar-Ruḥbah to the east. They were first deciphered by Halévy,[25] whose work has been carried on and completed by Littmann.[26] Their date is again uncertain, since graffiti of this kind give very few facts from which dates can be deduced. Littmann thinks that one of his inscriptions refers to Trajan's campaign of A.D. 106, and that they all belong to the first three centuries. They are found together with the earlier Greek and Latin graffiti of Roman soldiers and with later Moslem remarks in Kufic. Many of them are not yet published.

Bibliography—The best introductions are, for North Semitic, Lidzbarski's *Handbuch d. nordsemitischen Epigraphik* (Weimar, 1898); and G. A. Cooke's *Text-book of North-Semitic Inscriptions* (Oxford, 1903); for South Semitic, Hommel's *Süd-arabische Chrestomathie* (Munich, 1893); Alphabets and facsimiles in Berger, *Histoire de l'écriture*, 2nd ed. (Paris, 1892). The parts of the *Corpus Inscr. Sem.* published up to 1910 are: pars i., tom. i., and tom. ii., fascc. 1-3, 1881-1908 (Phoenician); pars ii., tom. i., 1889-1902 (Aramaic with Nabataean), tom. ii., fasc. i., 1907 (Sinaitic); pars iv., tom. i., fascc. 1-4, 1889-1908 (Himyaritic, including Minaean and Sabaean). In all these parts a full bibliography is given. For Palmyrene see de Vogüé's *Syrie Centrale* (Paris, 1868-1877). Works on special departments of the subject have already been mentioned in the notes.

(A. Cy.)

II. Indian Inscriptions

Materials on which the inscriptions were recorded.

The inscriptions of India are extremely numerous, and are found, on stone and other substances, in a great variety of circumstances. They were mostly recorded by incision. But we have a few, referable to the 2nd or 3rd century B.C., which were written with ink on earthenware, and some others, of later times, recorded by paint,—one on a rock, the others on the walls of Buddhist cave-temples. Those, however, were exceptional methods; and equally so was the process of casting, with the result of bringing the letters out in relief, of which we know at present only one instance,—the Sōhgaurā plate, mentioned again below. The Mussulman inscriptions on stone were, it is believed, nearly always carved in relief; and various Hindu inscriptions were done in the same way in the Mussulman period: but only one instance of a stone record prepared in that manner can as yet be cited for the earlier period; it is an inscription on the pedestal of an image of Buddha, of the Gupta period, found in excavations made not long ago at Sārnāth.

Amongst the inscriptions on metal there is one that stands out by itself, in respect of the peculiarity of having been incised on iron: it is the short poem, constituting the epitaph of the Gupta king Chandragupta II., which was composed in or about A.D. 415, and was placed on record on the iron column, measuring 23 ft. 8 in. in height, and estimated to weigh more than six tons, which stands at Meharaulī near Delhi. We have a very small number of short Buddhist votive inscriptions on gold and silver, a larger number of records of various kinds on brass, and a larger number still on bronze. The last-mentioned consist chiefly of seals and stamps for making

seals. And one of these seal-stamps, belonging to about the commencement of the Christian era, is of particular interest in presenting its legend in Greek characters as well as in the two Indian alphabets which were then in use. For the period, indeed, to which it belongs, there is nothing peculiar in the use of the Greek characters; those characters were freely used on the coins of India and adjacent territories, sometimes along with the native characters, sometimes alone, from about 325 B.C. to the first quarter of the 2nd century A.D.: but this seal-stamp, and the coins of the Kshaharāta king Nahapāna (A.D. 78 to about 125), furnish the only citable good instances of the use of the three alphabets all together. For the most part, however, the known inscriptions on metal were placed on sheets of copper, ranging in size from about 2½ in. by 1⅞ in. in the case of the Sōhgaurā plate to as much as about 2 ft. 6 in. square in the case of a record of 46 B.C. obtained at Suē-Vihār in the neighbourhood of Bahāwalpūr in the Punjab. Some of these records on copper were commemorative and dedicatory, and were deposited inside the erections—relic-mounds, and, in the case of the Suē-Vihār plate, a tower—to which they belonged. The usual copper record, however, was a donative charter, in fact a title-deed, and passed as soon as it was issued into private personal custody; and many of the known records of this class have come to notice through being produced by the modern possessors of them before official authorities, in the expectation of establishing privileges which (it is hardly necessary to say) have long since ceased to exist through the lapse of time, the dying out of families of original holders, rights of conquest, and the many changes of government that have taken place: but others have been found buried in fields, and hidden in the walls and foundations of buildings. The plates on which these inscriptions were incised vary greatly in the number of the leaves, in the size and shape of them, and in the arrangement of the records on them; partly, of course, according to the lengths of individual records, but also according to particular customs and fashions prevalent in different parts of the country and in different periods of time. In some cases a single plate was used; and it was inscribed sometimes on only one side of it, sometimes on both. More often, however, more plates than one were used, and were connected together by soldered rings; and the number ranges up to as many as thirty-one in the case of a charter issued by the Chōḷa king Rājēndra Chōḷa I. in the period A.D. 1011 to 1037. It was customary that such of the records on copper as were donative charters should be authenticated. This was sometimes done by incising on the plates what purports to be more or less an autograph signature of the king or prince from whom a charter emanated. More usually, however, it was effected by attaching a copper or bronze reproduction of the royal seal to the ring or to one of the rings on which the plates were strung; and this practice has given us another large and highly interesting series of Indian seals, some of them of an extremely elaborate nature. In this class of records we have a real curiosity in a charter issued in A.D. 1272 by Rāmachandra, one of the Yādava kings of Dēvagiri: this record is on three plates, each measuring about 1 ft. 3 in. in width by 1 ft. 8½ in. in height, which are so massive as to weigh 59 lb. 2 oz.; and the weight of the ring on which they were strung, and of an image of Garuḍa which was secured to it by another ring, is 11 lb. 12 oz.: thus, the total weight of this title-deed, which conveyed a village to fifty-seven Brāhmaṇs, is no less than 70 lb. 14 oz.; appreciably more than half a hundredweight.

Amongst substances other than metal we can cite only one instance in which crystal was used; this material was evidently found too hard for any general use in the inscriptional line: the solitary instance is the case of a short record found in the remains of a Buddhist stūpa or relic-mound at Bhaṭṭiprōlu in the Kistna district, Madras. In various parts of India there are found in large numbers small tablets of clay prepared from stamps, sometimes baked into terra-cotta, sometimes left to harden naturally. Objects of this class were largely used as votive tablets, especially by the Buddhists; and their tablets usually present the so-called Buddhist formula or creed: “Of those conditions which spring from a cause, Tathāgata (Buddha) has declared the cause and the suppression of them; it is of such matters that he, the great ascetic, discourses”: but others, from Sunet in the Ludhiāna district, Punjab, show by the legends on them that the Śaivas and Vaishṇavas also habitually made pious offerings of this kind on occasions of visiting sacred places. Recent explorations, however, in the Gōrakhpūr and Muzaffarpūr districts have resulted in the discovery, in this class of records, of great numbers of clay seals bearing various inscriptions, which had been attached to documents sent to and fro between administrative offices, both royal and municipal, between religious establishments, and between private individuals: and amongst these we have seals of the monastery at Kusinārā, one of the places at which the eight original portions of the corporeal relics of Buddha were enshrined in relic-mounds, and also a seal-stamp used for making seals of the monastery at Veṭhadīpa, another of those places. And from Kāṭhiawār we have a similar seal-stamp which describes itself as the property “of the prince and commander-in-chief Pushyēṇa, son of the illustrious prince Ahivarman, whose royal pedigree extends back unbroken to Jayadratha.” There are no indications that the use of brick for inscriptional purposes was ever at all general in India, as it was in some other eastern lands: but there have been found in the Ghāzīpūr district numerous bricks bearing the inscription “the glorious Kumāragupta,” with reference to either the first or the second Gupta king of that name, of the 5th century A.D.; in the Gōrakhpūr district there have been found brick tablets bearing Buddhist texts, one of which is a version in Sanskṛit of a short sermon preached by Buddha; and from the Jaunpūr district we have a brick tablet bearing an

inscription which registers a mortgage, made in A.D. 1217, of some lands as security for a loan. Inscribed earthenware relic-receptacles have been found in the Bhōpāl state: donative earthenware jars, bearing inscriptions, have been obtained near Chārsadda in the North-West Frontier province: and from Kāṭhiāwār we have a piece of earthenware, apparently a fragment of a huge pot, bearing an inscription which presents a date in A.D. 566-67 and the name of "the glorious Guhasēna," one of the Maitraka princes of Valabhī. For the great bulk of the inscriptions, however, stone was used: but limitation of space prevents us from entering into any details here, and only permits us to say that in this class the records are found all over India on rocks, on isolated monolith columns and pillars, of which some were erected simply to bear the records that were published on them, others were placed in front of temples as flagstaffs of the gods, and others were set up as pillars of victory in battle; on relic-receptacles hidden away in the interiors of Buddhist stūpas; on external structural parts of stūpas; on façades, walls, and other parts of caves; on pedestals and other parts of images and statues, sometimes of colossal size; on moulds for making seals; on walls, beams, pillars, pilasters, and other parts of temples; and on specially prepared slabs and tablets, sometimes built into the walls of temples and other erections, sometimes set up inside temples or in the courtyards of them, or in conspicuous places in village-sites and fields, where they have occasionally in the course of time become buried.

The inscriptional records of India which have thus come down to us do not, as far as they are known at present, pretend to the antiquity of the Greek inscriptions of the Hellenic world; much less to that of the inscriptions of Egypt and Assyria. But they are no less important; since we are dependent on them for almost all our knowledge of the ancient history of the country.

Reasons why the inscriptions are so valuable.

The primary reason for this is that the ancient Hindus, though by no means altogether destitute of the historical instinct, were not writers of historical books. In some of the *Purāṇas*, indeed, they have given us chapters which purport to present the succession of their kings from the commencement of the present age, the Kaliyuga, in 3102 B.C.: but the chronological details of those chapters disclose the fault of treating contemporaneous dynasties, belonging to different parts of India, as successive dynasties ruling over one and the same territory; with the result that they would place more than three centuries in the future from the present time the great Gupta kings who reigned in Northern India from A.D. 320 to about 530. They have given us, for Kashmīr the *Rājataraṃgiṇī*, the first eight cantos of which, written by Kalhaṇa in A.D. 1148-49, purport to present the general history of that country, with occasional items relating to India itself, from 2448 B.C., and to give the exact length, even to months and days, of the reign of each king of Kashmīr from 1182 B.C.: but, while we may accept Kalhaṇa as fairly correct for his own time and for the preceding century or so, an examination of the details of his work quickly exposes its imaginative character and its unreliability for any earlier period: notably, he places towards the close of the period 2448 to 1182 B.C. the great Maurya king Aśōka, whose real initial date was 264 B.C.; and he was obliged to allot to one king, Raṇāditya I., a reign of three centuries (A.D. 222 to 522, as placed by him) simply in order to save his own chronology. They have given us historical romances, such as the *Harshacharita* of Bāṇa, written in the 7th century, the *Vikramāṅkadēvacharita* of Bilhaṇa, written about the beginning of the 12th century, and the Tamiḷ poems, the *Kaḷavaḷi*, the *Kaliṅgattu-Paraṇi*, and the *Vikrama-Chōḷan-Uḷā*, the first of which may be of somewhat earlier date than Bāṇa's work, while the second and third are of much the same time with Bilhaṇa's: but, while these present some charming reading in the poetical line, with much of interest, and certainly a fair amount of important matter, they give us no dates, and so no means without extraneous help of applying the information that is deducible from them. Again, they have given us, especially in Southern India, a certain amount of historical details in the introductions and colophons of their literary works; and here they have often furnished dates which give a practical shape to their statements: but we quickly find that the historical matter is introduced quite incidentally, to magnify the importance of the authors themselves rather than to teach us anything about their patrons, and is not handled with any particular care and fulness; and it would be but a sketchy and imperfect history, and one relating to only a limited and comparatively late period, that we could piece together even from these more precise sources. The ancient Hindus, in short, have not bequeathed to us anything that can in any way compare with the historical writings of their Greek and Roman contemporaries. They have not even given us anything like the *Dīpavaṁsa* of Ceylon, which, while it contains a certain amount of fabulous matter, can be recognized as presenting a real and reliable historical account of that island, taken from records written up during the progress to the events themselves, from at any rate the time of Aśōka to about A.D. 350; or like the *Mahāvaṁsa*, which, commenting on and amplifying the details of the *Dīpavaṁsa*, takes up a similar account from the end of the period covered by that work. Even the Greek notices of India, commencing with the accounts of the Asiatic campaign of Alexander the Great, have told us more about its political history and geography during the earlier times than have the Hindus themselves: and in fact, in mentioning Sandrokottos, *i.e.* Chandragupta, the grandfather of

Aśōka, and in furnishing details which fix his initial date closely about 320 B.C., the Greeks gave us the first means of making a start towards arranging the chronology of India on accurate lines. It is in these circumstances, in the absence of any indigenous historical writings of a plain, straightforward, and authentic nature, that the inscriptions of India are of such great value. They are supplemented—and to an important extent for at any rate the period from the end of Aśōka's reign in 227 B.C. to the commencement of the reign of Kaṅishka in 58 B.C., and again from about a century later to the rise of the Gupta dynasty in A.D. 320—by the numismatic remains. But the coins of India present no dates until nearly the end of the 2nd century A.D.; the case of Parthia, which has yielded dated coins from only 38 B.C., illustrates well the difficulty of arranging undated coins in chronological order even when the assistance of historical books is available; and what we may deduce from the coins of India is still to be put into a final shape in accordance with what we can determine from the inscriptions. In short, the inscriptions of India are the only sure grounds of historical results in every line of research connected with its ancient past; they regulate everything that we can learn from coins, architecture, art, literature, tradition, or any other source.

That is one reason why the inscriptions of India are so valuable; they fill the void caused by the absence of historical books. Another reason is found in the great number of them and the wide area that is covered by them. They come from all parts of the country: from Shāhbāzgarhī in the north, in the Yūsufzai subdivision of the Peshāwar district, to the ancient Pāṇḍya territory in the extreme south of the peninsula; and from Assam in the east to Kāṭhiāwār in the west. For the time anterior to about A.D. 400, we already have available in published form, more or less complete, the contents of between 1100 and 1200 records, large and small; and the explorations of the Archaeological Department are constantly bringing to light, particularly from underground sites, more materials for that period. For the time onwards from that point, we have similarly available the contents of some 10,000 or 11,000 records of Southern India, and of at any rate between 700 and 800 records of Northern India where racial antagonism came more into play and worked more destruction of Hindu remains than in the south.

Another reason is found in the fact that from the first century B.C. the inscriptions are for the most part specifically dated: some in various eras the nature and application of which are now thoroughly well understood, often with also a mention of the year of the twelve-years or of the sixty-years cycle of the planet Jupiter; others in the regnal years of kings whose periods are now well fixed. And, in addition to usually stating the month and the day along with the year, the inscriptions sometimes give, under the influence of Hindu astrology, other details so exact that we can determine, even to the actual hour, the occurrence of the event registered by a particular record.

A final reason is found in the precise nature of the inscriptions. A certain proportion of them consists of plain statements of events,—recitals of the pedigrees and achievements of kings, records of the carrying out of public works, epitaphs of kings, heroes, and saints, compacts of political alliance, and so on; and some of these present, in fact, short historical compositions which illustrate well what the ancient Hindus might have done if they had felt any special call to write plain and veracious chronicles on matter-of-fact lines. But we are indebted for the great bulk of the inscriptions, not to any historical instinct, but to the religious side of the Hindu character, and to the constant desire of the Hindus to make donations on every possible occasion. The inscriptions devoted simply to the propagation of morality and religion are not very numerous: the most notable ones in this class are the edicts of Aśōka, which we shall notice again farther on. The general object of the inscriptions was to register gifts and endowments, made sometimes to private individuals, but more usually to gods, to priests on behalf of temples and charitable institutions, and to religious communities. And, as the result of this, in the vast majority of the inscriptional remains we have a mass of title-deeds of real property, and of certificates of the right to duties, taxes, fees, perquisites, and other privileges. Now, the essential part of the records was of course the specification of the details of the donor, of the donee, and of the donation. And we have to bear in mind that not only are the donative records by far the most abundant of all, but also, among them, by far the most numerous are those which we may call the records of royal donations; by which we mean grants that were made either by the kings themselves, or by the great feudatory nobles, or by provincial governors and other high officials who had the royal authority to alienate state lands and to assign allotments from the state revenues: also, that many of them register, not simply the gift of small holdings, but grants of entire villages, and large and permanent assignments from the public revenues. It is to these facts that we are indebted for the great value of the records from the historical point of view. The donor of state lands or of an assignment from the public revenues must show his authority for his acts. A provincial governor or other high official must specify his own rank and territorial jurisdiction, and name the king under whom he holds office. A great feudatory noble will often give a similar reference to his paramount sovereign, in addition to making his own position clear. And it is neither inconsistent with the dignity of a king, nor unusual, for something to be stated about his pedigree in charters and patents issued by him or in his name. The records give from very early times a certain amount of genealogical information. More and

more information of that kind was added as time went on. The recital of events was introduced, to magnify the glory and importance of the donors, and sometimes to commemorate the achievements of recipients. And it was thus, not with the express object of recording history, but in order to intensify the importance of everything connected with religion and to secure grantees in the possession of properties conveyed to them, that there was gradually accumulated almost the whole of the great mass of inscriptional records upon which we are so dependent for our knowledge of the ancient history of India in all its branches.

Survey of the inscriptions.

Coming now to a survey of the inscriptions themselves, we must premise that India is divided, from the historical point of view, though not so markedly in some other respects, into two well-defined parts, Northern and Southern. A classical name of Northern India is Āryāvarta, "the abode of the Āryas, the excellent or noble people." Another name, which figures both in literature and in the inscriptions, is Uttarāpatha, "the path of the north, the northern road." And, as a classical name of Southern India answering to that we have Dakshiṇāpatha, "the path of the south, the southern road," from the first component of which name comes our modern term Deccan, Dekkan, or Dekhaṇ. Sanskṛit literature names as the dividing-line between Āryāvarta or the Uttarāpatha and the Dakshiṇāpatha, *i.e.* between Northern and Southern India, sometimes the Vindhya mountains, sometimes the river Nerbudda (Narmadā, Narbadā) which, flowing close along the south of the Vindhya range, empties itself into the gulf of Cambay near Broach, in Gujarāt, Bombay. The river seems, on the whole, to furnish the better dividing-line of the two. But it does not reach, any more than the range exactly extends, right across India from sea to sea. And, to complete the dividing-line beyond the sources of the Narbadā, which are in the Māikal range and close to the Amarkaṇṭak hill in the Rēwā State, Baghēlkhaṇḍ, we have to follow some such course as first the Maniārī river, from its sources, which are in that same neighbourhood but on the south of the Māikal range, to the point where, after it has joined the Seonāth, the united rivers flow into the Mahānadī, near Seorī-Nārāyan in the Bilāspūr district, Central Provinces, and then the Mahānadī itself, which flows into the bay of Bengal near Cuttack in Orissa. Even so, however, we have only a somewhat rough dividing-line between the historical Northern and Southern India; and the distinction must not be understood too strictly in connexion with the territories lying close on the north and the south of the line sketched above. In Western India, Kāṭhiāwār and all the portions of Gujarāt above Broach lie to the north of the Narbadā; but from the palaeographic point of view, if not so much from the historical, they belong essentially to Southern India. Our modern Central India lies entirely in Northern India, but has various palaeographic connexions with Southern India. Our Central Provinces extend in the Saugar district into Northern India; and that portion of them presents in ancient times both northern and southern characteristics. Eastern India may be defined as consisting of Bengal, with Orissa and Assam: it belongs to Northern India.

The inscriptional remains of India, as known at present, practically begin with the records of Aśōka, the great Maurya king of Northern India,—grandson of that king Chandragupta whose name was written by the Greeks as Sandrokottos,—who reigned 264 to 227 B.C. The state of the alphabets, indeed, in the time of Aśōka renders it certain that the art of writing must have been practised in India for a long while before his period; and it gives us every reason to hope that systematic exploration, especially of buried sites, will eventually result in the discovery of records framed by some of his predecessors or by their subjects. But those discoveries have still to be made; and matters stand just now as follows. From before the time of Aśōka we have an inscription on a relic-vase from a stūpa or relic-mound at Piprahwa in the north-east corner of the Bastī district, United Provinces, which preserves the memory of the slaughtered kinsmen of Buddha, the Śākyas of Kapilavastu according to the subsequent traditional nomenclature. We may perhaps place before his time the record on the Sōhgaurā plate, from the Gōrakhpūr district, United Provinces, which notifies the establishment of two public storehouses at a junction of three great highways of vehicular traffic to meet any emergent needs of persons using these roads. And we may possibly decide hereafter to refer to the same period a few other records which are not at present regarded as being quite so early. But, practically, the known inscriptions of India begin with the records of that king who calls himself in them "the king Dēvānaṁpiya-Piyadassi, the Beloved of the Gods, He of Gracious Mien," but who is best known as Aśōka by the name given to him in the literature of India and Ceylon and in an inscription of A.D. 150 at Junāgaḍh (Junagarh) in Kāṭhiāwār. From his time onwards we have records from all parts in constantly increasing numbers, particularly during the earlier periods, from caves, rock-cut temples, and Buddhist stūpas. Many of them, however, are of only a dedicatory nature, and, valuable as they are for purposes of religion, geography, and other miscellaneous lines of research, are not very helpful in the historical line. We are interested here chiefly in the historical records; and we can notice only the most prominent ones even among them.

Of this king Aśōka we have now thirty-five different records, some of them in various recensions. Amongst them, the most famous ones are the seven pillar-edicts and the fourteen rock-edicts, found in various versions, and in a more or less complete state, at different places from Shāhbāzgarhī in the Yūsufzai country in the extreme north-west, to Radhia, Mathia, and

Rāmpūrwa in the Champāran district, Bengal, at Dhauli in the Cuttack district of Orissa, at Jaugada in the Gañjām district, Madras, at Girnār (Junāgaḍh) in Kāṭhiāwār, and even at Sopāra in the Ṭhāṇa district, Bombay. These edicts were thus published in conspicuous positions in or near towns, or close to highways frequented by travellers and traders, or in the neighbourhood of sacred places visited by pilgrims, so that they might be freely seen and perused. And the object of them was to proclaim the firm determination of Aśōka to govern his realm righteously and kindly in accordance with the duty of pious kings, and with considerateness for even religious beliefs other than the Brāhmaṇical faith which he himself at first professed, and to acquaint his subjects with certain measures that he had taken to that end, and to explain to them how they might co-operate with him in his objects. But, in addition to mentioning certain contemporaneous foreign kings, Antiochus II. (Theos) of Syria, Ptolemy Philadelphus of Egypt, Antigonus Gonatas of Macedonia, Magas of Cyrene, and Alexander II. of Epirus, they yield items of internal history, in detailing some of Aśōka's administrative arrangements; in locating the capital of his empire at Pāṭaliputra (Patna), and seats of viceroys at Ujjēni (Ujjain) and Takhasilā (Taxila); in giving the names of some of the leading peoples of India, particularly the Chōḷas, the Pāṇḍyas, and the Andhras; and in recording the memorable conquest of the Kaliṅga country, the attendant miseries of which first directed the thoughts of the king to religion and to solicitude for the welfare of all his subjects. Another noteworthy record of Aśōka is that notification, containing his Last Edict, his dying speech, issued by local officials just after his death, which is extant in various recensions at Sahasrām, Rūpnāth, and Bairāt in Northern India, and at Brahmagiri, Siddāpura, and Jaṭinga-Rāmēśvara in Mysore. Some three years before the end of his long reign of thirty-seven years, Aśōka became a convert to Buddhism, and was admitted as an Upāsaka or lay-worshipper. Eventually, he formally joined the Buddhist order; and, following a not infrequent custom of ancient Indian kings, he abdicated, took the vows of a monk, and withdrew to spend his remaining days in religious retirement in a cave-dwelling on Suvarnagiri (Sōngīr), one of the hills surrounding the ancient city of Girivraja, below Rājagṛiha (Rājgīr), in the Patna district in Behār. And there, about a year later, in his last moments, he delivered the address incorporated in this notification, proclaiming as the only true religion that which had been promulgated by Buddha, and expanding the topic of the last words of that great teacher: "Work out your salvation by diligence!" This record, it may be added, is also of interest because, whereas such of the other known records of Aśōka as are dated at all are dated according to the number of years elapsed after his anointment to the sovereignty, it is dated 256 years after the death of Buddha, which event took place in 483 B.C.

For the two centuries or nearly so next after the end of the reign of Aśōka, we have chiefly a large number of short inscriptions which are of much value in miscellaneous lines of research—palaeography, geography, religion, and so on. But historical records are by no means wanting; and we may mention in particular the following. From the caves in the Nāgārjunī Hills in the Gayā district, Bengal, we have (along with three of the inscriptions of Aśōka himself) three records of a king Daśaratha who, according to the *Vishṇu-Purāna*, was a grandson of Aśōka. From the stūpa at Bharaut in the Nāgōd state, Central India, we have a record which proves the existence of the dynasty of the Śuṅga kings, for whom the *Purānas*, placing them next after the line of Chandragupta and Aśōka, indicate the period 183 to 71 B.C. Two of the records from the stūpa at Bhaṭṭiprōlu in the Kistna district, Madras, give us a king of those parts, reigning about 200 B.C., whose name appears both as Kubiraka and as Khubiraka. From Bēsnagar in the Gwālior state we have an inscription, referable to the period 175 to 135 B.C., which mentions a king of Central India, by name Bhāgabhadra, and also mentions, as his contemporary, one of the Greek kings of the Punjab, Antalkidas, whose name is familiar from his coins in the form Antialkidas. From the Hāthigumphā cave near Cuttack, in Orissa, we have a record, to be placed about 140 B.C., of king Khāravēla, a member of a dynasty which reigned in that part of India. From a cave at Pabhōsā in the Allahābād district, United Provinces, we have two records which make known to us a short succession of kings of Adhichatrā, otherwise known as Ahichchhattra. From a cave at the Nānāghāt Pass in the Poona district, Bombay, we have a record of queen Nāyanikā, wife of one of the great Sātavāhana-Sātakarṇi kings of the Deccan. And from the stūpa No. 1 at Sāñchi in the Bhōpāl state, Central India, we have a record of a king Śrī-Sātakarṇi, belonging to perhaps another branch of the same great stock.

The historical records become more numerous from the time of the Kushan king Kaṇishka or Kāṇishka, who began to reign in 58 B.C., and founded the so-called Vikrama era, the great historical era of Northern India, beginning in that year.[27] For the period of him and his immediate successors, Vāsishka, Huvishka and Vāsudēva, we have now between seventy and eighty inscriptions, ranging from 54 B.C. to A.D. 42, and disclosing a sway which reached at its height from Bengal to Kābul: we are indebted for some of these to the Buddhists, in connexion with whose faith the memory of Kaṇishka was preserved by tradition, but for most of them to the Jains, who seem to have been at that time the more numerous sect in the central part of his dominions.

The dynasty of Kaṇishka was succeeded by another foreign ruler, Gondophernēs, popularly known as Gondophares, whose coins indicate that, in addition to a large part of north-western

India and Sind, his dominions included Kābul, Kandahār, and Sēistān. This king is well known to Christian tradition, in connexion with the mission of St Thomas the Apostle to the East. And the tradition is substantially supported by an inscription from Takht-i-Bahaī in the Yūsufzai country on the north-west frontier, which, like some of his coins, mentions him as Guduphara or Gunduphara, and proves that he was reigning there in A.D. 47.

Gondophernēs was followed by the Kadphisēs kings, belonging to another branch of the Kushan tribe, who perhaps extended their sway farther into India, as far at least as Mathurā (Muttra), and reigned for about three-quarters of a century. For their period, and in fact for the whole time to the rise of the Guptas in A.D. 320 we have as yet but scanty help from the inscriptions in respect of the political history of Northern India: we are mostly dependent on the coins, which tend to indicate that that part of India was then broken up into a number of small sovereignties and tribal governments. An inscription, however, from Panjtar in the Yūsufzai territory mentions, without giving his name, a Kushan king whose dominion included that territory in A.D. 66. And an inscription of A.D. 242 from Mathurā has been understood to indicate that some descendant of the same stock was then reigning there. The inscriptional records for that period belong chiefly to Southern India.

Meanwhile, however, in the south-west corner of Northern India, namely in Kāṭhiāwār, there arose another foreign king, apparently of Parthian extraction, by name Nahapāna, described in his records, whether by a family name or by a tribal appellation, as a Chhaharāta or Kshaharāta, in whom we have the founder of the so-called Śaka era, the principal era of Southern India, beginning in A.D. 78: in respect of him we learn from the *Periplus of the Erythraean Sea* that he was reigning between A.D. 80 and 89, and from inscriptions that he was still reigning in A.D. 120 and 124: at the latter time, his dominions included Nāsik and other territories on the south of the Narbadā; and the *Periplus* names as his capital a town which it calls Minnagar, and which Ptolemy would locate in such a manner as to suggest that it may be identified with the modern Dōhad in the Paňch Mahāls district of Gujarāt, Bombay. Nahapāna was overthrown, and his family was entirely wiped out, soon after A.D. 125, by the great Sātāvahana king Gautamīputra-Śrī-Sātakarṇi, who thereby recovered the territories on the south of the Narbadā. On the north of that river, however, he was followed by a line of kings founded by his viceroy Chashṭana, son of Ghsamotika, to whom Ptolemy, mentioning him as Tiastanēs, assigns Ujjain as his capital: these names, again, show a foreign origin; but, from the time of his son Jayadāman, the descendants of Chashṭana became Hinduized, and mostly bore purely Indian appellations. The coins show that the descendants of Chashṭana ruled till about A.D. 388, when they were overthrown by the great Gupta dynasty of Northern India. Only a few of their inscriptional records have been discovered: but amongst them a very noteworthy one is the Junāgaḍh (Junagarh) inscription of Chashṭana's grandson, Rudradāman, bearing a date in A.D. 150; it is remarkable as being the earliest known long inscription written entirely in Sanskṛit.

From Southern India we have, at Nāsik, inscriptions of the Sātavāhana king Gautamṕputra-Śrī-Sātakarṇi, mentioned just above, and of his son Vāsisṭhīputra-Śrī-Puḷumāyi, and of another king of that line named Gautamīputra-Śrī-Yajña-Sātakarṇi; and other records of the last-mentioned king come from Kaṇheri near Bombay, and from the Kistna district, Madras, and testify to the wide extent of the dominions of the line to which he belonged. The records of this king carry us on to the opening years of the 3rd century, soon after which time, in those parts at any rate, the power of the Sātavāhana kings came to an end. And we have next, also from Nāsik, an inscription of an Ābhīra king named Īśvarasēna, son of Śivadatta; in this last-mentioned person we probably have the founder of the so-called Kalachuri or Chēdi era, beginning in A.D. 248 or 249, which we trace in Western India for some centuries before the time when it was transferred to, or revived in, Central India, and was invested with its later appellation: we trace it notably in the records of a line of kings who called themselves Traikūṭakas, apparently from Trikūṭa as the ancient name of the great mountain Harischandragaḍ in the Western Ghauts, in the Ahmadnagar district.

We can, of course, mention in this account only the most prominent of the inscriptional records. Keeping for the present to Southern India, we have from Banawāsi in the North Kanara district, Bombay, and from Maḷavaḷḷi in the Shimoga district, Mysore, two inscriptions of a king Hārit putra-Sātakarṇi of the Viṇhukaḍḍa-Chuṭu family, reigning at Vaijayantī, *i.e.* Banawāsi, which disclose the existence there of another branch, apparently known as the Chuṭu family and having its origin at a place named Vishṇugarta, of the great stock to which the Sātavāhana-Sātakarṇis belonged. And another Maḷavaḷḷi inscription, of a king Śiva-Skandavarman, shows that the Sātakarṇis of that locality were followed by a line of kings known as the Kadambas, who left descendants who continued to rule until about A.D. 650. From the other side of Southern India, an inscription from the stūpa at Jaggayyapēṭa in the Kistna district, Madras, referable to the 3rd century A.D., gives us a king Māḍharīputra-Śrī-Vīra-Purushadatta, of the race of Ikshvāku. And some Prākṛit copperplate inscriptions from the same district, referable to the 4th century, disclose a line of Pallava kings at Kāňchī, the modern Conjeeveram near Madras, whose descendants, from about A.D. 550, are well known from the later records.

Reverting to Northern India, we have from the extreme north-west a few inscriptions dated in the era of 58 B.C. which carry us on to A.D. 322. The tale is then taken up chiefly by the records of the great Gupta kings of Pāṭaliputra, *i.e.* Patna, who rose to power in A.D. 320, and gradually extended their sway until it assumed dimensions almost commensurate with those of Aśōka and Kaṇishka: the records of this series are somewhat numerous; and a very noteworthy one amongst them is the inscription of Samudragupta, incised at some time about A.D. 375 on one of the pillars of Aśōka now standing at Allahābād, which gives us a wide insight into the political divisions, with their contemporaneous rulers, of both Northern and Southern India: it is also interesting because it, or another record of the same king at Éraṇ in the Saugar district, Central Provinces, marks the commencement of the habitual use of Sanskṛit for inscriptional purposes. The inscriptions of the Gupta series run on to about A.D. 530. But the power of the dynasty had by that time become much curtailed, largely owing to an irruption of the Hūṇs under Tōramāṇa and Mihirakula, who established themselves at Siālkōṭ, the ancient Śākala, in the Punjab. We have inscriptional records of these two persons, not only from Kura in the Salt Range, not very far from Siālkōṭ, but also from Éraṇ and from Gwālior. And next after these we have inscriptions from Mandasōr in Mālwā, notably on two great monolith pillars of victory, of a king Vishṇuvardhana-Yaśōdharman, which show that he overthrew Mihirakula shortly before A.D. 532, and, describing him as subjugating territories to which not even the Guptas and the Hūṇs had been able to penetrate, indicate that he in his turn established for a while another great paramount sovereignty in Northern India.

We have thus brought our survey of the inscriptions of India down to the 6th century A.D. There then arose various dynasties in different parts of the country: in Northern India, in Kāṭhiāwār, the Maitrakas of Valabhī; at Kanauj, the Maukharis, who, after no great lapse of time, were followed by the line to which belonged the great Harshavardhana, "the warlike lord (as the southern records style him) of all the region of the north;" and, in Behār, another line of Guptas, usually known as the Guptas of Magadha: in Southern India, the Chalukyas, who, holding about A.D. 625 the whole northern part of Southern India from sea to sea, then split up into two branches, the Western Chalukyas of Bādāmi in the Bijāpūr district, Bombay, and the Eastern Chalukyas of Veṅgī in the Godāvarī district, Madras; and, below them, the successors of the original Pallavas of Kāñchī (Conjeeveram). These all had their time, and passed away. And they and their successors have left us so great a wealth of inscriptional records that no further detailed account can be attempted within the limits available here. We must pass on to a few brief remarks about the language of the records and the characters in which they were written.

Alphabets.

The inscriptions of Aśōka present two alphabets, which differ radically and widely: one of them is known as the Brāhmī; the other, as the Kharōshṭhī or Kharōshṭrī. For the decipherment of the Brāhmī alphabet we are indebted to James Prinsep, who determined the value of practically all the letters between 1834 and 1837. The decipherment of the Kharōshṭhī alphabet was a more difficult and a longer task: it was virtually finished, some twenty years later, by the united efforts of C. Masson, Prinsep, C. L. Lassen, H. H. Wilson, E. Norris, Sir A. Cunningham, and John Dowson; but there are still a few points of detail in respect of which finality has not been attained.

The Kharōshṭhī script was written from right to left, and is undeniably of Semitic origin; and the theory about it, based on the known fact that the valley of the Indus was a Persian satrapy in the time of Darius (521-485 B.C.), is that the Aramaic script was then introduced into that territory, and that the Kharōshṭhī is an adaptation of it. Except in a few intrusive cases, the use of the Kharōshṭhī in India was limited to the valley of the Indus, and to the Punjab as defined on the south by the territory watered by the Biās (Beas) and the Satlaj (Sutlej): and the eastern locality of the meeting of the two alphabets is marked by coins bearing Kharōshṭhī and Brāhmī legends which come from the districts of the Jālandhar (Jullundhur) division, and by two short rock-cut records, each presented in both the alphabets, at Paṭhyār and Kanhiāra in the Kāṇgṛa valley. Outside India, this script was notably current in Afghānistān; and documents written in it have in recent years been found in Chinese Turkestān. In India it continued in use, as far as our present knowledge goes, down to A.D. 343.

The Brāhmī alphabet, written from left to right, belonged to the remainder of India; but it must also have been current in learned circles even in the territory where popular usage favoured the other script. Various views about its origin have been advanced: amongst them is the theory that it was derived from the oldest north-Semitic alphabet, which prevailed from Phoenicia to Mesopotamia, and may, it is held, have been introduced into India by traders at some time about 800 B.C. It is, however, admitted that the earliest known form of the Brāhmī is a script framed by Brāhmaṇs for writing Sanskṛit. Also, the theory is largely based on a coin from Ēraṇ, in the Saugar district, Central Provinces, presenting a Brāhmī legend running retrograde from right to left; from which it is inferred that that was the original direction of this writing, and that the script eventually assumed the other direction, which alone it has in the inscriptions, after passing, like the Greek, through a stage in which the lines were written in both directions alternately. But we can cite many instances in which ancient die-sinkers were careless, wholly or partially, in the matter of reversing the legends on their dies, with the result that not only syllables frequently, but sometimes entire words, stand in reverse on the coins themselves;

moreover, the Ēraṇ coin, being one of the earliest known Indian coins bearing a legend at all, may quite possibly belong to a period before the time when the desirability of working in reverse on the dies presented itself to the Indian die-sinkers. In all the circumstances, the evidence of the Ēraṇ coin cannot be regarded as conclusive; and we require some inscription on stone, or at least some longer record on metal than a brief legend of five syllables, to satisfy us that the Brāhmī writing ever had a direction different from that which it has in the inscriptions. Further, if there is any radical connexion between the Brāhmī and the Semitic alphabet indicated above, so many curious and apparently capricious changes must have been made, in adapting that alphabet, that it would seem more probable that the two scripts were derived from a joint original source. In view of the high state of civilization to which the Hindus had evidently attained even before the time of Chandragupta, the grandfather of Aśōka, it must still be regarded as possible that they were the independent inventors of that which was emphatically their national alphabet. The Brāhmī alphabet is the parent of all the modern Hindu scripts, including on one side the Nāgarī or Dēvanāgarī, and on the other the widely dissimilar rounded forms of the Kanarese, Tamiḻ, Telugu, and other southern alphabets; and the inscriptions enable us to trace clearly the gradual development of all the modern forms.

Languages.

The great classical Indian language, Sanskṛit, is not found in any inscriptional records of the earliest times. It is not, however, to be supposed therefrom that the use and cultivation of Sanskṛit ever lay dormant, and that there was a revival of this language when it did eventually come to be used in the inscriptions; the case simply is that, during the earlier periods, Sanskṛit was not known much, if at all, outside the Brāhmaṇical and other literary and priestly circles, and so was not recognized as a suitable medium for the notifications which were put on record in the inscriptions for the information of the people at large.

In Northern India, the inscriptions of the period before 58 B.C. present various early Prākṛits, *i.e.* vernaculars more or less derived from Sanskṛit or brought into a line with it. From 58 B.C., however, the influence of Sanskṛit began to manifest itself in the inscriptions, with the result that the records present from that time a language which is conveniently known as the mixed dialect, meaning neither exactly Prākṛit nor exactly Sanskṛit, but Prākṛit with an intermixture of Sanskṛit terminations and some other features; and we have, in fact, from Mathurā (Muttra), a locality which has yielded interesting remains in various directions, a short Brāhmanical inscription of 33 B.C. which was written wholly in Sanskṛit. The mixed dialect appears to have been the general one for inscriptional purposes in Northern India until about A.D. 320. But a remarkable exception is found in the inscription of Rudradāman, dated in A.D. 150, at Junāgaḍh in Kāṭhiāwār (mentioned on a preceding page), which is a somewhat lengthy record composed in thoroughly good literary Sanskṛit prose. Also, the extant inscriptions of the descendants of Rudradāman—(but only four of their records, ranging from A.D. 181 to 205, are at present available for study)—are in almost quite correct Sanskṛit; and this suggests that, from his time, the language may have been habitually used for inscriptional purposes in the dominions of his dynasty. That, however, is only a matter of conjecture; and elsewhere pure and good Sanskṛit, without any Prākṛit forms, appears next, and is found in verse as well as in prose, in the two inscriptions from Ēraṇ and Allahābād, referable to the period about A.D. 340 to 375, of the great Gupta king Samudragupta. From that time onwards, as far as our present knowledge goes, Sanskṛit, with a very rare introduction of Prākṛit or vernacular forms, was practically the only inscriptional language in the northern parts of India. We can, however, cite a record of A.D. 862 from the neighbourhood of Jōdhpur in Rājputānā, the body of which was written in Māhārāshṭrī Prākṛit.

In Southern India we have an instance of the mixed dialect in the Nāsik inscription, referable to A.D. 257 or 258, of the Ābhīra king Iśvarasēna, son of Śivadatta, which has been mentioned on a preceding page. With the exception, however, of that record and of the few which are mentioned just below, the inscriptional language of Southern India appears to have been generally Prākṛit of one kind or another until about A.D. 400, or perhaps even somewhat later. Sanskṛit figures first in one of the records at Nāsik of Ṛishabhadatta (Ushavadāta), son-in-law of the Kshaharāta king Nahapāna, which consequently gives it almost as early an appearance in the south as that which is established for it in the north; but it is confined in this instance to a preamble which recites the previous donations and good works of Ṛishabhadatta; the record passes into Prākṛit for the practical purpose for which it was framed. Sanskṛit figures next, in an almost correct form, in the short inscription of not much later date at Kaṇheri, near Bombay, of the queen (her name is not extant) of Vāsishṭhīputra-Śrī-Śātakarṇi. It next appears in certain formulae, and benedictive and imprecatory verses, which stand at the end of some of the Prākṛit records of the Pallava series referable to the 4th century; but here we have quotations from books, not instances of original composition. We have a Sanskṛit record, obtained in Khāndēsh but probably belonging to some part of Gujarāt, of a king named Rudradāsa, which is perhaps dated in A.D. 367. But the next southern inscription in Sanskṛit, of undeniable date, is a record of A.D. 456, belonging to the Vyārā subdivision of the Baroda state in Gujarāt, of the Traikūṭaka king Dahrasēna. The records of the early Kadamba kings of Banawāsi in North Kanara, Bombay, exhibit the use of Sanskṛit from an early period in the 6th century; and records of the Pallava kings show it from perhaps a somewhat earlier time on the other side of India. The records of the Chalukya kings present Sanskṛit from A.D. 578 onwards. And from this latter date the language

figures freely in the southern records. But some of the vernaculars, in their older forms, shortly begin to present themselves alongside of it; and, without entirely superseding Sanskṛit even to the latest times, the use of them for inscriptional purposes became rapidly more and more extensive. The vernacular that first makes its appearance is Kanarese, in a record of the Chalukya king Maṅgalēśa, of the period A.D. 597 to 608, at Bādāmi in the Bijāpūr district, Bombay. Tamiḷ appears next, between about A.D. 610 and 675, in records of the Pallava king Mahēndravarman I. at Vallam in the Chingalpat (Chingleput) district, Madras, and of his great-grandson Paramēśvaravarman I. from Kūram in the same district. Telugu appears certainly in A.D. 1011, in a record of the Eastern Chalukya king Vimalāditya; and it is perhaps given to us in A.D. 843 or 844 by a record of his ancestor Vishṇuvardhana V.; in the latter case, however, the authenticity of the document is not certain. Malayālam appears about A.D. 1150, in inscriptions of the rulers of Kēraḷa from the Travancore state. And on the colossal image of Gommaṭēśvara at Śravaṇa-Beḷgoḷa, in Mysore, there are two lines of Marāṭhī, notifying for the benefit of pilgrims from the Marāṭhā country the names of the persons who caused the image and the enclosure to be made, which are attributed to the first quarter of the 12th century: this language, however, figures first for certain in a record of A.D. 1207, of the time of the Dēvagiri-Yādava king Siṅghaṇa, from Khāndēsh in the north of Bombay.

Bibliography.—The systematic publication of the Indian inscriptions has not gone far. Cunningham inaugurated a *Corpus Inscriptionum Indicarum*, by giving us in 1877 the first volume of it, dealing with the records of Aśōka; but the only other volume which has been published is vol. iii., by Fleet, dealing with the records of the Gupta series. The other published materials are mostly to be found here and there in the *Journals* of the Royal Asiatic Society of London, its Bombay branch, and the Asiatic Society of Bengal, in the *Reports* of the various Archaeological Surveys, and in the *Indian Antiquary*, the *Epigraphia Indica* and the *Epigraphia Carnatica*; and much work has still to be done in bringing them together according to the periods and dynasties to which they relate, and in revising some of them in the light of new discoveries and the teachings of later research. The authority on Indian palaeography is Bühler's work, published in 1896 as part 2 of vol. i of the *Grundriss der Indo-Arischen Philologie und Altertumskunde*; an English version of it was issued in 1904 as an appendix to the *Indian Antiquary*, vol. xxxiii.

(J. F. F.)

III. Greek Inscriptions

Etymologically the term inscription (ἐπιγραφή) would include much more than is commonly meant by it. It would include words engraved on rings, or stamped on coins,[28] vases, lamps, wine-jar handles,[29] &c. But Boeckh was clearly right in excluding this *varia supellex* from his *Corpus Inscriptionum Graecarum*, or only admitting it by way of appendix. Giving the term inscription a somewhat narrower sense, we still include within it a vast store of documents of the greatest value to the student of Greek civilization. It happens, moreover, that Greek inscriptions yield the historian a richer harvest than those of Rome. Partly from fashion, but partly from the greater abundance of the material, the Romans engraved their public documents (treaties, laws, &c.) to a large extent on bronze. These bronze tablets, chiefly set up in the Capitol, were melted in the various conflagrations, or were carried off to feed the mint of the conqueror. In Greece, on the contrary, the mountains everywhere afforded an inexhaustible supply of marble, and made it the natural material for inscriptions. Some Greek inscribed tablets of bronze have come down to us,[30] and many more must have perished in the sack of cities and burning of temples. A number of inscriptions on small thin plates of lead, rolled up, have survived; these are chiefly imprecations on enemies[31] or questions asked of oracles.[32] An early inscription recently discovered (1905) at Ephesus is on a plate of silver. But as a rule the material employed was marble. These marble monuments are often found *in situ*; and, though more often they were used up as convenient stones for building purposes, yet they have thus survived in a more or less perfect condition.[33]

Inscriptions were usually set up in temples, theatres, at the side of streets and roads, in τεμένη or temple-precincts, and near public buildings generally. At Delphi and Olympia were immense numbers of inscriptions—not only those engraved upon the gifts of victorious kings and cities, but also many of a more public character. At Delphi were inscribed the decrees of the Amphictyonic assembly, at Olympia international documents concerning the Peloponnesian cities; the Parthenon and Acropolis were crowded with treaties, laws and decrees concerning the Athenian confederation; the Heraeum at Samos, the Artemisium at Ephesus, and indeed every important sanctuary, abounded with inscriptions. It is a common thing for decrees (ψηφίσματα) to contain a clause specifying where they are to be set up, and what department of the state is to defray the cost of inscribing and erecting them. Sometimes duplicates are ordered to be set up in various places; and, in cases of treaties, arbitrations and other international documents, copies were always set up by each city concerned. Accordingly documents like the *Marmor Ancyranum* and the *Edict of Diocletian* have been restored by a comparison of the various fragments of copies set up in diverse quarters of the empire.

Greek inscribed marbles varied considerably in their external appearance. The usual form was the στήλη, the normal type of which was a plain slab, from 3 to 4 or even 5 ft. high,[34] 3 or 4 in. thick, tapering slightly upwards from about 2 ft. wide at bottom to about 18 in. at the top, where it was either left plain or often had a slight moulding, or still more commonly was adorned with a more or less elaborate pediment; the slab was otherwise usually plain. Another form was the βωμός or altar, sometimes square, oftener circular, and varying widely in size. Tombstones were either στῆλαι (often enriched beneath the pediment with simple groups in relief, commemorative of the deceased), or κίονες, pillars, of different size and design, or sarcophagi plain and ornamental. To these must be added statue-bases of every kind, often inscribed, not only with the names and honours of individuals, but also with decrees and other documents. All these forms were intended to stand by themselves in the open air. But it was also common to inscribe state documents upon the surface of the walls of a temple, or other public building. Thus the antae and external face of the walls of the pronaos of the temple of Athena Polias at Priene were covered with copies of the awards made concerning the lands disputed between Samos and Priene (see *Gk. Inscr. in Brit. Mus.* iii. § 1); similarly the walls of the Artemisium at Ephesus contained a number of decrees (*ibid.* iii. § 2), and the *proscenium* of the Odeum was lined with crustae, or "marble-veneering," under 1 in. thick, inscribed with copies of letters from Hadrian, Antoninus and other emperors to the Ephesian people (*ibid.* p. 151). The workmanship and appearance of inscriptions varied considerably according to the period of artistic development. The letters incised with the chisel upon the wall or the στήλη were painted in with red or blue pigment, which is often traceable upon newly unearthed inscriptions. When Thucydides, in quoting the epigram of Peisistratus the younger (vi. 54), says "it may still be read ἀμυδροῖς γράμμασι," he must refer to the fading of the colour; for the inscription was brought to light in 1877 with the letters as fresh as when they were first chiselled (see Kumanudes in Ἀθήναιον, vi. 149; *I.G.* suppl. to vol. i. p. 41). The Greeks found no inconvenience, as we should, in the bulkiness of inscriptions as a means of keeping public records. On the contrary they made every temple a muniment room; and while the innumerable στῆλαι, *Hermae*, bases and altars served to adorn the city, it must also have encouraged and educated the sense of patriotism for the citizen to move continually among the records of the past. The history of a Greek city was literally written upon her stones.

The primary value of an inscription lay in its documentary evidence (so Euripides, *Suppl.* 1202, fol.). In this way they are continually cited and put in evidence by the orators (*e.g.* see Demosth. *Fals. Leg.* 428; Aeschin. *In Ctes.* § 75). But the Greek historians also were not slow to recognize their importance. Herodotus often cites them (iv. 88, 90, 91, v. 58 sq., vii. 228); and in his account of the victory of Plataea he had his eye upon the tripod-inscription (ix. 81; cf. Thuc. i. 132). Thucydides's use of inscriptions is illustrated by v. 18 fol., 23, 47, 77, vi. 54, 59. Polybius used them still more. In later Greece, when men's thoughts were thrown back upon the past, regular collections of inscriptions began to be made by such writers as Philochorus (300 B.C.), Polemon (2nd century B.C., called στηλοκόπας for his devotion to inscriptions), Aristodemus, Craterus of Macedon, and many others.

At the revival of learning, the study of inscriptions revived with the renewed interest in Greek literature. Cyriac of Ancona, early in the 15th century, copied a vast number of inscriptions during his travels in Greece and Asia Minor; his MS. collections were deposited in the Barberini library at Rome, and have been used by other scholars. (See *Bull. Corr. Hellén.* i.; Larfeld in Müller's *Handbuch* 1.[2], p. 368 f.; Ziebarth, "de ant. Inscript. Syllogis" in *Ephem. Epigr.* ix.). Succeeding generations of travellers and scholars continued to collect and edit, and Englishmen in both capacities did much for this study.

Thus early in the 19th century the store of known Greek inscriptions had so far accumulated that the time had come for a comprehensive survey of the whole subject. And it was the work of one great scholar, Augustus Boeckh, to raise Greek epigraphy into a science. At the request of the Academy of Berlin he undertook to arrange and edit all the known inscriptions in one systematic work, and vol. i. of the *Corpus Inscriptionum Graecarum* was published in 1828, vol. ii. in 1833. He lived to see the work completed, although other scholars were called in to help him to execute his great design; vol. iii., by Franz, appeared in 1853; vol. iv., by Kirchhoff, in 1856.[35] The work is a masterpiece of lucid arrangement and profound learning, of untiring industry and brilliant generalization. Out of the publication of the *Corpus* there grew up a new school of students, who devoted themselves to discovering and editing new texts, and working up epigraphical results into monographs upon the many-sided history of Greece. In the *Corpus* Boeckh had settled for ever the methods of Greek epigraphy; and in his *Staatshaushaltung der Athener* (3rd ed. of vols. i. ii. by Fränkel, 1886; well known to English readers from Sir G. C. Lewis's translation, *The Public Economy of Athens*, 2nd ed., 1842) he had given a palmary specimen of the application of epigraphy to historical studies. At the same time Franz drew up a valuable introduction to the study of inscriptions in his *Elementa Epigraphices Graecae* (1840).

Meanwhile the liberation of Greece and increasing facilities for visiting the Levant combined to encourage the growth of the subject, which has been advanced by the labours of many scholars, and chiefly Ludwig Ross, Leake, Pittakys, Rangabé, Le Bas and later by Meier, Sauppe,

Kirchhoff, Kumanudes, Waddington, Köhler, Dittenberger, Homolle, Haussoullier, Wilhelm and others. Together with the development of this school of writers, there has gone on a systematic exploration of some of the most famous sites of antiquity, with the result of exhuming vast numbers of inscriptions. To mention only some of the most important: Cyrene, Rhodes, Cos, Cnidus, Halicarnassus, Miletus, Priene, Ephesus, Magnesia on the Maeander, Pergamum, Delos, Thera, Athens, Eleusis, Epidaurus, Olympia, Delphi, Dodona, Sparta, have been explored or excavated by the Austrians, English, French, Germans and Greeks. German, French, British, Austrian and American institutes have been established at Athens, to a great extent engaged in the study of inscriptions. From every part of the Greek world copies of inscriptions are brought home by the students of these institutes and by other travellers. And still the work proceeds at a rapid rate. For indeed the yield of inscriptions is practically inexhaustible: each island, every city, was a separate centre of corporate life, and it is significant to note that in the island of Calymnos alone C. T. Newton collected over one hundred inscriptions, many of them of considerable interest.

The result of this has been that Boeckh's great work, though it never can be superseded, yet has ceased to be what its name implies. The four volumes of the *C.I.G.* contain about 10,000 inscriptions. But the number of Greek inscriptions now known is probably more than three or four times as great. Many of these are only to be found published in the scattered literature of dissertations, or in Greek, German and other periodicals. But several comprehensive collections have been attempted, among which (omitting those dealing with more limited districts of the Greek world) the following may be named:—Rangabé, *Antiquités helléniques* (2 vols., 1842-1855); Le Bas-Waddington, *Voyage archéologique, inscriptions* (3 vols., 1847-1876, incomplete); Newton, Hicks and Hirschfeld, *Greek Inscriptions in the British Museum* (parts i.-iv.); and above all the *Inscriptiones Graecae*, a Corpus undertaken by the Berlin Academy (absorbing the *Corpus Inscr. Attic.* and other similar collections). Of this work six complete volumes and parts of others have appeared (by 1906) representing Attica, Argolis, Megaris, Boeotia, Phocis, Locris, Aetolia, Acarnania, Ionian Islands, Aegean Islands (exc. Delos), Sicily, Italy and western Europe; they are edited by Kirchhoff, Köhler, Dittenberger, Fränkel, Hiller von Gaertringen, Kaibel and others. Of a similar Austrian publication dealing with Asia Minor (*Tituli Asiae Minoris*) only the first part (Lycian Inscriptions) has appeared. Of general selections of inscriptions on a smaller scale it is necessary to mention: Dittenberger, *Sylloge Inscriptionum Graec.* (2nd ed., 1898-1901, 3 vols.); the same, *Orientis Graeci Inscr. Selectae* (2 vols., 1903-1905); Hicks, *Greek Historical Inscriptions* (1st ed., 1882; 2nd ed., 1901); Michel, *Recueil d'inscriptions grecques* (1900); Roberts and Gardner, *Introd. to Gk. Epigraphy* (2 vols., 1887-1905); Röhl, *Inscr. gr. antiquissimae* (1882), and *Imagines Inscriptionum* (2nd ed., 1898).

Oldest Greek inscriptions.

The oldest extant Greek inscriptions appear to date from the middle of the 7th century B.C. During the excavations at Olympia a number of fragments of very ancient inscriptions were found (see *Olympia, Textband* v.); and other very early inscriptions from various places, as Thera and Crete, have been published (see Röhl, *op. cit.*). But what is wanted is a sufficient number of very early inscriptions of fixed date. One such exists upon the leg of a colossal Egyptian statue at Abu-Simbel on the upper Nile, where certain Greek mercenaries in the service of King Psammetichus recorded their names, as having explored the river up to the second cataract (*C.I.G.* 5126; Röhl, 482; Hicks^2, 3). Even if Psammetichus II. is meant, the inscription dates between 594 and 589 B.C. Another, but later, instance is to be found in the fragmentary inscriptions on the columns dedicated by Croesus in the Ephesian temple (*c.* 550 B.C.; *Gk. Inscr. in the Brit. Mus.* 518). Documents earlier than the Persian War are not very frequent; but after that period the stream of Greek inscriptions goes on, generally increasing in volume, down to late Byzantine times.

Greek inscriptions may most conveniently be classified under the following heads: (1) those which illustrate political history; (2) those connected with religion; (3) those of a private character.

Political inscriptions.

1. Foremost among the inscriptions which illustrate Greek history and politics are the *decrees* of senate and people (ψηφίσματα βουλῆς, ἐκκλησίας, &c.) upon every subject which could concern the interests of the state. These abound from every part of Greece. It is true that a large number of them are honorary, *i.e.* merely decrees granting to strangers, who have done service to the particular city, public honours (crowns, statues, citizenship and other privileges). One of these privileges was the *proxenia*, an honour, which entailed on the recipient the burthen of protecting the citizens of the state which granted it when they came to his city. But the importance of an honorary decree depends upon the individual and the services to which it refers. And even the mere headings and datings of the decrees from various states afford curious and valuable information upon the names and titles of the local magistrates, the names of months and other details. On the formulae, see Swoboda, *Die gr. Volksbeschlüsse* (1890). Droysen in his *Hellenismus* (1877-1878) has shown how the history of Alexander and his successors is illustrated by contemporary ψηφίσματα. And when the student of Athenian politics of the 5th and 4th centuries turns to the 1st and 2nd volumes of the *I.G.*, he may wonder at the abundance of material before him; it is like turning over the minutes of the Athenian parliament. One example out of many must suffice

—No. 17 in *I.G.* ii. pt. 1 (Hicks[2], 101) is the famous decree of the archonship of Nausinicus (378 B.C.) concerning the reconstruction of the Athenian confederacy. The terms of admission to the league occupy the face of the marble; at the bottom and on the left edge are inscribed the names of states which had already joined.

Inscribed *laws* (νόμοι) occur with tolerable frequency. The following are examples:—A citation of a law of Draco's from the πρῶτος ἄξων of Solon's laws (*I.G.* i. 61; cf. Dittenberger, *Syll.*[2] 52); the Civil Codes of Gortyna (5th century, Dareste, &c., *Inscr. jurid. gr.* i. 352 ff.); a reassessment of the tribute payable by the Athenian allies in 425 B.C. (*I.G.* i. 37; Köhler *Urkunden und Untersuchungen zur Geschichte des delisch-attischen Bundes*, 1870, p. 63; Hicks[2], 64); a law passed by the Amphictyonic council at Delphi, 380 B.C. (Boeckh, *C.I.G.* 1688; *I.G.* ii. 545); law concerning Athenian weights and measures (Boeckh, *Staatshaushaltung*[3], ii. 318; *I.G.* ii. 476); the futile sumptuary law of Diocletian concerning the maximum prices for all articles sold throughout the empire (Mommsen-Blümner, *Der Maximaltarif des Diocletian*, 1893). For a collection of such legal documents, see Dareste, Haussoullier and Reinach, *Recueil des inscr. juridiques gr.* (1891-1898).

Besides the inscribed *treaties* previously referred to, we may instance the following: Between Athens and Chalcis in Euboea, 446 B.c. (*I.G.* suppl. to vol. i. 27A); between Athens and Rhegium, 433 B.C. (Hicks[2], 51); between Athens and Leontini, dated the same day as the preceding (*ibid.* 52); between Athens and Boeotia, 395 B.C. (*ibid.* 84); between Athens and Chalcis, 377 B.C. (*ibid.* 102); between Athens and Sparta, 271 B.C. (*I.G.* ii. No. 332); between Hermias of Atarneus and the Ionian Erythrae, about 350 B.C. (Hicks[2] 138); treaties in the local dialect between the Eleans and the Heraeans, 6th century (*Olympia Inschr.* 9), and between various cities of Crete, 3rd century B.C. (*C.I.G.* 2554-2556; *Griech. Dial. Inschr.* 5039-5041, 5075). Egger's *Études historiques sur les traités publics chez les Grecs et chez les Romains* (Paris, 1866) embraces a good many of these documents; see also R. von Scala, *Die Staatsverträge des Altertums*, pt. i. (1898).

The international relation of Greek cities is further illustrated by *awards* of disputed lands, delivered by a third city called in (ἔκκλητος πόλις) to arbitrate between the contending states, *e.g.* Rhodian award as between Samos and Priene (*Gk. Inscr. in Brit. Mus.* 405; Dittenberger, *Syll.*[2] 315); Milesian between Messanians and Spartans, discovered at Olympia (*ibid.* 314; see Tac. *Ann.* iv. 43); and many others. Akin to these are decrees in honour of judges called in from a neutral city to try suits between citizens which were complicated by political partisanship (see *C.I.G.* No. 2349B, with Boeckh's remarks; *I.G.* xii. 722). On the general subject, E. Sonne, *De arbitris extends* (1888).

Letters from kings are frequent; as from Darius I. to the satrap Gadates, with reference to the shrine of Apollo at Magnesia (Hicks[2], 20); from Alexander the Great to the Chians (*ibid.* 158); from Lysimachus to the Samians (*C.I.G.* 2254; Hicks[1], 152); from Antigonus I. directing the transfer of the population of Lebedus to Teos (Dittenberger, *Syll.*[2] 177); from the same to the Scepsians (Dittenberger, *Or. Gr. Inscr. Sel.* 5), Letters from Roman emperors are commoner still; such as Dittenberger, *Syll.*[2] 350, 356, 373, 384-388, 404.

The internal administration of Greek towns is illustrated by the minute and complete lists of the treasures in the Parthenon of the time of the Peloponnesian War (Boeckh, *Staatshaush.*[3] vol. ii.); public accounts of Athenian expenditure (*ibid.*); records of the Athenian navy in the 4th century, forming vol. iii. of the 1840 ed. of the same work. To the same category belong the so-called Athenian tribute-lists, which are really lists of the quota (of the tribute paid by the Athenian allies) which was due to the treasury of Athena (ἀπαρχαί τῇ θεῷ μνᾶ ἀπο ταλάντου). Being arranged according to the tributary cities, they throw much light on the constitution of the Athenian empire at the time (*I.G.* i. 226-272 and suppl. p. 71 f.; Köhler, *Urkunden und Untersuchungen zur Gesch. des attisch-delischen Seebundes* 1870; Boeckh, *Staatshaush.*[3] ii. 332-498). The management of public lands and mines is specially illustrated from inscriptions (Boeckh, *op. cit.* vol. i. passim); and the political constitution of different cities often receives light from inscriptions which cannot be gained elsewhere (*e.g.* see the document from Cyzicus, *C.I.G.* 3665, and Boeckh's note, or that from Mytilene, Dittenberger, *Or. Gr. Inscr.* 2, and the inscriptions from Ephesus, Gk. *Inscr. in Brit. Mus.* pt. iii. § 2).

Inscriptions in honour of kings and emperors are very common. The *Marmor Ancyranum* (ed. Mommsen,[2] 1883) has already been mentioned; but an earlier example is the *Monumentum Adulitanum* (from Abyssinia, *C.I.G.* 5127A); Dittenberger, (*Inscr. or. Gr.* 54) reciting the achievements of Ptolemy III. Euergetes I.

Offerings in temples (ἀναθήματα) are often of great historical value, *e.g.* the dedications on the columns of Croesus at Ephesus mentioned above; Gelo's dedication at Delphi, 479 B.C. (Hicks[2] 16); the helmet of Hiero, now in the British Museum, dedicated at Olympia after his victory over the Etruscans, 474 B.C. (*C.I.G.* 16; Hicks[2] 22); and the bronze base of the golden tripod dedicated at Delphi after the victory of Plataea, and carried off to Constantinople by Constantine (Dethier and Mordtmann, *Epigraphik von Byzantion*, 1874; Hicks[2] 19).

2. The religion of Greece in its external aspects is the subject of a great number of inscriptions

(good selections in Dittenberger, *Syll.*[2] 550-816, and Michel 669-1330). The following are a few specimens. (1) Institution of festivals, with elaborate ritual directions: see Sauppe, *Die Mysterieninschrift aus Andania* (1860); Dittenberger, *Syll.*[2] 653, and the singular document from the Ephesian theatre in *Gk. Inscr. in Brit. Mus.* 481; the following also relate to festivals—*C.I.G.* 1845, 2360, 2715, 3059, 3599, 3641b; Dittenberger, *Syll.*[2] 634 (the lesser Panathenaea) and *Or. Gr. Inscr.* 383 (law of Antiochus I. of Commagene). (2) Laws defining the appointment, duties or perquisites of the priesthood: Dittenberger, *Syll.*[2] 601; Boeckh, *Staatshaush*. ii. 109 seq. (3) Curious calendar of sacrifices from Myconus: Dittenberger, *Syll.*[2] 615. (4) Fragment of augury rules, Ephesus, 6th century B.C.: *ibid.* 801. (5) Leases of τεμένη and sacred lands (see Dareste, &c., *Inscr. jur. Gr.* ii. § 19 and commentary). (6) Imprecations written on lead, and placed in tombs or in temples: Wünsch, *I.G.* iii. App.; Audollent, *Defixionum tabellae* (1904). (7) Oracles are referred to *I.G.* xii. 248; Michel 840-856. (8) Among the inscriptions from Delphi few are more curious than those relating to the enfranchisement of slaves under the form of sale to a god (see *Gr. dial. Inschr.* nos. 1684-2342); for enfranchisement-inscriptions of various kinds, Dareste, &c., *Inscr. jur. Gr.* § xxx. (9) Cures effected in the Asclepieum at Epidaurus (Dittenberger, *Syll.*[2] 802-805). (10) Inventories, &c., of treasures in temples: Michel 811-828, 832, 833, &c. (11) Inscriptions relating to dramatic representations at public festivals: A. Wilhelm, *Urkunden dramatischer Aufführungen in Athen* (Vienna, 1906). This catalogue might be enlarged indefinitely.

Religious Inscriptions.

3. There remain a large number of inscriptions of a more strictly private character. The famous Parian marble (*I.G.* xii. 444) falls under this head; it was a system of chronology drawn up, perhaps by a schoolmaster, in the 3rd century B.C. The excessive devotion of the later Greeks to athletic and other competitions at festivals is revealed by the numerous dedications made by victorious competitors who record their successes (see Michel 915-960; Dittenberger, *Syll.*[2] 683 f.). The dedications and honorary inscriptions relating to the Ephebi of later Athens (which occupy half of *I.G.* iii. pt. 1), dreary as they seem, have yet thrown a curious light upon the academic life of Roman Athens (see A. Dumont, *Essai sur l'éphébie attique*; Reinach, *Traité*, pp. 408-418; Roberts and Gardner ii. 145); and from these and similar late inscriptions the attempt has been made to construct *Fasti* of the later archons (von Schöffer in Pauly-Wissowa, *Realencyklopädie, s.v.* "Archontes"; W. S. Ferguson in *Cornell Studies*, x. The sepulchral monuments have been beautifully illustrated in Stackelberg's *Gräber der Hellenen*; for the Attic stelae see Conze, *Die attischen Grabreliefs* (1893 ff.). Some of the most interesting epitaphs in the *C.I.G.* are from Aphrodisias and Smyrna. Kumanudes's collection of Attic epitaphs has been mentioned above; see also Gutscher, *Die attischen Grabschr.* (1889); they yield a good deal of information about the Attic demes, and some of them are of high importance, *e.g.* the epitaph on the slain in the year 458 B.C. (Dittenberger, *Syll.*[2] 9), and on those who fell in the Hellespont, c. 440 B.C. (Hicks[2] 46). For the metrical inscriptions see Kaibel, *Epigrammata Graeca* (1878). Closely connected with sepulchral inscriptions is the famous "Will of Epicteta" (*I.G.* xii. 330). It was also customary at Athens for lands mortgaged to be indicated by boundary-stones inscribed with the names of mortgagor and mortgagee, and the amount (*I.G.* ii. 1103-1153; Dareste, &c., *Inscr. jur.* i. pp. 107-142); other ὅροι are common enough.

Private Inscriptions.

The names of sculptors inscribed on the bases of statues have been collected by E. Löwy (*Inschriften gr. Bildhauer*, 1885). In most cases the artists are unknown to fame. Among the exceptions are the names of Pythagoras of Rhegium, whom we now know to have been a native of Samos (Löwy 23, 24); Pyrrhus, who made the statue of Athena Hygieia dedicated by Pericles (Plut. *Per.* 13; Löwy 53); Polyclitus the younger (Löwy 90 f.), Paeonius of Mende, who sculptured the marble Nike at Olympia (Löwy 49); Praxiteles (Löwy 76), &c.

The bearing of inscriptions upon the study of dialects is very obvious. A handy selection has been made by Cauer (*Delectus inscr.* Gr. 2nd ed., Leipzig, 1883) of the principal inscriptions illustrating this subject, and a complete collection is in course of publication (Collitz and others, *Sammlung der griechischen Dialekt-Inschriften*, Göttingen, 1884 ff.). See also R. Meister, *Die griech. Dialekte* (1882-1889), and O. Hoffman, *Die griech. Dialekte* (1891-1898). The grammar of Attic inscriptions is treated by Meisterhans, *Grammatik der att. Inschr.* (3rd ed. by Schwyzer, 1900).

Study of Dialects.

The date of inscriptions is determined partly by the internal evidence of the subject, persons, and events treated of, and the character of the dialect and language. But the most important evidence is the form of the letters and style of execution. For the Attic inscriptions the development from the earliest times to about A.D. 500 is elaborately treated by Larfeld, *Handbuch der att. Inschr.* (1902). bk. ii. Much of the evidence is of a kind difficult to appreciate from a mere description. Yet—besides the βουστροφηδόν writing of many early documents—we may mention the contrast between the stiff, angular characters which prevailed before 500 or 450 B.C. and the graceful yet simple forms of the Periclean age. This development was part of the general movement of the time. Inscriptions of this period are usually written στοιχηδόν, *i.e.* the letters are in line vertically as well as horizontally. From the archonship of Eucleides (403 B.C.) onwards the Athenians officially adopted the fuller alphabet which had obtained in Ionia since the 6th century. Before 403 B.C. ζ and ψ were expressed in Attic inscriptions by ΧΣ and φΣ, while E did duty for η, ε, and

Date of Inscriptions.

sometimes ει, O for ο, ου, and ω—H being used only for the aspirate. There is, however, occasional use of the Ionic alphabet in Attica, even in official inscriptions, as early as the middle of the 5th century. The Macedonian period betrays a falling off in neatness and firmness of execution—the letters being usually small and scratchy, excepting in inscriptions relating to great personages, when the characters are often very large and handsome. In the 2nd century came in the regular use of *apices* as an ornament of letters. These tendencies increased during the period of Roman dominion in Greece, and gradually, especially in Asia Minor, the *iota adscriptum* was dropped. The Greek characters of the Augustan age indicate a period of restoration; they are uniformly clear, handsome, and adorned with *apices*. The lunate epsilon and sigma (ε, **C**) establish themselves in this period; so does the square form ⊏, and the cursive ω is also occasionally found. The inscriptions of Hadrian's time show a tendency to eclectic imitation of the classical lettering. But from the period of the Antonines (when we find a good many pretty inscriptions) the writing grows more coarse and clumsy until Byzantine times, when the forms appear barbarous indeed beside an inscription of the Augustan or even Antonine age.

Collections of Marbles.

The finest collections of inscribed Greek marbles are of course at Athens. There are also good collections, public and private, at Smyrna and Constantinople. The British Museum contains the best collection out of Athens (see the publication mentioned above); the Louvre contains a good many (edited by Fröhner, *Les Inscriptions grecques du musée du Louvre*, 1865); the Oxford collection is very valuable, and fairly large; and there are some valuable inscriptions also at Cambridge.

Bibliography.—The following essays give good outlines of the whole subject:—Boeckh, *C.I.G.*, preface to vol i.; C. T. Newton, *Essays on Art and Archaeology* (1880), pp. 95, 209; S. Reinach, *Traité d'épigraphie grecque* (Paris, 1885). Besides the works already quoted the following should be mentioned:—Boeckh's *Kleine Schriften*; Michaelis, *Der Parthenon*; Waddington, *Fastes des provinces asiatiques*, part i. (1872), and *Mémoire sur la chronologie de la vie du rhéteur Aristide*; Kirchhoff, *Studien zur Geschichte des griechischen Alphabets* (4th ed., 1887); Schubert, *De proxenia* (Leipzig, 1881); Monceaux, *Les Proxénies gr.* (Paris, 1886); Latyshev, *Inscr. ant. orae septentr. Ponti Euxini Gr. et Lat.* (2 vols., St Petersburg, 1885-1890); Bechtel, *Inschriften des ionischen Dialekts* (Göttingen, 1887); Paton and Hicks, *Inscriptions of Cos* (Oxford, 1891); Fränkel and others, *Inschriften von Pergamon* (2 vols., Berlin 1890-1895); Comparetti, *Le Leggi di Gortyna*, &c. (*Monum. antichi*, iii., 1893); E. Hoffmann, *Sylloge epigrammatum Graec.* (Halle a. S., 1893); O. Kern, *Inschriften von Magnesia am Maeander* (Berlin, 1900); S. Chabert, *Histoire sommaire des études d'épigraphie grecque* (Paris, 1906); Hackl, *Merkantile Inschr. auf attischen Vasen* (*Münch, arch Stud.*, 1909); Wilhelm, *Beiträge zur griech. Inschriftenkunde* (Vienna, 1909).

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IV. Latin Inscriptions

I. Latin or Roman Inscriptions (by which general name are designated, in classical archaeology, all non-literary remains of the Latin language, with the exception of coins, letters and journals) fall into two distinct classes, viz. (1) those which were written upon other objects of various kinds, to denote their peculiar purpose, and in this way have been preserved along with them; and (2) those which themselves are the objects, written, to be durable, as a rule, on metal or stone. The first class is that of *inscriptions* in the stricter sense of the word (styled by the Romans *tituli*, by the Germans *Aufschriften*); the second is that of instruments or charters, public and private (styled by the Romans first *leges*, afterwards *instrumenta* or *tabulae*, and by the Germans *Urkunden*).

No ancient Latin authors have professedly collected and explained or handed down to us Roman inscriptions. Some of the orators and historians, such as Cicero, Livy, Pliny the elder, and Suetonius among the Latins, and Polybius, Dionysius of Halicarnassus and Josephus among the Greeks, occasionally mention inscriptions of high historical interest. A few grammarians, as, for example, Varro, Verrius Flaccus and Valerius Probus of Berytus, quote ancient words or *formulae* from them, or explain the abbreviations used in them. Juridical instruments, laws, constitutions of emperors, *senatus consulta* and the like appear in the various collections of Roman jurisprudence.

Inscriptions (in the wider sense, as we shall henceforth call them without regard to the distinction which has been drawn) have been found in nearly every centre of ancient Roman life, but, like many other remains of antiquity, only seldom in their original sites. The great mass of them has to be sought for in the large European museums of ancient art, and in the smaller local collections of ancient remains which occur nearly everywhere in the European provinces of the former Roman empire as well as in the north of Africa, and also here and there in Asia Minor.

Only those copies of inscriptions are to be received with full confidence which are furnished by experienced and well-equipped scholars, or which have been made with the help of mechanical methods (casts, photographs, moist and dry rubbings), not always applicable with equal success, but depending on the position and the state of preservation of the monuments.[36] From the first revival of classical learning in the Carolingian age attention was paid anew, by pilgrims to Rome

and other places worth visiting, to epigraphic monuments also. In the time of the Renaissance, from the end of the 14th century downwards, some of the leading Italian scholars, like Poggio and Signorili, and the antiquarian traveller Cyriacus of Ancona, collected inscriptions, Greek and Latin.[37] In the 15th century large collections of the inscriptions of all countries, or of limited districts, were made by Giovanni Marcanova, Fra Felice Feliciano, Fra Michele Ferrarino, Fra Giocondo the architect of Verona, Marino Sanudo the Venetian polyhistor, and others. At the end of the 15th and the beginning of the 16th, the first printed collections can be recorded (Spreti's for Ravenna, 1489; Peutinger's for Augsburg, 1508; Huttich's for Mainz, 1520; Francesco degli Albertini's for Rome, printed in 1521 by Jacopo Mazochi), while during the same century a long list of epigraphic travellers, like Pighius, Rambertus and Accursius, or antiquarian collectors, like Sigonius, Panvinius, Antonius Augustinus with his collaborators Ursinus and Metellus, and many others, were busy in augmenting the stock of epigraphic monuments. The series of printed epigraphic *Corpora* begins with that of Apianus (Ingolstadt, 1534), the only one arranged in geographical order, and is continued in those of Smetius (1558, but edited only after the author's death by Justus Lipsius, 1588), Gruter (with Joseph Scaliger's *Indices*, 1603, and re-edited by Graevius, 1707), Gudius (about 1660, edited by Hessel, 1731), Reinesius (1682), Fabretti (1699), Gori (1726), Doni (1731), Muratori (1739), Maffei (1749), Donati (1765-1775). These collections, manuscript and printed, will never altogether lose their value, as great numbers of inscriptions known to the ancient collectors have since been lost or destroyed. But, inasmuch as even towards the beginning of the 15th century, as well as afterwards, especially from the 16th down to a very recent period, all sorts of inaccuracies, interpolations and even downright falsifications, found their way into the *Corpora*, these can be employed only with the greatest caution. Modern critical research in the field of epigraphy began with the detection of those forgeries (especially of the very extensive and skilful ones of Pirro Ligorio, the architect to the house of Este) by Maffei, Olivieri and Marini. The last-named scholar opens a new era of truly critical and scientific handling of Roman inscriptions (especially in his standard work on the *Atti dei fratelli arvali*, Rome, 1795); his disciple and successor, Count Bartolomeo Borghesi (who died at San Marino in 1860), may be rightly called the founder of the modern science of Roman epigraphy.[38] Orelli's handy collection of Roman inscriptions (2 vols., Zurich, 1828) is a first attempt to make accessible to a larger scientific public the results of the researches of Marini and his successors; but it was not completed, (and thoroughly corrected) until nearly thirty years later, by Henzen (Orelli, iii., with the indispensable *Indices*, Zurich, 1856), who, with Mommsen and De Rossi, carried out the plan of a universal *Corpus inscriptionum Latinarum*, previously projected by Maffei (1732), by Kellermann and Sarti (1832), with Borghesi's help, and by Letronne and Egger (1843). After the appearance of Mommsen's *Inscriptiones regni Neapolitani Latinae* (Leipzig, 1852) and his *Inscriptiones confoederationis Helveticae Latinae* (vol. x. of the publications of the Zurich Antiquarian Society, 1854), the publication of the *C.I.L.*, following the similar work of the Greek inscriptions, was undertaken by the Royal Academy of Sciences of Berlin.

This work, in which the previous literature is fully described and utilized, consists of the following parts:—vol. i., *Inscriptiones antiquissimae ad C. Caesaris mortem* (1863; 2nd ed., part i., 1893); Ritschl's *Priscae Latinitatis monumenta epigraphica* (Berlin, 1862, fol.) form the graphic illustration to vol. i., giving all extant monuments of the republican epoch (with five *Supplementa*, Bonn, 1862-1865; R. Garrucci's *Sylloge inscriptionum Latinarum aevi Romanae reipublicae usque ad C. Iulium Caesarem plenissima*, 2 vols., Turin, 1875-1877, must be used with caution); vol. ii., *Inscr. Hispaniae* (1869; with Supplement, 1892); vol. iii., *Inscr. Asiae, provinciarum Europae Graecarum, Illyrici* (1873; with Supplements and Index, 1889-1902); vol. iv., *Inscr. parietariae Pompeianae Herculanenses Stabianae* (the scratched and painted inscriptions chiefly of Pompeii) (1871; with Supplement, part i., 1898; part ii., 1909); vol. v., *Inscr. Galliae cisalpinae* (1872-1877; with Suppl., Et. Pais, *C.I.L. suppl. Italica*); vol. vi., *Inscr. urbis Romae* (1876-1902; with Supplement, 1902); vol. vii., *Inscr. Britanniae* (1873); vol. viii., *Inscr. Africae* (1881; with Supplement, 1891-1894, 1904); vol. ix., *Inscr. Calabriae, Apuliae, Samnii, Sabinorum, Piceni* (1883); vol. x., *Inscr. Bruttiorum, Lucaniae, Campaniae, Siciliae, Sardiniae* (1883); vol. xi., *Inscr. Aemiliae, Umbriae, Etruriae* (1888; part ii., 1901 sqq.); vol. xii., *Inscr. Galliae Narbonensis* (1888); vol. xiii., *Inscr. trium Galliarum et duarum Germaniarum* (1899 sqq.; part ii., 1905 sqq.); vol. xiv., *Inscr. Latii antiqui*; vol. xv., *Inscr. laterum* (1891; part ii., i. [*vasa, lucernae, fistulae*], 1899). The arrangement observed in the *Corpus* is the geographical (as in Apianus); within the single towns the order of subjects (*tituli sacri*, *magistratuum*, *privatorum*, &c., as in Smetius) is followed, with some few exceptions, where the monuments are so numerous (as in the *forum* of Rome and at Pompeii and Lambaesis) that they can be assigned to their original places. Running supplements to the *C.I.L.* are given in the *Ephemeris epigraphica, Corporis inscr. Latinarum supplementum* (Berlin, 1872 sqq.); and the new discoveries of each year are recorded in Cagnat's *L'Année épigraphique*.

The inscriptions in the other Italian dialects have been published by Conway, *Italic Dialects* (Cambridge, 1897); cf. vol. ii. of von Planta, *Grammatik der oskisch-umbrischen Dialekte* (Strassburg, 1897). A Corpus of the Etruscan inscriptions was begun in 1893 by Pauli and is now nearly complete. The inscriptions of the Veneti, a N. Italian people of the Illyrian stock, will be

found in vol. iii. of Pauli, *Altitalische Forschungen* (Leipzig, 1891). For the Christian inscriptions see De Rossi's *Inscr. Christianae urbis Romae septimo saeculo antiquiores*, vol. i. (Rome, 1857), vol. ii. (1888); the *Inscriptions chrétiennes de la Gaule of Le Blant* (2 vols., Paris, 1857-1865; new edition, 1892); the *Altchristliche Inschriften der Rheinlande* of Kraus (1890); the *Christliche Inschriften der Schweiz vom IV.-IX. Jahrhundert* of Egli (1895); and the *Inscr. Hispaniae Christianae and Inscr. Britanniae Christianae* of Hübner (Berlin, 1871, 1876). As splendidly illustrated works on the Latin inscriptions of some districts Alphonse de Boissieu's *Inscriptions antiques de Lyon* (Lyons, 1846-1854), Ch. Robert's *Épigraphie romaine de la Moselle* (Paris, 1875), and J. C. Bruce's *Lapidarium septentrionale* (London and Newcastle, 1875) can be recommended. Besides the above-mentioned Orelli-Henzen collection, G. Wilmanns's *Exempla inscriptionum Latinarum* (2 vols, Berlin, 1873, with copious indexes), and Dessau's *Inscriptiones Latinae selectae* (vol. i., 1892; vol. ii., 1903; ii., 1906) give a general synopsis of the materials. Inscriptions of interest to students of history are collected in Rushforth's *Latin Historical Inscriptions* (Oxford, 1893); Leroux, *Revue des publications épigraphiques relatives à l'antiquité romaine*, records those which bear on antiquities. Of other works may be mentioned Ruggiero, *Dizionario epigrafico di antichità romane* (1886); Olcott, *Thesaurus linguae Latinae epigraphicae* (1904 sqq.).

II. Information regarding the forms of letters used on Roman inscriptions will be found under the articles Latin Language, Palaeography and Writing (cf. Hübner, *Exempla scripturae epigraphicae Latinae*, 1895). The forms of the single letters vary not inconsiderably according to the material of the monuments, their age and their origin. Carefully cut letters, especially when on a large scale, naturally differ from those scratched or painted on walls by non-professional hands, or hewn on rocks by soldiers; and small incised (or dotted) letters on metal or ivory and bone, and those painted on earthenware, or impressed on it or on glass before burning, are also necessarily of a different character. The letters, ordinarily drawn with *minium* on the monument before being cut (and also often painted, after having been cut, with the same colour), sometimes have been painted with a brush, and thence receive a peculiar form. To save space, on coins first and afterwards in inscriptions also, two or three or even more letters were joined, especially at the end of the lines, to a *nexus* or a *ligatura*. This system of compendious writing, very rare in the republican epoch, and slowly extending itself during the 1st century, became rather frequent in the 2nd and 3rd, especially in Spain and Africa. There is no constant system in these *nexus litterarum*, but generally the rule is observed that no substantial element of a single letter is to be counted for twice (thus *e.g.* is *it* or *ti*, not *Titi*). Numerals are usually distinguished from letters in the ancient period, down to the end of the republic, by a stroke drawn through them, as in **++VIR**, *duo(m) vir(om)* **++S** *duo semis* (*sestertius*),  500; it was afterwards put above them, as in **ĪĪVIR**, **XVIR**,  **VIR**, *duovir*, *decemvir*, *sevir*.[39]

The direction of the writing is in the very oldest inscriptions from right to left and from left to right in alternate lines, an arrangement technically called βουστροφηδόν (D. Comparetti, *Iscrizione arcaica del Foro Romano*, Florence, 1900; H. Jordan, *Hermes*, vol. xv. p. 5, 1880), and in the Sabellic inscriptions similar arrangements are not infrequent. In all others it is from left to right. Each word is separated from the other by a sign of interpunction, which is not wanted, therefore, at the end of lines or of the whole text. Exceptions to this rule occur only in the later period (from the 2nd century downwards), and sometimes under special conditions, as when abridged words form the end of the line. Here and there even the different syllables of each word are separated by interpunction. The interpunction is formed by a single dot (except in some very ancient inscriptions, such as the recently found Forum inscription of the regal period and those of Pisaurum, where, as in Greek and other Italian monuments, three dots ⁖ are used). According to the technical skill of the different periods in stone-cutting this dot is in some very ancient inscriptions quadrangular, or similar to an oblique cross (×), or oblong (as a bold stroke), but, as a rule, triangular, and never circular. This triangular dot changes, by ornamentation, into a hook () or a leaf (); the ivy-leaf-shaped dot is especially frequent in inscriptions from about the 2nd century downwards. The dot is always placed at the middle height of the letters, not, as now, at the foot of the line. In large texts of instruments the interpunction is often omitted; in the later period it is often entirely wanting; and in short texts, in the disposition of the lines, in the varying sizes of the letters employed, in the division of words at the end of the lines, &c., certain rules are observed, which cannot be detailed here. In some instances older inscriptions have been cancelled and more recent ones substituted (*e.g.* on milestones), especially in the case of the *damnatio memoriae* (in cases of high treason), in consequence of which the names of consuls and emperors are often cancelled; but in modern times also inscriptions have been deliberately destroyed or lost ones restored.

For understanding the texts of the inscriptions an accurate knowledge of the system of abbreviations used in them is necessary (see Cagnat, *Cours d'épigraphie latine*, 3rd ed., 1898). These are almost invariably *litterae singulares*; that is to say, the initial letter is employed for the entire word (in all its grammatical forms), or if one initial, as belonging to more than one word, is not sufficiently clear, the first two or even the first three letters are employed; rarely more than three. Abbreviations in the true sense of the word (by dropping some letters at the end) are

to be found, in the older period, only at the end of lines, and not frequently. In the later period some instances of them have been observed. The *litterae singulares*, as Valerius Probus taught, are either generally employed (*usus generalis*) in all classes of written documents (and so in literature also), as, for instance, those of the individual names (the *praenomina*), the names of days and feasts (*kal.* for *kalendae*), and those of the chief magistrates (*cos.* for *consul*) and the like; or they belong chiefly (but not exclusively) to certain classes of documents, such as those used in juridical acts (*l.* for *lex*, *h.* for *heres*, *s. d. m.* for *sine dolo malo*, and so on), in sepulchral inscriptions (*h. s. e.*, *hic situs est*) or in dictatory inscriptions (*v. s. l. m.*, *votum solvit libens merito*), &c.[40]

It may be observed here that the *praenomina* are, as a rule, always written in the universally known abbreviations (in the few instances where they are written in full it is a consequence of Greek influence or of peculiar circumstances). The *gentilicia* in *-ius* are abridged, in the republican period, in *-i* (in the nominative, perhaps for *-is*). In the always abbreviated indications of ancestors or patrons (in the case of slaves and freedmen), as *C.f.*, *Gai filius*, *M.l.*, *Marci libertus* (*s.* for *servus* is not frequent), the feminine gender is sometimes indicated by inversion of the letters. Thus Ↄ. *l.* (or *lib.*) or **W** (an inverted **M**) *l.* designates a *mulieris libertus*; ꟻ and ꟻ are used for *filia*, *pupilla*. On the *tribus* and their abbreviations, and on the so-called military *tribus* (which are names of colonies collocated, for the sake of symmetry, at the place usually occupied, in the nomenclature, by the *tribus*), and on the other indications of origin used in the designation of individuals, the indexes to the above-named works give sufficient information; on the geographical distribution of the *tribus* see Grotefend's *Imperium Romanum tributim descriptum* (Hanover, 1863). For the abbreviations of official charges, urban and municipal, and, in the imperial period, civil and military (to which, beginning with the 4th century, some Christian designations are to be added), see also the explanations given in the indexes. Among these abbreviations the first instances are to be found of the indication of the plural number by doubling the last letter; thus *Augg.*, *Caess.*, *coss.*, *dd. nn.* (*domini nostri*), are used from the 3rd century downwards (see De Rossi's preface to the *Inscriptiones Christ. urbis Romae*) to distinguish them from *Aug.*, *Caes.*, as designating the singular. In the later period, a dot or a stroke over the abridged word, like that upon numerals, here and there indicates the abbreviation.

III.—1. Among the inscriptions in the stricter sense (the *tituli*), perhaps the oldest, and certainly the most frequent, are the *sepulchral inscriptions* (*tituli sepulcrales*). Of the different forms of Roman tombs, partly depending upon the difference between burial and cremation, which were in use side by side, a very complete account is given in Marquardt's *Handbuch der römischen Altertümer* (vol. vii. part i., Leipzig, 1879, p. 330 seq.). The most ancient examples are those of a *sepulcretum* at Praeneste (*C.I.L.* i. 74, 165, 1501 *a-d*; *Ephem. epigr.* i. 25-131; Wil. 153); the oldest of these contain nothing but the name of the deceased in the nominative; those of more recent date give it in the genitive. The oldest and simplest form remained always in use down to Christian times; it is that used on the large tectonic monuments of the Augustan age (*e.g.* that of Caecilia Metella, *C.I.L.* vi. 1274) and in the *mausolea* of most of the emperors, and is still frequent in the *tituli* of the large *columbaria* of the same age (*C.I.L.* vi. part ii.). It was early succeeded by the lists of names, given also in the nominative, when more than one individual, either dead or alive, were to be indicated as sharers of a tomb. To distinguish the members still alive, a *v* (*vivit*, *vivos*, *vivi*) was prefixed to their names (*e.g. C.I.L.* i. 1020, 1195, 1271); the deceased were sometimes marked by the θῆτα *nigrum* (*C.I.L.* i. 1032; Wil. 158; see also *C.I.L.* vi. 10251 seq.). Only the names in the nominative are shown, too, on the *sarcophagi* of the *Turpleii* and *Fourii* at Tusculum (*C.I.L.* i. 65-72; Wil. 152), and in the oldest inscriptions on those of the *Scipiones*, painted with *minium* (*C.I.L.* i. 29; Wil. 537), to which were added afterwards the insignia of the *magistratus curules* (*C.I.L.* i. 31; Wil. 538) and the poetical *elogia*. Of a somewhat different kind are the inscriptions scratched without much care on very simple earthen vessels which belonged to a *sepulcretum* of the lower class, situated outside the *porta Capena* at Rome, on the Appian road, near the old church of San Cesario (*C.I.L.* i. 882-1005, 1539, 1539 *a-d* = *C.I.L.* vi. 8211-8397; Wil. 176); they can be ascribed to the period of the Gracchi. On these *ollae*, besides the name of the deceased, also for the most part in the nominative, but on the more recent in the genitive, the date of a day, probably that of the death, is noted; here and there *obit* (or *o.*) is added. About the same epoch, at the beginning of the 6th century, along with the growing taste for tectonic ornamentation of the tombs in the Greek style, poetical epigrams were added to the simple sepulchral *titulus*, especially amongst the half-Greek middle class rapidly increasing in Rome and Italy; Saturnian (*C.I.L.* i. 1006), iambic (1007-1010) and dactylic (1011) verses become more and more frequent in epitaphs (see Buecheler, *Anthologia Latina*, ii.). In prose also short designations of the mental qualities of the deceased (*homo bonus*, *misericors*, *amans pauperum*, or *uxor frugi*, *bona*, *pudica* and the like), short dialogues with the passer-by (originally borrowed from Greek poetry), as *vale salve*, *salvus ire*, *vale et tu*, *te rogo praeteriens dicas* "*sit tibi terra levis*," &c. (Wil. 180), then indications of his condition in his lifetime, chiefly among the Greek tradesmen and workmen, *e.g. lanius de colle Viminale* (*C.I.L.* i. 1011), *margaritarius de sacra via* (1027) and the like, and some formulae, such as *ossa hic sita sunt*, *heic cubat*, *heic situs est* (in republican times mostly written in full, not abridged) were added (J. Church "Zur Phraseologie der lat. Grabinschriften" in *Arch. lat. Lexikogr.* 12. 215 sqq.). The

habit of recording the measurement of the sepulchre, on the sepulchral *cippus*, by such formulae as *locus patet in fronte pedes tot*, *in agro* (or *in via*, or *retro*) *pedes tot*, seems not to be older than the Augustan age (*C.I.L.* i. 1021, with Mommsen's note; Wil. 188). About the same time also the epitaphs more frequently state how long the deceased lived, which was formerly added only on certain occasions (*e.g.* in the case of a premature death), and mostly in poetical form. The worship of the *dei Manes*, though undoubtedly very ancient, is not alluded to in the sepulchral inscriptions themselves until the close of the republic. Here and there, in this period, the tomb is designated as a (*locus*) *deum Maanium* (*e.g.* at Hispellum, *C.I.L.* i. 1410); or, it is said, as on a *cippus* from Corduba in Spain (*C.I.L.* ii. 2255; Wil. 218), *C. Sentio Sat(urnino) co(n)s(ule)*—that is, in the year 19 B.C.—*dei Manes receperunt Abulliam N(umerii) l(ibertam) Nigellam*. In the Augustan age the *titulus sepulcralis* begins to be confounded with the *titulus sacer*; it adopts the form of a dedication *deis Manibus*, offered to the *dei Manes* (or *dei inferi Manes*, the *dei parentum* being the *Manes* of the parents) of the deceased (see Orel. 4351; Wil. 217-228). This formula, afterwards so common, is still very rare at the end of the republic, and is usually written in full, while in later times it is employed, both simply and in many varied forms (as *dis manibus sacrum*, or *d. m. et memoriae*, *d. m. et genio*, or *memoriae aeternae*, *paci et quieti*, *quieti aeternae*, *somno aeternali* and so on; Wil. 246), in thousands of monuments. By similar degrees the *titulus sepulcralis* adopts many of the elements of the *titulus honorarius* (the indication of the *cursus honorum*, of the military charges, &c., as *e.g.* in the inscription of Cn. Calpurnius Piso, *C.I.L.* i. 598 = vi. 1276, Wil. 1105, on the pyramid of Cestius, *C.I.L.* vi. 1374, and on the monument at Ponte Lucano of Ti. Plautius Silvanus Aelianus, consul A.D. 74, Orel. 750, Wil. 1145 and many others), of the *tituli operum publicorum* (*e.g. monumentum fecit*, *sibi et suis*, &c.), and of the *instrumenta*. Testaments (like those of Dasumius of the year A.D. 109.—*C.I.L.* vi. 10229; Wil. 314; and T. Flavius Syntrophus—*C.I.L.* vi. 10239; Henz. 7321; Wil. 313), or parts of them (like that on the tomb of a Gaul of the tribe of the Lingones, belonging to Vespasian's time, Wil. 315), funeral orations (as those on Turia—*C.I.L.* vi. 1527; *Notizie degli scavi* (1898), p. 412; Hirschfeld, *Wiener Studien Bormannheft*, p. 283; Fowler, *Classical Review*, xix. 261; on Murdia —*C.I.L.* vi. 10230; Orel. 4860; Rudorff, *Abhandlungen der Königl. Akademie der Wissenschaften zu Berlin* (1868), p. 217 seq.; and that of Hadrian on the elder Matidia, found at Tivoli—Mommsen in the same *Abhandlungen* (1863), p. 483 seq; Dehner, *Laudatio Matidiae*, Neuwied (1891), numerous statements relating to the conservation and the employment of the monuments (*C.I.L.* vi. 10249; Wil. 287-290), to their remaining within the family of the deceased—from which came the frequent formula "*h(oc) m(onumentum) h(eredem) n(on) s(equetur)*" and the like (Wil. 280; cf. Hor. Sat. i. 8. 13),—and relating to the annual celebration of *parentalia* (Wil. 305 seq.), down to the not uncommon prohibition of violation or profanation of the monument *noli violare*, &c., with many other particulars (on which the index of Wil. p. 678 seq. may be consulted), form the text of the sepulchral inscriptions of the later epoch from Augustus downwards. The thoroughly pagan sentiment *non fui non sum non curo*, or *n. f. n. s. n. c.*, is common, apparently a translation of the Greek οὐκ ἤμην, ἐγενόμην οὐκ ἔσομαι οὐ μέλει μοι. Another type of epitaph, much affected by the poorer classes (like our "Affliction sore" &c.), is: *noli dolere mater eventum meum, Properavit aetas, hoc voluit fatus* (sic) *mihi* (Lier, "Topica carminum sepulcralium Latinorum" in *Philologus*, 62. 445 sqq.). To these are to be added many local peculiarities of provinces (as Spain and Africa), districts (as the much-disputed *sub ascia dedicare* of the stones of Lyons and other parts of Gaul), and towns, of which a full account cannot be given here.

2. Of the *dedicatory inscriptions* (or *tituli sacri*), the oldest known are the short indications painted (along with representations of winged *genii*, in the latest style of Graeco-Italian vase painting), with white colour on black earthen vessels, by which those vessels (*pocula*) are declared to be destined for the worship, public or private, of a certain divinity (*C.I.L.* i. 43-50; *Ephem. epigr.* i. 5-6; Wil. 2827 a-i); they give the name of the god, as that of the possessor, in the genitive (*e.g. Saeturni pocolom*, *Lavernai pocolom*). The proper form of the dedication, the simple dative of the name of a divinity and often nothing else (as *Apolenei*, *Fide*, *Junone*, &c., which are all datives), is shown on the very primitive altars found in a sacred wood near Pisaurum (*C.I.L.* i. 167-180; Wil. 1-14); but also the name of the dedicants (*matrona*, *matrona Pisaurese*, which are nomin. plur.) and the formulae of the offering (*dono dedrot* or *dedro*, *donu dat*, where *dono* and *donu* are accus.) are already added to them. This most simple form (the verb in the perfect or in the present) never disappeared entirely; it occurs not infrequently also in the later periods. Nor did the dative alone, without any verb or formula, go entirely out of use (see *C.I.L.* i. 630; Wil. 36; *C.I.L.* i. 814 = vi. 96; Orel. 1850; Wil. 32; *C.I.L.* i. 1153; Henz. 5789; Wil. 1775). But at an early date the verb *donum dare* and some synonyms (like *donum portare*, *ferre*, *mancupio dare*, *parare*) were felt to be insufficient to express the dedicator's good-will and his sense of the justice of the dedication, which accordingly were indicated in the expanded formula *dono dedet lub(e)s mereto* (*C.I.L.* i. 183, cf. p. 555; Wil. 21; *C.I.L.* i. 190; Wil. 22), or, with omission of the verb, *dono mere(to) lib(e)s* (*C.I.L.* i. 182). The dative case and this formula, completely or partially employed (for *merito* alone is also used, as *C.I.L.* i. 562, cf. *Ephem. epigr.* ii. 353, Wil. 29), remained in solemn use. To *lubens* (or *libens*) was added *laetus* (so in Catullus 31. 4), and, if a vow preceded the dedication, *votum solvit* (or *voto condemnatus dedit*; see *C.I.L.* i. 1175; Henz. 5733; Wil. 142, and *C.I.L.* ii. 1044); so, but not before the time of Augustus (see *C.I.L.* i. 1462 = iii. 1772), the solemn formula of the dedicatory inscriptions of the later period, *v. s. l. m.* or *v. s. l. l. m.*, arose. To the same effect, and of equally ancient origin with the solemn words *dare* and *donum dare*, the word *sacrum* (or other forms of it, as *sacra* [*ara*]), conjoined

with the name of a divinity in the dative, indicates a gift to it (*e.g. C.I.L.* i. 814; Wil. 32; *C.I.L.* i. 1200-1201; Wil. 33 *a b*); the same form is to be found also in the later period (*e.g. C.I.L.* i. 1124; Henz. 5624-5637), and gave the model for the numerous sepulchral inscriptions with *dis Manibus sacrum* mentioned before. *Sacrum* combined with a genitive very seldom occurs (Orel. 1824; Wil. 34); *ara* is found more frequently (as *ara Neptuni* and *ara Ventorum*, Orel. 1340). Dedications were frequently the results of vows; so victorious soldiers (such as L. Mummius, the conqueror of Corinth—*C.I.L.* i. 541 seq.; Orel. 563; Wil. 27), and prosperous merchants (*e.g.* the brothers Vertuleii—*C.I.L.* i. 1175; Henz. 5733; Wil. 142) vow a tenth part of their booty (*de praedad*, as is said on the basis erected by one of the Fourii of Tusculum—*C.I.L.* i. 63, 64; Henz. 5674; Wil. 18) or gain, and out of this dedicate a gift to Hercules or other divinities (see also *C.I.L.* i. 1503; Wil. 24; *C.I.L.* 1113; Wil. 43). Again, what one man had vowed, and had begun to erect, is, by his will, executed after his death by others (as the *propylum Cereris et Proserpinae* on the Eleusinian temple, which Appius Claudius Pulcher, Cicero's well-known predecessor in the Cilician proconsulate, began—*C.I.L.* i. 619 = iii. 347; Wil. 31); or the statue that an *aedilis* vowed is erected by himself as *duovir* (*C.I.L.* iii. 500; Henz. 5684); what slaves had promised they fulfil as freedmen (*C.I.L.* 1233, *servos vovit liber solvit*; *C.I.L.* 816, Wil. 51, "*ser(vos) vov(it) leibert(us) solv(it)*"), and so on. The different acts into which an offering, according to the circumstantially detailed Roman ritual, is to be divided (the *consecratio* being fulfilled only by the solemn *dedicatio*) are also specified on dedicatory inscriptions (see for instance, *consacrare* or *consecrare*, Orel. 2503, and Henz. 6124, 6128; for *dedicare*, *C.I.L.* i. 1159, Henz. 7024, Wil. 1782, and compare Catullus's *hunc lucum tibi dedico consecroque Priape*; for *dicare* see the *aara leege Albana dicata* to Vediovis by the *genteiles Iuliei*, *C.I.L.* i. 807, Orel. 1287, Wil. 101). Not exactly dedicatory, but only mentioning the origin of the gift, are the inscriptions on the pedestals of offerings (ἀναθήματα, *donaria*) out of the booty, like those of M. Claudius Marcellus from Enna (*C.I.L.* i. 530; Wil. 25, "*Hinnad cepit*") or of M. Fulvius Nobilior, the friend of the poet Ennius, from Aetolia (*C.I.L.* i. 534; Orel. 562; Wil. 26 a, and *Bullettino dell' Instituto*, 1869, p. 8; *C.I.L.* vi. 1307; Wil. 26 b, "*Aetolia cepit*" and "*Ambracia cepit*"); they contain only the name of the dedicator, not that of the divinity. Of the similar offerings of L. Mummius, already mentioned, two only are preserved in their original poetical form, the Roman in Saturnian verses of a *carmen triumphale* (*C.I.L.* i. 541; Orel. 563; Wil. 27 *a*) and that found at Reate in dactylic hexameters (*C.I.L.* i. 542; Wil. 27 *b*); the rest of them contain only the name of the dedicant and the dative of the community to which they were destined (*C.I.L.* i. and Wil. *l.c.*). Of a peculiar form is the very ancient inscription on a bronze tablet, now at Munich, probably from Rome, where two *aidiles*, whose names are given at the beginning as in the other *donaria*, "*vicesma(m) parti(m)* or [*ex*] *vicesma parti Apalones* (that is, *Apollinis*) *dederi* (that is, *dedere*)" (*C.I.L.* i. 187; Orel. 1433). Many, but not substantial, varieties arise, when old offerings are restored (*e.g. C.I.L.* i. 638, 632 = Orel. 2135, and Wil. 48; *C.I.L.* i. 803; Henz. 5669, 6122); or the source of the offering (*e.g. de stipe*, *C.I.L.* i. 1105; Henz. 5633 a; *ex reditu pecuniae*, *ex patrimonio suo*, *ex ludis*, *de munere gladiatorio*, and so on); or the motive (*ex jusso*, *ex imperio*, *ex visu*, *ex oraculo*, *monitu*, *viso moniti*, *somnio admonitus* and the like), or the person or object, for which the offering was made (*C.I.L.* i. 188, *pro poplod*; *Ephem. epigr.* ii. 208, *pro trebibos*, in the British Museum; *pro se*, *pro salute*, *in honorem domus divinae*, &c.), are indicated; or, as in the *tituli operum publicorum*, the order of a magistrate (*de senati sententia*, *C.I.L.* i. 560 = vi. 1306; Orel. 5351; i. 632 = vi. 110; Orel. 2135; Wil. 48; *decurionum decreto*, &c.), and the magistrates or private persons executing or controlling the work, the place where and the time when it was erected, are added. On all these details the indexes, especially that of Wil. (ii. 675), give further information. The objects themselves which are offered or erected begin to be named only in the later period just as in the *tituli operum publicorum* ("*basim donum dant*," *C.I.L.* i. 1167; "*signum basim*," *C.I.L.* i. 1154; "*aram*," *C.I.L.* i. 1468; Orel. 1466; Wil. 52; *C.I.L.* i. 1109; Wil. 54); in the later period this custom becomes more frequent. It is hardly necessary to observe that all kinds of offerings have very frequently also been adorned with poetry; these *carmina dedicatoria* are given by Buecheler, *Anthologia Latina*, ii.; cf. Wil. 142-151.

3. Statues to mortals, whether living or after their death (but not on their tombs), with *honorary inscriptions* (*tituli honorarii*), were introduced into the Roman republic after the Greek model and only at a comparatively late date. One of the oldest inscriptions of this class comes from Greek soil and is itself Greek in form, with the name in the accusative governed by some (suppressed) verb like "honoured" (*C.I.L.* i. 533; Wil. 649), "*Italicei L. Cornelium Scipionem* (*i.e. Asiagenum*) *honoris caussa*," lost and of not quite certain reading, belonging to 561 A.U.C. (193 B.C.); the same form (in the accusative) appears in other (Latin or Latin and Greek) inscriptions from Greece (*C.I.L.* i. 596 = iii. 532; Wil. 1103; *C.I.L.* iii. 365, 7240; compare also *C.I.L.* i. 587, 588; Orel. 3036). The noble house of the Scipios introduced the use of poetical *elogia* in the ancient form of the *carmina triumphalia* in Saturnian verses (from the 6th century in elegiac distichs). They were added to the short *tituli*, painted only with *minium* on the sarcophagi, giving the name of the deceased (in the nominative) and his curulian offices (exclusively), which were copied perhaps from the well-known *imagines* preserved in the *atrium* of the house (*C.I.L.* i. 29 sq; Orel. 550 sq.; Wil. 537 sq., and elsewhere). They hold, by their contents, an intermediate place between the sepulchral inscriptions, to which they belong properly, and the honorary ones, and therefore are rightly styled *elogia*. What the Scipios did thus privately for themselves was in other cases done publicly at a period nearly as early. The first instance preserved of such a usage, of which Pliny the elder speaks (*Hist. nat.* xxxiv. § 17 sq.), is the celebrated *columna*

rostrata of C. Duilius, of which only a copy exists, made in or before the time of the emperor Claudius (*C.I.L.* i. 195 = vi. 1300; Orel. 549; Wil. 609). Then follow the *elogia* inscribed at the base of public works like the *Arcus Fabianus* (*C.I.L.* i. 606, 607 and 278, elog. i.-iii. = vi. 1303, 1304; Wil. 610), or of statues by their descendants, as those belonging to a *sacrarium domus Augustae* (*C.I.L.* i. elog. iv.-vi. = *C.I.L.* vi. 1310, 1311) and others belonging to men celebrated in politics or in letters, as Scipio, Hortensius, Cicero, &c., and found in Rome either on marble tablets (*C.I.L.* i. vii.-xii. = *C.I.L.* vi. 1312, 1279, 1283, 1271, 1273; Wil. 611-613) or on busts (*C.I.L.* i. xv.-xix. = *C.I.L.* vi. 1327, 1295, 1320, 1309, 1325, 1326; Wil. 618-621; see also *C.I.L.* i. 40 = vi. 1280; Wil. 1101; and *C.I.L.* i. 631 = vi. 1278; i. 640 = vi. 1323, vi. 1321, 1322, where *T. Quincti* seems to be the nominative), and in divers other places (*C.I.L.* i. xiii., xiv.; Wil. 614, 615). This custom seems to have been resumed by Augustus (Suet. *Aug.* 31) with a political and patriotic aim, praised by the poet Horace (*Od.* iv. 8. 13, "*incisa notis marmora publicis, per quae spiritus et vita redit bonis post mortem ducibus*"); for he adorned his *forum* with the statues of celebrated men from Aeneas and Romulus downwards (*C.I.L.* i. xxiv., xxv., xxvii., xxxii. = *C.I.L.* vi. 1272, 1308, 1315, 1318; Wil. 625, 626, 627, 632), and other towns followed his example (so Pompeii, *C.I.L.* i. xx., xxii. = Wil. 622, 623; Lavinium, *C.I.L.* i. xxi.; Wil. 617; Arretium, *C.I.L.* i. xxiii., xxviii., xxix., xxx., xxxi., xxxiii., xxxiv. = Wil. 624, 625, 629-633). All these *elogia* are written in the nominative. In the same way in the colonies statues seem to have been erected to their founders or other eminent men, as in Aquileia (*C.I.L.* i. 538 = v. 873; Wil. 650; compare also *C.I.L.* v. 862; Orel. 3827) and Luna (*C.I.L.* i. 539 = Wil. 651).

But along with this primitive and genuine form of the *titulus honorarius* another form of it, equivalent to the dedicatory inscription, with the name of the person honoured in the dative, begins to prevail from the age of Sulla onwards. For the oldest examples of this form seem to be the inscriptions on statues dedicated to the dictator at Rome (*C.I.L.* i. 584 = vi. 1297; Orel. 567; Wil. 1102*a*) and at other places (Caieta and Clusium, *C.I.L.* i. 585, 586; Wil. 1102*b*, *c*), in which the whole set of honours and offices is not enumerated as in the *elogia*, but only the *honores praesentes*; compare also the inscription belonging to about the same date, of a *quaestor urbanus* (*C.I.L.* i. 636). Within the Greek provinces also, at the same period, this form is adopted (*C.I.L.* i. 595 = iii. 531; Henz. 5294; Wil. 1104). Similar dedications were offered to Pompey the Great (at Auximum and Clusium, *C.I.L.* i. 615, 616; Orel. 574; Wil. 1107) and to his legate L. Afranius (at Bologna, but erected by the citizens of the Spanish colony Valentia, *C.I.L.* i. 601; Henz. 5127; Wil. 1106). They are succeeded by the statues raised to Caesar (at Bovianum, *C.I.L.* i. 620; Orel. 582; Wil. 1108), and, after his death, *iussu populi Romani*, in virtue of a special law, at Rome (*C.I.L.* i. 626 = vi. 872; Orel. 586; Wil. 877). With him, as is well known, divine honours begin to be paid to the *princeps*, even during life. In this same form other historical persons of high merit also begin to be honoured by posterity, as, for example, Scipio the elder at Saguntum (*C.I.L.* ii. 3836; Wil. 653), Marius at Cereatae Marianae, the place which bears his name (*C.I.L.* x. 5782; Wil. 654). Of statues erected by the community of a municipium to a private person, that of L. Popillius Flaccus at Ferentinum seems to be the oldest example (*C.I.L.* i. 1164; Wil. 655, and his note). In Rome, Augustus and his successors in this way permitted the erection of statues, especially to *triumphatores*, in the new *fora*, including that of Augustus (*C.I.L.* vi. 1386; Orel. 3187; Wil. 634; *C.I.L.* vi. 1444; Henz. 5448; Wil. 635) and that of Trajan (*C.I.L.* vi. 1377; Henz. 5478; Wil. 636; vi. 1549; Henz. 5477; Wil. 639; iv. 1549; Orel. 1386; Wil. 637; *C.I.L.* 1565, 1566; Wil. 640); and this custom lasted to a late period (*C.I.L.* vi. 1599; Henz. 3574; Wil. 638), as is shown by the statues of Symmachus the orator (*C.I.L.* vi. 1698, 1699; Orel. 1186, 1187; Wil. 641), Claudian the poet (*C.I.L.* vi. 1710; Orel. 1182; Wil. 642), Nicomachus Flavianus (*C.I.L.* vi. 1782, 1783; Orel. 1188; Henz. 5593; Wil. 645, 645a), and many other eminent men down to Stilicho (*C.I.L.* vi. 1730, 1731; Orel. 1133, 1134; Wil. 648, 648a), who died in the year 408. In similar forms are conceived the exceedingly numerous dedications to the emperors and their families, in which the names and titles, according to the different historical periods, are exhibited, in the main with the greatest regularity. They are specified in detailed indexes by Henzen and Wilmanns, as well as in each volume of the *Corpus*. In the provinces, of course, the usages of the capital were speedily imitated. Perhaps the oldest example of a *titulus honorarius* in the form of an *elogium* (but in the dative), with the full *cursus honorum* of the person honoured, is a *bilinguis* from Athens, of the Augustan age (*C.I.L.* iii. 551; Henz. 6456*a*; Wil. 1122); the honours are here enumerated in chronological order, beginning with the lowest; in other instances the highest is placed first, and the others follow in order.[41] In the older examples the formula "*honoris causa*," or *virtutis ergo* (*Hermes*, vi., 1871, p. 6), is added at the end, as in an inscription of Mytilene belonging to the consul of the year 723 A.U.C., *i.e.* 31 B.C. (*C.I.L.* iii. 455; Orel. 4111; Wil. 1104b); the same, abbreviated (h.c.), occurs on an inscription of about the same age from Cirta in Africa (*C.I.L.* viii. 7099; Wil. 2384). Shortly afterwards the honour of a statue became as common in the Roman *municipia* as it was in Athens and other Greek cities in the later period. Each province furnishes numerous examples, partly with peculiar formulae, on which the indexes of Wilmanns (pp. 673, 696 sq.) may be consulted. Special mention may be made of the numerous honorary inscriptions belonging to *aurigae*, *histriones* and *gladiatores*; for those found in Rome see *C.I.L.* vi. 10,044-10,210.

He who erects a temple or a public building, or constructs a road, a bridge, an aqueduct or the like, by inscribing his name on the work, honours himself, and, as permission to do so has to be given by the public authorities, is also honoured by the community. Therefore the *tituli operum*

publicorum, though in form only short official statements (at least in the older period) of the origin of the work, without any further indications as to its character and purpose, partake of the style of the older honorary inscriptions. Of the ancient and almost universally employed method of erecting public buildings by means of the *locatio censoria* one monument has preserved some traces (*Ephem. epigr.* ii. 199). The oldest instance of this class is that commemorating the restoration of the temple of the Capitoline Jupiter, begun, after its destruction by fire in the year 671 (83 B.C.), by Sulla and continued five years later by the well-known orator and poet Q. Lutatius Catulus, but completed only about twenty years afterwards. Here, after the name of Catulus in the nominative and the indication of the single parts of the building (as, for example, *substructionem et tabularium*), follows the solemn formula *de s(enati) s(ententia) faciundum coeravit eidemque probavit* (*C.I.L.* i. 592 = vi. 1314; Orel. 31, 3267; Wil. 700). With the same formula the praetor Calpurnius Piso Frugi (of about the same period) dedicated an unknown building (*C.I.L.* i. 594 = vi. 1275), restored afterwards by Trajan. On a work executed by the *collegium tribunorum plebis* (*C.I.L.* i. 593 = vi. 1299; Wil. 787), perhaps the public streets within the town, the sum employed for it is also inscribed. Precisely similar is the oldest inscription of one of the bridges of Rome, the *ponte dei quattro capi*, still preserved, though partly restored, on its original site, which commemorates its builder, the tribune of the year 692 (62 B.C.), L. 634
Fabricius (*C.I.L.* i. 600 = vi. 1305; Orel. 50; Wil. 788); it was restored by the consuls of the year 733 (21 B.C.).[42] On privately erected buildings the founder after his name puts a simple *fecit* (as also on sepulchral inscriptions); so, possibly, did Pompey, when he dedicated his theatre as a temple of Venus Victrix and, on Cicero's clever advice, as Varro and Tiro had it from Cicero himself, inscribed on it COS. TERT (not *tertium* or *tertio*) (see Gellius, *Noct. Att.* x. 1). So Agrippa, when he dedicated his Pantheon in the year 727 (27 B.C.), inscribed on it only the words *M. Agrippa, L. f. cos. tertium fecit* (*C.I.L.* vi. 896; Orel. 34; Wil. 731), as all who visit the Eternal City know. Of municipal examples it will be sufficient to name those of the majestic temple of Cora (*C.I.L.* i. 1149-1150; Wil. 722, 723), of Ferentinum, with the measurements of the foundation (*C.I.L.* i. 1161-1163; Wil. 708), of the walls and towers at Aeclanum (*C.I.L.* i. 1230; Orel. 566; Henz. 6583; Wil. 699), of the theatre, amphitheatre, baths and other structures at Pompeii (*C.I.L.* i. 1246, 1247, 1251, 1252; Orel. 2416, 3294; Henz. 6153; Will. 730, 1899-1901). At Aletrium a munificent citizen gives an enumeration of a number of works executed by him in the period of the Gracchi, in his native town ("*haec quae infera scripta sunt de senatu sententia facienda coiravit,*" *C.I.L.* i. 1166; Orel. 3892; Wil. 706); and, more than a century later, the same is done at Cartima, a small Spanish town near Malaga, by a rich woman (*C.I.L.* ii. 1956; Wil. 746). Military works, executed by soldiers, especially frequent in the Danubian provinces, Africa, Germany and Britain, give, in this way, manifold and circumstantial information as to the military administration of the Romans. On a column found near the bridge over the Minho at Aquae Flaviae, the modern Chaves in northern Portugal, ten communities inscribed their names, probably as contributors to the work, with those of the emperors (Vespasian and his sons), the imperial legate of the province, the legate of the legion stationed in Spain, the imperial *procurator*, and the name of the legion itself (*C.I.L.* ii. 2477; Wil. 803); and similarly, with the name of Trajan, on the famous bridge over the Tagus at Alcántara, in Spanish Estremadura, the names of the *municipia provinciae Lusitaniae stipe conlata quae opus pontis perfecerunt* are inscribed (*C.I.L.* ii. 759-762; Orel. 161, 162; Wil. 804).

As in some of the already-mentioned inscriptions of public works the measurements of the work to which they refer (especially, as may be supposed, in the case of works of great extent, such as walls of towns or lines of fortification, like the walls of Hadrian and Antoninus Pius in Britain) are indicated, so it early became a custom in the Roman republic to note on *milestones* the name of the founder of the road and, especially at the extremities of it and near large towns, the distances. So in the *val di Diana* in Lucania P. Popillius Laenas, the consul of the year 622 (132 B.C.), at the end of a road built by him, set up the *miliarium Popilianum* (*C.I.L.* i. 551; Orel. 3308; Wil. 797), which is a general elogium to himself, in which he speaks in the first person (*viam fecei ab Regio ad Capuam*, &c.). One of the single *miliaria* set up by him is also preserved (*C.I.L.* i. 550; Henz. 7174 *d*; Wil. 808), which contains only his name and the number of miles. In the same brief style are conceived the other not very frequent republican miliaria found in Italy (*C.I.L.* i. 535-537; Henz. 5348; Wil. 567; *C.I.L.* i. 540; Henz. 5350, 6226; Wil. 807; *C.I.L.* i. 558, 559; Henz. 5353; Wil. 808; *C.I.L.* i. 561; Henz. 5180; Wil. 811; *C.I.L.* i. 633; Wil. 812) down to the time of Augustus (*C.I.L.* x. 6895, 6897, 6899; Wil. 813), and also the even more rare specimens from the provinces (from Asia—*C.I.L.* i. 557 = iii. 479, Wil. 826, *C.I.L.* i. 622 = iii. 462, Wil. 827; from Spain—*C.I.L.* i. 1484-1486 = ii. 4920-4925, 4956, Wil. 828, 829). Augustus inscribed on each milestone on his road across Spain "*a Baete et Jano Augusto ad Oceanum*" (*e.g. C.I.L.* ii. 4701; Wil. 832), Claudius on those of a road in Upper Italy founded by his father Drusus "*viam Claudiam Augustam quam Drusus pater Alpibus bello patefactis derexserat munit ab Altino* (or *a flumine Pado*) *ad flumen Danuvium*" (*C.I.L.* v. 8002, 8003; Orel. 648, 708; Henz, 5400; Wil. 818). The later milestones vary greatly in form, but all contain most precious materials for ancient geography and topography; in the volumes of the *Corpus* they are taken together under the special head *viae publicae* (and here and there *privatae*) at the end of each chapter.

A similar character, resulting from the combination of a mere authentic record with the peculiar form of the honorary inscription, belongs to the kindred classes of *inscriptions of the aqueducts* and of the different *boundary-stones*. The large dedicatory inscriptions of the

celebrated aqueducts[43] of Rome (as the Aquae Marcia, Tepula and Julia, *C.I.L.* vi. 1244-1246, Orel. 51-53, Wil. 765; the Virgo, *C.I.L.* vi. 1252, Orel. 703, Wil. 763; the Claudia, &c., *C.I.L.* vi. 1256-1258. Orel. 54-56, Wil. 764) have quite the character of honorary inscriptions, while the various *cippi terminales*, which mark the ground belonging to the aqueduct, show the greatest analogy to the milestones (*e.g. C.I.L.* vi. 1243 *a-g*; Henz. 6635, 6636; Wil. 775-779). The other Italian and provincial varieties cannot be specified here. Of boundary-stones, or *cippi terminales*, some very ancient specimens have been preserved. To the age preceding the Second Punic War belong two, found at Venusia and erected by municipal magistrates (*C.I.L.* i. 185, 186; Orel. 3527, 3528; Wil. 863); they give a short relation of a decree, by which certain localities were declared to be sacred or public ("*aut sacrom aut poublicom locom ese*"). Then follow the *cippi Gracchani*, by which Gaius Gracchus and his two colleagues, as *tres viri agris iudicandis adsignandis*, measured the *ager Campanus*, for its division among the plebs. They contain the names of the *tres viri* in the nominative, and in addition, on the top, the lines and angles of the *cardo* and *decumanus*, according to the rules of the *agrimensores*, or the boundary lines between the *ager publicus* and *privatus* (*C.I.L.* i. 552-556; Henz. 6464; Wil. 859-861). From the age of Sulla we still have various boundary-stones giving the line of demarcation between different communities (between Fanum and Pisaurum—*C.I.L.* i. 583, Orel. 570, Wil. 861; between Ateste, Vicetia and Patavium—*C.I.L.* i. 547-549, Orel. 3110, Henz. 5114, 5115, Wil. 865, 866). To the town of Rome belong the *termini ripae Tiberis* (*C.I.L.* i. 608-614 = vi. 1234 *a-l*), beginning in the Augustan age, and the *termini of the pomoerium* of Claudius and Vespasian as censors, and of the *collegium augurum* under Hadrian (*C.I.L.* vi. 1231-1233; Orel. 710, 811; Wil. 843, 844), while others, of the consuls of the year A.D. 4 (*C.I.L.* vi. 1263; Orel. 3260; Wil. 856), of Augustus (*C.I.L.* vi. 1265; Henz. 6455; Wil. 852), &c., show the boundary between the *ager publicus* and *privatus*. With similar objects boundary-stones were erected by the emperors, or, under their authority, by magistrates, mostly military, in the rest of Italy also (as in Capua—*C.I.L.* x. 3825, Orel. 3683, Wil. 858; at Pompeii—*C.I.L.* x. 1018, Wil. 864) and in the provinces (as in Syria—*C.I.L.* iii. 183; and Macedonia—*C.I.L.* iii. 594; in Dalmatia—*C.I.L.* iii. 2883; in Africa— *C.I.L.* viii. 7084-7090, 8211, 8268, 10,803, 10,838, Wil. 869, 870; in Spain—*C.I.L.* ii. 2349, 2916, Wil. 871—where the *pratum* of a legion is divided from the territory of a *municipium*; in Gaul—Wil. 867; in Germany, in the column found at Miltenberg on the Main, *Bonner Jahrbücher*, vol. lxiv., 1878, p. 46, &c.). Private grounds (*pedaturae*) were unfrequently marked off by terminal *cippi*. To this class of *tituli* must be added also the curious inscriptions incised upon the steps of Roman circuses, theatres and amphitheatres (see Hübner, *Annali dell' Instituto archeologico*, vol. xxviii., 1856, p. 52 sq., and vol. xxxi., 1859, p. 122 sq.), as, for instance, upon those of the Coliseo at Rome (*C.I.L.* vi., 1796, 1-37; compare R. Lanciani, *Bullettino archeologico municipale*, 1881).

4. We now come to the last class of *tituli*, viz. those which in the *Corpus* are arranged, at the end of each volume, under the head of *Instrumentum*. By this very comprehensive term are designated objects which vary greatly among themselves, but which are of such a character as not to fall within any of the classes of *tituli* described before, or the class of the *instrumenta* in the proper sense of that word,—the laws, &c. The *tituli* of the *instrumentum* embrace movable objects, destined for public and private use, and illustrate almost every side of the life of the ancient Romans. As systematic treatment of them is hardly possible, a simple enumeration only of their different classes can be given, without citing special examples. The first species of them is metrological, comprehending the inscriptions on measures and weights. The gold and silver plate used in the best Roman houses was also always marked with a note of its weight,—as is seen, for instance, on the different objects belonging to the Hildesheim find (see *Hermes*, iii., 1868, p. 469 sq.; *Philologus*, xxviii., 1869, p. 369), the Corbridge *lanx* in Northumberland House (*C.I.L.* vii. 1268) and many others. A second species is formed by the *tesserae*, tokens or marks, mostly in bronze, bone and ivory, but also earthen, of which the most interesting are the so-called *tesserae gladiatoriae*, little staves of bone with holes at the top, and with names of slaves or freedmen and consular dates upon them, the relation of which to the *munera gladiatoria* is by no means certain (see *C.I.L.* i. 717 sq., and *Hermes*, xxi. p. 266; *Rhein. Mus.* xli. p. 517; xlii. p. 122; *Berl. phil. Woch.*, 1888, p. 24). The other circular *tesserae* (the so-called *tesserae theatrales*) of ivory or bone, with emblems and short inscriptions, partly Greek and Latin, used to be attributed to the *ludi scaenici* (see Henzen, *Annali dell' Instituto archeologico*, vol. xx., 1848, p. 273 sq., and vol. xxii., 1850, p. 357 sq.) and to other *ludi*; but this account has been questioned (Huelsen, *Bullett. dell' Instituto*, 1896, p. 227). A third species is that of inscriptions carved, inscribed, painted or stamped upon various materials, raw or manufactured, for trade or household use. Such are, to begin with, the most solid and heavy, the inscriptions carved or painted on masses of stone, mostly columns, in the quarries, and preserved either on the rocks themselves in the quarries or on the roughly hewn blocks transported to the Roman *emporium* on the Tiber bank. Curious specimens of the first kind are preserved in Lebanon, and in the north of England, near Hadrian's Wall and elsewhere; on the second may be consulted a learned treatise by Padre L. Bruzza ("Iscrizioni dei marmi grezzi," in the *Annali dell' Instituto archeologico*, vol. xlii., 1870, pp. 106-204). Of a kindred character are the inscriptions, mostly stamped or engraved in the mould, of pigs of silver, bronze and lead (and pewter), found in the Roman mines in Spain and England (see Hübner, "Römische Bleigruben in Britannien," in *Rheinisches Museum für Philologie*, vol. xi., 1857, p. 347 sq., and *C.I.L.* vii. 220 sq.; A. Way, *Archaeological Journal*, vol. xvi., 1859, p. 23, and vol. xxiii., 1866, p. 63). A fourth species of *tituli* of this class is strictly related to the military institutions of the Roman empire. Many of the

weapons are marked with the names of the bearer and of the military corps to which he belonged,—so, for example, the buckles of their shields (see Hübner, "Römische Schildbuckel," in *Archäologisch-epigraphische Mitteilungen aus Österreich*, vol. ii., 1878, p. 105 sq.; by far the best extant specimen is the umbo of a legionary soldier of the eighth legion found in the Tyne near South Shields, *C.I.L.* vii. 495), and sometimes the swords, as that of Tiberius from Mainz (now in the British Museum, see *Bonner Winckelmannsprogramm* of 1848). The leaden *glandes* used by the *funditores*, the slingers, in the Roman army bear curious historical inscriptions (see *C.I.L.* i. 642 sq., *Ephem. epigr*. vi. and, on the question of the authenticity of many of them, Zangemeister, *C.I.L.* ix., 35* sqq.). Special mention must be made also of the leaden seals or marks (*bullae*), evidently of military origin (perhaps to be borne by the soldiers as a countersign), which have been found in many parts of England (*C.I.L.* vii. 1269; *Ephem. epigr*. iii. 144, 318, iv. 209, vii. 346). Of the highest interest are the manifold productions of the Roman tile and brick kilns (*C.I.L.* xv. *Inscriptiones laterum*; cf. Descemet in the *Bibliothèque des écoles françaises*, vol. xv.). Next to the tiles with consular dates made at Veleia (*C.I.L.* i. 777 sqq.), those signed with the name of legions or other military corps, and employed in the various military buildings of these, are especially worthy of mention; they form an important chapter in every geographical part of the *Corpus*. But private persons, too, especially the rich landed proprietors, and afterwards the emperors and their kinsmen, kept large *figulinae*, and their manufactures—tiles of every description and other earthenware—were spread over the Roman empire (Dressel, *Untersuchungen über die Chronologie der Ziegelstempel der Gens Domitia*, 1888; *C.I.L.* xv.). The different sorts of earthen vessels and lamps, the fragments of which are found in great quantities wherever Roman settlements occurred, are arranged at the end of each volume of the *Corpus* and are collected in vol. xv part ii. p. i. On the maker's marks on earthenware, see Habert, *La Poterie antique parlanté* (1893); Dragendorf, "Terra Sigillata," in *Bonn. Jahrbüch.* xcvi. 18. On Roman lamps and their inscriptions the accurate catalogue of the Vienna collection by Kenner ("Dicantiken Thonlampen des K. K. Münz- und Antiken-Cabinetes und der K. K. Ambraser Sammlung," in the *Archiv für Kunde österreichischer Geschichtsquellen*, vol. xx., Vienna, 1858) may be consulted with advantage. The chief deposit of earthenware fragments, the *Monte testaccio* in Rome, has been explored by Dressel ("Ricerche sul Monte testaccio," in the *Annali dell' Instituto archeologico*, vol. i., 1878, p. 118-192). Inscriptions are found on various classes of vessels, painted (as the consular dates on the large *dolia* for wine, oil, &c., see Schöne, *C.I.L.* iv. 171 sq., and *Ephem. epigr*. i. 160 sq.), stamped on the clay when still wet or in the mould, and scratched in the clay when dry, like those on the walls of ancient buildings in Pompeii, Rome and other places of antiquity. Like the corresponding Greek ware, they contain chiefly names of the makers or the merchants or the owners, and can be treated in a satisfactory manner only when brought together in one large collection (*C.I.L.* xv. part ii.), inasmuch as, besides being made in many local potteries, they were exported principally from some places in Italy (*e.g.* Arezzo) and Spain, in nearly every direction throughout northern and western Europe, the countries outside the Roman frontiers not excluded. Vessels and utensils of glass and of metal (gold, silver and especially bronze) were also exported from Italy on a large scale, as is being more and more readily recognized even by those antiquaries who formerly were wont to assume a local origin for all bronze finds made in the north of Europe. These utensils, ornaments and other objects made of precious metals (such as cups, spoons, mirrors, *fibulae*, rings, gems), not unfrequently bear Latin inscriptions. On the very ancient silver and bronze caskets, for holding valuable articles of the female toilet, which have been found at Praeneste, are inscribed, in addition to the names of the artist and of the donor, occurring once, the names of the persons in the mythical representations engraved upon them (*C.I.L.* i. 54-60, 1500, 1501; Jordan, *Kritische Beiträge zur Geschichte der lateinischen Sprache*, Berlin, 1879, p. 3 sq.). In the ancient well of the *Aquae Apollinares*, near Vicarello in Tuscany, three silver cups have been found with circumstantial itineraries "*a Gades* (sic) *usque Romam*" engraved upon them, evidently gifts to the divinity of the bath for recovered health presented by travellers from the remote city named (Henzen 5210). Similar is the Rudge Cup, found in Wiltshire and preserved at Alnwick Castle, which contains, engraved in bronze, an itinerary along some Roman stations in the north of England (*C.I.L.* vii. 1291). The inscriptions of the Hildesheim silver find and others of a similar character have been already mentioned; and many examples might be enumerated besides. On the ancient glass ware and the inscriptions on it the splendid works of Deville (*Histoire de l'art de la verrerie dans l'antiquité*, Paris, 1873) and Froehner (*La Verrerie antique, description de la collection Charvet*, Paris, 1879) may be consulted; on the Christian glasses that of Garrucci (*Vetri ornati di figure in oro trovati nei cimiteri dei cristiani primitivi di Roma*, Rome, 1858); on the makers' marks on bronze objects, Mowat, *Marques de bronziers sur objets trouvés ou rapportés en France* (1884) (extracted from *Bulletin épigraphique*, 1883-1884). The last species of *tituli* is formed by the stamps themselves with which the inscriptions on many of the objects already named are produced. They are mostly of bronze, and contain names; but it is not easy to say what sort of objects were marked with them, as scarcely any article stamped with a still existing stamp has been found. Amongst the materials stamped leather also is to be mentioned. One class only of stamps differs widely from the rest,—the oculists' stamps, engraved mostly on steatite (or similar stones), and containing remedies against diseases of the eyes, to be stamped on the glass bowls in which such remedies were sold, or on the medicaments themselves (see Grotefend, *Die Stempel der römischen Augenärzte gesammelt und erklärt* (Göttingen, 1867); de Villefosse and Thédenat, *Cachets d'oculistes romains* (1882); Espérandieu, *Recueil des cachets d'oculistes romains* (1894).

IV. The other great class of inscriptions above referred to, the *instrumenta* or *leges*, the laws, deeds, &c., preserved generally on metal and stone, from the nature of the case have to be considered chiefly with regard to their contents; their form is not regulated by such constant rules as that of the *tituli*, so far as may be inferred from the state of completeness in which they have been preserved. The rules for each special class therefore, though, generally speaking, maintained—as was to be expected of Roman institutions—with remarkable steadiness from the earliest times down to a late period, must be based upon a comprehensive view of all the examples, including those preserved by ancient writers, and not in the monumental form. These documents are, as a rule, incised on bronze plates (only some private acts are preserved on wood and lead), and therefore have their peculiar form of writing, abbreviation, interpunction, &c., as has been already explained. The older Roman laws are now collected, in trustworthy texts, in the *Corpus*, vol. i.; of the documents belonging to the later period a very comprehensive *sylloge* is given in C. G. Bruns's *Fontes juris Romani antiqui*.

1. Among the earliest occasions for committing to writing agreements, which may be supposed to have been originally verbal only, must certainly be reckoned international transactions (*leges foederis or foedera*). At the head of the prose records written in the Latin language we find the treaties of alliance of Tullus Hostilius with the Sabini (Dionysius Halic. iii. 33), of Servius Tullius with the Latini (Dionysius iv. 26; Festus p. 169; this was, partly, at the same time, as will afterwards appear, the oldest document of the sacred class), of the second Tarquinius with Gabii (Dionysius iv. 58; Festus, *Epit.* p. 56). They are followed, in the oldest republican period, by the celebrated *foedera* with Carthage; by the pacts of Sp. Cassius Vecellinus with the Latini of the year 261 (493 B.C.), which Cicero seems to have seen still in the *forum* behind the *rostra*, written on a bronze column (*Pro Balbo*, 23, 53; see also Livy ii. 33; Festus p. 166; and Mommsen's *Römische Forschungen*, ii. 153 sq.); and by the *foedus Ardeatinum* of 310 (444 B.C.) mentioned by Livy (iv. 7). Of all these documents nothing has been preserved in an authentic form, save some few words quoted from them by the ancient grammarians. Of one *foedus* only is there a fragment still in existence, relating to the Oscan *civitas libera* Bantia (*C.I.L.* i. 197); it contains the *clausula* of the *foedus*, which was written in Latin and in Oscan (see APULIA). On account of this peculiar circumstance, the document gave occasion to Klenze, and afterwards to Mommsen, to resume (for the sake of Roman jurisprudence, in the first instance) inquiry into the Oscan and other Italian dialects. Some other Roman *foedera* are preserved only in Greek, *e.g.* that with the Jews of the year 594 (160 B.C.)(Josephus, *Ant.* xii. 6. 10). Some others, made with the same nation between 610 and 615 (144 and 139 B.C.) (Jos. *Ant.* xiii. 5. 6 and 7. 8), are mentioned in an abridged form only, or given in that of a *senatus consultum*, to which they must formally be ascribed. Amongst the *foedera* may be reckoned also the curious oath, sworn, perhaps, according to a general rule obtaining for all *civitates foederatae*, by the citizens of a Lusitanian *oppidum*, Aritium, to Gaius Caesar on his accession to the throne in A.D. 37 (*C.I.L.* ii. 172; Wil. 2839).

Closely related to the *foedera* are the pacts between communities and private individuals, respecting *patronatus* or *hospitium* (*tabulae patronatus et hospitii*), also, when in small portable form, *tesserae hospitales*; cf. Plautus, *Poen.* 1047, of which many specimens from the end of the republic down to a late period of the empire have been preserved (see Gazzera, *Memorie dell' Academia di Torino*, vol. xxxv., 1831, p. 1 sq., and Mommsen, *Römische Forschungen*, i. 341 sq.). Of the numerous examples scattered through the different volumes of the *Corpus* may be quoted the *tessera Fundana*, containing the pact of hospitality between the community of Fundi and a certain Ti. Claudius (who cannot, with certainty, be identified), the oldest hitherto known, in the form of a bronze fish (*C.I.L.* i. 532; Henz. 7000; Wil. 2849); the *tabula* of the *pagus Gurzensium* in Africa, delivering the patronate to L. Domitius Ahenobarbus, Nero's grandfather, in 742 (12 B.C.), in the afterwards solemn form of a *tabella fastigata*, to be fixed in the *atrium* of the person honoured (Orel. 3693; Wil. 2850); that of the *civitas Pallantina* with a *peregrinus* named *Acces Licirni* of the year 752 (2 B.C.) (*Ephem. epigr.* i. 141; *Hermes*, v., 1871, p. 371 seq.); that of *Lacilbula*, in Spain, with one Q. Marius Balbus, of A.D. 5 (*C.I.L.* ii. 1393); that of the *Bocchoritani* on the island of Majorca, of A.D. 6 (*C.I.L.* ii. 3695; Wil. 2851); the four relating to C. Silius Aviola, dating from A.D. 27 to 28, all found at Brescia (*C.I.L.* v. 4919-4922); that of the *colonia Julia Aug. legionis vii. Tupusuctu*, in Africa, with the imperial legate Q. Julius Secundus, of A.D. 55 (*C.I.L.* viii. 8837; Wil. 2851); that of two *gentilitates*, the *Desonci* and *Tridiavi*, of the *gens* of the *Zoelae*, in Spain, now in the museum of Berlin, which contains an older act of the year 27, and another more recent of the year A.D. 127 (*C.I.L.* ii. 2633; Orel. 156); that of the *respublica Pompelonensis* (Pampeluna in Spain) of A.D. 185 (*C.I.L.* ii. 2960; Wil. 2854); that of the *Segisamonenses*, in Spain, of A.D. 239, now in the museum at Burgos (*Ephem. epigr.* ii. 322); that of the *fabri subidiani* (*i.e.* subaediani, qui sub aede consistunt) of Cordova, of A.D. 348 (*C.I.L.* ii. 2211; Wil. 2861); and, in addition to many others, those found together at Rome, on the site of the palace of Q. Aradius Valerius Proculus, and belonging to him and other members of his family, from divers African cities and executed in A.D. 321 and 322 (*C.I.L.* vi. 1684-1688; Orel. 1079, 3058).

2. Hardly inferior in antiquity, and of superior value, are the remains of laws in the stricter sense of the word (*leges* and *plebiscita*), preserved to us in the originals, although unfortunately only in fragments more or less extensive. Of those laws the oldest and most important are the *lex Acilia* (for so it is in all probability to be styled) *repetundarum* of the year 631 (*C.I.L.* i. 198),

which is incised on a bronze table about 2 metres broad, in 90 lines of about 200 to 240 letters each, and therefore extremely inconvenient to read, and the *lex agraria* of 643 (111 B.C.), written on the reverse of the table of the Acilia, abrogated shortly afterwards (*C.I.L.* i. 200); this is the third of the celebrated laws of C. Gracchus bearing upon the division of public lands. Then follow the *lex Cornelia de viginti quaestoribus*, a fragment of Sulla's legislation, the eighth table only, of the whole set, being preserved (*C.I.L.* i. 202); the *plebiscitum de Thermensibus*, on the autonomy of Termessus in Pisidia, proposed by the *tribuni plebis*, in 682 (72 B.C.), one of four or five large bronze plates (*C.I.L.* i. 204); the *lex Rubria de civitate Galliae cisalpinae* of 705 (49 B.C.), written in a new and more convenient form (belonging as it does to Caesar's legislation), in two columns, with numbered divisions, being the fourth out of an unknown number of plates (*C.I.L.* i. 205); the *lex Julia municipalis*, or, from the place where it was found, the *tabulae Heracleenses* of 709 (45 B.C.), written on the reverse of the much older Greek law of that community, preserved partly at Naples, partly in the British Museum (*C.I.L.* i. 206), also a fragment of Caesar's general municipal institutions; it contains a curious passage relating to the public promulgation of laws (v. 15). These are the laws of the Roman republic preserved in important fragments; some minor ones (brought together in *C.I.L.* i. 207-211) may be left out of account here. In the imperial age, laws in general were replaced by *senatus consulta* or by imperial decrees. It was also in the form of a *senatus consultum* that the *leges de imperio*, on the accession of the emperors, seem to have been promulgated. An example of such a law, preserved in part on a bronze tablet found at Rome, is the *lex de imperio Vespasiani* (*C.I.L.* vi. 930; Orel. i. 567). There is, besides, one special category of imperial constitutions which continued to be named *leges*, viz. the constitutions given by the emperors to the divers classes of *civitates*, based upon the ancient traditional rules of government applied to Rome itself as well as to the *coloniae* and *municipia*. Of this sort of *leges* some very valuable specimens have come from Spanish soil, viz. the *lex coloniae Juliae Genetivae Urbanorum sive Ursonis* (now Osuna), given to that colony by Caesar in 710 (44 B.C.), but incised, with some alterations, in the time of Vespasian, of which three bronze tables out of a much larger number remain (Hübner and Mommsen, *Ephem. epigr.* ii. 150 sq. and 221 sq.); the *lex Salpensana* and the *lex Malacitana*, given to these two *municipia* by Domitian, between A.D. 81 and 84, each on a large bronze plate, written respectively in two and in five columns, with the single chapters numbered and rubricated (*C.I.L.* ii. 1963, 1964; compare Mommsen, "Die Stadtrechte der lateinischen Gemeinden Salpensa und Malacca in der Provinz Baetica," in the *Abhandlungen der sächsischen Gesellschaft der Wissenschaften, philol.-histor. Classe*, vol. iii., 1857, p. 363 sq.); the *lex metalli Vipascensis*, given, with all probability, by one of the three Flavii, as a constitution to a mining district of southern Portugal, one bronze plate numbered iii.—three or more, therefore, being lost (see Hübner, *Ephem. epigr.* iii. 165 sq. and, for a popular account, the *Deutsche Rundschau*, August 1877, p. 196 sq.). The so-called military diplomas, although in certain respects nearly related to the *leges* of the later period, are better placed along with the imperial decrees.

3. A third species of official documents is formed by decrees of the senate of Rome, of the analogous corporations in the *coloniae* and *municipia*, and of the divers *collegia* and *sodalicia*, constituted, as a rule, after a similar fashion and debating in nearly the same way as the Roman and the municipal senates. The oldest Roman *senatus consulta* are those translated into the Greek language and containing treaties of alliance, as already mentioned. They are preserved either on monuments or by ancient authors, as Josephus: *e.g.* the fragment found at Delphi, from the year 568 (186 B.C.), and the *senatus consultum Thisbaeum*, from Thisbe in Boeotia, 584 (170 B.C.) (*Ephem. epigr.* i. 278 sq., ii. 102, and Joh. Schmidt, *Zeitschrift der Savigny-Stiftung*, vol. iii., 1881), those of 616, 619, 621, 649 (138-105 B.C.) (*C. I. Graec.* 2905, 2908, ii. 2485, 2737; Le Bas and Waddington iii. 195-198; *Annali dell' Instituto*, vol. xix. 1847, p. 113; *Ephem. epigr.* iv. 213 sq.), and those relating to the Jews, dating from 615, 621 and 710 (139, 133 and 44 B.C.) (Josephus, *Ant.* xiii. 9. 2, xiv. 8. 5 and 10. 9). The two oldest *senatus consulta* written in Latin are also preserved in a more or less complete form only by ancient authors; they are the *sc. de philosophis et rhetoribus* of 593 (161 B.C.) (Gellius, *Noct. Att.* xv. 11. 1) and that *de hastis Martiis* of 655 (99 B.C.) (Gellius iv. 6. 2). The only one belonging to the oldest period preserved in the original Latin form, of which only a part exists, together with the Greek translation, is the *sc. Lutatianum*, relating to Asclepiades of Clazomenae and his companions, dating from 676 (77 B.C.) (*C.I.L.* i. 203). The rest, belonging to the later epoch from Cicero downwards, about twenty in number, are mostly preserved only in an abridged form by ancient writers,—such as Cicero, Frontinus, Macrobius,—or in Justinian's *Digesta* (see Hübner, *De senatus populique Romani actis*, Leipzig, 1859, p. 66 sq.); a few exist, however, in a monumental form, complete or in fragments—as the two sc. on the *ludi saeculares*, dating from 17 B.C. and A.D. 47, preserved on a marble slab found at Rome (*C.I.L.* vi. 877); the fragments of two sc. in honour of Germanicus and the younger Drusus, from Rome, on bronze tablets (*C.I.L.* vi. 911-912; Henz. 5381-5282); the two *sc. Hosidianum* and *Volusianum*, containing regulations for the demolition and rebuilding of houses in Rome, incised on the same bronze plate, found at Herculaneum, dating from Nero's time, between A.D. 41 and 46 and from 56 (Orel. 3115; Mommsen, *Berichte der sächs. Gesellschaft der Wissenschaften, philol.-histor. Classe*, 1852, p. 272 sq.); and, of a later period, the *sc. Cassianum* or *Nonianum* of A.D. 138, containing a market regulation for the *saltus Beguensis* in Africa, where it has been found preserved in two examples on stone slabs (*Ephem. epigr.* ii. 271 sq., not complete in Wil. 2838), and the fragment of that for Cyzicus, belonging to the reign of Antoninus Pius (*Ephem. epigr.* iii. 156 sq.). There exists, besides, a chapter of a sc.,

relating to the *collegia*, inserted in the decree of a *collegium* at Lanuvium, to be mentioned below. Of the municipal decrees, of which a greater number is preserved (see Hübner, *De sen. populique Rom. actis*, p. 71 sq.), only a few of the more important may be mentioned here: the *lex Puteolana de parieti faciundo* of 649 (105 B.C.) (*C.I.L.* i. 577; Orel. 3697; Wil. 697); the two *decreta* (or so-called *cenotaphia*) *Pisana* in honour of Lucius and Gaius Caesar, the grandsons of Augustus, of A.D. 3 (*C.I.L.* xi. 1420, 1421; Orel. 642, 643; Wil. 883); the *decretum Lanuvinum* of A.D. 133, containing the regulations of a *collegium funeraticium*, styled *collegium salutare Dianae et Antinoi* (Orel. 6086; Wil. 319); and the *decretum Tergestinum*, belonging to the time of Antoninus Pius (*C.I.L.* v. 532; Henz. 7167; Wil. 693). There are, however, more than thirty others preserved, some of them, such as those from Naples, written in the Greek language. Of the third speciality, the *decreta collegiorum*, only the *lex collegii aquae* of the 1st century (Marini, *Atti de' fratelli arvali*, p. 70; Rudorff and Mommsen, *Zeitschrift für Rechtsgeschichte*, vol. xv., 1850, pp. 203, 345 sq.), and the *lex collegii Aesculapii et Hygiae*, of 153 (*C.I.L.* vi. 10,234; Orel. 2417; Wil. 320) need be mentioned here; many more exist. One of them, the *lex collegii Jovis Cerneni*, dating from A.D. 167, found at Alburnus major in Dacia, is preserved on the original *tabella cerata* on which it was written (*C.I.L.* iii. 924; Henz. 6087; Wil. 321).

4. The fourth species of *instrumenta* are the decrees, sometimes in the form of letters, of Roman and municipal magistrates, and of the emperors and their functionaries, incised, as a rule, on bronze tablets. The oldest decree in the Latin language which has been preserved is that of L. Aemilius Paulus, when praetor in Hispania Baetica, dating from 189 B.C., for the Turris Lascutana in southern Spain (*C.I.L.* ii. 5041; Wil. 2837); of the same date is a Greek one of Cn. Manlius, consul of the year 565, for the Heracleenses Cariae (Le Bas and Waddington n. 588). Then follow the famous *epistula consulum* (falsely styled *senatus consultum*) *ad Teuranos de bacchanalibus*, dated 568 (186 B.C.) (*C.I.L.* i. 196); the sentence of the two Minucii, the delegates of the senate, on a dispute concerning the boundaries between the Genuates and Viturii, 117 B.C. (*C.I.L.* i. 199; Orel. 3121; Wil. 872); and the *epistula* of the praetor L. Cornelius (perhaps Sisenna), the praetor of 676 (78 B.C.) *ad Tiburtes* (*C.I.L.* i. 201). These belong to the republican age. From the imperial period a great many more have come down to us of varying quality. Some of them are decrees or constitutions of the emperors themselves. Such are the decree of Augustus on the aqueduct of Venafrum (*C.I.L.* x. 4842; Henz. 6428; Wil. 784); that of Claudius, found in the Val di Nona, belonging to A.D. 46 (*C.I.L.* v. 5050; Wil. 2842); of Vespasian for Sabora in Spain (*C.I.L.* ii. 1423), and for the Vanacini in Corsica (Orel. 4031); of Domitian for Falerii (Orel. 3118); the epistles of Hadrian relating to Aezani in Phrygia, added to a Greek decree of Avidius Quietus (*C.I.L.* iii. 355; Henz. 6955), and relating to Smyrna, in Greek, with a short one of Antoninus Pius, in Latin (*C.I.L.* iii. 411; Orel. 3119); the decrees of Commodus relating to the *saltus Burunitanus* in Africa (*C.I.L.* viii. 10,570; cf. *Eph. epigr.* v. 471); of Severus and Caracalla for Tyra (Akkerman in Moesia), Latin and Greek (*C.I.L.* iii. 781; Henz. 6429); of Valerian and Gallienus for Smyrna, also Latin and Greek (*C.I.L.* iii. 412); of Diocletian *de pretiis rerum venalium*, containing a long list of prices for all kinds of merchandise, preserved in divers copies more or less complete, in Latin and Greek (*C.I.L.* iii. 801 sq.; compare *Ephem. epigr.* iv. 180, and, as similar monuments, the *lex portus* of Cirta, of A.D. 202 Wil. 2738, and the fragment of a regulation for the importation of wines into Rome, Henz. 5089, Wil. 2739); and some of the age of Constantine, as that relating to Hispellum in Umbria (Henz. 5580; Wil. 2843), that of Julian found at Amorgos (*C.I.L.* iii. 459; Henz. 6431), and some others, of which copies exist also in the juridical collections. Of two imperial rescripts of a still later age A.D. 413, fragments of the originals, written on papyri, have been found in Egypt (see Mommsen and Jaffé, *Jahrbüch des gemeinen deutschen Rechts*, vol. vi., 1861, p. 398; Hänel, *Corpus legum*, p. 281). Imperial decrees, granting divers privileges to soldiers, are the *diplomata militaria* also, mentioned above, incised on two combined bronze tablets in the form of *diptycha* (L. Renier, "Recueil de diplômes militaires"; *C.I.L.* iii. 842 sqq., 1955 sqq.; Wil. 2862-2869), belonging to nearly all emperors from Claudius down to Diocletian. Though not a decree, yet as a publication going back directly to the emperor, and as being preserved in the monumental form, the speech of the emperor Claudius, delivered in the senate, relating to the Roman citizenship of the Gauls, of which Tacitus gives an abstract (*Ann.* xi. 23), ought also to be mentioned here; it was engraved on large bronze slabs by the public authority of Lugudunum (Lyons), where a large fragment of it is still preserved (Boissieu, *Inscriptions antiques de Lyon*, p. 132 sq.). Another sort of decrees, relating to a great variety of subjects, has to be mentioned, emanating, not directly from the emperors, but from their functionaries. Such are the decree of the proconsul L. Helvius Agrippa, of the year A.D. 68, on the boundaries of some tribes on the island of Sardinia (*C.I.L.* x. 7852; Wil. 872 a); that of the prefect of Egypt, Tiberius Julius Alexander, written in Greek, the same year (*C. I. Graec.* 4957); that of C. Helvidius Priscus, on a similar question relating to Histonium, belonging perhaps to the end of the 1st century (Wil. 873); that of the legate of Trajan, C. Avidius Nigrinus, found at Delphi, in Greek and Latin (*C.I.L.* iii. 567; Orel. 3671; Wil. 874); a rescript of Claudius Quartinus, perhaps the imperial legate of the Tarraconensis, of the year A.D. 119, found at Pampluna (*C.I.L.* ii. 2959; Orel. 4032); the epistle of the *praefecti praetorio* to the magistrates of Saepinum, of about A.D. 166-169 (*C.I.L.* ix. 2438; Wil. 2841); the decree of L. Novius Rufus, another legate of the Tarraconensis, who *ex tilia recitavit*, of A.D. 193 (*C.I.L.* ii. 4125; Orel. 897; Wil. 876); the sentence of Alfenius Senecio, then subprefect of the *classis praetoria Misenensis*, belonging to the beginning of the 3rd century, formerly existing at Naples (*C.I.L.* x. 3334); and some others of the 4th and 5th centuries, not requiring specific mention here. Quite a collection of epistles of

high Roman functionaries is found in the celebrated inscription of Thorigny (Mommsen, *Berichte der sächs. Gesellschaft der Wissenschaften*, 1852, p. 235 sq.). The letter of a provincial functionary, a priest of Gallia Narbonensis, to the *fabri subaediani* of Narbonne, of the year 149, may also be mentioned (Henz. 7215; Wil. 696 a). To these must be added the *tabulae alimentariae*, relating to the well-known provision made by Trajan for the relief of distress among his subjects, such as that of the Ligures Baebiani (*C.I.L.* ix. 1455; Wil. 2844) and that of Veleia near Parma (Wil. 2845); while evidence of similar institutions is furnished by inscriptions at Tarracina, at Sicca in Africa, and at Hispalis in Spain (Wil. 2846-2848; *C.I.L.* ii. 1174). At the close of this long list of official documents may be mentioned the *libellus* of the *procurator operum publicorum a columna divi Marci* of the year 193 (*C.I.L.* vi. 1585; Orel. 39; Wil. 2840) and the *interlocutiones* of the *praefecti vigilum* on a lawsuit of the *fullones* of Rome, of A.D. 244, inscribed on an altar of Hercules (*C.I.L.* vi. 266; Wil. 100). These documents form a most instructive class of *instrumenta*.

5. Many documents, as may be supposed, were connected with religious worship, public and private. The oldest *lex templi*, which continued in force until a comparatively late period, was the regulation given by Servius Tullius to the temple of Diana on the Aventine, after the conclusion of the federal pact with the Latini, noticed above. Mention is made of this ancient law as still in force in two later documents of a similar character, viz. the dedication of an altar to Augustus by the plebs of Narbo in southern France, of A.D. 764, but existing only, at Narbonne, in a copy, made perhaps in the 2nd century (*C.I.L.* xii. 4333; Orel. 2489; Wil. 104), and that of an altar of Jupiter, dedicated at Salonae in Dalmatia in A.D. 137, still existing in part at Padua (*C.I.L.* iii. 1933; Orel. 2490; Wil. 163). Another *lex fani* still existing is that of a temple of Jupiter Liber at Furfo, a *vicus* of southern Italy, of the year 696 (58 B.C.), but copied, in vernacular language, from an older original (*C.I.L.* i. 603; Orel. 2488; Wil. 105; compare Jordan in *Hermes*, vol. vii., 1872, pp. 201 sq.). The lists of objects belonging to some sanctuaries or to the ornaments of statues are curious, such as those of the *Diana Nemorensis* at Nemi (Henz. *Hermes*, vol. vi., 1871, pp. 8 sq.), and of a statue of Isis in Spain (Hübner, *Hermes*, vol. i., 1866, pp. 345 sq.; compare *C.I.L.* ii. 2060, 3386, Orel. 2510, Wil. 210), and two *synopses* from a temple at Cirta in Africa (Wil. 2736, 2737). The *sortes* given by divinities may also be mentioned (see *C.I.L.* i. 267 sq.; Wil. 2822). To a temple also, though in itself of a secular character, belonged a monument of the highest historical importance, viz. the *Index rerum a se gestarum*, incised on bronze slabs, copies of which Augustus ordered to be placed, in Latin and Greek, where required, in the numerous Augustea erected to himself in company with the Dea Roma. This is known as the *Monumentum Ancyranum*, because it is at Angora in Asia Minor that the best preserved copy of it, in Greek and Latin, exists; but fragments remain of other copies from other localities (see *C.I.L.* iii. 779 sq., and the special editions of Mommsen, Berlin, 1865, and Bergk, Göttingen, 1873). Among the inscriptions relating to sacred buildings must also be reckoned the numerous fragments of Roman calendars, or *fasti anni Juliani*, found at Rome and other places, which have been arranged and fully explained by Mommsen (*C.I.L.* i., 2nd ed., part ii.; compare for those found in Rome, *C.I.L.* vi. 2294-2306). Local, provincial or municipal *calendaria* have likewise been found (as the *feriale Cumanum*, *C.I.L.* i. part ii. p. 229, and the *Capuanum*, *C.I.L.* x. 3792). Many other large monumental inscriptions bear some relation, more or less strict, to sacred or public buildings. Along with the official calendar exhibited on the walls of the residence of the *pontifex maximus*, the list of the eponymous magistrates, inscribed by the order of Augustus on large marble slabs, was publicly shown—the *fasti consulares*, the reconstruction and illustration of which formed the life-work of Borghesi. These have been collected, down to the death of Augustus, by Henzen, and compared with the additional written testimonies, by Mommsen, in the *Corpus* (vol. i., 2nd ed., part ii.), along with the *acta triumphorum* and other minor fragments of fasti found in various Italian communities, while the *fasti sacerdotum publicorum populi Romani*, together with the *tabula feriarum Latinarum*, are given in the volume devoted exclusively to the monuments of Rome (vol. vi. 441 sq.; compare *Hermes*, vol. v., 1870, p. 379, and *Ephem. epigr.* ii. 93, iii. 74, 205 sq.). Documents of the same kind, as, for example, the *album ordinis Thamugadensis* from Africa (*C.I.L.* viii. 2403, 17903), and a considerable mass of military lists (*latercula*, of which those belonging to the garrison of the metropolis are brought together in *C.I.L.* vi. 651 sq.), are given on many dedicatory and honorary monuments, chiefly from Lambaesis in Africa (*C.I.L.* viii.). As those documents, though having only a partial claim to be ranked with the sacred ones, derive, like many other dedicatory monuments, their origin and form from that class, so also the protocols (*acta*), which, from Augustus downwards, seem to have been preserved in the case of all important *collegia magistratuum*, now survive only from one of the largest and most distinguished *collegia sacerdotum*, in the *acta collegii fratrum Arvalium*, to which Marini first drew the attention of epigraphists; they form one of the most important masses of epigraphic monuments preserved to us in the Latin language (see *C.I.L.* vi. 459 sq., *Ephem. epigr.* ii. 211 sq., and Henzen's *Acta fratrum Arvalium*, Berlin, 1874).

6. Another species of instruments is formed by private documents. They have been incidentally preserved (inserted, for instance, into sepulchral and honorary inscriptions), in the later period not unfrequently in monumental form, as the testaments, given partly or in full, mentioned above (viz. that of Dasumius and the Gaul, *C.I.L.* vi. 10229, Wil. 314, 315, and some *capita testamentorum* or *codicilli*, as that of M. Meconius Leo found at Poetelia—*C.I.L.* x. 113, 114; Orel. 3677, 3678; Wil. 696), and the donations, such as those of T. Flavius Syntrophus (*C.I.L.* vi.

10239; Wil. 313), of T. Flavius Artemidorus (Wil. 310), of Statia Irene and Julia Monime (*C.I.L.* vi. 10231, 10247; Wil. 311, 318). Of a peculiar description is the *pactum fiduciae*, found in Spain, engraved on a bronze tablet, and belonging, in all probability, to the 1st century (*C.I.L.* ii. 5042), which seems to be a formulary. Other documents relating to private affairs exist in their original form, written on *tabellae ceratae*. Those found together in a mining district of Dacia have been arranged and explained by Mommsen and Zangemeister (*C.I.L.* iii. 291 sq., with facsimiles); those found at Pompeii in 1875, containing receipts of the banker L. Caecilius Jucundus, have been published in *C.I.L.* iv. (suppl.). These documents are written in cursive letters; and so mostly, too, are some other curious private monuments, belonging partly to the sacred inscriptions—the *defixiones* (cf. Tac. *Ann.* ii. 69), imprecations directed against persons suspected of theft or other offences, who, according to a very ancient superstition, were in this way believed to be delivered to punishment through the god to whom the *defixio* was directed. The numerous Greek and Latin (and even Oscan) examples of this usage have been brought together by Audollent, *Defixionum tabellae quotquot innotuerunt tam in Graecis Orientis quam in totius Occidentis partibus praeter Atticas* (Paris, 1904); compare *C.I.L.* i. 818-820, *C.I.L.* vii. 140). Only a few of them are incised on stone (as that to the *Dea Ataecina* from Spain, *C.I.L.* ii. 462); for the most part they are written, in cursive letters, or in very debased capitals, on small bronze or lead tablets (so *C.I.L.* i. 818, 819; Henz. 6114, 6115; Wil. 2747, 2748), to be laid in the tombs of the "defixi," or deposited in the sanctuaries of some divinity.

7. Many of the private documents just alluded to have not a monumental character similar to that of the other inscriptions in the wider sense of the word, as they are written on materials not very durable, such as wood and lead—in the majority of cases, in cursive characters; but, nevertheless, they cannot be classed as literature. As a last species, therefore, of *instrumenta*, there remain some documents, public and private, which similarly lack the strict monumental character, but still are to be reckoned among inscriptions. These are the inscriptions painted or scratched (*graffiti*) on the walls of the buildings of ancient towns, like Pompeii, where, as was to be expected, most of them have been preserved, those from other ancient cities buried by the eruptions of Vesuvius and from Rome being very small in number. All the various classes of these inscriptions—public and private advertisements, citations for the municipal elections, and private scribblings of the most diverse (and sometimes most indecent) character, one partly collected by Chr. Wordsworth (*Inscriptiones Pompeianae*, &c., London, 1837, 1846)—are now arranged by Zangemeister in the *Corpus*, vol. iv. with supplement (some specimens in Wil. 1951 sq.), whence their peculiar palaeographic and epigraphic rules may be learned. And, lastly, as related to some of these advertisements, though widely differing from them in age and character, may be mentioned the so-called *diptycha consularia*, monuments, in the first instance, of the still very respectable skill in this branch of sculpture to be found at this late period. They are carved-ivory tablets, in the form of *pugillaria*, and seem to have been invitations to the solemnities connected with the accession of high magistrates, especially to the spectacles of the circus and amphitheatre; for they contain, along with representations of such spectacles, the names, and often the portraits, of high functionaries, mostly of the 5th and 6th centuries. Since Gori's well-known work on this class of monuments (*Thesaurus veterum diptychorum*, &c., 3 vols., Florence, 1759) no comprehensive collection of them has been published, but a full list is given by H. de Villefosse in the *Gazette Archéologique* of 1884; as specimens see *C.I.L.* ii. 2699, and v. 8120, 1-9.

Bibliography.—As a "Textbook" of Roman epigraphy R. Cagnat, *Cours d'épigraphie latine* (3rd ed., Paris, 1898, with supplement, 1904) can be heartily recommended. But students must be warned against Zell's *Handbuch der römischen Epigraphik* (2 vols., Heidelberg, 1850-1852), an unsatisfactory work which is open to serious criticism. J. C. Egbert's *Introduction to the Study of Latin Inscriptions* (1896) is designed for American and English students. For Christian inscriptions Le Blant's *Manuel d'épigraphie chrétienne d'après les marbres de la Gaule* (Paris, 1869) may still be consulted with advantage.

(E. Hü.; W. M. L.)

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1 See Winckler in Schrader's *Keilinschr. Bibl.* v. (Berlin, &c., 1896).

2 A nearly complete text has been made from these with the help of a squeeze taken before its destruction. See the handbooks mentioned below.

3 Published with other fragments in the *Jew. Quart. Review*, xvi. 1.

4 *Zeitsch. f. Aegypt. Spr.* (1879). These were the first specimens found. See also Erman and Krebs, *Aus den Papyrus d. kgl. Mus.* p. 290 (Berlin, 1899).

5 *Mittheilungen ... Rainer*, i. 38 (Wien, 1886).

6 Those in France were collected by Schwab in *Nouvelles archives*, xii. 3. See also Chwolson, *Corpus Inscr. Hebr.* (St Petersburg, 1882).

7 These have been collected by J. H. Stevenson, *Babyl. and Assyr. Contracts* (New York, 1902). A more complete collection has been prepared by Professor A. T. Clay.

8 For the literature see Kalinka, *Tituli Lyciae*, No. 152 (Vienna, 1901).

9 *Répertoire d'épigr. sém.*, No. 438.

10 So Bacher in *J. Q. R.* xix. 441.

11 In *Mém. Acad. inscr.* 1re sér. xi. 297. See also *Rép. d'épigr. sém.*, for some smaller fragments, Nos. 244-248.

12 Sayce and Cowley, *Aramaic Papyri* (London, 1906).

13 Sachau, "Drei aram. Papyrusurkunden" *Abh. d. kgl. Preuss. Akad.* (Berlin, 1907).

14 See *P.S.B.A.* (1907), p. 260.

15 See Lidzbarski, *Ephemeris*, ii. 247.

16 *J.Q.R.* xvi. 7.

17 ed. E. O. Winstedt (Cambr. 1909), p. 154.

18 A view revived by C. Forster, even after Beer, in *The Israelitish Authorship of the Sinaitic Inscriptions* (London, 1856) and other works.

19 The cross and other Christian symbols often found with the inscriptions have been added later by pilgrims.—*C.I.S.* ii. 1, p. 352.

20 *Reise in Syrien* (Leipzig, 1883).

21 *Inscriptions sém. de la Syrie, &c.* i. (Paris, 1907).

22 J. H. Mordtmann, "Beitr. zur Minäischen Epigraphik," in *Semitistische Studien*, 12 (Weimar, 1897).

23 In Bent's *Sacred City of the Ethiopians* (London, 1893).

24 *Revue sémitique* (1901).

25 *Journ. As.* x., xvii., xix.

26 *Zur Entzifferung d. Safā-Inschr.* (Leipzig, 1901).

27 It may be remarked that there are about twelve different views regarding the date of Kaṇishka and the origin of the Vikrama era. Some writers hold that Kaṇishka began to reign in A.D. 78: one writer would place his initial date about A.D. 123: others would place it in A.D. 278. The view maintained by the present writer was held at one time by Sir A. Cunningham; and, as some others have already begun to recognize, evidence is now steadily accumulating in support of the correctness of it.

28 The legends on coins form part of numismatics, though closely connected with inscriptions.

29 The amphorae which conveyed the wine and other products of various localities have imprinted on their handles the name of the magistrate and other marks of the place and date. Large collections have been made of them, and they repay inquiry. See Dumont, *Inscriptions céramiques* (1872); Paul Becker, *Henkelinschriften* (Leipzig, pt. i. 1862, pt. ii. 1863); Hiller v. Gaertringen, *I.G.* xii. 1065-1441.

30 *e.g.* Treaty between Elis and the Heraeans, about 550-500 B.C., from Olympia (Boeckh, *C.I.G.* 11, Hicks, 29, and others in Dittenberger-Purgold, *Inschr. v. Olympia*, 1-43); a similar bronze treaty from the Locri Ozolae (Dittenberger, *I.G.* ix. 334); bronze plate from Dodona, recording the victory of Athens over the Lacedaemonians in a sea-fight, probably 429 B.C. (Dittenberger, *Syll.* 2. 30).

31 See Wünsch *I.G.* iii., App.; Audollent, *Defixionum Tabellae* (1904).

32 See Karapanos, *Dodone et ses ruines*; Hoffman, Gr. *Dial. Inschr.* 1558-1598.

33 What was done by Themistocles under stress of public necessity (Thucyd. i. 93) was done by others with less justification elsewhere; and from Byzantine times onward Greek temples and inscriptions were found convenient quarries.

34 It appears from Cicero, *De Legibus*, ii. 26, 27, that the size of Athenian gravestones was limited by law.

35 An index to the four volumes was long wanting; it was at length completed and appeared in 1877.

36 See E. Hübner, *Über mechanische Copieen von Inschriften* (Berlin, 1881).

37 Compare De Rossi, *Bullettino dell' instituto archeologico* (1871), p. 1 sq.

38 His works have been published by the French government in several volumes 4to (Paris, 1862 sqq.).

39 For other details of numerical notation, fractions, &c., see the manuals of metrology.

40 On the system of Roman nomenclature and the abbreviations employed in it see Cagnat's textbook, and for more detail Mommsen in *Römische Forschungen*, i. 1 seq., and in *Hermes*, iii. (1869), p. 70, W. Schulze, *Zur Geschichte lateinischen Eigennamen* (Berlin, 1904); on the *cognomina* (but only those occurring in ancient literature), Ellendt, *De cognomine et agnomine Romano* (Königsberg, 1853), and on the local *cognomina* of the Roman patriciate, Mommsen, *Röm. Forsch.* ii. 290 seq.; on the *nomina gentilicia*, Hübner (*Ephem. epigr.* ii. 25 seq.). The indexes to Orelli, Wilmanns, and the volumes of the *Corpus* may also be consulted.

41 This observation, applied to a large number of monuments, gave rise to many of the splendid epigraphical labours of Borghesi (see *e.g.* his dissertation upon the inscription of the consul L. Burbuleius, *Œuvres*, iv. 103 sq.).

42 The character of an *elogium* is assumed in a special way by the inscriptions on triumphal arches,

such as that of Augustus on the arch of Susa in Piedmont, dating from the year 745 (9 B.C.) (*C.I.L.* v. 7231; Orel. 626), and the similar one on the *tropaea Augusti* (*la Turbia*) (*C.I.L.* v. 7817) of the year 747 (7 B.C.), which Pliny also (*Hist. Nat.* iii. § 136) records, and those of the other emperors at Rome, of which only that of Claudius, the conqueror of Britain (*C.I.L.* vi. 920, 921; Orel. 715; Wil. 899), with the statues of himself and his family, need be mentioned.

43 See the important work of R. Lanciani, *Commentari di Frontino intorno le acque e gli acquedotti, &c.* (Rome, 1880).

INSECT, the anglicized form of the Late Lat. *insectum*, used by Pliny in his *Natural History* as the equivalent of the Gr. ἔντομον. Aristotle had included in one class "Entoma" the six-legged arthropods which form the modern zoological class of the Hexapoda or Insecta, besides the Arachnida, the centipedes and the millipedes. The word was introduced to English readers in a translation (1601) of Pliny's *Natural History* by Philemon Holland, who defined "insects" as "little vermine or smal creatures which have (as it were) a cut or division betwene their heads and bodies, as pismires, flies, grashoppers, under which are comprehended earthworms, caterpilers, &c." Few zoological terms have been more loosely used both by scientific and popular writers. The definition just quoted might include all animals belonging to the groups of the Arthropoda and Annelida, and U. Aldrovandi in *De animalibus insectis* (1602) almost contemporaneously distinguished between "terrestrial insects," including woodlice, earthworms and slugs, and "aquatic insects," comprising annelids and starfishes. Perhaps the widest meaning ever attached to the word was that of R.A.F. de Réaumur, who "would willingly refer to the class of insects all animals whose form would not allow them to be placed in the class of ordinary quadrupeds, in that of birds, or in that of fishes. The size of an animal should not suffice to exclude it from the number of insects.... A crocodile would be a terrible insect; I should have no difficulty, however, in giving it that name. All reptiles belong to the class of insects, for the same reasons that earthworms belong to it."

The class Insecta of Linnaeus (1758) was co-extensive with the Arthropoda of modern zoologists. The general practice for many years past among naturalists has been to restrict the terms "Insecta" and "insect" to the class of Arthropods with three pairs of legs in the adult condition: bees, flies, moths, bugs, grasshoppers, springtails are "insects," but not spiders, centipedes nor crabs, far less earthworms, and still less slugs, starfishes or coral polyps.

For a general account of the structure, development and relationships of insects, see ARTHROPODA and HEXAPODA, while details of the form, habits and classification of insects will be found in articles on the various orders or groups of orders (APTERA, COLEOPTERA, DIPTERIA, HEMIPTERA, HYMENOPTERA, LEPIDOPTERA, NEUROPTERA, ORTHOPTERA, THYSANOPTERA), and in special articles on the more familiar divisions (ANT, BEE, DRAGON-FLY, EARWIG, &c.). The history of the study of insects is sketched under ENTOMOLOGY.

(G. H. C.)

INSECTIVORA, an order of non-volant placental mammals of small size, with a dentition adapted to an insect-diet. In nearly all cases these creatures are nocturnal, and the majority are terrestrial, many burrowing in the ground, although a few are arboreal and others aquatic. They have plantigrade or partially plantigrade feet, that is to say, they apply the whole or the greater portion of the soles to the ground when walking; and there are generally five toes, each terminating in a claw, and the first never being opposable to the others in either the fore or hind limb. A full series of differentiated teeth, including temporary or deciduous milk-molars, is developed, and the cheek-teeth have distinct roots and are crowned with sharp cusps, which in some instances are three in number and arranged in a triangle. Very frequently the number of the teeth is the typical forty-four, arranged as *i.* $\frac{3}{3}$, *c.* $\frac{1}{1}$, *p.* $\frac{4}{4}$, *m.* $\frac{3}{3}$, but occasionally there is a fourth pair of molars, while the incisors may be reduced to two pairs above and one below, and the canine is frequently like an incisor or a premolar. The skull is of a primitive type, often with vacuities on the palate, as in marsupials, with a small brain-chamber, and the tympanic bone generally ring-like instead of forming a bladder-shaped bulla; except in the African *Potamogale*, clavicles, or collar-bones, are always present; the humerus generally has a perforation on the inner side of its lower extremity; and a centrale bone is usually present in the carpus. In the brain the smooth hemispheres are so short as to leave the cerebellum and sometimes even the corpora quadrigemina exposed. The uterus is two-horned; the placenta, so far as known, is

deciduate and discoidal; the testes are abdominal or inguinal; and the teats usually numerous. The body in several instances is covered with sharp spines in place of hair.

The great majority of the Insectivora are nocturnal in their habits, and their whole structure indicates an extremely low grade of organisation, fully as low as that of marsupials. It is noteworthy that the dentition in several of the groups approximates to that of the extinct mammals of the Jurassic epoch (see MARSUPIALIA), and exhibits more or less distinctly the primitive tritubercular type. Although the past history of the group is very imperfectly known, it seems probable that the Insectivora are nearly related to the original primitive mammalian stock. Indeed, it has been stated that were it not for the apparently advanced type of placenta, they might easily be regarded as the little modified descendants of the ancestors of most other mammals. Probably they are in some way related to the creodont carnivores (see CREODONTA), but if, as has been suggested, the latter are akin to the primitive ungulates, the connexion would seem to be less close than has been sometimes supposed.

Representatives of this order are found throughout the temperate and tropical parts of both hemispheres, with the exception of South America (where only a few shrews have effected an entrance from the north) and Australia, and exhibit much variety both in organization and in habit. The greater number are cursorial, but some (*Talpa*, *Chrysochloris*, *Oryzorictes*) are burrowing, others (*Limnogale*, *Potamogale*, *Nectogale*, *Myogale*) aquatic, and some (*Tupaiidae*) arboreal. To the great majority the term insectivorous is applicable, although *Potamogale* is said to feed on fish, and the moles live chiefly on worms. Notwithstanding the nature of their food, much variety prevails in the form and number of the teeth, and while in many cases the division into incisors, canines, premolars and molars may be readily traced, in others, forming the great majority of the species, such as the shrews, this is difficult.

In most cases the brain-cavity is of small relative capacity, and in no instance is the brain-case elevated to any considerable extent above the face-line. The facial part of the skull is generally much produced, and the premaxillary and nasal bones well developed; but the cheek, or zygomatic arch, is usually slender or deficient, the latter being the case in most of the species, and post-orbital processes of the frontals are found only in the *Tupaiidae* and *Macroscelididae*. The number of dorsal vertebrae varies from 13 in *Tupaia* to 19 in *Centetes*, of lumbar from 3 in *Chrysochloris* to 6 in *Talpa* and *Sorex*, and of caudal from the rudimentary vertebrae of *Centetes* to the 40 or more well-developed ones of *Microgale*.

The breast-bone, or sternum, is variable, but generally narrow, bilobate in front and divided into segments. The shoulder-girdle presents extreme adaptive modifications in the mole, in relation to the use of the fore-limbs in burrowing; but in the golden moles the fore-arm and fore-foot alone become specially modified. In *Macroscelides* the bones of the fore-arm are united at their lower ends, but in all other Insectivora the radius and ulna are distinct. The fore-foot has generally five digits; but in *Rhynchocyon* and in one species of *Oryzorictes* the first toe is absent, and in the moles it is extremely modified. The femur has, in most species, a prominent ridge below the greater trochanter presenting the characters of a third trochanter. In *Tupaia*, *Centetes*, *Hemicentetes*, *Ericulus* and *Solenodon* the tibia and fibula are distinct, but in most other genera united. The hind-foot consists usually of five digits (rarely four by reduction of the first), and in some, as in the leaping species (*Macroscelides*, *Rhynchocyon*), the tarsal bones are elongated. The form of the pelvis, and especially of the symphysis pubis, varies within certain limits, so that while in the *Tupaiidae* and *Macroscelididae* there is a long symphysis, in the *Erinaceidae*, *Centetidae* and *Potamogalidae* it is short, and in the *Soricidae*, *Talpidae* and *Chrysochloridae* there is none.

Owing to the similarity in the character of the food, the truly insectivorous species, forming more than nine-tenths of the order, present little variety in the structure of the digestive organs. The stomach is a simple, thin-walled sac; sometimes as in *Centetes*, with the pyloric and oesophageal openings close together; the intestinal canal has much the same calibre throughout, and varies from three (in the shrews) to twelve times (in the hedgehogs) the length of the head and body. In the arboreal *Tupaia* and the allied *Macroscelididae*, which probably feed on vegetable substances as well as insects most of the species possess a caecum. The liver is deeply divided into lobes, the right and left lateral being cut off by deep fissures; both the caudate and Spigelian lobes are generally well developed, and the gall-bladder, usually large and globular, is placed on the middle of the posterior surface of the right central lobe.

All the members of the order appear to be highly prolific, the number of young varying from two to eight in the hedgehog, and from twelve to twenty-one in the tenrec. The position of the milk-glands and the number of teats vary greatly. In *Solenodon* there is a single pair of post-inguinal teats, but in most species these organs range from the thorax to the abdomen, varying from two pairs in *Gymnura* to twelve in the tenrec. In the golden moles the thoracic and inguinal teats are lodged in deep cut-shaped depressions.

Scent-glands exist in many species. In most shrews they occur on the sides of the body at a

short distance behind the axilla, and their exudation is probably protective, as few carnivorous animals will eat their dead bodies. In both species of *Gymnura* and in *Potamogale* large pouches are situated on each side of the rectum, and discharge their secretions by ducts, opening in the first-named genus in front of and in the latter within the margin of the vent. In the tenrec similarly situated glands discharge by pores opening at the bottom of deep pits.

The skin is thin, but in many species lined with well-developed muscles, which are probably more developed in hedgehogs than in any other mammals. In this family and in the tenrec most of the species are protected by spines implanted in the skin-muscle, or panniculus carnosus.

Tree-Shrews.

The Insectivora may be divided into two groups, according to the degree of development of the union between the two halves of the pelvis. The first group is characterized by the full development of this union, both pubis and ischium entering into the symphysis. The tympanum remains as a ring within an auditory bulla; the orbit is either surrounded by bone, or separated from the hinder part of the skull by a post-orbital process of the frontal; the upper molars have broad 5-cusped crowns with a **W**-shaped pattern; and the intestine is generally furnished with a caecum. The first family of this group is the *Tupaiidae*, represented by the tree-shrews, or tupaias, of the Indo-Malay countries, characterized by the complete bony ring round the eye-socket, the freedom of the fibula from the tibia in the hind-limb, and the absence of any marked elongation of the tarsus. The dental formula is *i.* $\frac{2}{3}$, *c.* $\frac{1}{1}$, *p.* $\frac{3}{3}$, *m.* $\frac{3}{3}$, total 38. In appearance and habits tree-shrews are extremely like squirrels, although they differ, of course, *in toto* as regards their dentition. A large number of species are included as the typical genus *Tupaia*, which ranges from north-eastern India to the great Malay Islands. In these animals the tail has a fringe of long hairs on opposite sides throughout its length. In the pen-tailed, tree-shrew (*Ptilocercus lowii*), fig. 1, the only representative of its genus, and a native of Sumatra, Borneo and the Malay Peninsula, the fringes of long hair are confined to the terminal third of the tail. There are also differences in the skulls of the two genera. A third genus, *Urogale*, represented by *U. cylindrura* of the mountains of Mindanao, in the Philippines, and *U. everetti*, of Borneo, has been established for the round-tailed tupaias, in which the tail is uniformly short-haired, and the second upper incisor and the lower canines are unusually large, the third lower incisor being proportionately small, and also erect, while the second upper incisor resembles a canine. (See Tree-Shrew.)

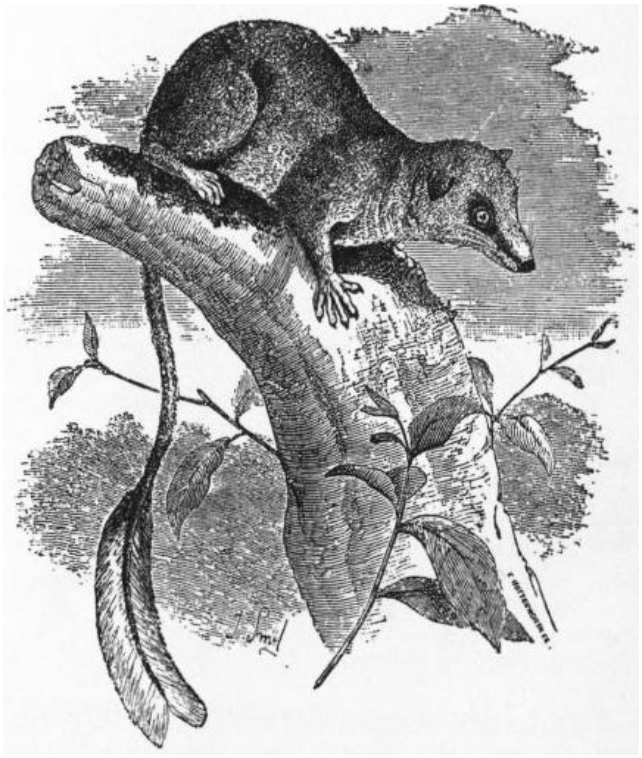

Fig. 1. Pen-tailed Tree-Shrew (*Ptilocercus lowii*).

In Africa the tupaias are apparently represented by the jumping-shrews, or elephant-shrews (so called from their elongated muzzles), constituting the family *Macroscelididae*. From the *Tupaiidae* the members of this family are readily distinguished by the fact that the socket of the eye, in place of having a complete bony ring, is separated from the hinder part of the skull merely by a post-orbital process of the frontal bone, and also by the more or less marked elongation of the tarsus or lower portion of the hind-limb; another feature being the union of the lower ends of the tibia and fibula. As indicated by one of their names, the members of the group leap after the fashion of gerbils, or jerboas, and hence walk much more on their toes than the majority of the order. In the typical genus *Macroscelides*, which ranges all over Africa and has numerous specific representatives, the dental formula is *i.* $\frac{3}{3}$, *c.* $\frac{1}{1}$, *p.* $\frac{4}{4}$, *m.* 2/(2 or 3), total 40 or

42; while there are five toes to each foot, and the lower ends of the radius and ulna are united. In *Petrodromus* (fig. 2) of East Africa, there are only four front-toes, and the hairs on the lower part of the tail form stiff bristles, with swollen tips; the dental formula being the same as that of those species of *Macroscelides* as have only two lower molars. A further reduction of the number of the digits takes place in the long-nosed jumping-shrews of the genus *Rhynchocyon*, which are larger animals with a much longer snout, only four toes to each foot, and a dental formula of *i.* (1 or 0)/3, *c.* 1/1, *p.* 4/4, *m.* 2/2, total 36 or 34. Some of the species, all of which are East African, differ from the members of the typical genus by the deep rufous brown instead of olive-grey colour of their coat. (See JUMPING-SHREW.)

In the second group, which includes all the other members of the order, the pelvic symphysis is either lacking or formed merely by the epiphyses of the pubes; the orbit and temporal region of the skull are confluent; and, except in the *Talpidae* and *Chrysochloridae*, the tympanum is ring-like, the tympanic cavity being formed by the alisphenoid and basisphenoid bones. The upper molars are triconodont, being either of the typical or a modified form of what is known as the tritubercular sectorial type. There is no caecum.

Moles.

The first representatives of this group are the moles, or *Talpidae*, in which the lower ends of the tibia and fibula are united (fig. 3, *t*, *fb*), there is a descent of the testes, the tympanum forms a bladder-like bulla, the zygomatic, or cheek-arch, although slender, is complete, there is no pelvic symphysis, the upper molars are five-cusped, and the first upper incisor is simple, and the lower vertical. In habits the majority of the family are burrowing, but a few are aquatic; and all feed on animal substances. The distribution is limited to the temperate regions of Europe, Asia and North America.

Throughout the family the eyes are minute, and in some species are covered with skin; the ears are short and hidden in the fur; and the fore-limbs are generally more or less modified for digging.

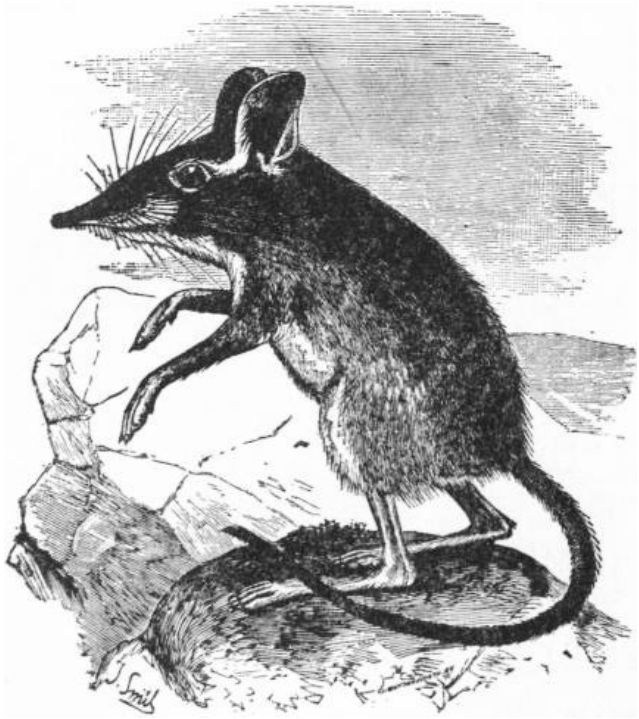

FIG. 2.—Peter's Jumping-Shrew (*Petrodromus tetradactylus*).

The true moles of the genus *Talpa* are the typical representatives of the first subfamily, or *Talpinae*, in which the clavicle (fig. 3, cl.) and humerus (*h*) are very short and broad, while there is an additional sickle-like bone (*fc*) on the inner side of the fore-foot. In Talpa itself the first upper incisor is but little larger than the second, the fore-foot is very broad, and the dental formula is *i.* 2/2, *c.* 1/(1 or 0), *p.* 3/3, 3/4, or 4/4, *m.* 3/3. There are about a dozen species, all confined to the Old World. The variation in the dental formula of some of the best known of these is as follows:—

i. 3/3, *c.* 1/0, *p.* 4/4, *m.* 3/3 × 2 (*T. wogura*, *robusta*).
i. 3/3, *c.* 1/1, *p.* 4/4, *m.* 3/3 × 2 (*T. europaea*, *caeca*, *romana*, *longirostris*, *micrura*).
i. 3/3, *c.* 1/1, *p.* 3/4, *m.* 3/3 × 2 (*T. leucura*, *leptura*).
i. 3/3, *c.* 1/1, *p.* 3/3, *m.* 3/3 × 2 (*T. moschata*).

Except in *T. europaea*, the eyes are covered by a membrane. In *T. micrura* the short tail is concealed by the fur. *T. europaea* extends from England to Japan.

T. caeca and *T. romana* are found south of the Alps, the remaining species are all Asiatic, two only—*T. micrura* and *T. leucura*—occurring south of the Himalaya.

The genus may be split up into subgenera corresponding with the above table; these subdivisions being sometimes accorded full generic rank. For instance the Japanese *T. wogura* and the Siberian *T. robusta* are often referred to under the ill-sounding titles of *Mogera wogura* and *M. robusta*.

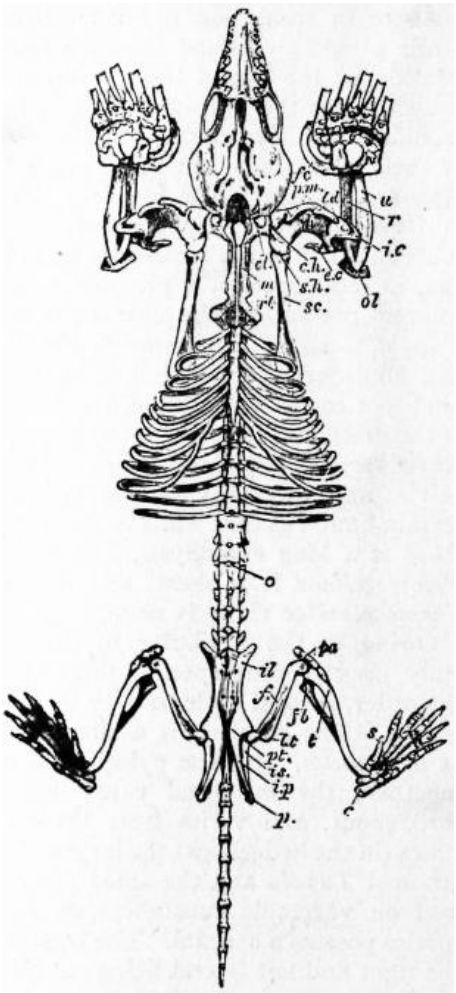

FIG. 3.—Skeleton of Mole (*Talpa europaea*) (lower jaw removed to show base of skull).

c, Calcaneum.
c.h, Clavicular articulation of the humerus.
cl, Clavicle.
e.c, External condyle of humerus.
f, Femur.
fb, Fibula.
fc, Falciform bone (radial sesamoid).
h, Humerus.
i.c, Internal condyle of humerus.
il, Left iliac bone.
i.p, Ramus of the ilium and pubis.
is, Ischium.
l.d, Ridge of insertion of latissimus dorsi muscle.
l.t, Lesser trochanter.
m, Manubrium sterni.
o, Fourth hypapophysial sesamoid ossicle.
ol, Olecranon.
p, Pubic bone widely separated from that of the opposite side.
pa, Patella.
p.m, Ridge for insertion of pectoralis major muscle.
pt, Pectineal eminence.
r, Radius.
rb, First rib.
s, Plantar sesamoid ossicle corresponding to the radial sesamoid (os falciform) in the manus.
sc, Scapula.
s.h, Scapular articulation of

the humerus.
t, Tibia.
u, Ulna.

Referring more fully to the European species, it may be mentioned that the mole exhibits in its organization perfect adaptation to its mode of life. In the structure of the skeleton striking departures from the typical mammalian forms are noticeable. The first sternal bone is so much produced as to extend forward as far as a vertical line from the second cervical vertebra, carrying with it the very short almost quadrate clavicles, which are articulated with its anterior extremity and externally with the humeri, being also connected ligamentously with the scapula. The fore-limbs are thus brought opposite the sides of the neck, and from this position a threefold advantage is derived:—in the first place, as this is the narrowest part of the body, they add little to the width, which, if increased, would lessen the power of movement in a confined space; secondly this position allows of a longer fore-limb than would otherwise be possible, and so increases its lever power; and, thirdly, although the entire limb is relatively short, its anterior position enables the animal, when burrowing, to thrust the claws so far forward as to be in a line with the end of the muzzle, the importance of which is evident. Posteriorly, we find the hind-limbs removed out of the way by approximation of the hip-joints to the centre line of the body. This is effected by inward curvature of the innominate bones at the acetabulum to such an extent that they almost meet in the centre, while the pubic bones are widely separated behind. The shortness of the fore-limb is due to the humerus, which, like the clavicle, is so reduced in length as to present the appearance of a flattened **X**-shaped bone, with prominent ridges and deep depressions for the attachments of powerful muscles. Its upper extremity presents two rounded prominences; the smaller, the true head of the bone, articulates as usual with the scapula; the larger, which is the external tuberosity rounded off, forms a separate joint with the end of the clavicle. This double articulation gives the rigidity necessary to support the great lateral pressure sustained by the fore-limb in excavating. The bones of the fore-leg are normal, but those of the fore-foot are flattened and laterally expanded. The great width of the fore-foot is also partly due to the presence of a peculiar bone on the inner side of the palm and articulating with the wrist.

The muscles acting on these modified limbs are homologous with those of cursorial insectivora, differing only in their relative development. The tendon of the biceps traverses a long bony tunnel, formed by the expansion of the margin of the bicipital groove for the insertion of the pectoralis major muscle; the anterior division of the latter muscle is unconnected with the sternum, extending across as a band between the humeri, and co-ordinating the motions of the fore-limbs. The teres major and latissimus dorsi muscles are of immense size, inserted into the prominent ridge below the pectoral attachment, and are the principal agents in the excavating action of the limb. The cervical muscles connecting the slender scapulae, and through them the fore-limbs, with the centre line of the neck and with the occiput are large, and the ligamentum nuchae between them is ossified. The latter condition appears to be due to the prolongation forwards of the sternum, preventing flexion of the head downwards; and accordingly, the normal office of the ligament being lost, it ossifies, and affords a fixed point for the origins of the superficial cervical muscles.

The skull is long, with slender zygomatic arches; the nasal bones are strong and early become united, and in front of them the nostrils are continued forwards in tubes formed of thick cartilage, the septum between which becomes partially or wholly ossified beneath. There are 7 cervical, 13 dorsal, 6 lumbar, 6 sacral and 10-12 caudal vertebrae; of the dorsal and lumbar there may be one more or less. The sacral vertebrae are united by their expanded and compressed spinous processes, and all the others, with the exception of the cervical, are closely and solidly articulated together, so as to support the powerful propulsive and fossorial actions of the limbs. The upper incisors are simple chisel-edged teeth; the canine is long and two-rooted; then follow three subequal conical premolars, and a fourth, much larger, and like a canine; these are succeeded by three molars with **W**-shaped cusps. In the lower jaw the three incisors on each side are slightly smaller, and slant more forwards; close behind them is a tooth which, though like them, must, from its position in front of the upper canine, be considered as the canine; behind it, but separated by an interval, is a large double-rooted conical tooth, the first premolar; the three following premolars are like the corresponding teeth above, but smaller, and are succeeded, as above, by the three molars. See Mole.

FIG. 4.—Russian Desman (*Myogale moschata*).

In the other members of the *Talpinae*, which are North American, the first upper incisor is much taller than the second. They include the curious star-nosed mole (*Condylura cristata*), which has the typical series of 44 teeth and a series of fleshy appendages round the extremity of the snout; the species known as *Scapanus townsendi* and *Parascalops americanus*, each representing a genus by itself, and characterized by the absence of nasal appendages and the presence of only two pairs of lower incisors; and, finally, *Scalops aquaticus*, in which the dentition is further reduced by the loss of the lower canine, the total number of teeth thus being forty.

Forming a transition to the subfamily *Myogalinae*, in which the clavicle and humerus are typically of normal form, and there is no sickle-shaped bone in the fore-foot, is the Chinese mole (*Scaptonyx piscicauda*), characterized by having the clavicle and humerus of the true mole-type, but the foot like that of the under-mentioned *Urotrichus*. The relative proportions of the first and second upper incisors are also as in *Talpa*, but there are only two pairs of lower incisors.

Among the more typical *Myogalinae*, mention may be made of *Dymecodon pilirostris*, from Japan, representing a genus by itself; nearly allied to which are the shrew-moles, as represented by the small and long-tailed *Urotrichus* of Japan, with incisors $\frac{2}{1}$ and premolars $\frac{4}{3}$, and *U. (Neurotrichus) gibbsi* of North America, in which the premolars are $\frac{3}{4}$. A still more interesting form is the Tibetan *Uropsilus soricipes*, a non-burrowing species, with the external appearance of a shrew combined with the skull of a mole, the feet being much narrower than in *Urotrichus*, and the dental formula *i.* $\frac{2}{1}$, *c.* $\frac{1}{1}$, *p.* $\frac{3}{3}$, *m.* $\frac{3}{3}$.

The typical representatives of the subfamily are the two European desmans, *Myogale moschata* and *M. pyrenaica*, which are aquatic in habits and have the feet webbed and the full series of 44 teeth. The former is by far the largest member of the whole family, its total length being about 16 in. Its long proboscis-like snout projects far beyond the margin of the upper lip; the toes are webbed as far as the bases of the claws; and the long scaly tail is laterally flattened, forming a powerful instrument of propulsion when swimming. This species inhabits the banks of streams and lakes in south-east Russia, where its food consists of various aquatic insects. *M. pyrenaica*, living in a similar manner in the Pyrenees, is much smaller, has a cylindrical tail, and a relatively long snout.

Shrews.

The Shrew-mice, or, shortly, shrews (*Soricidae*), are closely related to the *Talpidae*, with which they are connected by means of some of the subfamily *Myogalinae*. They are, however, distinguished by the ring-like tympanic, the incompleteness of the zygomatic arch, the tubercular-sectorial type of upper molar, the two-cusped first upper incisor, and the forward direction of the corresponding lower tooth. As a rule they are terrestrial, but a few are aquatic.

The dentition (fig. 5) is characteristic, and affords one of the chief means of classifying this exceedingly difficult group of mammals. There are no lower canines, and always six functional teeth on each side of the lower jaw, but in some rare instances an additional rudimentary tooth is squeezed in between two of the others. The first pair of

teeth in each jaw differ from the rest; in the upper jaw they are hooked and have a more or less pronounced basal cusp; in the lower jaw they are long and project horizontally forwards, sometimes with an upward curve at the tip. Behind the first upper incisor comes a variable number of small teeth, of which, when all are developed, the first two are incisors, the third the canine, and the next two premolars; behind these, again, are four larger teeth, of which the front one is the last premolar, while the other three are molars. Thus we have in the typical genus *Sorex* (fig. 5) the dental formula *i.* 3/2, *c.* 1/0, *p.* 3/1, *m.* 3/3, total 32, or twenty upper and twelve lower teeth. The lower formula, as already stated, is constant, but the number of the upper series varies from the above maximum of twenty to a minimum of fourteen in *Diplomesodon* and *Anurosorex*, in which the formula is *i.* 2, *c.* 1, *p.* 1, *m.* 3. From the relation of the fourth upper tooth to the premaxillo-maxillary suture it has been supposed that shrews, like many polyprotodont marsupials, have four pairs of upper incisors; but this is improbable, and the formula is accordingly here taken to follow the ordinary placental type.

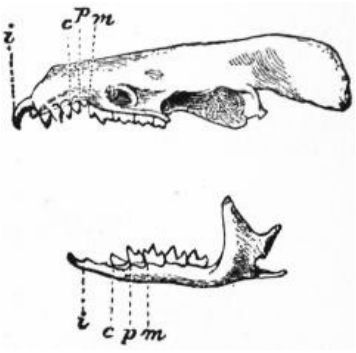

FIG. 5.—Skull and Dentition of a Shrew-mouse (*Sorex-verae-pacis*); *i*, first incisors; *c* in the upper jaw is the canine; and *p-m* the three premolars, behind which are the three molars; in the lower jaw *c* is the second incisor, and *p* the single premolar.

Shrews may be divided into two sections, according as to whether the teeth are tipped with brownish or reddish or are wholly white, the former group constituting the *Soricinae* and the latter the *Crocidurinae*.

In the red-tipped group is the typical genus *Sorex*, which ranges over Europe and Asia north of the Himalaya Mountains to North America. There are twenty upper teeth with the formula given above, the ears are well developed, the tail is long and evenly haired, and the aperture of the generative organs in at least one of the sexes is distinct from the vent. The common shrew-mouse (*Sorex araneus*) has a distribution co-extensive with that of the genus in the Old World, and the North American *S. richardsoni* can scarcely be regarded as more than a local race. A few species, such as *Sorex hydrodomus* of Alaska and *S. palustris* of the United States, have fringes of long hairs on the feet, and are aquatic in habit. The latter has been made the type of the genus *Neosorex*, but such a distinction, according to Dr J. E. Dobson, is unnecessary. The same authority likewise rejects the separation of the North American *S. bendirei* as *Atophyrax*, remarking that this species is an inhabitant of marshy land, and appears to present many characters intermediate between *S. palustris* and the terrestrial species of the genus, differing from the former in the absence of well-defined fringes to the digits, but agreeing with it closely in dentition, in the large size of the infra-orbital foramen, and in the remarkable shortness of the angular process of the lower jaw. In India and Burma the place of *Sorex* is taken by *Soriculus*, in which the upper teeth are generally 18, although rarely 20, and the generative organs have an opening in common with the vent after the fashion of the monotreme mammals. The latter feature occurs in the North American *Blarina*, which is characterized by the truncation of the upper part of the ear and the short tail, the number of upper teeth being 20 or 18. Another American genus, *Notiosorex*, in which the ear is well developed and the tail medium, has only 16 upper teeth. From all the rest of the red-toothed group the water-shrew, *Neomys* (or *Crossopus*) *fodiens*, of Europe and northern Asia, differs by the fringe of long hairs on the lower surface of the tail; the number of upper teeth being 18.

In the white-toothed, or crocidurine, group, the small African genus *Myosorex*, which has either 18 or 20 upper teeth, includes long-tailed and large-eared species in which the aperture of the generative organs and the vent, although close together, are yet distinct. In the musk-shrews (*Crocidura*), on the other hand, which are common to Europe, Asia and Africa, the reproductive organs and the alimentary canal discharge into a common cloaca, the long tail is sparsely covered with long and short hairs, there are anal glands secreting a strong musky fluid, and the number of upper teeth is 16 or 18. *Diplomesodon pulchellus* of the Kirghiz steppes, has, on the other hand, only 14 upper teeth, and is further characterized by the moderately long tail and the hairy soles of the hind-feet. Another genus is represented by the Tibetan *Anurosorex squamipes*, which has the same dental formula, but a mole-like form, rudimentary tail and scaly hind-soles. Lastly, we have two Asiatic mountain aquatic species, *Chimarrogale himalayaca* of the Himalayas and *Nectogale elegans* of Tibet, which have fringed tails like the European water-shrew, and 16 upper teeth, the former characterized by the small but perfect external ears, and the latter (fig. 6) by the absence of the ears and presence of adhesive disks on the feet.

It will be seen that the red- and the white-toothed series have parallel representative forms, which may indicate that the division of the family into the two groups is one based rather on convenience than on essential differences. See SHREW.

From the shrews, the hedgehogs and gymnuras, or rat-shrews, collectively forming the family *Erinaceidae*, differ structurally by the broader ring made by the tympanic, the complete zygomatic arch, the five-cusped broad upper molars, and the presence of a short pubic

symphysis. At the present day they are an exclusively Old World group.

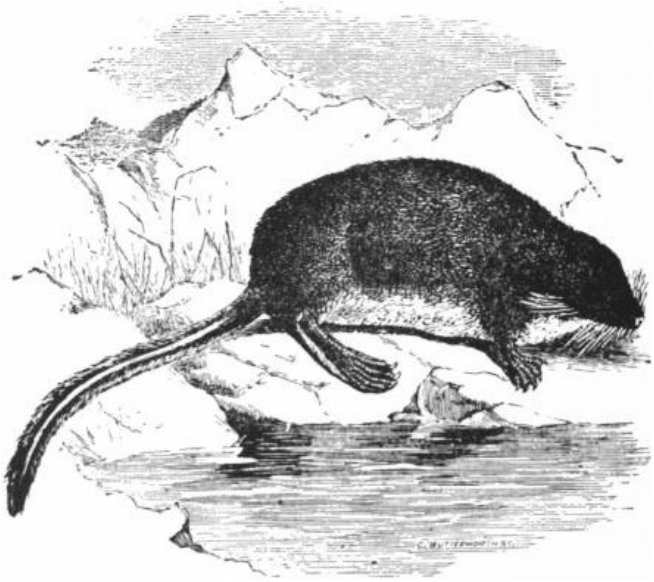

FIG. 6.—The Tibetan Water-shrew (*Nectogale elegans*).

Hedgehogs.

The typical group, or *Erinaceinae*, is represented only by the hedgehogs, with the one genus *Erinaceus*, easily recognized by their spiny coats, and further characterized by the rudimentary tail, the presence of vacuities in the palate, and the broad pelvis. Hedgehogs (*Erinaceus*) have the dental formula *i.* $\frac{2}{2}$, *c.* $\frac{1}{1}$, *p.* $\frac{3}{2}$, *m.* $\frac{3}{3}$, and are represented by over a score of species, distributed throughout Europe, Africa and the greater part of Asia, but unknown in Madagascar, Ceylon, Burma, Siam, the Malay countries, and, of course, Australia. All the species resemble one another in the armour of spines covering the upper surface and sides of the body; and all possess the power of rolling themselves up into the form of a ball protected on all sides by these spines, the skin of the back being brought downwards and inwards over the head and tail so as to include the limbs by the action of special muscles.

Curiously enough the European hedgehog (*E. europaeus*) is the most aberrant species, differing from all the rest in the peculiarly-shaped and single-rooted third upper incisor and first premolar (fig. 7, A), and in its very coarse harsh fur. The dentition of the long-eared Indian *E. grayi* (fig. 7, B) may, on the other hand, be considered characteristic of all the other species, the only important differences being found in the variable size and position of the second upper premolar, which is very small, external and deciduous in the Indian *E. micropus* and *E. pictus*. The former species, limited to South India, is further distinguished by the absence of the jugal bone. Of African species, *E. diadematus*, with long frontal spines, is probably the commonest, and *E. albiventris* has been made the type of a separate genus on account of the total absence of the first front-toe. See HEDGEHOG.

Rat-shrew.

The members of the second subfamily, *Gymnurinae*, are more or less rat-like animals, confined to the Malay countries, and easily distinguished from the hedgehogs by the absence of spines among the fur and the well-developed tail. They also lack vacuities in the palate, and have a long and narrow pelvis. The typical representative of the family is the greater rat-shrew, or greater gymnura (*Gymnura rafflesi*) a creature which may be compared to a giant shrew, and whose colour is partly black and partly white, although a uniformly pale-coloured race. (*G. r. alba*) inhabits Borneo. In common with the next genus, it has the full series of 44 teeth; and its range extends from Tenasserim and the Malay Peninsula to Sumatra and Borneo, the island individuals being stated to be considerably larger than those from the mainland. In this species the length of the tail is about three-fourths that of the head and body; but in the lesser rat-shrew (*Hylomys suillus*), ranging from Burma and the Malay Peninsula to Java and Sumatra, the former dimension is only about one-sixth of the latter. In the Philippines the group is represented by *Podogymnura truei*, distinguished from the other genera by the great elongation of the hind-foot, the tail being likewise long. There are only three pairs of premolars in each jaw.

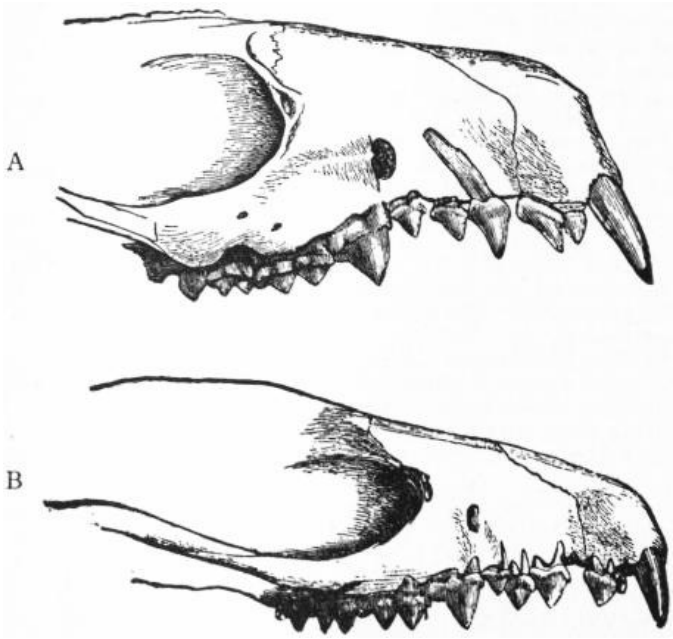

FIG. 7.—Fore-part of Skulls of Common Hedgehog (*Erinaceus europaeus*), A, and Gray's Hedgehog (*E. grayi*), B, much enlarged.

FIG. 8.—The Insectivorous Otter (*Potagmogale velox*).

In the remaining families of the Insectivora the tibia and fibula may be either separated or united at the lower end; there is no descent of the testes, except in *Solenodon*; a short symphysis is formed by the junction of the pubic epiphyses; and the upper molars are generally small, and triangular, with three cusps arranged in a **V**. The first family, *Potamogalidae*, is represented by the otter-like *Potamogale velox* of the rivers of West Africa (fig. 8), distinguished from all other members of the order by the absence of clavicles. The tibia and fibula are united interiorly, the skull has a ring-like tympanic, no zygomatic arch, and the upper molars are of the tuberculo-sectorial type, with broader crowns than in the following families. The dental formula is *i.* ⅔, *c.* ¼, *p.* ⅔, *m.* ⅔, total 40. This animal inhabits the banks of streams in west equatorial Africa, and its whole structure indicates an aquatic life. It is nearly 2 ft. in length, the tail measuring about half. The long cylindrical body is continued uninterruptedly into the thick laterally compressed tail, the legs are very short, and the toes are not webbed, progression through the water depending wholly on the action of the powerful tail, while the limbs are folded inwards and backwards. The muzzle is broad and flat, and the nostrils are protected by valves. The fur is dark brown above, the extremities of the hairs on the back being of a metallic violet hue by reflected light, beneath whitish.

Insectivorous Otter.

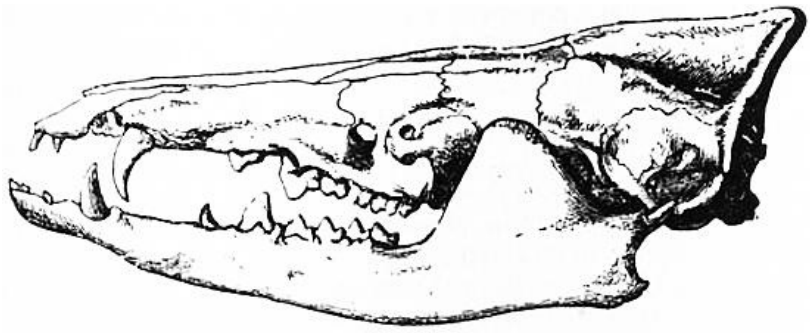

FIG. 9.—Skull of the Tenrec (*Centeles ecaudatus*), somewhat reduced.

Tenrec.

In the remaining groups the upper molars form narrow V's of the true tritubercular type. The family, *Centetidae*, represented by the tenrec and a number of allied animals from Madagascar, is specially characterized by the ring-like tympanic, and the absence of a zygomatic arch and of any constriction of the skull behind the orbits, and the presence of teats on the breast as well as the abdomen. In the more typical members of the family the tibia and fibula are separate, and, as in hedgehogs, spines are mingled with the fur. The true or great tenrec (*Centetes ecaudatus*), alone representing the typical genus, has the dental formula *i.* (3 or 2)/3, *c.* 1/1, *p.* 3/3, *m.* (3 or 4)/(3 or 4), total 38, 40, 42 or 44. The fourth lower molar, when developed, does not appear till late in life. Of the long and sharp canines, the tips of the lower pair are received into pits in the upper jaw (fig. 9). The creature grows to a length of aoout a foot. The young have strong white spines arranged in longitudinal lines along the back, but these are lost in the adult which has only a crest of long rigid hairs on the nape of the neck. The lesser tenrecs, *Hemicentetes semispinosus* and *H. nigriceps*, are distinguished by the persistence of the third upper incisor and the form of the skull. The two species are much smaller than the great tenrec, and spines are retained in the adult on the body. The hedgehog-tenrec, *Ericulus setosus*, has the whole upper surface, and even the short tail, densely covered with close-set spines. The facial bones are much shorter than in the preceding genera, and the first upper incisors are elongated; while there are only two pairs of incisors in each jaw. Judging from the slight development of the cutaneous muscles compared with those of the hedgehog, it would seem that these creatures cannot roll themselves completely into balls in hedgehog-fashion. A second species of this genus, *Ericulus* (*Echinops*) *telfairi*, has two, in place of three, pairs of molars, thus reducing the total number of teeth to 32. Moreover, the zygomatic arches of the skull are reduced to mere threads. Here should perhaps be placed *Geogale aurita*, a small long-tailed Malagasy insectivore, with 34 teeth, and no spines; the tibia and fibula being separate. It has been classed in the *Potamogalidae*, but from its habitat such a reference is improbable. The absence of spines may entitle it to separation from the *Centetinae*, so that it should perhaps be regarded as representing a subfamily, *Geogalinae*, by itself.

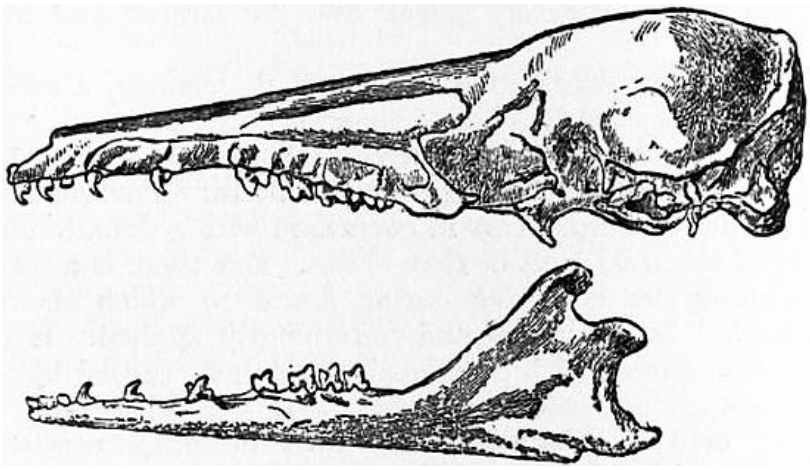

FIG. 10.—Skull of the Lesser Tenrec (*Hemicentetes spinosus*).

The absence of spines coupled with the union of the tibia and fibula form the leading characteristics of the subfamily *Oryzorictinae*, typified by the rice-tenrecs *Oryzorictes*, of which there are several species. These creatures, which excavate burrows in the rice-fields of Madagascar, are somewhat mole-like in appearance, but have tails of considerable length. In the typical *O. hova* the fore-feet are five-toed, but in *O. tetradactylus* the number of front digits is reduced to four. The long-tailed tenrecs (*Microgale*) are represented by fully half-a-dozen species with tails of great length; that appendage in the typical *M. longicaudata* being more than double the length of the head and body, and containing no fewer than forty-seven vertebrae. The teeth are generally similar to those of *Centetes*, but are not spaced in front; their number being *i.* 3/3, *c.* 1/1, *p.* 3/3, *m.*, 3/3, total 40, or the same as in *Oryzorictes*. Finally, *Limnogale mergulus*, a creature

about the size of a black rat, has webbed toes and a laterally compressed tail, evidently adapted for swimming. See TENREC.

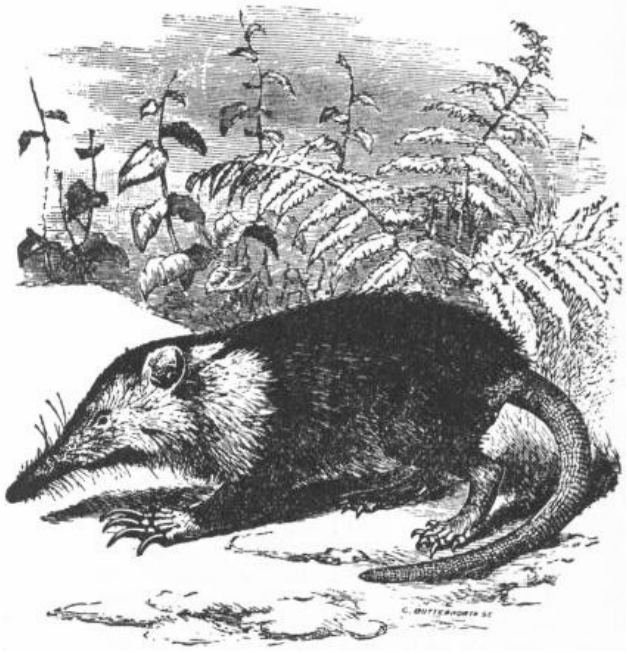

FIG. 11.—*Solenodon cubanus.*

Solenodon.

All the foregoing are natives of Madagascar. It has been suggested however, that two remarkable West Indian insectivores, namely *Solendon cubanus* of Cuba (fig. 11) and *S. paradoxus* of Hayti, should be regarded as representing merely a subfamily of *Centetidae*. It is true that the main features distinguishing these strange creatures from the Malagasy representatives of that family are the constriction of the skull behind the orbits, the descent of the testes into the perineum, and the post-inguinal position of the teats, and that none of these are of very great importance. But the geographical positions of the two groups are so widely sundered that it seems preferable to await further evidence before definitely assigning the two to a single family; and the family *Solenodontidae* may accordingly be retained for the West Indian animals. Solenodons, which look like huge long-nosed, parti-coloured rats, have the tibia and fibula separate, and the same dental formula as *Microgale*. Each of the two species (which differ in colour and the quality of the fur) has a long cylindrical snout, an elongated naked tall, feet formed for running, and the body clothed with long, coarse fur. The position of the teats on the buttocks is unique among Insectivora. The first upper incisors are much enlarged, and like the other incisors, canines and premolars, closely resemble the corresponding teeth of *Myogale*; the second lower incisors are much larger than the upper ones, and hollowed out on the inner side.

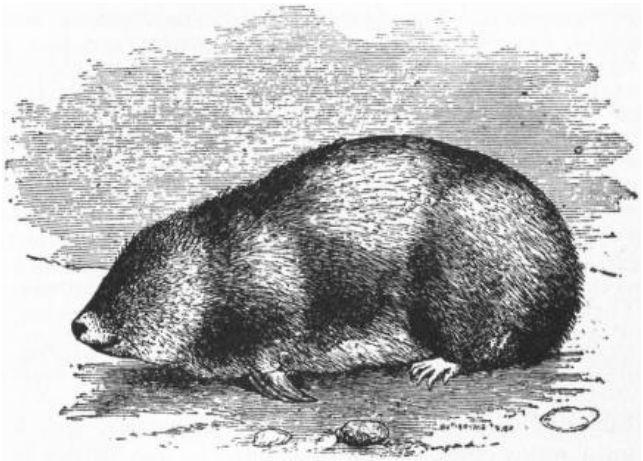

FIG. 12.—A Golden Mole (*Chrysochloris obtusirostris*) reduced.

Golden Mole.

The last family, *Chrysochloridae*, is represented by the golden moles of South and East Africa, which differ from the *Centetidae* and *Solenodontidae* by the development of a bulla to the tympanic, and the presence of a zygomatic arch to the skull; the tibia and fibula being separate, and the symphysis of the pelvis formed merely by ligament. The skull is not constricted across the orbits. The teats, which are placed both on the breast and in the groin, are situated in shallow depressions. The ears are buried in the fur, and the eyes concealed beneath the skin; the feet are four-toed and provided with powerful claws for burrowing in the fashion of the mole, but it is interesting to note that the

skeleton is modified for the same purpose in a manner quite different from that obtaining in the latter animal. These animals derive their name from the metallic iridescence of the fur of most of the species. In the more typical species the dental formula is the same as in *Microgale*, that is to say, there are 40 teeth. In other species, which it has been proposed to separate as *Amblysomus*, there are, however, only 36 teeth, owing to the absence of the last pair of molars. The group is evidently nearly related to the *Centetidae*—most nearly perhaps to the *Oryzorictinae*.

Fossil Insectivora.

Some years ago Dr F. Ameghino, of Buenos Aires, described from the Tertiary formation of Santa Cruz, in Patagonia, the remains of an insectivore under the name of *Necrolestes*. The occurrence of a member of the Insectivora in these beds is remarkable, since this group is represented at the present day in South America only by a shrew or two which have wandered from the north. Dr Ameghino expressed his belief that the extinct Patagonian insectivore was nearly related to the golden moles, and although this opinion appears to have been withdrawn, Professor W. B. Scott states that he is convinced of the close affinity existing between *Necrolestes* and *Chrysochloris*. Although this view may not be accepted, it must be remembered that it represents the opinion of a palaeontologist who has had better opportunities than most of his fellow-workers of forming a trustworthy judgment. So convinced is Dr Scott of the closeness of the relationship between *Necrolestes* and the golden moles that he regards it as rendering probable the former existence of a direct land-connexion between Africa and South America. There is no reason, he says, to suppose that the track of migration could have been by way of Europe and North America, for no trace of the group has been found anywhere north of the equator. This supposed connexion between Africa and South America in Tertiary times has often been suggested, and is supported by many independent lines of evidence; and the presumed affinity between the two mammals here referred to adds to the weight of such evidence.

The discovery in the Oligocene Tertiary deposits of Dakota of the remains of a species of hedgehog is a fact of great interest, for the hedgehog-tribe (*Erinaceidae*) is at the present day an exclusively Old World group. The discovery of the fossil American species, which has been made the type of a new genus under the name of *Protherix*, serves to strengthen the view that the northern countries of the Western and Eastern hemispheres form a single zoological region; and that formerly there was comparatively free communication between them in the neighbourhood of Bering Sea, under climatic conditions which permitted of temperate forms passing from one continent to the other. As might have been expected, remains of hedgehog-like mammals have been obtained in the Tertiary deposits of Europe. Among these, *Palaeoerinaceus*, from the Upper Oligocene of France, seems scarcely separable from the existing genus. *Necrogymnurus* (*Neurogymnurus*) from the Lower Oligocene, of the same country, appears to be allied to *Hylomys*, which is itself the most generalised of the family, so that the extinct genus, of which *Caluxotherium* is a synonym, may represent the ancestral type of the *Erinaceidae*. The genus *Galerix*, or *Lanthanotherium*, of the Oligocene, which has the typical series of 44 teeth, a bony ring round the orbit, and conjoint tibia and fibula, has been regarded as representing the *Tupaiidae* and *Macroscelididae*, but is more probably referable to the *Erinaceidae*, being apparently akin to *Gymnura*. The moles are represented in the French Oligocene by *Amphidozotherium* and in the Miocene by *Talpa*, while in the North American early Tertiary we have the primitive *Talpavus*. Shrews are also known from the Lower Oligocene upwards both in the eastern and western hemispheres. Of the Lower Eocene *Adapisorex*, with the typical 22 lower teeth, *Adapisoriculus* and *Orthaspidotherium*, all from France, the affinities are quite uncertain. The American Oligocene *Leptictis*, with i. 2, *c.* 1, *p.* 4, *m.* 3 in the upper jaw, and Ictops, with *i.* ⅔, *c.* ⅓, *p.* ¾, *m.* ⅗, may be insectivorous mammals, with affinities to the creodont Carnivora. It is, indeed, probable that not only is there a relationship between the Creodonta and the Insectivora, but also one between the latter and the Marsupialia, so that the marked similarity between the cheek-teeth of the insectivorous *Chrysochloris* and the Marsupial *Notoryctes* may be due to genetic relationship. That the bats and the flying-lemur are descendants of the Insectivora cannot be doubted.

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(R. L.*)

INSECTIVOROUS PLANTS. Insectivorous or, as they are sometimes more correctly termed, carnivorous plants are, like the parasites, the climbers, or the succulents, a physiological assemblage belonging to a number of distinct natural orders. They agree in the extraordinary

habit of adding to the supplies of nitrogenous material afforded them in common with other plants by the soil and atmosphere, by the capture and consumption of insects and other small animals. The curious and varied mechanical arrangements by which these supplies of animal food are obtained and utilized are described under the headings of the more important plants.

The best known and most important order of insectivorous plants—Droseraceae—includes six genera: *Byblis*, *Roridula*, *Drosera*, *Drosophyllum*, *Aldrovanda* and *Dionaea*, of which the last three are monotypic, *i.e.* include only one species. The Sarraceniaceae contain the genera *Sarracenia*, *Darlingtonia*, *Heliamphora*, while the true pitcher plants or Nepenthaceae consist of the single large genus *Nepenthes*. These three orders are closely allied and form the series Sarraceniales of the free-petalled section (Choripetalae) of Dicotyledons. The curious pitcher-plant, *Cephalotus follicularis*, comprises a separate natural order Cephalotaceae, closely allied to the Saxifragaceae. Finally the genera *Pinguicula*, *Utricularia*, *Genlisea* and *Polypompholix* belong to the gamopetalous order Lentibulariaceae.

While the large genus *Drosera* has an all but world-wide distribution, its congeners are restricted to well-defined and usually comparatively small areas. Thus *Drosophyllum* occurs only in Portugal and Morocco, *Byblis* in tropical Australia, and, although *Aldrovanda* is found in Queensland, in Bengal and in Europe, a wide distribution explained by its aquatic habit, *Dionaea* is restricted to a few localities in North and South Carolina. *Cephalotus* occurs only near Albany in Western Australia, *Heliamphora* on the Roraima Mountains in Venezuela, *Darlingtonia* on the Sierra Nevada of California, and these three genera too are as yet monotypic; of *Sarracenia*, however, there are seven known species scattered over the eastern states of North America. The forty species of *Nepenthes* are mostly natives of the hotter parts of the Indian Archipelago, but a few range into Ceylon, Bengal, Cochin China, and some even occur in tropical Australia on the one hand, and in the Seychelles and Madagascar on the other. *Pinguicula* is abundant in the north temperate zone, and ranges down the Andes as far as Patagonia; the 250 species of *Utricularia* are mostly aquatic, and some are found in all save polar regions; their unimportant congeners, *Genlisea* and *Polypompholix*, occur in tropical America and south-western Australia respectively. It is remarkable that all the insectivorous plants agree in inhabiting damp heaths, bogs, marshes and similar situations where water is abundant, but where they are not brought into contact with the plenteous supply of inorganic nitrogenous food as are the roots of terrestrial plants.

INSEIN, a town of British India, in the Hanthawaddy district of Burma, 10 m. N.W. of Rangoon; pop. (1901) 5350. It is an important railway centre, containing the principal workshops of the Burma railway company, also a government engineering school, a reformatory school and the largest gaol in the province.

INSOMNIA, or deprivation of sleep (Lat. *somnus*), a common and troublesome feature of most illnesses, both acute and chronic. It may be due to pain, fever or cerebral excitement, as in *delirium tremens*, or to organic changes in the brain. The treatment, when failure to sleep occurs in connexion with a definite illness, is part of the treatment of that illness. But there is a form of sleeplessness not occurring during illness to which the term “insomnia” is commonly and conveniently applied. It must not be confounded with occasional wakefulness caused by some minor discomfort, such as indigestion, nor with the “bad nights” of the valetudinarian. Real insomnia consists in the prolonged inability to obtain sleep sufficient in quantity and quality for the maintenance of health. It is a condition of modern urban life, and may be regarded as a malady in itself. It is a potent factor in causing those nervous breakdowns ascribed to “overwork.” It may occur as a sequel to some exhausting illness, notably influenza, which affects the nervous system long after convalescence. But it very often occurs without any such cause. Professional and business men are the most frequent sufferers. Insomnia is comparatively rare among the poor, who do little or no brain work. It may be brought on by some exceptional strain, by long-continued worry, or by sheer overwork. The broad pathology is simple enough. It has been demonstrated by exact observations that in sleep the blood leaves the brain automatically. The function is rhythmical, like all the vital functions, and the mechanism by which it is carried out is no doubt the vaso-motor system, which controls the contraction and dilation of the blood-vessels. In sleep the vessels in the brain automatically contract, but when the brain is working actively a plentiful supply of blood is required, and the vessels are dilated. If the activity is

carried to great excess the vessels become engorged, the mechanism does not act and sleep is banished. In insomnia this condition has become fixed.

When a breakdown has happened or is pending the only treatment is complete rest, combined, if possible, with change of air and scene; but if the mischief has gone far it will take very long to repair, and may never be repaired at all. In no matter of health is the importance of “taking it early” more pronounced. Delay is the worst economy. A few days’ holiday at the commencement of trouble may save months or years of enforced idleness. Sea-air sometimes acts like a charm. But if it is impossible to give up work and leave worry behind, even for a short time, sleep should be carefully wooed by every possible means. In the first place, plenty of time should be devoted to it, and no chance should be missed. That is to say, the night should not be curtailed at either end, and if sleepiness approaches in the daytime, as it often does, it should be encouraged. It is better to lie still at night and try to sleep than to give way to restlessness, and a few minutes snatched in the daytime, when somnolence offers the opportunity, has a restorative effect out of all proportion to the time occupied. Then all accidental causes of disturbance should be avoided. Lights and sounds should be excluded, comfort studied and digestion attended to. Fresh air is a great help. As much time should be spent out of doors as possible, and exercise, even to the point of fatigue, may be found helpful. But this requires watching: in some cases bodily exhaustion aggravates the malady. A little food (*e.g.* a glass of hot milk) immediately before going to bed is useful in inducing sleep, and persons who are apt to wake in the night and lie awake for hours may obtain relief by the same means. Hypnotic drugs, which have greatly multiplied of late years, should only be taken under medical advice. The real end to aim at is the restoration of the natural function, and the substitution of artificial sleep, which differs in character and effect; tends rather to prevent than to promote that end. It is often possible to induce sleep by rhythmic breathing.

INSPIRATION (Lat. *inspirare*, breathe upon or into), strictly the act of drawing physical breath into the lungs as opposed to “expiration.” Metaphorically the term is used generally of analogous mental phenomena; thus we speak of a sudden spontaneous idea as an “inspiration.” The term is specially used in theology for the condition of being directly under divine influence, as the equivalent of the Greek θεοπνευστία (the adjective θεόπνευστος is used of the Holy Scriptures in 2 Timothy iii. 16). Similar in meaning is ἐνθουσιασμός, enthusiasm (from ἐνθουσιάζω from ἔνθεος). Possession by the divine spirit (πνεῦμα) was regarded as necessarily accompanied by intense stimulation of the emotions. The possibility of a human being becoming the habitation and organ of a divinity is generally assumed in the lower religions. In the popular religion of China some of the priests, the *Wu*, claim to be able to take up into their body a god or a spirit, and thereby to give oracles. In wild frenzy they rush about half naked with hair hanging loose, wounding themselves with swords, knives, daggers, and uttering all kinds of sounds, which are then interpreted by people who claim to be able to understand such divine speech. The Maoris at the initiation of the young men into the tribal mysteries sing a song, called “breath,” to the mystic wind by which they believe their god makes his presence known. An Australian woman claimed to have heard the descent of the god as a rushing wind. In some savage tribes blood is drunk to induce the frenzy of inspiration; music and dancing are widely employed for the same purpose. Dionysus, the god of wine in Greece, was also the god of inspiration; and in their orgies the worshippers believed themselves to enter into real union with the deity. In Delphi the Pythia, the priestess who delivered the oracles, was intoxicated by the vapour which rose from a well, through a small hole in the ground. As the oracles were often enigmatic, they were interpreted by a *prophet*. In Rome the inspiration of Numa was derived from the nymph Egeria; and great value was attached to the books of the Cumaean Sibyl. In Arabia the *kahin* (priest) was recognized as the channel of divine communication. Inspiration may mean only possession by the deity, or it may mean further that the person so possessed becomes the channel through which the deity reveals his word and will. (See J. A. Macculloch’s *Comparative Theology*, chap. xv., 1902).

Prophecy in the Old Testament in its beginnings is similar to the phenomenon in other religions. Saul and his servant came to Samuel, the man of God, the seer, with a gift in their hands to inquire their way (1 Sam. ix. 8). The companies of prophets who went about the country in Samuel’s time were enthusiasts for Yahweh and for Israel. When Saul found himself among them he was possessed by the same spirit (1 Sam. x. 10, 11.). The prophesying in which he took part probably included violent movements of the body, inarticulate cries, a state of ecstasy or even frenzy. The phrase “holy spirit” in Acts, as applied to the Apostolic Church, probably indicates a similar state of religious exaltation; it was accompanied by speaking with tongues, inarticulate utterances, which needed interpretation (1 Corinthians xiv. 27). In every religious

revival, when the emotions are deeply stirred, similar phenomena are met with. Such a movement was Montanism in the 3rd century. At the Reformation, while Luther was at the Wartburg, fanaticism broke out, and spread from Wittenberg; prophets went about declaring the revelations which they had received. The Evangelical Revival in the 18th century also had its abnormal religious features. The Revival in Scotland in 1860 was marked by one curious feature —the Gospel dance—when in their excitement men and women got up and spun round and round till they were exhausted. Spontaneous praise and prayer marked the revival in Wales in 1905-1906.

Prophecy, as represented by the writings of the prophets, arose out of this state of religious exaltation, but left behind many of its features. Yahweh was believed to guide and guard the history of His chosen people Israel; He controlled the action of the nations that came in contact with His people, so that, using them as His instruments, He might accomplish His purpose. The function of the prophets was to interpret the course of history so as to communicate God's Word and will in judgment or in mercy. They were divinely endowed for this function by their inspiration. While these prophets seem to have continued in the exercise of all their normal faculties, which were stimulated and not suppressed, yet they do claim a distinctive divine activity in their consciousness, and distinguish with confidence their own thoughts from the revealed word. That abnormal psychic states, such as visions and voices, were sometimes experienced is not improbable; but the usual prophetic state seems to have been one of withdrawal of attention from the outer world, absorption of interest in the inner life, devout communion and intercession with God, and the divine response in a moral or a spiritual intuition rather than an intellectual ratiocination. Possession by the Spirit in its external manifestations is ascribed to Gideon, Jephthah, Samson, Saul, Elijah; but even when the same language is used of the later prophets, it is probably such an inward state as has just been described which is to be assumed. A feature inseparable from this later phase of prophecy is *prediction*. For the warning or the encouragement of the people the prophet as Jehovah's messenger declares what He is about to do. Thus the fall of Samaria in 722 B.C., the deliverance of Jerusalem in 701, the overthrow of the kingdom of Judah in 586, the return from exile in 537 were all heralded by prophecy. This prediction was no shrewd political conjecture, but an application to existing conditions of the permanent laws of God's government. The abnormal phenomena of inspiration, the presence and operation of the Holy Spirit, in the Apostolic Church, have already been noticed. While Paul does not deny nor depreciate these charisms, as tongues, miracles, &c., he represents as the more excellent way the Christian life in faith, hope and love (1 Cor. xii. 31). The New Testament represents the Christian life as an inspired life. It is living communion with Christ, and therefore constant possession of the Holy Spirit. Every Christian in the measure in which he has become a new creature in Christ is a prophet, because he knows by the enlightening of God's Spirit "what is the good and acceptable and perfect will of God" (Romans xii. 2). An occasional state of divine possession in the other religions becomes in the prophets of Israel a permanent endowment for a few select agents of God's revelation; but when that revelation is consummated in Christ, inspiration becomes the universal privilege of all believers.

While there is much superstition in the view of inspiration found in many religions, and much imposture in the claims to the possession of it, yet it would be illogical to conclude that this feature of religion is altogether human error and not at all divine truth. Man's knowledge of God is conditional, and therefore limited by his knowledge of the world and himself, and has accordingly the same imperfection. The reality of a divine communion and communication with man is not to be denied because its nature has been imperfectly apprehended. We must estimate the worth of inspiration by the higher and not the lower stages, by the vision of an Isaiah or the consecration of a Paul; but at the same time we must be prepared to recognize its lowly beginnings.

In dealing with the inspiration of the Bible, to which the use of the term has in the Christian Church been largely restricted, it is important to remember that inspiration is primarily personal; and that it assumes varied forms and allows varying degrees.

Other religions besides Christianity possess their sacred scriptures. The value attached to the Sibylline writings in Rome has already been mentioned. In Greece, Homer and Hesiod were esteemed as authoritative exponents of the mythology; a distinction was made between the poet's own words and the divine element, and what was offensive to reason, conscience or taste was explained allegorically. Hinduism distinguishes two classes of sacred writings, the *S'ruti* (hearing), which were believed to have been heard by inspired men from a divine source, and were endowed with supernatural powers, and the *Smriti* (recollection) derived from tradition. While the poets of the Rig-Veda, the oldest of the holy writings, do not claim inspiration, it is ascribed to them in the highest degree. Some of the Hindu sects—Vaishnavist and Saivist—regard some of the later writings, as also divine revelation. In Zoroastrianism, the books of the *Zend-Avesta* were conceived by later generations at least as having been eternally formed by Ormuzd, and revealed at the creation to his prophet Zoroaster, who, however, guarded the communication carefully in his mind until a very much later date in the world's history. Ormuzd

drove Ahriman back to hell by reciting one of the holy hymns. Buddhism has its *Tripitaka* (three baskets), and the reading, reciting and copying of the sacred scriptures is one of the surest means of acquiring merit. But as it ignores the gods, and places Buddha far above them, it does not claim divine inspiration for its writings. Buddha himself enlightens, but every man must save himself by walking in the true way which has been shown to him. Confucianism has its literature of absolute authority on manners, morals, rites and politics, but its claim does not rest on inspiration. These writings are revered as preserving the beliefs and customs of former ages, which are believed to have been more familiar than the present with the Way of Heaven. For the *Koran* very extravagant claims are made by orthodox Islam. Although Mahomet at first feared that his call to be a prophet was a deception of evil spirits, and wished to take his own life, yet afterwards he uttered his decisions on most trivial matters as divine oracles. God preserves the original text of the *Koran* in Heaven, and blots out what He wills and leaves what He wills. By the angel Gabriel God communicated this book word for word to the prophet, so that the *Koran* is a faithful copy of the heavenly book. The angels in heaven read the *Koran*. While the orthodox theology asserted the eternity of the *Koran*, the Mo'tazilite school denied this for the reason that the spoken sounds and the written signs in which alone a revelation could be given must have come to be in time. As Islam was not altogether independent of Christianity and Judaism, this doctrine of the *Koran* was probably intended as a reply to the claims of Jews and Christians for their holy writings.

The Pentateuch was accepted as authoritative law by the Jewish Church in 444 B.C. About two centuries later the Prophets (including the histories as well as the prophetic writings proper) were also acknowledged as sacred scriptures, although of inferior authority to the Law. In the century before the Christian era the Writings, including Psalms and Proverbs, were included in the Canon. Palestinian and Hellenistic Judaism disagreed about the recognition of the books now known as the Apocrypha. The writers of the New Testament use the Old Testament as holy scriptures, as an authoritative declaration of the mind and will of God; but the inaccuracy of many of the quotations, together with the use of the Greek translation as well as the original Hebrew, forbid our ascribing to them any theory of verbal inspiration. By the middle of the 2nd century the four Gospels were probably accepted as trustworthy records of the life of Jesus. The Epistles were accepted as authoritative in virtue of apostolic authorship. By the end of the 3rd century the use and approval of the churches had established the present canon.

The doctrine of the inspiration of these writings in the Jewish and Christian Church now claims attention. Inspiration is first of all ascribed to persons to account for abnormal states, or exceptional powers and gifts; in this doctrine it is transferred to writings, and its effects in securing for these inerrancy, authority, &c., are discussed with little regard for the psychic state of the writers.

The New Testament affirms the inspiration of the Old Testament. Jesus introduced a quotation from the 110th Psalm with the words "David himself by the Holy Spirit said" (Mark xii. 36), and in appealing to the law against tradition He used the phrase "God said" (Matt. xv. 4). The author of the first Gospel describes a prediction as that "which was spoken by the Lord through the prophet" (Matt. i. 22), and so Peter refers to "the scripture which the Holy Spirit spake before by the mouth of David" (Acts i. 16). For Paul as for Peter the utterances of the Old Testament are "the oracles of God" (Romans iii. 2; 1 Peter iv. 11). The final appeal is to what is written. God spoke in the prophets (Romans ix. 25; Hebrews i. 1). The use of θεόπνευστος in regard to the Scriptures in 2 Timothy iii. 16 has already been noted. The Spirit of Christ is said to have been in the prophets (1 Peter i. 11); and it is affirmed that "no prophecy ever came by the will of man; but men spake from God, being moved by the Holy Spirit" (2 Peter i. 21). The constant use of the Old Testament in the New confirms this doctrine of inspiration. Contemporary Jewish thought was in agreement with this view of the Old Testament. Philo describes Moses as "that purest mind which received at once the gift of legislation and of prophecy with divinely inspired wisdom" (*De congr. erud.* c. 24). Josephus again and again expresses his deep reverence for the holy Scriptures, and his belief that the authors wrote under the influence of the Spirit of God. According to Weber the doctrine of the Talmud is that "the holy scripture came to be through the inspiration of the Holy Spirit, and has its origin in God Himself, who speaks in it." But the nature of this inspiration must be more closely defined, and hence have arisen a number of theories of inspiration.

The first theory is that of *mechanical dictation*, or *verbal inspiration*. The writers of the books of the Bible were God's pens rather than His penmen; every word was given them by God. Their faculties were suppressed that God alone might be active in them. This conception is found in Plato, "God has given the art of divination, not to the wisdom, but to the foolishness of man. No man, when in his wits, attains prophetic truth and inspiration; but when he receives the inspired word, either his intelligence is enthralled in sleep, or he is demented by some distemper or possession" (*Timaeus*, 71). Philo declares that "the understanding that dwells in us is ousted on the arrival of the Divine Spirit, but is restored to its own dwelling when that Spirit departs, for it is unlawful that mortal dwell with immortal" (*Quis rer. div. haeres*, c. 53). Athenagoras adopted

this view in regard to the prophets. “While entranced and deprived of their natural powers of reason by the influence of the Divine Spirit, they uttered that which was wrought in them, the spirit using them as its instrument, as a flute player might blow a flute.” Other figures used are these; the inspired writer was the lyre, and the Holy Spirit the plectrum, or the writer was the vase, and the Holy Spirit filled it. The extravagances of Montanism threw some discredit on this conception, and we find Miltiades writing a treatise with the title *That the Prophet ought not to speak in Ecstasy*. But Gregory the Great called the writers of Scripture the *calami* of the Holy Spirit. After the Reformation the Protestant Scholastics revived this view. Gerhard, Calovius and Quenstedt agree in ascribing to the Scriptures absolute infallibility in all matters, and describe the writers as “amanuenses of God, or Christ,” “hands of the Spirit,” “clerks,” “secretaries,” “manus et Spiritus sive.” The *Formula consensus Helvetica* probably reaches the extreme statement, when it declares that the Old Testament was “tum quoad consonas, tum quoad vocalia, sive puncta ipsa, sive punctorum saltem potestatem, et tum quoad res, tum quoad verba θεόπνευστος.” Seeing that the vowel-point system was introduced by Jewish scribes centuries after the books were written, this statement shows how recklessly theory may override fact. Of this theory, which has now few advocates, it is sufficient to say that it ignores all the data the Bible itself offers. On the one hand it is impossible to maintain the inerrancy of the Bible in matters of science, philosophy, history, and even in doctrine and morals there is progress; on the other hand the personal characteristics, the historical circumstances, the individual differences of the writers are so reproduced in the writings that the action of the human factor must be frankly and fully recognized as well as the divine activity.

The second theory is that of *dynamic influence or degrees of inspiration*. While the Spirit controls and directs, the human personality is not entirely suppressed. Even Philo recognized that all portions of Scripture were not equally inspired, and assigned to Moses the highest degree of inspiration. The Jewish rabbis placed the Law, the Prophets and the Writings on a descending scale of inspiration. “The schoolmen followed them, and some distinguished four degrees of influence: *superintendence*, which saved from positive error; *elevation*, which imparted loftiness to the thought; *direction*, which prompted the writer what to insert and what to omit; and *suggestion*, which inspired both thoughts and words” (M. Dods, *The Bible, its Origin and Nature*, p. 118, 1905). The co-operation of the divine and the human factors is recognized in Augustine’s saying about the authors: “Inspiratus a Deo, sed tamen homo.” It is interesting to note that Plutarch had to account for the same human peculiarities and imperfections in the Pythian responses as the Christian apologist in the Bible, and he offers a similar explanation. “If she were obliged to write down, and not to utter the responses, we should not, I suppose, believe the handwriting to be the god’s, and find fault with it, because it is inferior in point of calligraphy to the imperial rescripts; for neither is the old woman’s voice, nor her diction, nor her metre the god’s; but it is the god alone who presents the visions to this woman, and kindles light in her soul regarding the future; for this is the inspiration” (*op. cit.* p. 119). While degrees of inspiration must be recognized, the distinction must be made objectively, and not subjectively. We may say that where the revelation is the clearest, there inspiration is the fullest, that nearness to the perfect fulfilment in Christ of God’s progressive purpose determines the degree of inspiration; but we cannot formulate any elaborate theory of the operation of the Spirit from the standpoint of the psychic states of the writers. While subjectively we cannot separate the divine and the human spirit in the process, so objectively we cannot distinguish the divine substance and the human form in the product of inspiration. This theory neither helps us to explain the origin of the writings nor guides us in estimating the contents.

The third theory, which is a modification of the second, is that of *essential inspiration*, which distinguishes *matters of doctrine and conduct* as closely related to God’s purpose in the Scriptures from the remaining contents of the Scripture, and claims for the Bible only such inspiration as was necessary to secure accuracy in regard to these. The theology and the morality of the Bible are inspired, but not its history, science, philosophy. This distinction is already anticipated in Thomas Aquinas’ theory of two kinds of inspiration, “the *direct*, which is to be found where doctrinal and moral truths are directly taught, and the *indirect*, which appears in historical passages, whence the doctrinal and moral can only be indirectly evolved by the use of allegorical interpretation.” This view has the support of such names as Erasmus, Hugo Grotius, Richard Baxter, W. Paley and J. J. I. von Döllinger. It is to be observed that it lays emphasis on the necessity of correct views about doctrine and conduct; and this is an intellectualist standpoint which is not in accord either with the character or the influence of the Bible. Further, it does not explain how the same human mind can by divine inspiration obtain infallible knowledge in some matters, and yet be left prone to err in others. Again it does not take account of the fact that the teaching of the Old Testament as regards belief and morals is progressive; and that the imperfections of the earlier stages of the development are corrected in the later. That it is an advance on the other theories must be acknowledged, as from this standpoint errors in history or science are no difficulties to the believer in the Bible as so inspired. It is necessary here to add that this emphasis on the infallibility of the knowledge of doctrine and morals communicated by the Scriptures had as its legitimate inference in the

patristic and medieval period the claim that the Church alone was the infallible interpreter of the Scriptures.

The fourth theory—that of the Reformers (though not of their successors, the Protestant scholastics)—might be called that of *vital inspiration*, as its emphasis is on religious and moral life rather than on knowledge. While giving to the Scriptures supreme authority in all matters of faith and doctrine, the Reformers laid stress on the use of the Bible for edification; it was for them primarily a means of grace for awakening and nourishing the new life in the hearts of God's people. By the enlightening work of the Spirit of God the World of God is discovered in the Scriptures: it is the *testimonium Spiritus Sancti* in the soul of the Christian that makes the Bible the power and wisdom of God unto salvation. By thus laying stress on this redemptive purpose of the divine revelation, the Reformers were delivered from the bondage of the letter of Scripture, and could face questions of date and authorship of the writings frankly and boldly. Hence a pioneer of the higher criticism in Great Britain, W. Robertson Smith, was able to appeal to this Reformation doctrine. "If I am asked why I receive Scripture as the Word of God, and as the only perfect rule of faith and life, I answer with all the fathers of the Protestant Church, 'Because the Bible is the only record of the redeeming love of God, because in the Bible alone I find God drawing near to man in Christ Jesus, and declaring to us in Him His will for our salvation. And this record I know to be true by the witness of His Spirit in my heart, whereby I am assured that none other but God Himself is able to speak such words to my soul'" (in Denney's *Studies in Theology*, p. 205). The Reformers' application of this theory to the Bible was necessarily conditioned by the knowledge of their age; but it is a theory wide enough to leave room for our growing modern knowledge of the Bible.

Briefly stated, these are the conclusions which our modern knowledge allows. (1) Inspiration, or the presence and influence of the Divine Spirit in the soul of man, cannot be limited to the writers of the Scriptures; but, comparing the Bible with the other sacred literature of the world, its religious and moral superiority cannot be denied, and we may, therefore, claim for it as a whole a fuller inspiration. (2) As different writings in the Bible have more or less important functions in the progressive divine revelation, we may distinguish degrees of inspiration. (3) This inspiration is primarily personal, an inward enlightening and quickening, both religious and moral, of the writer, finding an expression conditioned by his individual characteristics in his writing. (4) The purpose of inspiration is practical; the inspired men are used of God to give guidance in belief and duty by declaring the word and will of God as bearing on human life. (5) As revelation is progressive, inspiration does not exclude defects in doctrine and practice in the earlier stages and their correction in the later stages of development. (6) As the progressive revelation culminates in Christ, so He possesses fullest inspiration; and it varies in others according to the closeness of their contact, and intimacy of their communion with Him. (7) As the primary function of Christ is redemptive, so the inspiration of the Bible is directed to make men "wise unto salvation." (8) It is the presence and influence in the souls of men of the same Spirit of God as inspired the Scriptures which makes the Bible effective as a means of grace; and only those who yield themselves to the Spirit of God have the witness in themselves that the Bible conveys to them the truth and the grace of God.

In addition to the books mentioned, see: A. B. Bruce, *The Chief End of Revelation* (1881); C. A. Briggs, *The Bible, the Church, and the Reason* (1892); W. N. Clarke, *The Use of the Scriptures in Theology* (1906); H. E. Ryle, *The Canon of the Old Testament* (1892); B. F. Westcott, *A General Survey of the History of the Canon of the New Testament* (7th ed., 1896); W. Sanday, *Inspiration* (3rd ed., 1896); A. B. Davidson, article "Prophecy" in Hastings's *Bible Dictionary*, iv.; A. E. Garvie, "Revelation" in Hastings's *Bible Dictionary* (extra volume).

(A. E. G.*)

INSTALLATION, the action of installing or formally placing some one in occupation of an office or place. The med. Lat. *installare* meant literally "to place in a seat or stall" (*stallum*), and the word, as now, was particularly used of the ceremonial induction of an ecclesiastic, such as a canon or prebendary, to his stall in his cathedral choir. Similarly knights of an order of chivalry are ceremonially led to their stalls in the chapel of their order. The term is transferred to any formal establishment in office or position. From a French use of *installer* and *installation*, the word is frequently applied in a transferred sense to the fixing in position and making ready for use of a mechanical, particularly electrical, apparatus or plant.

INSTALMENT (for earlier *stallment* or *estallment*, from Fr. *estaler*, to fix, arrange; the change is probably due to the influence of the verb "install"), the payment of a sum of money at stated intervals and in fixed portions instead of in a lump sum; hence the sums of money as they fall due at the periods agreed upon. For the system of purchase by deferred payments or instalments see HIRE-PURCHASE AGREEMENT.

INSTERBURG, a town in the kingdom of Prussia, situated at the point where the Angerapp and Inster join to form the Pregel, 57 m. E. of Königsberg by the railway to Eydtkuhnen, and at the junction of lines to Memel and Allenstein. Pop. (1900) 27,787. It has four Evangelical churches, of which the town church is celebrated for its fine wood carvings, a Roman Catholic church, a synagogue, several schools and a park. Besides flax-spinning and iron-founding, Insterburg has manufactures of machinery, shoes, cement, leather and beer, along with a considerable trade in cereals, vegetables, flax, linseed and wood, while horse-breeding is extensively carried on in the neighbourhood. Close to the town lies the demesne of Georgenburg, with an old castle which formerly belonged to the Teutonic order. Insterburg, the "burg" on the Inster, was founded in the 14th century by the knights of the Teutonic order. Having passed to the margraves of Brandenburg, the village which had sprung up round the castle received civic privileges in 1583. During the next century it made rapid advances in prosperity, partly owing to the settlement in it of several Scottish trading families. In 1679 it was besieged by the Swedes; in 1690 it suffered severely from a fire; and in 1710-1711 from pestilence.

See Töws, *Urkunden zur Geschichte des Hauptamts Insterburg* (Inst., 1895-1897, 3 parts); and *Kurze Chronik der Stadt Insterburg* (Königsberg, 1883).

INSTINCT. It is in the first place desirable to distinguish between the word "instinct" (Lat. *instinctus*, from *instinguere*, to incite, impel) as employed in general literature and the term "instinct" as used in scientific discourse. The significance of the former is somewhat elastic, and is in large measure determined by the context. Thus in social relationships we speak of "instinctive" liking or distrust; we are told that the Greeks had "instinctive" appreciation of art; we hear of an instinct of reverence or "instinctive" beliefs. We understand what is meant and neither desire nor demand a strict definition. But in any scientific discussion the term instinct must be used within narrower limits, and hence it is necessary that the term should be defined. There are difficulties, however, in framing a satisfactory definition. That given by G. J. Romanes in the 9th edition of the *Encyclopaedia Britannica* runs as follows: "Instinct is a generic term comprising all those faculties of mind which lead to the conscious performance of actions that are adaptive in character but pursued without necessary knowledge of the relation between the means employed and the ends attained." This has been criticized both from the biological and from the psychological standpoint. From the biological point of view the reference of certain modes of behaviour, termed instinctive, to faculties of mind for which "instinct" is the generic term is scarcely satisfactory; from the psychological point of view the phrase "without necessary knowledge of the relation between the means employed and the end attained" is ambiguous. (See INTELLIGENCE OF ANIMALS.) In recent scientific literature the term is more frequently used in its adjectival than in its substantive form; and the term "instinctive" is generally applied to certain hereditary modes of behaviour. Investigation thus becomes more objective, and this is a distinct advantage from the biological point of view. It is indeed sometimes urged that instinctive modes of behaviour should be so defined as to entirely exclude any reference to their psychological concomitants in consciousness, which are, it is said, entirely inferential. But as a matter of fact no small part of the interest and value of investigations in this field of inquiry lies in the relationships which may thereby be established between biological and psychological interpretations. Fully realizing, therefore, the difficulty of finding and applying a criterion of the presence or absence of consciousness, it is none the less desirable, in the interests of psychology, to state that truly instinctive acts (as defined) are accompanied by consciousness. This marks them off from such reflex acts as are unconsciously performed, and from the tropisms of plants and other lowly organisms. There remains, however, the difficulty of finding any satisfactory criterion of the presence of consciousness. We seem forced to accept a practical criterion for purposes of interpretation rather than one which can be theoretically defended against all adverse criticism. We have reason to believe that some organisms profit by experience and show that they do so by the

Conscious concomitant.

modification of their behaviour in accordance with circumstances. Such modification is said to be individually acquired. To profit by individual experience is thus the only criterion we possess of the existence of the conscious experience itself. But if hereditary behaviour is unaccompanied by consciousness, it can in no wise contribute to experience, and can afford no data by which the organism can profit. Hence, for purposes of psychological interpretation it seems necessary to assume that instinctive behaviour, including the stimulation by which it is initiated and conditioned, affords that naive awareness which forms an integral part of what may be termed the primordial tissue of experience.

We are now in a position to give an expanded definition of instinctive behaviour as comprising those complex groups of co-ordinated acts which, though they contribute to experience, are, on their first occurrence, not determined by individual experience; which are adaptive and tend to the well-being of the individual and the preservation of the race; which are due to the co-operation of external and internal stimuli; which are similarly performed by all members of the same more or less restricted group of animals; but which are subject to variation, and to subsequent modification under the guidance of individual experience.

Definitions.

If a brief definition of instinct, from the purely biological point of view be required, that given in the *Dictionary of Philosophy and Psychology* may be accepted: “An inherited reaction of the sensori-motor type, relatively complex and markedly adaptive in character, and common to a group of individuals.” Instinctive behaviour thus depends solely on how the nervous system has been built through heredity; while intelligent behaviour depends also on those characters of the nervous system which have been acquired under the modifying influence of individual relation to the environment.

Such definitions, however, are not universally accepted. Wasmann, for example, divides instinctive actions under two groups: (1) those which immediately spring from the inherited dispositions; (2) those which indeed proceed from the same inherited dispositions but through the medium of sense experience. The first group, which he regards as instinctive in the strict acceptance of the term, seem exactly to correspond to those which fall under the definition given above. The second group, which he regards as instinctive in the wider acceptance of the term, nearly, if not quite, correspond to those above spoken of as intelligent—though he regards this term as falsely applied (see Intelligence of Animals). By using the term instinctive in both its strict and its wider significance, Wasmann includes under it the whole range of animal behaviour.

Examples from bird life.

It will be seen that from the biological standpoint there fall under the stricter definition those hereditary modes of behaviour which are analogous to hereditary forms of structure; and that a sharp line of distinction is drawn between the behaviour which is thus rendered definite through heredity, and the behaviour the distinguishing characteristics of which are acquired in the course of individual life. What in popular usage are spoken of as the instincts of animals, for example, the hunting of prey by foxes and wolves, or the procedure of ants in their nests, are generally joint products of hereditary and acquired factors. Wasmann’s comprehensive definition so far accords with popular usage. But it tends to minimize the importance of the distinction of that which is prior to individual experience and that which results therefrom. It is the business of scientific interpretation to disentangle the factors which contribute to the joint-products. It is indeed by no means easy to distinguish between what is dependent on individual experience, and what is not. Only the careful observation of organisms throughout the earlier phases of their life-history can the closely related factors be distinguished with any approach to scientific accuracy. By the patient study of the behaviour of precocious young birds, such as chicks, pheasants, ducklings and moorhens, it can be readily ascertained that such modes of activity as running, swimming, diving, preening the down, scratching the ground, pecking at small objects, with the characteristic attitudes expressive of fear and anger, are so far instinctive as to be definite on their first occurrence—they do not require to be learnt. No doubt they are subsequently guided to higher excellence and effectiveness with the experience gained in their oft-repeated performance. Indeed it may be said that only on the occasion of their initial performance are they purely instinctive; all subsequent performance being in some degree modified by the experience afforded, by previous behaviour of like nature and the results it affords. It should be remembered that such comparatively simple activities, though there is little about them to arrest popular attention, are just the raw material out of which the normal active life of such organisms is elaborated, and that for scientific treatment they are therefore not less important than those more conspicuous performances which seem at first sight to call for special treatment, or even to demand a supplementary explanation. The instincts of nest-building, incubation and the rearing of young, though they occur later in life than those concerned in locomotion and the obtaining of food, are none the less founded on a hereditary basis, and in some respects are less rather than more liable to modification by the experience gained by the carrying out of hereditarily definite modes of procedure. Here the instinctive factor probably predominates over that which is experiential. But in the “homing” of pigeons there is little question that the

experiential factor predominates. The habit results mainly from the modification of the higher nerve-centres through individual and intelligent use. In the migration of birds we are still uncertain as to the exact nature and proportional value of the instinctive and intelligent factors. The impulse to migrate, that is to say, the calling forth of specific activities by climatal or other presentations, appears to be instinctive; whether the direction of migration is in like manner instinctive is a matter of uncertainty; and, if it be instinctive, the nature of the stimuli and the manner in which they are hereditarily linked with responsive acts is unexplained. To say that it is due to hereditary experience is generally regarded as inadmissible. For modern interpretation hereditary modes of behaviour afford experience; in no other sense can it be said that experience is inherited.

A good example of the methods of recent investigation is to be found in Dr G. W. and Mrs Peckham's minute observations on the habits and instincts of the solitary wasps. They enumerate the following primary types of instinctive behaviour: the manner of attacking and capturing a particular kind of prey which alone affords the requisite presentation to sense; the manner of conveying the prey to the nest; the general style and locality of the nest; the method and order of procedure in stocking the nest with food for the unseen young. It is noteworthy, however, that although the manner in which the prey is stung (for example) is on the whole similar in the case of the members of any given species—that is to say, all the wasps of the species behave in very much the same manner—yet there are minor variations in detail. This outcome of prolonged and careful observation is of importance. It affords a point of departure for the interpretation of the genesis of existing instincts. Furthermore, the observations on American wasps render it probable that the earlier accounts of the instinctive behaviour of such wasps are exaggerated. Romanes thought that the manner of stinging and paralysing their prey might be justly deemed the most remarkable instinct in the world. Spiders, caterpillars and grasshoppers are, he said, stung in their chief nerve-centres, in consequence of which the victims are not killed outright, but rendered motionless and continue to live in this paralysed condition for several weeks, being thus available as food for the larvae when these are hatched. Of course, he adds, the extraordinary fact which stands to be explained is that of the precise anatomical, not to say the physiological, knowledge which appears to be displayed by the insect in stinging only the nerve-centres of its prey. But the Peckhams' careful observations and experiments show that, with the American wasps, the victims stored in the nests are quite as often dead as alive; that those which are only paralysed live for a varying number of days, some more, some less; that wasp larvae thrive just as well on dead victims, sometimes dried up, sometimes undergoing decomposition, as on living and paralysed prey; that the nerve-centres are not stung with the supposed uniformity; and that in some cases paralysis, in others death, follows when the victims are stung in parts far removed from any nerve-centre. It would seem then that by the stinging of insects or spiders their powers of resistance are overcome and their escape prevented; that some are killed outright and some paralysed is merely an incidental result.

Examples from insect life.

Granted that instinctive modes of behaviour are hereditary and definite within the limits of congenital variation, the question of their manner of genesis is narrowed to a clear issue. Do they originate through the natural selection of those variations which are the more adaptive; or do they originate through the inheritance of those acquired modifications which are impressed on the nervous system in the course of individual and intelligent use? Romanes, taking up the inquiry where Darwin left it, came to the conclusion that some instinctive modes of behaviour which he termed "primary" are due to the operation of natural selection alone; that others, which he termed "secondary," and of which he could give few examples, were due to the inheritance of acquired modifications from which, in the phrase of G. H. Lewes, the intelligence had lapsed; while others, which he termed "blended," were partly due to natural selection and partly resulted from the inheritance of acquired habit. There has been a prolonged controversy between the school of interpretation, commonly spoken of as Lamarckian, which advocates a belief in the inheritance of acquired characters, and the school, with Weismann as their leader, which questions the evidence for, or the probability of, such inheritance. The trend of modern opinion appears to be in the direction of the Weismannian interpretation. And it must be regarded as questionable, if not improbable, that instinctive modes of behaviour are in any degree directly due to the inheritance of habits intelligently acquired. That intelligent habits may secure the survival of those organisms whose germ-plasm bears the seeds of favourable congenital variations is not improbable. But in that case intelligent procedure only contributes to the survival and not to the origin of hereditary variations.

Mode of origin.

To test the hypothesis that natural selection is an essential condition to the genesis of instinctive behaviour it should be the aim of investigation to find crucial cases. This is, however, no easy task. We ought to be able to adduce cases in which, where the incidence of natural selection is excluded, acquired habits do not become instinctive. But it is difficult to do so. It seems, however, that in young chicks drinking from still water is a habit acquired through imitation of the acts of the

Crucial observations.

hen-mother. The presentation of such water to sight does not evoke the appropriate instinctive response, while the presentation of water taken into the bill does at once evoke a characteristic response. Now it would seem that in the former case, since the hen “teaches” all her chicks to peck at the water, she shields them from the incidence of natural selection. But though the hen can lead her young to peck at the water, she cannot “teach” them how to perform the complex movements of mouth, throat and head required for actual drinking. In this matter they are not shielded from the incidence of natural selection. Thus it would seem that, where natural selection is excluded, the habit has not become congenitally linked with a visual stimulus; but where natural selection is in operation, the response has been thus linked with the stimulus of water in the bill.

Imitation.

If this interpretation be correct we have here an example of the manner in which imitation plays an important part in the formation of habits which though oft-repeated are not transmitted as hereditary instincts. But the imitative act is itself instinctive. The characteristic feature of the imitative act, at the instinctive level, is that the presentation to sight or hearing calls forth a mode of behaviour of like nature to, or producing like results to, that which affords the stimulus. The nature of instinctive imitation needs working out in further detail. But it is probable that what we speak of as the imitative tendency is, in any given species, the expression of a considerable number of particular responses each of which is congenitally linked with a particular presentation or stimulus. The group of instincts which we class as imitative (and they afford only the foundations on which intelligent imitation is based) are of biological value chiefly, if not solely, in those species which form larger or smaller communities.

Relation to heredity

The study of instinct is in the genetic treatment of evolutionary science a study in heredity. The favouring bionomic conditions are those of a relatively constant environment under which relatively stereotyped responses are advantageous. If the environment be complex, there is a corresponding complexity in instinctive behaviour. But adjustment to a complex environment may be reached in two ways; by instinctive adaptation through initially stereotyped behaviour; or by plastic accommodation by acquired modifications. The tendency of the evolution of intelligence is towards the disintegration of the stereotyped modes of response and the dissolution of instinct. Natural selection which, under a uniform and constant environment, leads to the survival of relatively fixed and definite modes of response, under an environment presenting a wider range of varying possibilities leads to the survival of plastic accommodation through intelligence. This plasticity is, however, itself hereditary. All intelligent procedure implies the inherited capacity of profiting by experience. Instinctive in the popular sense, it does not fall within the narrower definition of the term; it is more conveniently described as innate. It is important to grasp clearly the distinction thus drawn. A duckling only a few hours old if placed in water swims with orderly strokes. The stimulus of water on the breast may be regarded as a sensory presentation which is followed by a definite and adaptive application of behaviour. But this specific application is dependent upon a prolonged racial preparation of the organism to respond in this particular way. Such response is instinctive. It is wholly due, as such, to racial preparation. Compare the case of a boy who learns to ride a bicycle. This is not wholly due, as such, to racial preparation, but is also partly due to individual preparation. The boy no doubt inherits a capacity for riding a bicycle, otherwise he could never do so. But he has to learn to ride none the less. Individual experience is a condition which without the innate capacity cannot take effect. Instinct involves inherited adaptation; intelligence, an inherited power, embodied in the higher nerve-centres, of accommodation to varying circumstances.

See C. Lloyd Morgan, *Habit and Instinct* (1896), and *Animal Behaviour* (1900); G. J. Romanes, *Mental Evolution in Animals* (1883), and *Natural History of Instinct* (1886); Lord Avebury, *On the Instincts of Animals* (1889); Marshall, *Instinct and Reason* (1898); Mills, *Nature of Animal Intelligence* (1898); St George Mivart, *Nature and Thought* (1882), and *Origin of Human Reason* (1899); E. Wasmann, *Zur Entwickelung der Instincte* (1897), *Instinct und Intelligenz im Tierreich* (1899, Eng. trans. 1903); G. and C. Peckham, *Instincts and Habits of Solitary Wasps* (1898); see also the bibliography (section “Instinct and Impulse”) in Baldwin’s *Dict. of Philosophy and Psychology*.

(C. Ll. M.)

INSTITUTE (from Lat. *instituere*, to establish or set up), something established, an institution, particularly any society established for an artistic, educational, scientific or social purpose. The word seems to have been first applied in English to such institutions for the advancement of science or art as were modelled on the great French society, the *Institut National* (see

ACADEMIES). It is thus the name of such societies as the Royal Institute of British Architects, the Imperial Institute and the like. It is extended to similar organizations, particularly to educational, on a smaller or local scale, such as Mechanics' or Workmen's Institutes, and is sometimes applied to charitable foundations. In the United States the word is, in a particular sense, applied to periodic classes giving instruction in the principles of education to the teachers of elementary and district schools. The term "institute" is often used to translate the Lat. *institutio*, in the sense of a treatise on the elements of any subject, and particularly of law or jurisprudence; thus the compilation of the principles of Roman law, made by order of the emperor Justinian, is known as *Justinian's Institutes*, and hence Coke's treatise on English law, of which the first part is better known as *Coke upon Littleton*, is called *The Institute*. The same title is borne by Calvin's work on the elements of the Christian doctrine. In Scots law "institute" is the person named, in a settlement or testament to whom an estate is first limited; those who follow, failing him, are termed "substitutes."

INSTITUTIONAL CHURCH, the name generally applied both in the British Isles and in America to a type of church which supplements its ordinary work by identifying itself in various ways with the secular interests of those whom it seeks to influence. The idea of such extension of function grew out of the recognition of the fact that the normal activities of church work entirely failed to retain the interest of a large class of the population to whom the ritual formality of ordinary services was unacceptable. Various attempts were made to overcome this deficiency, *e.g.* by modifying the form of service or of some services, by the addition to the ordinary services of more or less informal meetings (*e.g.* the Pleasant Sunday Afternoon services), by specially excusing persons from wearing the normal church-going attire in holiday resorts, and by holding services out of doors. The principle underlying all these changes is systematized in the Institutional Church which, in addition to its main building for specifically religious services, provides other rooms or buildings which during the week are open for the use of members and friends. Lectures, concerts, debates and social gatherings are organized; there are reading rooms, gymnasiums and other recreations rooms; various clubs (cycling, cricket, football) are formed. The organization of the whole is subdivided into special departments managed by committees. By these various means many persons are attracted into the atmosphere of the church's work who could not be induced to attend the formal services.

This expansion of normal church work may be traced back in England to at least as early as 1840, but the full development of the Institutional Church belongs only to the latter years of the 19th century. The chief example in England is Whitefield's Central Mission in Tottenham Court Road, London, a church which, in addition to an elaborate organization on the lines above described, has an official journal. In the United States the movement may be said to date from about 1880. The name "Institutional" was first applied to Berkeley Temple, Boston, by Dr William Jewett Tucker, then president of Dartmouth College. The obvious criticism that this epithet emphasizes the administrative and secular side to the exclusion of the spiritual led to the tentative adoption of other titles, *e.g.* the "Open Church," the "Free Church," the former of which is the more commonly used. In 1894 was formed the "Open and Institutional Church League" at New York, which held a number of conventions and served as a headquarters for the numerous separate churches. In connexion with this league was formed the "National Federation of Churches and Christian Workers," which held a convention in 1905.

See C. Silvester Horne, *The Institutional Church* (London, 1906); G. W. Mead, *Modern Methods in Church Work* (New York, 1897); R. A. Woods, *English Social Movements* (New York, 1891).

INSTRUMENT (Lat. *instrumentum*, from *instruere*, to build up, furnish, arrange, prepare), that which can be used as a means to an end, hence a mechanical contrivance, implement or tool; the word is more particularly applied to the implements of applied science, in mathematics, surgery, surveying, &c., while those of the handicrafts are generally known as "tools." A specific use of the term is for the various contrivances used to produce musical sounds, "musical instruments."

In law an "instrument" is any formal or written document by which expression is given to a legal act or agreement. This is a classical use of the Lat. *instrumentum*, a document, record. The

term may be used in a wide sense, as a mere writing, meant only to form a record, or in a particular sense with reference to certain statutes. For example, the Stamp Act 1891 defines an instrument as an expression including every written document; for the purposes of the Forgery Act 1861 a post-office telegram accepting a wager has been defined as an instrument. In expressions such as “deed, will, or other written instrument” the word means any written document under which a right or liability, legal or equitable, exists.

INSTRUMENTATION. “Instrumentation” is the best term that can be found for that aspect of musical art which is concerned with timbre. The narrower term “orchestration” is applied to the instrumentation of orchestral music. Since the most obvious differences of timbre are in those of various instruments, the art which blends and contrasts timbre is most easily discussed as the treatment of instruments; but we must use this term with philosophic breadth and allow it to include voices. Instrumentation is in all standard text-books treated as a technical subject, from the point of view of practical students desirous of writing for the modern orchestra. And as there is no branch of art in which mechanical improvements, and the consequent change in the nature of technical difficulties, bear so directly upon the possibilities and methods of external effect, it follows that an exclusive preponderance of this view is not without serious disadvantage from the standpoint of general musical culture. There is probably no other branch of art in which orthodox tradition is so entirely divorced from the historical sense, and the history, when studied at all, so little illuminated by the permanent artistic significance of its subjects. When improvements in the structure of an instrument remove from the modern composer’s memory an entire category of limitations which in classical music determined the very character of the instrument, the temptation is easy to regard the improvement as a kind of access of wisdom, in comparison with which not only the older form of the instrument, but the part that it plays in classical music, is crude and archaic. But we should do better justice to improvements in an instrument if we really understood how far they give it, not merely new resources, but a new nature. And, moreover, those composers who have done most to realize this new nature (as Wagner has done for the brass instruments) have also retained, to an extent unsuspected by their imitators, the definite character which the instrument had in its earlier form.

As it is with mechanical improvements, so is it to a still greater degree with changes in the function of timbre in art. Throughout the 19th century so fatal was the hold obtained on the popular mind by the technical expert’s view of instrumentation, that it was impossible to hear the works of Handel and Bach without “additional accompaniments” conceived in terms of art as irrelevant to those of 18th-century polyphonys as the terms of Turnerian landscape are irrelevant to the decoration of the outside walls of a cathedral. There is some reason to hope that the day of these misconceptions is passed; although there is also some reason to fear that on other grounds the present era may be known to posterity as an era of instrumentation comparable, in its gorgeous chaos of experiment and its lack of consistent ideas of harmony and form, only to the monodic period at the beginning of the 17th century, in which no one had ears for anything but experiments in harmonic colour. We do not propose to concern ourselves here with those technical subjects which are the chief concern of standard treatises on instrumentation. Our task is simply to furnish the general reader with an account of the types of instrumentation prevalent at various musical periods, and their relation to other branches of the art.

The Vocal Style of the 16th Century.—In the 16th century instrumentation was, in its normal modern sense, non-existent; but in a special sense it was at an unsurpassable stage of perfection, namely, in the treatment of pure vocal harmony. In every mature period of art it will be found that, however much the technical rules may be collected in one special category, every artistic category has a perfect interaction with all the others; and this is nowhere more perfectly shown than when the art is in its simplest possible form of maturity. Practically every law of harmony in 16th-century music may be equally well regarded as a law of vocal effect. Discords must not be taken unprepared, because a singer can only find his note by a mental judgment, and in attacking a discord he has to find a note of which the harmonic meaning is at variance with that of other notes sung at the same time. Melody must not make more than one wide skip in the same direction, because by so doing it would cause an awkward change of vocal register. Two parts must not move in consecutive octaves or fifths, because by so doing they unaccountably reinforce each other by an amount by which they impoverish the rest of the harmony. Thus we justify, on grounds of instrumentation, laws usually known as laws of harmony and counterpoint. Apart from such considerations, 16th-century vocal harmony shows in the hands of its greatest masters an inexhaustible variety of refinements of vocal colour. A volume might be written on Orlando di Lasso’s art of so crossing the voices as to render possible

successions of chords which, on a keyed instrument where such crossing cannot be expressed, would be a horrible series of consecutive fifths; the beauty of the device consisting in the extreme simplicity of the chords, combined with the novelty due to the fact that these chords cannot be produced by any ordinary means without incorrectness.

Decorative Instrumentation.—In the 17th century the use of instruments became a necessity; but there were at first no organized ideas for their treatment except those which were grounded on their use as supporting and imitating the voice. The early 17th-century attempts at their 652
independent use and characterization are historically interesting, but artistically almost barbarous. Sometimes they achieve rare beauty by accident. Heinrich Schütz's *Lamentatio Davidi* is written for a bass voice accompanied by four trombones and organ. The trombone parts are on exactly the same material as the voice, which in fact forms with them a five-part fugue-texture. The effect is magnificent, and admirably suited to the dignity of the trombone. Moreover, the opening theme is formed of slow arpeggios; and the more modern harmonic elements, though technically chromatic, consist, from the modern point of view, rather in swift changes between nearly related keys than in chromatic blurring of the main key. All this, especially in a writer like Schütz, who is saturated with every progressive tendency of the time, seems to point to a deep sense of the appropriate style of trombone writing. Yet, so insensible is Schütz to the euphony of his own work, that he proposes, as an alternative for the first and second trombones, two violins an octave higher, the other parts remaining unaltered! Imagination boggles at the vileness of this effect.

The chief work done in instrumentation in the 17th century is undoubtedly that of the Italian writers for the violin, who developed the technique of that instrument until it proved not only more resourceful but more artistically organized than that of the solo voice, which by the time of Handel had become little better than an acrobatic monstrosity. In the art of Bach and Handel, instrumentation, as distinguished from choral writing, has attained a definite artistic coherence. Choral writing itself has become different from what it was in the 16th century. The free use of discords and of wider intervals, together with the influence of the florid elements of solo-singing, enlarged the bounds of choral expression almost beyond recognition, while they crowded into very narrow quarters the subtleties of 16th-century music. These, however, by no means disappeared; and such devices as the crossing of parts in the second Kyrie of Bach's *B Minor Mass* (bars 7, 8, 14, 15, 22, 23, 50) abundantly show that in the hands of the great masters artistic truths are not things which a change of date can make false.

But the treatment of instruments in Bach and Handel has a radical difference from that of the art which was soon to succeed it. It has precisely the same limitation as the treatment of form and emotion; it cannot change as the work proceeds. Its contrasts are like those of an architectural scheme, not those of a landscape or a drama. It admits of the loveliest combinations of timbre, and it can alternate them in considerable variety. Modern composers have often produced their most characteristic orchestral effects with fewer contrasting elements than Bach uses in his *Trauer-Ode*, in the pastoral symphony in his *Christmas Oratorio*, in the first chorus of the cantata *Liebster Gott, wann werd' ich sterben*, and in many other cases; but the modern instrumental effects are as far outside Bach's scope as a long passage of preparation on the dominant leading to the return of a first subject is beyond the scope of a gigue in a suite. Bach's conception of the function of an instrument is that it holds a regular part in a polyphonic scheme; and his blending of tones is like the blending of colours in a purely decorative design.

Those instruments of which the tones and compass are most suitable for polyphonic melody are for the most part high in pitch; a circumstance which, in conjunction with the practice (initiated by the monodists and ratified by science and common sense) of reckoning chords upwards from the bass, leads to the conclusion that the instruments which hold the main threads in the design shall be supported where necessary by a simple harmonic filling-out on some keyed instrument capable of forming an unobtrusive background. The chords necessary in this part, which with its supporting bass is called the *continuo*, were indicated by figures; and the evanescent and delicate tones of the harpsichord lent themselves admirably to this purpose where solo voices and instruments were concerned. For the support of the chorus the more powerful organ was necessary. It is in the attempt to supply the place of this *continuo* (or *figured bass*) by definite orchestral parts that modern performances, until the most recent times, have shown so radical an incapacity to grasp the nature of 18th-century instrumentation. The whole point of this filling-out is that, the polyphonic design of the main instruments being complete in itself, there is no room for any such additional inner parts as can attract attention. In the interest of euphony some harmonious sound is needed to bridge the great gap which almost always exists between the bass and the upper instruments, but this filling out must be of the softest and most atmospheric kind. Bach himself is known to have executed it in a very polyphonic style, and this for the excellent reason that plain chords would have contrasted so strongly with the real instrumental parts that they could not fail to attract attention even in the softest tones of the harpsichord or the organ, while light polyphony in these tones would elude the ear and at the same time perfectly bridge over the gap in the harmony. There seems no good

reason why in modern performances the pianoforte should not be used for the purpose; if only accompanists can be trained to acquire the necessary delicacy of touch, and can be made to understand that, if they cannot extemporize the necessary polyphony, and so have to play something definitely written for them, it is not a mass of interesting detail which they are to bring to the public ear. A lamentable instance of the prevalent confusion of thought on this point is shown by the vocal scores of the Bach cantatas corresponding to the edition of the *Bach Gesellschaft* (which must not be held responsible for them). In these Bach's polyphonic designs are often obliterated beneath a mass of editorial counterpoint (even where Bach has carefully written the words "*tasto solo*," *i.e.* "no filling out"). The same comments apply to the attempts sometimes made to fill out the bare places in 18th-century clavier music. There is no doubt that such filling out was often done on a second harpsichord with stops of a very light tone; but, if it cannot be done on the modern pianoforte in a touch so light as to avoid confusion between it and the notes actually written as essential to the design, it certainly ought not to be done at all. The greater richness of tone of the modern pianoforte is a better compensation for any bareness that may be imputed to pure two-part or three-part writing than a filling out which deprives the listener of the power to follow the essential lines of the music. The same holds good, though in a lesser degree, of the resources of the harpsichord in respect of octave-strings. To sacrifice phrasing, and distinctness in real part-writing, to a crude imitation of the richness produced mechanically on the harpsichord by drawing 4-ft. and 8-ft. registers, is artistically suicidal. The genius of the modern pianoforte is to produce richness by depth and variety of tone; and players who cannot find scope for such genius in the real part-writing of the 18th century will not get any nearer to the 18th-century spirit by sacrificing the essentials of its art to an attempt to imitate its mechanical resources by a modern *tour de force*.

Symphonic Instrumentation.—The difference between decorative and symphonic instrumentation is admirably shown by Gluck. In the famous dedicatory letter of his *Alceste* he mentions among other conceptions on which his reform of opera was to be based, that the co-operation of the instruments ought to be regulated in proportion to the interest and the passion, a doctrine of which the true significance lies in its connexion with other conditions of opera which are incompatible with the polyphonic treatment of instruments as threads in a decorative scheme. The date of this famous letter was 1767, but after *Alceste* Gluck was still able to use material from earlier work; and the overture to *Armide* is adapted from that of *Telemacco*, written in the year of Bach's death (1750).

To write an account of symphonic instrumentation in any detail would be like attempting a history of emotional expression; and all that we can do here is to point out that the problem which was, so to speak, shelved by the polyphonic device of the *continuo*, was for a long time solved only by methods which, in any hands but those of the greatest masters, were very inartistic conventions. In the new art the concentration of attention upon *form*, as a more important source of dramatic interest and climax than *texture*, resulted in a neglect of polyphony which seriously damaged even Gluck's work, and which always had the grave inconvenience that while the new methods of blending and contrasting instruments stimulated an increase in the variety, if not in the size of orchestras, there was at the same time extreme difficulty in finding occupation for the members of the lower middle class of the orchestra in ordinary passages. On the other hand, it is significant how everything in the development of new instruments seems to suggest, and be suggested by, the new methods of expression. The invention of the damper-pedal in the pianoforte epitomizes the difference between polyphony and symphonic art, for it is the earliest device by which sounds are produced and prolonged in a way contrary to the spirit of "real" part-writing. It is possible to conceive of any number of notes struck and sustained by the fingers as consisting of so many quasi-vocal parts; but when a series of single sounds is played and each sound continues to vibrate by means of a pedal which prevents the dampers from falling on the strings, then we are conscious that the sounds have been produced as from one part, and that they nevertheless combine to form a chord; and this is as remote from the spirit of polyphonic part-writing as modern English is from classical Greek.

The pianoforte trios of Haydn are perhaps the only works of first-rate artistic importance in which there is no doubt that the earlier stages of the new art do not admit of sufficient polyphony to give the instruments fair play. Haydn finds the pianoforte so completely capable of expressing his meaning that he is at a loss to find independent material for any accompanying instruments; and the violoncello in his trios has, except perhaps in four passages in the whole collection of thirty-three works, not a note to play that is not already in the bass of the pianoforte; while the melodies of the violin are, more often than not, doubled in the treble. Yet there is a certain difference between this and the work of a poor artist whose designs are threadbare. It would be impossible to add a note to Haydn's trio; the only question is how to account for the superfluity of much of the string parts and how to make the trios effective in performance. It is sometimes suggested that the 'cello part is best omitted and these works played as violin sonatas. But experiment shows that in this condition much of the violin part sounds incomplete; and the truth appears to be that Haydn is thinking, like any modern composer, of the opposition of two solid bodies of tone—the pianoforte and the stringed

instruments. And it will be found that the method of performance which most nearly justifies the instrumental effect of these otherwise beautiful works is that in which the pianoforte player regards himself as frequently doubling the stringed instruments, and not vice versa. He should therefore in all such passages play extremely lightly, so as to give the violin and 'cello the function of drawing the main outline. In the time of Bach such writing was beautifully suited to enliven the dry glitter of the harpsichord, and Bach's duets for clavier and violin seem to have been sometimes played as trios with a violoncello playing from the clavier bass. But this was ineffective with the pianoforte, and is only explicable in Haydn as a survival. His trios were, indeed, published under the title of "pianoforte sonatas with accompaniment of violin and violoncello"; but this in no way militates against the above remarks as to their proper method of performance nowadays, when we take into consideration the greater strength of tone of the modern pianoforte, especially in the bass, and the fact that in no case could a violinist consent to play as an accompaniment such melodies as that at the beginning of the G major trio known as No. 1.

For Mozart there never was any such *embarras de richesse* in any combination of instruments. His music is highly polyphonic, and modern in its instrumental treatment throughout. It was lucky for the development of instrumentation (as in all branches of music during the change from polyphonic to formal design) that whenever the texture is not polyphonic the natural place for melody is on the surface: in other words, when the accompaniment is simple the tune is generally on the top. Haydn, when he was not tempted by the resources of an instrument so complete in itself as the pianoforte, soon learnt to write artistically perfect string quartets in which the first violin, though overwhelmingly the most important part, is nevertheless in perfect balance with the other members of the scheme, inasmuch as they contribute exactly what their pitch and the little polyphonic elaboration admissible by the style will enable them to give. In the treatment of the orchestra volumes might be written about Haydn's and Mozart's sense of fitness, as shown in Haydn's experiments and Mozart's settled methods. Where they consent to any practical custom from practical necessity they also consent because it is artistically right for them, and if it had not been artistically right they would have soon swept it away. For example, it has often been said that the extent to which their orchestral viola parts double the basses is due, partly to bad traditions of Italian opera, and partly to the fact that viola players were, more often than not, simply persons who had failed to play the violin. This was in many cases true, and it is equally true that Mozart and Haydn often had no scruple in following the customs of very bad composers. But, when we look at the many passages in which the violas double the basses, we shall do well to consider whether there is room in the harmonic scheme for the violas to do anything else, and whether the effect would not be thin without them. As music becomes more polyphonic the inner parts of the orchestra become more and more emancipated. Already Mozart divides his violas into two parts quite as often as he makes them play with the basses. In Beethoven's orchestration there is almost always room for an independent viola part. There is not room for one together with an independent violoncello part; the wonderful use of muted solo violoncellos in the slow movement of the *Pastoral Symphony* being a special effect, like the earlier instance in Haydn's 12th *Salomon Symphony*. Otherwise, when Beethoven has anything special for the violoncellos to say, he invariably softens and deepens their singularly incisive cantabile tones by doubling them with the violas. In the orchestras of his day this was perhaps the only safe proceeding for players unaccustomed to such responsibilities, and that may have been one of Beethoven's reasons for it. But it is equally certain that the pure violoncello tone in large masses belongs to a distinctly different region of orchestral effect. Haydn's numerous examples of independent violoncello melodies are almost all either marked *solo* or written for such small orchestras that they would be played as solos.

Similar principles apply in infinite detail to the treatment of wind instruments, and we must never lose sight of them in speculating as to the reasons why the genius of Beethoven was able to carry instrumentation into worlds of which Haydn and Mozart never dreamt, or why, having gone so far, it left anything unexplored. A subject so vast and so incapable of classification cannot be discussed here, but its aesthetic principles may be illustrated by the extreme case of the trumpets and horns, which in classical times had no scale except that of the natural harmonic series. This could be fixed, within certain limits, at whatever pitch suited the composition; but on the horn it could be only very partially filled out by notes of a muffled quality produced by inserting the hand into the bell of the instrument, a device impossible on the trumpet. These instruments thus produced, in Haydn's and Beethoven's times, a very remarkable but closely limited series of effects, which, as Sir George Macfarren pointed out in the article "Music" in the 9th edition of the *Encyclopaedia Britannica*, gave them a peculiar character and function in strongly asserting the main notes of the key. An instance of this characteristic function, specially remarkable because the composer has taken exceptional measures for it, is Beethoven's overture to *Fidelio*. It is in E major, while Beethoven chooses to use trumpets in C. The only note which these can play in E major is the tonic, to which they are accordingly confined until the recapitulation of the second subject. This is unexpectedly placed in C major, the remotest key reached in the overture, and one that had already appeared in an

impressive passage in the introduction which foreshadows the reference in the first act to the hero in his dungeon (“Der kaum mehr lebt und wie ein Schatten schwebt”). In this key the trumpets blaze out with an effect which entirely depends upon their restricted part hitherto. On a sufficient acquaintance with the work this would probably have revealed the essential nature of the instrument to a hearer unacquainted with technicalities, and revealed it rather as a characteristic than as a limitation. A still more remarkable instance will be found in the third statement of the theme of the finale of the 9th symphony. When the trumpets take it up they make a remarkable change at its 11th bar, for no other reason than that one of the notes, though perfectly within their scale, and, indeed, already produced by them in the very same bar, is so harmonized as to suggest the freedom of an instrument with a complete scale. This passage shows that if Beethoven had had the modern trumpet at his disposal, while he would no doubt freely have used its resources, he would nevertheless have maintained its character as an instrument founded on the natural scale, and would have agreed with Brahms that the nobility and purity of its tone depends upon its faithful adherence, at least within symphonic limits, to types of melody suggestive of that scale.

This brings us to the latest radical change effected in instrumentation, the change from symphonic to dramatic principles. It will be convenient to take one supreme composer as the artist who has dealt so consistently with the essentials of the new style that he may be conveniently regarded as its creator. Even with this limitation the subject is too vast for us to enter into details.

Dramatic Instrumentation.—There is hardly one of Wagner’s orchestral innovations which is not inseparably connected with his adaptation of music to the requirements of drama; and modern conductors, in treating Wagner’s orchestration, as the normal standard by which all previous and contemporary music must be judged, are doing their best to found a tradition which in another fifty years will be exploded as thoroughly as the tradition of symphonic additional accompaniments is now exploded in the performances of Bach and Handel. The main difference between symphonic and modern dramatic orchestration depends on this: that in a symphony any important incident will probably be heard again within five minutes, in every circumstance of formal symmetry and preparation that can attract the attention. This being so, it is absurd in a symphony to use only such orchestral colours as would be fit for dramatic moments which are not likely to recur for an hour or two, if they recur at all. Such a passage as bars 5 to 8 in the first movement of Beethoven’s 8th symphony is as unintelligible from the point of view of Wagnerian opera as the opening of the *Rheingold* is unintelligible from the point of view of symphony. But both are quite right. The modern Wagnerian conductor is apt to complain that Beethoven, in his four-bar phrase, drowns a melody which lies in the weakest register of the clarinet by a crowd of superfluous notes in oboes, horns and flutes. The complainer entirely overlooks the fact that this is the kind of music in which such a phrase will certainly be heard again before we have time to forget it; and as a matter of fact the strings promptly repeat it *fortissimo* in a position which nothing can overpower. A crowd of instruments that seemed at first to overwhelm it in sympathetic comments is perfectly dramatic and appropriate on the symphonic scale. On the operatic scale established by Wagner such detail is simply lost. Far greater polyphonic detail of another kind is no doubt possible, but it requires far longer time for its expression. It cannot change so rapidly. It engages the ear more exclusively, and therefore it needs an accuracy and an elaboration of paraphernalia quite irrelevant to symphonic art. The accuracy and the paraphernalia are equally exemplified in all Wagner’s additions and alterations of the classical orchestral scheme, for these all consist in completing the families of instruments so that each timbre can be presented pure in complete harmony. But the greatness of Wagner is shown in the fact that with all the effect his additions have in revolutionizing the resources of orchestration, he never regards his novelties as substitutes for the natural principles of instrumental effect. His brass instruments have lost nothing of their ancient nobility. In his gigantic designs it inevitably happens that instrumental resources are strained to their utmost, and there is, perhaps, hardly anything which the makers and players of instruments can be trained to do which is too remote to be demanded by some extreme dramatic necessity in Wagner’s scheme. But it is always some such extreme necessity that demands it, and never an appetite too jaded for natural resources. The crucial example of this is what Richard Strauss has ingeniously called the “al fresco” treatment of instruments in large orchestral masses (Berlioz-Strauss, *Instrumentationslehre*, edition Peters). Experience shows that in the modern orchestra there is safety in numbers, and that passages may with impunity be written for thirty-two violins which no single player can execute clearly. Whether this justifies Wagner’s successors and imitators in showing a constant preference for passages of which not even the general outline is practicable; whether it justifies a state of things in which the normal compass of every instrument in an advanced 20th-century score would appear to be about a fifth higher than any player of that instrument will admit; whether it proves that it is artistically desirable that when there are eight horns in the orchestra their material should be indistinguishable from pianoforte writing, and that, in short, the part of every instrument should look exactly like the part of every other—such questions are for posterity to decide. At present we can only be certain that the

criterion according to which Brahms, being a symphonic writer, has no mastery of orchestration whatever, is not a criterion compatible with any sense of symphonic style. It is therefore not a criterion which can do justice to the principles of Wagner's non-symphonic art, for its appreciation thereof is inevitably one-sided. Least of all can it conduce to the formation of sound critical standards for the new instrumentation which is now in process of development for the future forms of instrumental music. These, we cannot doubt, will be as profoundly influenced by Wagner as the sonata style was influenced by Gluck.

Finally it must be remembered that musical euphony and emotional effect are inseparable from considerations of harmony and polyphony. Timbre itself is, as Helmholtz shows, a kind of harmony felt but not heard. Not even the imagination and skill of Berlioz could galvanize into permanent artistic life an instrumentation based exclusively upon instruments, however suggestive his wonderful orchestral effects may have been to contemporary and later artists, who realize that artistic effects must proceed from artistic causes.

Chamber-music—The instrumentation of solo combinations is one of the largest and most detailed subjects in the art of music. Something has been said above as to its earlier aspects in the time of Haydn. Before that time it was based exclusively on the use of the harpsichord either as a means of supporting the other instruments or its also contributing principal parts to the combination. Thus there were no string-quartets before Haydn—at least none that can be distinguished from symphonies for string-band.

Richard Strauss, in his edition of Berlioz's works on *Instrumentation*, paradoxically characterizes the classical orchestral style as that which was derived from chamber-music. Now it is true that in Haydn's early days orchestras were small and generally private; and that the styles of orchestral and chamber-music were not distinct; but surely nothing is clearer than that the whole history of the rise of classical chamber-music lies in its rapid differentiation from the coarse-grained orchestral style with which it began. Orchestral wind-parts have been discovered belonging to Haydn's string-quartet Op. 1, No. 5; his quartet in D minor, Op. 9, No. 4, is already in a style which not even the most casual listener could mistake for anything orchestral. On this differentiation of styles rests the whole aesthetics of chamber-music; but the subject is very subtle, and there is much, as for example in Schubert's quartets and his C major quintet, that is inspired by orchestral ideas without in the least vitiating the chamber-music style; though, judged by its appearance on paper, it seems as unorthodox as the notoriously orchestral beginnings of Mendelssohn's quartet in D and quintet in B♭. The beginning of Mendelssohn's F minor quartet is, again, a case usually, but perhaps wrongly, condemned for its orchestral appearance on paper. Such matters cannot be decided off-hand by the mere fact that *tremolos* are characteristic of orchestras: the question is whether in individual cases they have not a special character when played by single players. Where this is so there need be no confusion of style; but the danger of such confusion is great, and with the rise of modern dramatic instrumentation it may be doubted whether there are any standards of criticism in current use for chamber-music of other than the sonata style. The development of pianoforte technique since Beethoven has been in some ways even more revolutionizing than that of the brass instruments; and pianoforte instrumentation, both in solo and in chamber-music, is a study for a lifetime.

Orchestral Schemes Typical of Different Periods.

1. *16th Century.*—We, with our stereotyped modern notions of the grouping of voices, may get some idea of the freedom of the 16th-century composers' imagination by noting that the four-part movements for semi-chorus or solo voices in Palestrina's Masses present us with no fewer than seventeen different combinations of voices, and that of these the familiar group of soprano, alto, tenor and bass is not the most common, though it is invariable as that used for entire four-part Masses. In three-part movements Palestrina presents us with twelve combinations of voices. In his five-part Masses and single movements we find eight combinations, and his six-part Masses and single movements show eleven. And when he writes in eight parts for a double chorus the two groups are seldom identical.

2. *18th Century.*—17th-century instrumentation may be neglected here as having begun in chaos and ended in the schemes of the 18th-century decorative instrumentation. The following is Bach's fullest orchestra: the string-band, consisting (as at the present day) of violins in two parts, violas, violoncellos, doubled (where the contrary is not indicated) by double basses; the wind instruments (generally one to each part, as the string-band was never large)—2 flutes, 2 or 3 oboes, or *oboe d' amore* (a lower-pitched and gentler type), *taille* or *oboe da caccia* (some kind of alto oboe corresponding to the cor anglais), bassoon, generally doubling the string basses, 2 horns, with parts needing much greater practice in high notes than is customary to-day, 3 (occasionally 4) trumpets, of which at least the first 2 were played by players especially trained to produce much higher notes than are compatible with the power to produce the lower notes (the high players were called *Clarin-Bläser*; and the others *Principal-Bläser*); a pair of kettle-drums, tuned to the tonic and dominant of the piece.

Handel's orchestra is less detailed. He does not seem to have found any English trumpeters capable of playing as high parts as those of the German *Clarin-Bläser*, and his plan seems generally to get as many oboes and bassoons as could be procured to double the top and bottom of his string-band. But his definite orchestral effects in certain places (*e.g.* "He led them forth like sheep," in *Israel in Egypt*, and the music of the *Witch of Endor*, and the appearance of Samuel's spirit in Saul) are as modern as Gluck's.

3. *Symphonic Orchestration.*—Mozart's full symphonic scheme requires the string-band, 1 flute (rarely 2), 2 oboes, 2 clarinets (whenever he could obtain them, he being the first composer who really appreciated them, instead of regarding them either as cheap substitutes for the *clarino* or high trumpet of Bach, or, like Gluck and, with rare and late exceptions, Haydn, as merely adding to the force of *tutti* passages). Further, 2 horns, 2 bassoons, 2 trumpets and a pair of kettle-drums.

Mozart imports from church music 3 trombones for special passages in his operas.

Beethoven almost always has 2 flutes, and invariably 2 clarinets. In his 5th symphony he introduced 3 trombones and extended both the upper and lower extremes of the wind-band by a piccolo and a double bassoon. "Turkish music," *i.e.* the big drum, cymbals and triangle, was used by Haydn in his *Military Symphony*, and Mozart in his *Entführung*, for reasons of "local colour"; it appears as an extreme means of climax in the finale of Beethoven's 9th symphony.

4. *Wagner's Orchestra: Tristan und Isolde.*—(Families of instruments are connected by a brace.)

Strings: as usual, but subject to minutely complex grouping.

3 flutes (3rd to play piccolo when required).

2 oboes.

1 cor anglais.

3 bassoons.

2 clarinets.

1 bass clarinet.

4 horns. (The mechanical improvements by which horns and trumpets acquired a complete scale have revolutionized the nature of those instruments; and Wagner's orchestration, more than that of any other composer, has profited by this. Yet, in the preface to the score Wagner speaks very strongly of the loss of the original character of the horn in the hands of ordinary players; and goes so far as to say that, if experience had not shown that they could be trained to play *nearly* as smoothly as the classical players, he would have renounced all the advantages of the new mechanism.)

3 trumpets.

3 trombones.

1 tuba.

2 or, for safety in tuning, 3 kettle-drums.

Triangle and cymbals.

1 harp (multiplied *quant. suf.*).

In *Der Ring des Nibelungen* Wagner specifies the proportions of the string-band as 16 first and 16 second violins, 12 violas, 12 violoncellos, 8 double basses. The rest of the orchestra consists of—

Piccolo and 3 flutes.

3 oboes and cor anglais, or 4th oboe.

3 bassoons, or 2 and contra-fagotto.

3 clarinets and 1 bass clarinet.

8 horns, 4 of whom are also required to play 4 specially constructed tenor and bass tubas.

1 ordinary (double-bass) tuba.

3 trumpets.

1 bass trumpet. (A project of Wagner's which instrument-makers found impracticable, so that Wagner had to content himself with a kind of valve trombone shaped like a trumpet.)

3 trombones and 1 double-bass trombone.

2 pairs of kettle-drums.

Triangle.

Cymbals.

Big drum.

Gong.

6 harps.

5. *Chamber-music.*—Bach's and his contemporaries' combinations with the harpsichord show the natural fondness, in his day, for instruments of a tone too gentle for prominent use in large rooms, or indeed for survival in modern times. Thus there was quite as much important solo music for the flute as for the violin; and almost more music for the viola da gamba than for the violoncello. A frequent combination was flute, violin and harpsichord (very probably with a violoncello doubling the bass), and in more than one case the violin was partly tuned lower to soften its tone.

Classical and modern chamber-music in the sonata style consists mainly of string-quartets for 2 violins, viola and violoncello; string-trios (rare, because very difficult to write sonorously); pianoforte-trios (pianoforte, violin and violoncello); pianoforte-quartets (pianoforte with string-trio); pianoforte-quintets (pianoforte with string-quartet); string-quintets (with 2 violas, very rarely with 2 violoncellos), and (in two important cases by Brahms) string-sextets. Larger combinations, being semi-orchestral, especially where the double-bass and wind instruments are used, lend themselves to a somewhat lighter style; thus Beethoven's septet and Schubert's octet are both in the nature of a very large serenade.

Wind instruments produce very special effects in chamber-music, and need an exceedingly adroit technique on the part of the composer. Magnificent examples are Mozart's trio for pianoforte, clarinet and viola, his quintet for pianoforte, oboe, clarinet, horn and bassoon (imitated by Beethoven), his quintet for clarinet and strings, Brahms's clarinet-quintet for the same combination, and his trio for pianoforte, violin and horn.

(D. F. T.)

INSTRUMENT OF GOVERNMENT, the name given to the decree, or written constitution, under which Oliver Cromwell as "lord protector of the commonwealth" governed England, Scotland and Ireland from December 1653 to May 1657.

The Long Parliament was expelled in April 1653 and the council of state dissolved; the Little, or Nominated, parliament which followed ended its existence by abdication; and Cromwell, officially lord general of the army, with a new council of state, remained the only recognized authority in the country. It was in these circumstances that the Instrument of Government, drawn up by some officers in the army, prominent among whom was John Lambert, was brought forward. The document appears to have been under consideration since the middle of October 1653, but Ludlow says it was "in a clandestine manner carried on and huddled up by two or three persons," a remark probably very near the truth. The nominated parliament abdicated on the 12th of December 1653, and after certain emendations the Instrument was accepted by Cromwell on the 16th. Consisting of forty-two articles, the Instrument placed the legislative power in the hands of "one person, and the people assembled in parliament"; the executive power was left to the lord protector, whose office was to be elective and not hereditary, and a council of state numbering from thirteen to twenty-one members. The councillors were appointed for life; fifteen were named in the Instrument itself; and Cromwell and the council were empowered to add six. To fill vacancies parliament must name six persons, of whom the council would select two, the choice between these two being left to the protector. A parliament was to meet on the 3rd of September 1654, and until that date the protector with the consent of the council could make ordinances which would have the force of laws. After the meeting of parliament, however, he had no power of legislation, nor had he any veto upon its acts, the utmost he could do being to delay new legislation for twenty days. A new parliament must be called "once in every third year," elaborate arrangements being made to prevent any failure in this respect, and for five months it could not be dissolved save with its own consent. The parliament, composed of a single chamber, was to consist of 460 members—400 for England and Wales, and 30 each for Scotland and Ireland—and the representative system was entirely remodelled, growing towns sending members for the first time, and many small boroughs being disfranchised. A large majority of the English members, 265 out of 400, were to be elected by the counties, where voters must possess land or personal property of the value of £200, while in the boroughs the franchise remained unaltered. In Scotland and Ireland the arrangement of the representation was left to the protector and the council. Roman Catholics and all concerned in the Irish rebellion were permanently disfranchised and declared incapable of sitting in parliament, and those who had taken part in the war against the parliament were condemned to a similar disability during the first four parliaments. The protector was empowered to raise a revenue of £200,000 in addition to a sum sufficient to maintain the navy and an army of 30,000 men, and religious liberty was granted "provided this liberty be not extended to Popery or

Prelacy." The chief officers of state were to be chosen with the consent of parliament, and a parliament must be summoned at once in case of war. The practical effect of the Instrument was to entrust the government of the three countries to the parliament for five months out of every three years, and to the protector and the council for the remainder of the time. Although the Instrument bristled with possibilities of difference between parliament and protector, "it is impossible," as Gardiner says, "not to be struck with the ability of its framers."

Having issued many ordinances and governed in accordance with the terms of the Instrument, Cromwell duly met parliament on the 3rd of September, and on the following day he urged the members to give it the force of a parliamentary enactment. Many representatives objected to the provision placing the supreme power in the hands of a single person and of parliament, a discussion which was futile, as clause XII. of the Instrument declared that "the persons elected shall not have power to alter the government as it is hereby settled in one single person and a parliament." The proceedings were soon stopped by Cromwell, who on the 12th of September explained that there was a difference between "fundamentals" which they might not, and "circumstantials" which they might, alter. He concluded by stating that they would be excluded unless they subscribed a recognition to be true to the protector and the commonwealth, and to respect the terms of clause XII. Over three hundred members took the required step; but they proceeded to alter the Instrument in other ways, and over the question of the control of the army they were soon in sharp conflict with the protector. At length, on the 22nd of January 1655, Cromwell, counting twenty weeks as five months, dissolved parliament.

Regarding the Instrument as still in force the protector sought for a time to rule in accordance with its provisions; but new difficulties and growing discontent forced him to govern in a more arbitrary fashion. However, in July 1656 he issued writs for a second parliament which met in the following September. Many members, men of advanced views, were excluded by the council of state, acting on the strength of clause XVII., which declared that those elected must be "persons of known integrity, fearing God, and of good conversation." The remainder discussed the question of the future government of the country, and in May 1657 Cromwell assented to the Humble Petition and Advice, which supplanted the Instrument of Government. Gardiner says the Instrument was "the first of hundreds of written constitutions which have since spread over the world, of which the American is the most conspicuous example, in which a barrier is set up against the entire predominance of any one set of official persons, by attributing strictly limited functions to each."

The text of the Instrument is printed in S. R. Gardiner's *Constitutional Documents of the Puritan Revolution* (Oxford, 1899). See also S. R. Gardiner, *History of the Commonwealth and Protectorate*, vols. ii. and iii. (London, 1897-1901); L. von Ranke, *Englische Geschichte* (1859-1868); and T. Carlyle, *Cromwell's Letters and Speeches* (London, 1897-1901).

(A. W. H.*)

INSUBRES (Ἴσομβρες, Ἴνσουβροι), a Celtic people of upper Italy, the most powerful in Gallia Transpadana, inhabiting the country between the Adda, the Ticinus and the Alps. According to Livy (v. 34) they appear to have been a branch of the Aedui in Gallia Transalpina, though others assume that they were Umbrians, a view to some extent supported by the form Is-ombr-es. Livy states that Bellovesus and his Gauls, having crossed the Alps and defeated the Etruscans near the Ticinus, found themselves in the territory of the Insubres (also the name of a *pagus* of the Aedui). Here they built a city and called it Mediolanum (Milan), after the name of a village in their home in Gallia Transalpina. The name Insubres thus appears applied to the inhabitants (1) of the Aeduan *pagus*, (2) of the territory in Gallia Transpadana occupied by Bellovesus, (3) to the founders of Mediolanum. From 222 to 195 B.C. the Insubres were frequently at war with the Romans. In 222 they were defeated at Clastidium by M. Claudius Marcellus, who gained the *spolia opima* by slaying with his own hand their king Viridomarus (Virdumarus), and in 194 they were finally subdued by L. Valerius Flaccus.

See H. Nissen, *Italische Landeskunde* (1902) ii. 179; A. Holder, *Altkeltischer Sprachschatz*, ii. (1904).

INSURANCE, a term meaning generally "making oneself safe against" something, but specially used in connexion with making financial provision against certain risks in the business

of life. The terms Assurance and Insurance are in ordinary usage synonymous, but in the profession “assurance” is confined to the “life” business, and “insurance” to fire, marine and other miscellaneous risks. Assurance was the earlier term, and was used of all forms of insurance indiscriminately till the end of the 16th century. Insurance—in its earlier form, “ensurance”—was first applied to fire risks (see note *s.v.* “Insurance” in the *New English Dictionary*).

I. General History

During the latter half of the 19th century the practice of insurance extended with unprecedented rapidity, partly in novel forms. While its several branches, such as life insurance, casualty insurance and others, have each had an independent and characteristic development, all these together form an institution peculiar to the modern world, the origin and growth of which attest a remarkable change in men’s ideas and habits of thought.

The simplest and most general conception of insurance is a provision made by a group of persons, each singly in danger of some loss, the incidence of which cannot be foreseen, that when such loss shall occur to any of them it shall be distributed over the whole group. Its essential elements, therefore, are foresight and co-operation; the former the special distinction of civilized man, the latter the means of social progress. But foresight is possible only in the degree in which the consequences of conduct are assured, *i.e.* it depends on an ascertained regularity in the forces of nature and the order of society. To the savage, life is a lottery. In hunting, rapine and war, all his interests are put at hazard. The hopes and fears of the gambler dominate his impulses. As nature is studied and subdued, and as society is developed, the element of chance is slowly eliminated from life. In a progressive society, education, science, invention, the arts of production, with regular government and civil order, steadily work 657
together to narrow the realm of chance and extend that of foresight. But there remain certain events which may disturb all anticipations, and in spite of any man’s best wisdom and effort may deprive him of the fruits of his labour. These are mainly of two classes: (1) damage to property by the great forces of nature, such as lightning and hail, by the perils of the sea and by fire; (2) premature death. A useful life has an economical value. But no skill can make certain its continuance to its normal close. In the reasonable expectation that it will last until a competence is gained or the family ceases to be dependent, young men marry; but some will die too soon, and in the aggregate multitudes are left destitute. Both classes of loss are alike, in that they fall on individuals in the mass who are not known beforehand nor selected by any traceable law. But the sufferers are ruined, while the same pecuniary loss, if distributed over the whole number, would be little felt. Wherever the sense of community has existed this has been discerned, and some effort made to act upon it. Thus in feudal Europe it was customary for the houses of vassals to be restored after fire at the cost of the estate. In England in the 17th century the government practised a method of relief after accidental fires. When such a loss was proved to the king in council, the chancellor sent a king’s brief to churches, sheriffs and justices, asking contributions, and trustees for the sufferers administered the funds collected. But under the last two Stuarts gross frauds resulted, and the system fell into disrepute and disuse. At best, the voluntary relief provided by charity after losses are incurred is but sporadic and irregular. Insurance begins when the liability to loss is recognized as common, and provision is made beforehand to meet it from a common fund. The efficient organization of communities or groups for this purpose is an essentially modern achievement of social science. But the history of the conception in its formative stages is extremely obscure.

Its first appearance in business life is often sought in the marine loans of the ancient Greeks, fully described by Demosthenes. Money was advanced on a ship or cargo, to be repaid with large interest if the voyage prosper, but not repaid at all if the ship be lost, the rate of interest being made high enough to pay not only for the use of the capital, but for the risk of losing it. Loans of this character have ever since been common in maritime lands, under the name of bottomry and respondentia bonds. (See below, *Marine Insurance*.) But the direct insurance of sea-risks for a premium paid independently of loans began, as far as is known, in Belgium about A.D. 1300. During the next century the risks of insurance for the usual voyages between London and European ports were carefully considered, and customary rates became established. In his address in opening Elizabeth’s first parliament in 1559, Sir Nicholas Bacon said, “Doth not the wise merchant in every adventure of danger give part to have the rest assured?” In 1601 parliament created a commission to decide disputes under contracts for marine insurance, and the preamble of the act (43 Eliz. ch. 12) expresses the best thought of the British mind in that day upon the subject. Thus the business of marine insurance was intelligently and wisely practised three centuries ago. But the underwriters were private persons, acting independently, so that the insured lacked the benefit of large aggregations of capital to make his contract safe; while the insurer, who took one or a few risks, was without the security of large averages and might be crushed by an exceptional loss. A partial remedy was gradually reached in London. Men who had capital to employ in this hazardous business used to meet at fixed hours when

shipowners and merchants could negotiate with them. The higgling of the open market, in view of all the circumstances of each risk—as the character and condition of the ship, its crew and cargo, the length and route of the voyage, the season, the current rate of interest and profits—determined the rate of premium; and when this obtained general assent, the written agreement was signed by each underwriter for that part of the risk which he assumed. Towards the end of the 17th century these meetings were held in Lloyd’s coffee-house, and their simple practice gradually grew into the complete and complicated system of marine insurance now general. The underwriters together evolved rules and improved methods, but continued for generations to insure severally, without corporate powers or common responsibility, so that the name Lloyd’s became throughout the commercial world the symbol of marine insurance. More recently the name has been adopted in the United States by associations of private or individual underwriters as distinguished from insurance corporations.

Although the underwriters at Lloyd’s often considered and assumed other than marine risks, and made contracts some of which were merely wagers on public or private events, there is no record of insurances by them against fire on land. But fire insurance, it is vaguely known, had previously been practised, in a crude form, in several European cities. In 1635, and again in 1638, citizens of London petitioned Charles I. for a patent of monopoly to insure houses at the rate of one shilling yearly for each £20 of rent, the association to repair or rebuild those burned, to maintain a perpetual fire-watch in the streets, and to pay £200 yearly towards rebuilding St Paul’s cathedral until finished. The attorney-general approved the project, but in the disorders of the kingdom it was forgotten. The Great Fire of 1666 revived interest in the subject, and led to practical measures. In May 1680 a private fire office was opened “at the back side of the Royal Exchange” to insure houses in London, by assuming the risk of loss to a fixed amount for a fixed premium, namely, 2½% of the yearly rent for brick houses and 5% for frame houses, the rent being always assumed to be one-tenth of the value of the fee. The estimates of the promoters are interesting. In the fourteen years since the Great Fire 750 houses had been burned in London, with an average loss of £200. A fund of £40,000 subscribed as guaranty was to be increased by £20,000 for every 10,000 houses insured, and the interest of the fund alone therefore might be expected to meet all losses and leave a surplus. Thus the security was perfect and the promise of profit great. Meagre as was the basis of facts for the calculations, and crude as was the statistical method employed, the insurance offered met a general want and the business grew rapidly. Within a year a strong demand was heard that the city of London should itself insure the houses of its citizens, and the common council voted to do so at lower rates than the fire office. But the courts put a speedy end to this movement, holding that the charter conferred on the city no power to transact such business. Thus the socialistic theory that insurance is properly a branch of government is almost as old as the business itself, though it has never found favour or been practically tested on a large scale in Great Britain or America.

The next notable step in the evolution of modern methods was the organization of mutual insurance associations. In 1684 the Friendly Society was organized. Each member paid a small entrance fee for expenses, made a cash deposit as a reserve for emergencies, to be returned at the end of his term, and agreed to meet equitable assessments for current losses. Payments were computed on the assumption that one house in 200 is burned every fifteen years. The rivalry between the proprietary and the mutual systems began at once, and has continued till now. In 1686 “the Fire Office at the back side of the Royal Exchange” petitioned for a patent of the fire insurance policy and a monopoly of its issue for thirty-one years. The Friendly Society opposed the grant. The most eminent lawyers for both were heard by the king in council, and on the 30th of January 1687 King James II. decided the case. No charter was granted, but the Fire Office might continue its business, having a monopoly for one year. Thereafter the Friendly Society might for three months sell policies, but must then suspend for three months, and so on for alternate quarters. But the Fire Office must pay the ordinance service for its work in extinguishing fires, the amount to be fixed for each fire by the king. This was the first appearance of the plan, so widely prevalent in after years, of imposing on insurance companies the support of fire departments; that is, of taxing the prudent who insure to protect the reckless who do not.

After 1688 the atmosphere of England was freer, and underwriting was soon practised without special licence. In 1704 the societies began to insure household goods and stocks in trade, and the insurance of personal property rapidly became as important as that of buildings. In 1706 the Sun Fire Office was founded, and began to issue policies on both real and personal property in all parts of England. Other associations arose in quick succession of which the Union Fire Office, dating from 1714, and the Westminster from 1717, still survive. Before 1720 both fire and marine insurance had become general in all great centres of trade. But life insurance was as yet hardly conceived. Sporadic evidences that it was needed, and that men were feeling after it, occur in very early records. It was a medieval custom to advance to a mariner goods or money, to be restored with large additions, but only in case of safe return; or to contract, for a sum in hand, to ransom him if captured by pirates, or to pay a fixed amount to his family if he were lost. To evade the usury laws life annuities were often sold at a low rate, redeemable for a stipulated

sum. Life estates were sold upon some guess at their probable duration; and leases, especially of church lands, were made for one, two or three lives on rude and conventional estimates of the time they would run. Thus there was a commercial and social pressure for some intelligent method of valuing life contingencies. But the direct insurance of life, as a means of reducing the element of chance in human affairs, was hardly thought of. Indeed, such contracts were commonly regarded as mere forms of gambling, and were prohibited in France as against good morals.

The earliest known policy of life insurance was made in the Royal Exchange, London, on the 18th of June 1583, for £383 6s 8d. for twelve months, on the life of William Gibbons. Sixteen underwriters signed it, each severally for his own share, and the premium was 8%. The age of the insured is not referred to, nor was it then considered, except when far advanced, in fixing the premium. Gibbons died on the 29th of May 1584. The underwriters refused to pay, alleging that twelve months, in law, are twelve times twenty-eight days, and that Gibbons had survived the term. The court, of course, enforced payment. A few instances of similar contracts are found, mostly in judicial records, during the 17th century; but every such transaction was justly regarded as a mere wager, at least on the part of the insurer. It could not be otherwise until the principles of probability and the uniformity of large averages were understood and trusted. A few great thinkers were groping for principles which were profoundly to modify the practical reasoning of after-generations. But their work first obtained wide recognition upon the publication of the *Ars Conjectandi*, the posthumous treatise of Jacques Bernoulli, in 1713. Meanwhile the social need for insurance continued to express itself in empirical efforts, which at least helped to make clearer the problems to be solved. Thus in 1699 “The Society of Assurance for Widows and Orphans” was founded in London, a crude form of what is now called an assessment company. Each of 2000 healthy men under fifty-five years of age was to pay 5s. as entrance fee, 1s. quarterly for expenses, and 5s. at the death of another member; and at his own death his estate should receive £500, less 3%. On default in any payment his interest was forfeited. The society lasted about eleven years, and the accounts of its eighth year are preserved, showing the payment of £5200 upon twenty-four claims. The economic significance of this society lies in its distinct recognition of the principle of association for the distribution of losses. Together with the Friendly Society, it shows that this principle had now been so widely grasped by business men that, when embodied in a practical venture, it found substantial support.

The conception of a corporation as an artificial person to hold property and support obligations uninterrupted by the death of individuals was found in Roman law and custom. Its first use in modern business enterprise was perhaps the Bank of St George in Genoa, about A.D. 1200, a joint-stock company with transferable shares, whose owners were liable only to the amount of their shares. In England the crown, itself the chief and type of corporations sole, was the source of chartered rights, and from about 1600 the principle steadily gained recognition, the advantages of incorporation being attested by the successes of the great trading companies. Experience showed that the corporate form was the obvious remedy for the chief difficulties in the practice of insurance. Single risks were but speculative wagers; a great number must be taken together to obtain a trustworthy average. A larger capital than an average private fortune was demanded as a guaranty, and this capital must not be exposed to the dangers of trade, but set aside for the special purpose. Individual underwriters may die or fail; only a permanent institution can be trusted in long contracts. Several projects were devised on this basis. Early in the 18th century, indeed, the English government refused a charter for marine insurance, declaring that corporate insurance was an untried and needless experiment, while private underwriting was satisfactory and sufficient. But in 1720, when two sets of promoters offered £300,000 each for a charter, exclusive of other associations though not of individuals, to insure marine risks, parliament chartered the Royal Exchange and the London Assurance Company with a monopoly to this extent. The business disappointed its projectors at first, and the government accepted half the price rather than revoke the grant. In 1721 the companies extended their operations to fire insurance throughout England.

Thus the principle of insurance had now become a distinct part of the common stock of thought in enlightened nations, and gradually, by association with successive new ideas, plans and methods, was developed into a business or trade, which before the middle of the 18th century already formed an essential element of the social scheme. Most of the modern forms of insurance against the elements were known, and at least crudely practised. But there was no scientific basis for the business. Premiums were fixed, not by computation from known facts or reasonable assumptions, but by guess and the higgling of the market. Only the competition of capital checked the extortionate demands of underwriters. The first important steps towards a scientific valuation of hazards were taken in dealing with the class of risks hitherto so much neglected, those which depend upon human mortality. Marine and fire insurance had their origin in the pressure of need. The practice began before a theory existed. But life insurance had its origin in the scientific study of the facts of human mortality. Both marine and fire insurance became general before there was any intelligent study of the risks by statistical or mathematical

methods, nor can it be said that much progress has since been made towards establishing a scientific basis for the valuation of risks in these classes. But life insurance may be said to have been impossible until the theory of probabilities had become a recognized part of the common stock of ideas.

The value of insurance as an institution cannot be measured by figures. No direct balance-sheet of profit and loss can exhibit its utility. The insurance contract produces no wealth. It represents only expenditure. If a thousand men insure themselves against any contingency, then, whether or not the dreaded event occurs to any, they will in the aggregate be poorer, as the direct result, by the exact cost of the machinery for effecting it. The distribution of property is changed, its sum is not increased. But the results in the social economy, the substitution of reasonable foresight and confidence for apprehension and the sense of hazard, the large elimination of chance from business and conduct, have a supreme value. The direct contribution of insurance to civilization is made, not in visible wealth, but in the intangible and immeasurable forces of character on which civilization itself is founded. It is pre-eminently a modern institution. Some two centuries ago it had begun to influence centres of trade, but the mass of civilized men had no conception of its meaning. Its general application and popular acceptance began within the first half of the 19th century, and its commercial and social importance have multiplied a hundred-fold within living memory. It has done more than all gifts of impulsive charity to foster a sense of human brotherhood and of common interests. It has done more than all repressive legislation to destroy the gambling spirit. It is impossible to conceive of our civilization in its full vigour and progressive power without this principle which unites the fundamental law of practical economy, that he best serves humanity who best serves himself, with the golden rule of religion, “Bear ye one another’s burdens.”

II. Casualty and Miscellaneous Insurance

Before proceeding with an account of the standard institutions of fire and life insurance, it is proper to glance at the modern vast extension of casualty insurance, and to notice certain novel applications of the insurance principle to other special classes of events. The novelty of these enterprises, however, is not in the general idea underlying each of them. In almost every instance in which insurance has been extended, so as successfully to cover new kinds of risks, it will be found that the suggestion is nearly as old as the practice of life insurance. Many more kinds of insurance than are even now found useful were attempted more than a century ago. But no statistical basis then existed for determining the probability of loss from various casualties, nor had the methods of canvassing, accounting, proving and checking losses, reached the perfection now recognized as necessary for efficiency and safety. The various branches of business which, in distinction from the great standard institutions of life, fire and marine insurance, are commonly treated as miscellaneous insurance, differ widely in their subjects and methods. The most general of them, and that most widely known, is insurance against personal injury by accidents of every kind. Much has already been done by the companies in collecting and analysing facts, so as to determine the average risk of injury and disablement among different classes of men. But there is as yet no such union of effort among them to combine their resources for such purposes as among the life companies, nor does the subject admit of treatment so exact as that of human mortality. Hence it is impossible to speak of a theory of accident insurance in a scientific sense; and in its practice premiums and necessary reserves are determined by the trained business judgment of individual managers rather than by the calculations of actuaries from statistical collections of facts.

The insurance of railway travellers against injury upon trains was the first form of accident insurance which proved widely acceptable. This is still practised as a special business by several companies, tickets, entitling the purchaser or his family to a fixed compensation in case of his injury or death, being offered for sale with the railway tickets. But the development of insurance against personal injuries, which is most characteristic of the times, is the wholesale insurance of the employer against liability to the employed for accidental injuries sustained in his service. This was first undertaken on a large scale by the “Employers’ Liability Assurance Corporation of London,” founded for the purpose in 1880, immediately after the passage of the Employers’ Liability Act by parliament, which made employers of labour liable for injuries sustained in their service to an extent unknown to the common law. The Workmen’s Compensation Act 1906 greatly extended the classes of employers liable for accidents to their servants, and the number of companies devoting themselves to accidents and workmen’s compensation has greatly increased, while practically every fire insurance office has taken up the business. The policies are issued to employers of labour, agreeing to indemnify them for any loss to which they may be subjected, at common law or by statute, in consequence of bodily injuries suffered by any employee while engaged in their service. In some cases the insurance company undertakes the investigation and settlement of each claim within the limits prescribed by the policy, and conducts any litigation which may result. The adjustment of damages can be made with more economy and skill by the companies than is usually possible for the employer, and the danger of

fraudulent claims is largely reduced by methods experience has taught them. The price charged for such insurance is either a small percentage of the aggregate wages paid during the term, or a standard rate for each particular class of employment, or (in the case of large employers of labour) an “all-round” rate designed to cover every class of employee.

The most common form of accident insurance, however, is still represented by the policy which promises the assured a fixed sum in case of death by accident, and a weekly compensation during disability from such a cause. Many policies also specify a sum to be paid for the loss or permanent damage of a member, as an eye, a hand or foot. Another extension of the personal accident policy is the addition of some form of health insurance, especially the grant of a weekly sum to the insured during incapacity for work caused by certain named diseases. Besides the ordinary joint stock companies which carry on this class of business with fixed premiums, many associations organize for insurance against personal injury by accident, relying upon the assessment of members to pay claims as they mature. Many of these are local and ephemeral; but a number of them, formed by men engaged in common pursuits, for mutual protection, have attained importance. Such are especially some of the commercial travellers’ and the railway employees’ accident associations, and a few connected with the Masonic or similar beneficiary orders.

Another large class of casualty insurances applies to various forms of damage to property. The branch which seems most to have attracted promoters is the insurance of plate glass against fracture, which is carried on by a number of companies in Great Britain, and is the only business of several of them. In the United States there are five corporations which insure plate glass alone, while many other casualty companies issue also policies on glass. This business is not conducted in any other country upon so large a scale as in the United States, but is attracting more attention than heretofore in Europe, and especially in Great Britain.

There are several companies in the United Kingdom and in America which make the insurance against damage by the explosion of steam boilers a special feature of their work, but by far the greater part of the business is transacted by one company in each country. The service rendered is one of special skill and vigilance, extending far beyond the contract for indemnity. The company, in fact, employs inspectors of the highest scientific qualifications, who assume constant supervision of the machinery, and require its structure and conduct to be freed from elements of danger. It is prevention rather than compensation that is sought, and the outlay made by the companies is mainly for inspection and control, not for losses. It is usual to promise in a policy upon a steam boiler some compensation also for any personal injury which may result from an explosion.

There are some companies in England having insurance against burglary for their principal purpose, while several of the British and American accident companies issue policies of this kind. It is somewhat of an experiment, and the risks taken are for moderate sums, at premiums determined in each case by an estimate of the danger founded on a study of all the circumstances. There is no information published concerning this branch of insurance in other countries, but the aggregate premiums paid are not at present very large. It is believed by many that there is an important future for burglary insurance, in connexion with improved methods of protection, by safes, automatic alarms and constant inspection, for dwelling-houses, shops and offices, which are often unoccupied.

Insurance against damage to growing crops by hail is practised in several parts of Europe and America, commonly by small local associations on the mutual plan or as an incident to the business of fire insurance. No statistics can be obtained of these operations. The same is true of the insurance against the ravages of tornadoes, and against sickness and accident in domestic animals.

A wholly distinct business, commonly classed as a branch of insurance, has now grown to great importance, that of guaranteeing the fulfilment of contracts and of indemnifying employers against defalcations in their service. The bond of a corporation of large capital is widely taking the place which personal surety has filled in connexion with undertakings on contract, and with offices and occupations of trust, both in public and in private life. Fidelity insurance is carried on by a few of the general casualty companies, but as the practice of it extends it becomes more and more the work of special institutions organized for this purpose alone. In the United States there are many corporations of excellent standing, with aggregate paid-up capital of more than $15,000,000 and surplus funds of nearly $10,000,000 more, and collecting in premiums about $4,000,000 annually upon bonds and guaranties amounting to more than $1,250,000,000. The business practically only started at the close of the 19th century. It has had similar if not equal development in Great Britain and in several other countries, but it is only in the United States that the statistics of it are officially collected.

The insurance of titles to real property is also becoming widely extended. This business, however, has indemnity for losses as but an incidental purpose. The principal aim is to furnish a final and responsible assurance that the title is flawless. Several of the companies in the United States possess elaborate and expensive collections of records, covering the sources of title for cities or large districts; all of them employ expert ability of a high order; and when they approve

a title as perfect, the purchaser or lender of money may receive, with the approval, a guaranty against loss in accepting it, which private examiners or counsel cannot give. Titles are insured also in other countries, but the business has nowhere else attained such importance, nor do the institutions transacting it make full and separate statements of their accounts. Other minor forms of insurance are against bad debts, bonds and securities in transit, earthquakes, failure of issue, loss on investment, leasehold redemption, non-renewal of licences, loss of or damage to luggage in transit, damage to pictures, loss of profits through fire, imperfect sanitation, birth of twins, &c.

III. Fire Insurance

The growth of the business of fire insurance since 1880 or thereabouts has been commensurate with the increase of wealth and of commercial activity in the foremost nations, while the practice of it has also become general in countries in which it was formerly little known. The statistics of the subject have in recent years become far more full and more accessible than formerly; partly because many governments require detailed reports of resources, receipts and expenditures from all companies permitted to establish agencies within their jurisdiction, and periodically publish summaries of the returns; but also largely because the companies seek the widest publicity as their best means of advertising. It is to be regretted that there is as yet no uniformity of method in these returns; while some of the most important elements of the subject are not sufficiently illustrated for the student in the published statistics. Many companies of the United Kingdom transact business throughout a great part of the world, and there is no means of determining how much of their receipts or their losses must be referred to Great Britain. Further, they fail to give classified amounts at risk, so that it is impossible to estimate with any confidence the total sum for which any kind of property, such as dwellings, factories, household goods, stocks of merchandise or wares in transit, is insured. The returns of the London Fire Brigade, however, which is in part maintained by regular contributions from the fire underwriters at the rate of £35 for each £1,000,000 of risks assumed by them within the metropolitan district, continue to exhibit a regular growth. The aggregate amount insured in the metropolis was reported as follows:—

In 1882	£696,715,141
1886	741,109,316
1890	806,131,385
1895	858,899,409
1900	963,291,097
1905	1,034,819,587

It appears probable that the rate of increase here shown is not greater than the actual growth of insurable property during the same period, so that it may be reasonably supposed that the custom of protecting all exposed property by insurance was already general in London many years ago. But the transactions of the British fire offices have grown much more rapidly, and indicate that, outside of the metropolitan district, the practice of insurance has extended greatly. The returns show that there is a tendency to concentrate the business in the control of large capital and experience, for practically all the premiums received and losses paid were shared by thirty-one companies, although there are at the same time a greater number of corporations of foreign countries with agencies for fire insurance in the United Kingdom; but many of these do but a nominal amount of business, and twenty-three of them are exclusively or chiefly engaged in re-insurance. This tendency has been a marked feature in the later history of fire insurance everywhere. The companies which are now in the field are the survivors of tenfold as many projected enterprises which have failed. The records of about two thousand organizations for the purpose, in America alone, which have undertaken the work and disappeared within fifty years, show the dangers to which inadequate skill and capital are exposed. But a small proportion of these failures were the direct result of sweeping disasters, though about seventy of them followed the memorable fires in Chicago and Boston in 1871 and 1872. Many more, nearly one-half of the whole, have followed a short career, in which the helplessness of inexperience to compete with long training and complete organization was demonstrated. Many hundreds of these projects were mere speculations or even frauds from the beginning; and the better education of the community at large in the principles and methods of insurance has been the chief agent in checking such enterprises, aided by the stringent legislation of several countries and of the United States in America and by the criticism of the press.

The difficulty of establishing a new joint-stock fire insurance company is far greater in the present highly perfected state of the business than formerly, and constantly increases. The reports of the state insurance departments in America show that less than one-eighth of the premiums are now collected by companies founded since 1880; and, except in districts remote from the principal financial centres, or mutual associations for special classes of hazards, new companies are not often formed. In Great Britain a considerable number of new corporations are

registered every year, with fire insurance among their professed objects, but almost always in connexion with some forms of casualty insurance, which appear to be practically the purpose in view. The reports of the fire business in the United Kingdom for recent years, as collected in *Bourne's Manual*, show that less than one-fourteenth of it is done by companies organized since 1870. Though new companies have been registered, usually several every year, the number actually transacting successful business has not increased since 1880. Of the various British companies now recognized, the twelve smallest together collect but 1% of the premiums received by one of the largest, and the tendency to concentrate the business seems progressive. These facts are explained by the necessity of a vast basis of average and of a large capital for security, and still more by the increasing demand for a thoroughly trained and organized body of agents, able to protect their companies from fraud and imposition, and at the same time to compete for public patronage.

The *Mutual* principle has a strong attraction for many insurers and projectors. When a large number of pieces of property, so distributed that a single fire cannot destroy a considerable proportion of the whole, are yet owned and controlled by persons who can fully trust one another, both for financial responsibility and for good faith, there may be no need of a large capital in hand, nor of much of the costly machinery required for general competition. A contract for the assessment on all the property of losses as they occur, at rates fixed by the estimated exposure, may form a safe basis for an association. The fixed payments may be limited to necessary expenses, with a moderate reserve for emergencies, all excess of collections to be returned to the insured. This simple conception of an insurance association, with such modifications as experience indicates, has been accepted for a time as ideal in almost every civilized community, and attempts are continually made to realize it, but in the vast majority of instances with complete failure as the result. Like every other product of human skill, insurance is, for the most part, best supplied to the market by those who make it their calling to produce it for gain. But while the mutual plan has proved poorly adapted to the general service of the commercial world, in some communities, and especially among the owners of certain classes of property, it has achieved great and apparently permanent success. This is particularly true of manufacturing districts, in which numbers of mills and factories are exposed to peculiar danger of fire by the nature of their own operations. The best safeguard they can have is by employing great skill in the construction, arrangement and conduct of their works. A group of such properties, associated for the prevention of loss, is naturally stimulated to highest efficiency when the whole group undertakes to bear all losses which are not prevented, and thus every member has a strong interest in making the protection complete. It is in associations of this character that the mutual plan of fire insurance has rendered its greatest services. The mutual plan has been widely adopted also in local associations for the insurance of dwellings and farm improvements, where the individual risks are small, and where technical classification and special safeguards against fraud are not considered necessary, often with the result of affording satisfactory protection at low rates. But the ratio of this part of the business to that conducted by joint-stock companies diminishes from year to year, even in the agricultural and rural districts of the United States. According to the reports of the insurance departments of the states, as summarized in the Spectator Company's Year-Book, more than half of the cash premiums of mutual insurance companies are collected in the two manufacturing states of Massachusetts and Rhode Island.

Mutual system.

It is, after all, only within a very limited field that the mutual principle can be adopted. The essential principle of fire insurance is the distribution of loss. It does not aim, directly at least, at the prevention and only in a secondary way even at the minimizing of loss; but what it seeks to accomplish is that such losses shall not fall exclusively, and possibly with overwhelming effect, on the owner of the property destroyed, but shall be borne in easy proportions by a large number of persons who are all alike exposed to the risk of a similar catastrophe. To work out the equitable solution of such a problem an amount of technical skill and extended experience is required which few bodies or communities possess. Certainly, experience in Great Britain has shown that the one system of fire insurance which has contributed most to the public benefit is that which is conducted by joint-stock companies, offering to the insured the guarantee of their capital and other funds, and looking to make a profit by the business. In France, Belgium, Holland, Russia and Norway, also, the joint-stock plan is almost exclusively employed.

Such an opinion must be qualified by observing that, under the fostering influence of the national and municipal governments, the mutual plan has reached an important development in Austria-Hungary, Germany, Switzerland and Sweden. In all these countries, indeed, corporate enterprise on a large scale, in every branch of business, is of comparatively late growth, and mutual fire insurance was a familiar practice long before joint-stock companies entered upon this field of activity. The tendency in the large cities and commercial centres is to throw new insurances into the business corporations, while the time-honoured mutual associations retain their standard character and customary clientage. But in these countries the mutual plan has an established place in the confidence of the rural population, who are generally strongly prejudiced against moneyed corporations. This is especially true of the cantons in Switzerland and certain districts in Austria-Hungary, where fire insurance is administered by the local

governments in connexion with a minute police supervision of the construction of buildings and of other conditions affecting the risk. From the published returns of the companies and the authorities, as collected for the *Post Magazine Almanack* (1900), it would appear that of all the fire insurance premiums paid in Switzerland nearly 54% is collected by the mutual associations and the cantonal authorities; while in Italy 37%, in Germany 27%, in Sweden 27% and in the Austro-Hungarian monarchy 20% go to mutual companies.

The earliest plan of insurance which was successful as a business was that practised at Lloyd's Coffee-house (see LLOYD'S) in London, and there applied almost exclusively to marine risks.

Lloyd's.

Although the association known as Lloyd's has been for generations a strong financial institution, with every modern safeguard, and since 1871 has been a chartered corporation with large funds, yet its name has become accepted as the symbol of the primitive practice of combined underwriting by individuals, each upon his own credit, for a share of the risk and without common liability.

A few associations on this general principle were known to exist in America, and to issue fire policies on a small scale, before 1892, but chiefly for mutual insurance. In that year, in a general revision of the insurance law of New York, such associations already in existence were expressly exempted from all its provisions. Speculators at once discerned an opportunity. If a company by omitting to take corporate form could carry on the business free from all restrictions and burden of state supervision, it would compete at great advantage with the insurance corporations. While the new law was in prospect there was time to take action; and upon its passage there suddenly appeared a multitude of "organizations" claiming the exemption as Lloyd's, or associations of individual underwriters, and offering fire policies at rates materially lower than those of the joint-stock companies. Each of these was represented and managed by an attorney for the subscribers, supposed to have power to bind them severally to the amount of their subscriptions. The standard policy prescribed by law in New York was issued, with a clause making the liability several only, and fixing the amount. The Lloyd's entered the market with the zeal and prestige of a new idea and a great name, and they grew rapidly in number and in business, but made no reports. Extending their agencies into other states, they occasioned much litigation concerning their legal existence and rights and some rash and inharmonious legislation. But several attempts to establish similar Lloyd's in other places failed. Experience soon showed that it was impossible to enforce claims in the courts, when the liability was distributed among many, without excessive expense and delay, even when all the subscribers were solvent, while a few good names, however useful in canvassing, were no guarantee of the responsibility of unknown associates. In 1896 the executive and legal authorities of New York assumed a hostile attitude towards speculative schemes of this class, and indictments were found against a number of promoters for falsely antedating constituent agreements. The bubble burst suddenly, and within three years more than one hundred of the Lloyd's disappeared. A few reinsured their risks or were merged in permanent companies, but the mass of them proved to have no substance. Four or five only of the best Lloyd's continue to issue fire policies within a narrow and special circle, but as a group they no longer compete for general business.

The rate of premium varies with the supposed risk, but certain descriptions of property are specially and more elaborately rated. This has been done to a considerable extent by common agreement amongst the offices, and the arrangements are known as the "tariff system," which requires here a few words of explanation.

We may suppose the question to arise, What ought to be paid for insuring a cotton-mill, or a flax or woollen mill, or a weaving factory, or a wharf or warehouse in some large city? The experience of any one office scarcely affords adequate data, and a rate based on the combined experience of many offices has a greater chance of being at once safe and fair. The problem, indeed, is a more complicated one than what has been already said would indicate. The property to be insured may consist of several distinct buildings and the contents of them: one building may be devoted to operations involving in a high degree the risk of fire; in another the processes carried on may be more simple and safe; a third may be used only for the storage of materials having little tendency to burn. Fairly to measure these various hazards it has been found necessary that the experience and skill at the command of many companies shall be combined, and that the rates shall be the result of consultation and a common understanding.

Now it is clear that no office will contribute its skill and experience to such a common stock if the effect is to be that other offices may avail themselves of the information in order to undersell it. Consultation about rates and a common understanding necessarily involve a reciprocal obligation to charge not less than the rates thus agreed on; in other words, a tariff of rates is developed to which each office binds itself to adhere. The system tends to restrain and moderate the competition for business which inevitably and to some extent properly exists among the companies, and its value to them is manifest. But it is also of service to the insuring public. At first sight it might seem that free competition would suit the public best, and that a combination among the offices must tend to keep up rates, and to secure for the companies excessive profits, but a little consideration will show that this is a mistake.

It is an unquestionable truth, though one often lost sight of, that all losses by fire must

ultimately be borne by the public. The insurance companies are the machinery for distributing these losses, nothing more. If the losses fell on them, their funds, large as they are, would speedily be exhausted, and the service which they render to the public would come to an end. To those who require insurance against loss by fire it must be a manifest advantage that they should have many sound and prosperous offices ready to accept their business, and no less able than desirious to earn or to retain the public favour by fair and liberal conduct. A necessary condition of this state of things is that the rates of premium paid for insurance should be remunerative to the offices, and the main object of the tariff system is to secure such remunerative rates.

This it endeavours to do by two methods—by an agreement as to what rates are to be charged, and by affixing such a penalty to dangerous constructions, substances and processes as to induce, if possible, a lessening of the danger. In other words, and reversing the order, it seeks to diminish the risk of fire, and to secure adequate payment for what risk remains. On the supposition that the offices are correct in their estimate of risks, the effect, and indeed the intention, of their rule is not so much to put money into their own coffers as to lessen the danger, and to save themselves in the first instance, and the owners of property ultimately, from the consequences of preventible fires.

These rules, as will readily be seen, must have powerful influences on trade and manufactures. Many individual warehouses and mills are, with their contents, insured for very large sums, £10,000, £20,000, £50,000, £100,000 and more. An additional charge of 5s. or 10s. % in respect of a supposed increase of risk may mean a payment by the owner of several hundred pounds a year, and may operate as a complete veto on some arrangement or some machine which it might otherwise be desirable to resort to. The occurrence of a few severe fires in one town, followed by an increase of insurance rates, may have, and indeed has had, the effect of driving some branch of trade to another locality, the seat of greater caution or better fortune. It is therefore obviously desirable that so important an influence should be exercised, not precariously or capriciously, but according to the combined wisdom and experience of those associations which may be supposed to understand the subject best, and which obtain their experience in the way that makes it perhaps of most value, by paying for it.

It is equally for the public benefit that rates of insurance should be fixed on some common scale. Suppose the system of unrestricted competition to be tried, the first effect will be a general and great reduction in rates. But it may be said, “So much the better for the insured; if the offices can afford this reduction of rate, it will only be a fair result of competition; if they cannot afford it, they will be the losers, but the public will gain; will the effect not be simply to reduce the rates to the paying point and no further?” This would be all very well if the paying point could be absolutely ascertained or determined in any way beforehand, but the rate comes first and the losses come afterwards. In other businesses prices are based on some certainty as to the cost of production, but in selling fire insurance the cost is not known till after it has been sold. In a free competition it is the sanguine man’s views which regulate the market price, and the rates therefore cease to be remunerative. The consequences are that some offices disappear altogether, others take fright in time to avoid ruin, though not to escape serious loss, persons who might establish new offices are deterred from doing so, the business gets the character of being a highly speculative and hazardous one, requiring extravagant profits to induce men to carry it on at all, and the public have to bear the cost. Unrestricted competition therefore is not for their advantage.

The combination for uniform rates has another beneficial effect; it serves to distribute the burden of losses fairly. If it is a just thing that cotton-spinners should bear all the losses that arise in cotton-mills, and not leave them to be borne by the owners of private dwelling-houses, or vice versa, it is well that the loss by each class of risks should be measured fairly. But, while the experience of any one office, taken by itself, furnishes a very imperfect criterion, each contributes its quota of knowledge and experience to the common stock, and the public get the benefit both of broad and trustworthy data and of that peculiar and intimate acquaintance with each different class of property or process which the conductors of one company or another are sure to possess.

No conventional or excessive rates can, however, be maintained for any length of time. Some member of the union is sure to perceive that popularity and profit may be gained by introducing a lower rate, if a lower rate is manifestly sufficient, or a new company starts into existence to remedy the grievance. It is to be remembered, too, that the directors and shareholders who control the offices are likewise insurers, quick to raise the question of how far the rates they have to pay as individuals are justified by the risks run; and if it cannot be shown that these rates are a true measure of the risk, offices are soon constrained by a sense of justice or by self-interest or by pressure from without to mitigate them. In short, the association is a union bound together by necessity and tempered by competition.

Adequately to measure the risk of loss by fire demands not merely reference to an extended experience but a watchful regard to current changes. While the profits of fire insurance business fluctuate considerably from year to year, and seem even to follow cycles of elevation and

depression, the tendency on the whole appears to be towards a growth of risk, although excessive competition among offices prevents the rates from rising in proportion.

The *Tariff* system has steadily developed in minuteness of classification and in adaptation to wider experience, as well as to the changes in the character of many classes of risks by improvements in building and by the introduction of new kinds of goods and machinery. The estimates of risk and the determination of premiums are largely governed by individual opinion and by competition, no amount of experience furnishing a statistical basis on which trustworthy predictions of average loss can be made. Hence it is only by constant co-operation among insuring institutions in the exchange and combination of their observations that justice can be done to them and to the public. The proper extent of this co-operation is easily attained where the business is free from all restrictions except those of the common law, as in Great Britain, and the competition of capital for profits is keen enough to keep the rates within reasonable limits. But in countries in which the government regulates the business in a more paternal spirit, and meddles with all its details for the avowed purpose of securing the safest and best public service, many difficulties arise. This is increasingly the case in several of the nations of Europe, notably in Austria, Switzerland and Germany.

Tariff difficulties.

But it is in the several states of the United States that the government supervision of insurance has most interfered with and modified the natural development of the business. In recent years, beginning with 1885, sixteen of these states have enacted legislation, dictated by the growing jealousy of corporate powers and privileges, forbidding fire insurance companies or their agents to combine in any form for the determination of rates. Companies have often been indicted, fined and deprived of authority to issue policies because of membership in associations for the purely scientific purpose of ascertaining their average experience. The courts have frequently narrowed in their interpretations the sweeping intent of such laws, but have generally sustained them as within the power of the legislature, and at the present time there is an overwhelming public sentiment in large sections of the country arrayed against every semblance of union or consultation among the companies upon the basis of their business. In several instances all the important insurance companies have withdrawn their agencies at once from particular states, and the business community has been sorely distressed for want of their protection. But the popular prejudice has not yielded to its demand, and the companies have never been able to maintain their own position with unanimity, the temptation to secure a vast business upon any terms being always too strong for some of them to resist. This form of legislation has beyond dispute increased the cost of insurance to the people, while it has embarrassed and disturbed the regular work of the companies.

Another pernicious tendency of popular legislation in the United States is found in the *Valued Policy laws*, the first of which was adopted by Wisconsin in 1874, providing that when any insured building is wholly destroyed by fire the amount of the policy shall be conclusively taken as the amount of the loss. This principle, with various modifications and extensions, has become law in some twenty states of the Union, though in many of them its enactment has been vigorously resisted by the executive government; several governors have vetoed such bills, while most of the supervising officers have had the intelligence to disapprove them. The provision is regarded by all insurance authorities as highly dangerous, inviting over-insurance and incendiarism; and there is no doubt that it has this tendency in many instances. But the statistics available, while showing that in general the rate of loss has increased where such laws are in force, do not demonstrate any such wide and ruinous stimulation of fraudulent practices as has been apprehended by thoughtful critics. The actual result is commonly to throw upon the insurer the responsibility for providing in advance against over-insurance by minute surveys and, in special cases, for continual watchfulness against depreciation. Like all other interference of government with private contract, however, it has a marked effect in increasing the difficulty and expense of business transactions.

The direction in which fire insurance as a social institution calls most pressingly for improvement is the extension of the principle of co-insurance. The importance of this can only be understood by remembering that the aggregate losses of the community by fire are chiefly made up of innumerable small fires and not of sweeping conflagrations. The experience of every company confirms the general truth, that the number of fires in which a building is totally destroyed, or in which the loss amounts to the greater part of the property exposed under the same risk, is comparatively very small. It may be asserted with confidence that, in the grand aggregate of the business, much more than three-fourths of the loss occurs in fires in which less than one-tenth of the insurable value at risk is destroyed. The practical result is obvious. If fires destroy a million of dollars' worth in property insured for its full value, and a million's worth more in property insured for one-tenth of its value, the insurers will pay $1,000,000 upon the first group and more than $750,000 upon the second. But if all the insurance is taken at the same rate the insurers will have received premiums ten times as great on the former group as upon the latter. This rough illustration shows that in an equitable adjustment of rates the amount insured as compared with the value exposed is a prime element, and that premiums might justly form a

Need of co-insurance.

scale, highest on the smallest fractions of value, and diminishing rapidly as the percentage of insurance increases. Such a scale is, however, impracticable for many reasons, apart from the endless complications which, even if it could be constructed, it would introduce into the classification of risks. Any scientific plan of insurance, therefore, must provide another method for maintaining the proportion between amounts of premiums paid and the share in its benefits obtained for them. This is the purpose of what are generally called *average* or *co-insurance clauses*. The principle is, that when a proper rate for a class of risks is found, then the insured may protect at that rate any percentage of such a risk, and in case of fire shall be indemnified for the same percentage of his loss. When once clearly grasped, this principle largely simplifies and rectifies the business. It is in universal use in marine insurance under the name of "average," and is there recognized as indispensable. It is embodied in all fire policies in France, Germany and several other countries of Europe, and in 1826 was made compulsory in Great Britain by law in all "floating policies," those, that is, which cover stocks of goods distributed in several places and in fluctuating amounts. But it has not yet become general in Great Britain or America, although every writer of authority on the subject, and every practical underwriter of large experience, approves it. Systematic attempts have been made since about 1892 to extend its application in the United States with much success, but they have been met by strong opposition, which shows a widespread misunderstanding of its true bearing.

> The co-insurance clause, indeed, which has been generally approved by the American associations of underwriters, and applied in the great commercial cities, is less sweeping than the parallel agreements used in France and Germany. The latter regard the insured owner as self-insurer for the entire value at risk not covered by the policy, and grant indemnity only for that fraction of the loss which the amount insured bears to the whole amount exposed. The American clause is less logical, commonly providing that: "If at the time of fire the whole amount of insurance on the property covered by this policy shall be less than 80% of the actual cash value thereof, this company shall ... be liable only for such portion of such loss or damage as the amount insured by this policy shall bear to the said 80% of the actual cash value of such property." But this limitation of the basis of co-insurance average to 80% of the total value is in perfect harmony with the conservative policy which seeks in all cases to prevent over-insurance. The most serious danger to which the entire system is open is that a fire may promise profit to the insured. To avoid this, it is a small enough margin to exclude from protection by the policy one-fifth of the estimated value, and to require the owner to assume that proportion of the risk. It is therefore reasonable not to require in any case a larger share than four-fifths to be covered, and not to press the co-insurance principle so far as to offer a differential advantage to those who insure above this limit. Thus, for practical purposes, and in the general mass of business, the 80% clause may be accepted as approximately the best application of the principle. It makes possible substantial equity in distributing the cost, while it does not interfere with proper safeguards against over-insurance. The cordial support of the mercantile community in the great cities, and of the most intelligent state officers, has been given to it.
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> A popular outcry has, however, arisen against all forms of co-insurance, on the superficial and mistaken assumption that in every case the principal sum named in the policy measures the insurance paid for by the premium; and that any limitation upon it must be a wrong to the insured, for the emolument of the insurance corporation. No less than ten states have passed laws prohibiting the clause within their jurisdiction, though Maine in 1895, after a trial of two years, repealed the prohibition. The law of Tennessee, a typical form, is as follows: "Insurance companies shall pay their policyholders the full amount of loss sustained upon property insured by them, provided said amount of loss does not exceed the amount of insurance expressed in the policy, and all stipulations in such policies to the contrary are and shall be null and void" (except in case of insurance upon cotton in bales). In several states the use of the co-insurance clause is made a penal offence. It is an interesting fact, however, that while this principle, whenever it has been generally applied, has led not only to a fairer equalization of premium rates, but, on the whole, to a marked reduction of them, the laws in question have deprived the people adopting them of the resulting benefit. In the year 1899 the average premium rate upon all fire risks written in the states in which co-insurance was wholly or partly prohibited was something more than $1.20 per $1000, while in the rest of the country, where the clause was permitted and to a large extent used, the rate was but 96 cents per $1000. The marked difference, which tends to increase, is a perpetual object-lesson which must in the end appeal strongly to the popular intelligence.

Taxation of insurance.

The varying attitude of several civilized governments towards the institution of insurance has found significant expression in their tax laws. In Great Britain a stamp duty of 6d. was imposed in 1694 upon "every piece of vellum or parchment or sheet of paper upon which any policy of insurance should be engrossed or written," and was doubled in 1698. It was further increased (reaching 3s. 10d. per policy in 1713) and varied by many subsequent acts, under some of which the percentage duty on fire insurance was also made payable by stamps upon policies. But in 1865 the stamp tax was finally reduced to the nominal sum of 1d. upon each policy. A far heavier burden, however, was imposed upon insurers by the measure of Lord North in 1782, charging all fire insurances in

force with an annual duty of 1s. 6d. for every £100 insured. In 1815 the general rate was made 3s. per £100, but was collected once for all upon the policy when issued; and it so remained until reductions began in 1864. The duty was wholly abolished in 1869. The revenue from this source reached its highest point in 1863, when it was £1,714,622, presumably representing insurances effected in that year to the amount of £1,143,081,333. There are no data for determining the amount of premium receipts or of losses realized on the same volume of insurance; but the tax was recognized by economists as well as by all parties to the policy contracts as an excessive burden. In many instances it more than doubled the cost of insurance. Its effect in discouraging the prudent custom of insuring against fire was very serious, and after its abolition this custom extended so rapidly that it soon became, and continues, practically universal in Great Britain. Upon the continent of Europe fire insurance is generally taxed quite heavily; most so in France, where the direct duties on the premiums, together with the registry and stamp taxes paid by the companies, have been estimated to add one-fourth, or perhaps one-third, to the cost of insurance.

In the United States the companies are taxed, each by the state in which it is domiciled, upon their real estate, and often upon their capital, surplus of profits, and are required in other states to pay fees to the insurance departments, and commonly an excise of from 1 to 2½% of their premiums. An elaborate table is prepared each year by a committee of the National Board of Fire Underwriters, showing the aggregate amount of taxes paid by the companies operating in New York in comparison with their receipts and profits. The statement received and published by the board in 1900 contained the following:—

	For the Year 1899.	For Twelve Years 1888-1899.
Premiums (fire and marine)	$134,450,639	$1,425,929,631
Losses paid (fire and marine)	91,031,677	856,978,494
Expenses	52,849,129	517,667,238
Increase of liability (unearned premiums, &c.)	8,998,526	59,104,388
Net loss in the last year	18,428,693	..
Net profit in twelve years	..	7,820,489
Amount of taxes paid	4,495,332	35,984,081
Taxes were of premiums	3.34%	2.52%
Taxes were of premiums, less losses	10.35%	6.32%

In qualification of this statement, it may be said that the reported expenses appear to include taxes, and that the additions charged, to liability are to some extent theoretical and flexible. It also appears from the state reports that upon the entire capital and net surplus of $191,000,000 employed in the business in the United States by 316 joint-stock companies, dividends to the amount of $8,000,000, or 4.2%, were paid in 1899 to shareholders. Nevertheless it is true that competition among the companies, together with unfriendly legislation, has reduced the profit upon their aggregate capital near the vanishing point, and that the taxes, the average rate of which increased 50% within the period 1891-1899, are heavier in many states than can be justified by public policy or by the analogy of other corporate interests. The true principle, doubtless, is that while the capital employed in insurance for gain ought to contribute to the state the same share of its profits as other capital, yet the premiums, agencies, policies and entire machinery representing only losses, and providing for their distribution, should be exempted, as far as the necessities of the public treasury permit.

One aspect of the taxation of fire insurance is of especial interest, namely, the very general disposition of legislatures and municipal authorities to impose upon the underwriters the cost of fire departments. The systematic prevention and extinguishment of fires are everywhere assumed to be proper work for the community at large. But the first license granted by the crown to issue insurance policies in London in 1687 was conditioned upon regular contributions by the authorities to support the king’s gunners as a fire brigade, and in the public mind the privilege of insuring the prudent has ever since been vaguely associated with the duty of guarding the property of the whole community. The voluntary support of fire patrols by the companies in London, New York and other cities has done much to promote this view; and a substantial part of the taxes paid upon fire policies in the United States is levied for the support of fire departments, the pay and pensions of firemen and similar purposes. The tendency to increase such taxes, under the pretext that the protection afforded is for the special benefit of the companies, is strong in some of the states; though it would be equally rational to compel life insurance companies to maintain general hospitals for the sick.

Statistics.

The most complete statistics of the fire insurance business collected in any country are those presented in the *United States* to the National Board of Fire Underwriters at each annual meeting. The following summary of part of the information submitted by the committee on statistics, 10th May 1900, giving the amount of fire risks insured in the United States, premiums received for them, and losses paid upon them, by all joint-stock fire insurance companies for the year 1899 will serve as an example:—

Companies.		Fire Risks assumed.	Fire Premiums received.	Fire Losses paid.	Premiums per $100 of Risk.	Loss per $100 of Risk.	Loss per $100 of Premiums.
		$	$	$	$	$	$
American	218	12,251,299,499	93,577,169	59,119,018	.7638	.4826	.6318
Foreign	35	6,087,570,275	42,958,472	29,865,014	.7057	.4906	.6975
All	253	18,338,869,774	136,535,641	88,984,032	.7445	.4852	.6517

These returns do not include mutual companies. The compilers of the *Insurance Year-Book*, however, obtain from the several state departments of insurance the reports of all companies made to them of the business done within each state; and from these it appears that in 1899, for example, 160 mutual companies assumed fire risks to the amount of $1,119,772,848. Many small local associations have made no returns, but their operations are too limited to materially affect the aggregate. It is noteworthy that while mutual companies transact less than 6% of the business of the whole country, yet in the state of Rhode Island, a densely peopled manufacturing community, they have more than 78%, and in Massachusetts nearly 24%; and that, while less than one-ninth of the insured property of the United States is situated in these two states, they contain nearly two-thirds of that which is insured by mutual associations.

The fire insurance business of foreign companies in the United States was comparatively small until 1870. Four strong British corporations were then in the field, and their transactions amounted to less than 9% of the entire joint-stock business. But their success attracted others in rapid succession, especially from Great Britain and from Germany, and in 1880, 19 foreign companies assumed 23.7% of all the risks reported to the National Board; in 1889, 23 such companies took 30.3%; and in 1899, 35 such companies took 33.2%. The distribution of the business among them is not given by the board tables, but can be gathered from the reports of the American branches to the insurance departments of the states, which are summarized in the Spectator Company's Year-Books. The total net payments of the British and colonial fire insurance companies in connexion with the disastrous fire in San Francisco in 1906 amounted to over ten million pounds, and the prompt settlement of all claims strengthened considerably their position in the United States.

In the *United Kingdom* the statistics of fire insurance are less accessible and less complete, no official records being made of the local distribution of the property insured, while the published accounts of the companies are not sufficiently uniform and detailed to make a trustworthy summary of the entire business possible. Much of it is done by foreign companies, of whose British business we have no separate statement. A statement of the revenue accounts of the various British companies insuring against fire will be found in the annual *Insurance Blue Book and Guide*.

In the *Dominion of Canada* the insurance companies make detailed reports to the government bureau, and the statistics of the business are full and accurate. The following table shows the aggregate business of five companies in the Dominion in 1869 and 1907:—

Companies.	Net Cash Premiums received.	Amount of Policies taken.	Amount at Risk in 1869.	Amount at Risk in 1907.	Losses paid.
	$	$	$	$	$
Canadian Companies	54,849,706	5,663,696,931	59,340,916	412,019,532	36,073,543
British Companies	159,372,986	14,745,342,255	115,222,003	937,240,828	105,203,259
American Companies	32,449,482	2,801,078,045	13,796,890	265,401,198	20,129,323
All Companies	246,672,174	23,210,117,231	188,359,809	1,614,661,558	161,406,125

Upon the *continent of Europe* the fire insurance business is conducted partly by local companies in each country and partly by the great international offices of Great Britain and Germany. The local associations in Austria, Germany and Switzerland are of three classes—public assurance organizations connected with local governments, private mutual companies and joint-stock companies. It is impossible to obtain balance-sheets of all, nor is any information available concerning the local distribution of the risks, or the whole amount of property insured. The capital employed by stock corporations in this business in each country, and the aggregate premium receipts and payments for losses in the last year of which a report is available will be found in the annual *Post Magazine Almanack*.

While most of the fire insurance business in the *Australian colonies* is in the hands of British companies, local institutions for the purpose have had a considerable development on the same general lines as in Great Britain and with similar freedom from interference by the governments. But no accounts of the receipts and losses are available, most of the companies conducting a

marine or life insurance business, or both, under the same general management.

Beyond the limits of the great commercial nations, no satisfactory information is accessible concerning the practice of fire insurance. Even in Spain and Portugal there is far less intelligent interest in the subject than in neighbouring countries, and the agencies of foreign companies transact much of the business in the large towns. Six Portuguese companies have maintained themselves for many years, a few of them for nearly a century, and have established agencies in the Spanish islands and in Madeira. For other nations than those mentioned, the only systematic effort to collect the facts is made by the compilers of the *Year-Book*, and the results are extremely meagre. The great British and German corporations are zealous in extending their transactions to the commercial ports everywhere, and local companies are often formed in the British colonies. In addition to those in Canada and Australia some companies in South Africa have become financially important. Small native companies have been successful in establishing their credit in Japan, Brazil, the Argentine Republic, Chile and Peru. A considerable business is done in insuring the property of foreign residents in the Levant, on the coasts of Asia, in South Africa and the Pacific Islands, but mostly by European companies, and as an incident to the more general practice of marine insurance. There are several successful fire companies among the Dutch in Java. The small business in Mexico appears to be wholly in the hands of foreign companies.

IV. Life Insurance

History.

Guesses at the probable length of life for the purpose of valuing or commuting life-estates, leases or annuities were made even by the ancients, and crude estimates of the number of years' purchase such interests are worth occur in Roman law and in many medieval writings. In 1540 the English parliament enacted that an estate for a single life should be valued as a lease of seven years, one for two lives as a lease of fourteen years, and for three lives as a lease of twenty-one years. More than a century later *The Cambridge Tables for renewing of Leases and purchasing Liens*, a standard work in England, with the certificate of Sir Isaac Newton to its accuracy, proposed, as a remedy for the inequity of this fanciful rule, to make the increase for each additional life less by one year, so that, valuing a single life at ten years, two lives shall be reckoned as nineteen years and three lives as twenty-seven years. No distinction of ages was recognized, and the results, tabulated to decimal parts of months, are worthless. Thus the foremost minds of the world had as yet no apprehension of a true method of reasoning on the subject. The first clear insight into the character of the problem appears in *Natural and Political Observations on the Bills of Mortality*, published in 1661 under the name of John Graunt, a haberdasher and train-band captain of London. Graunt recognized the principle of uniformity in large groups of vital and social facts, and actually prepared, from the mortality registers of London, what he calls a "Table showing of one hundred quick conceptions, how many die within six years, how many the next decade, and so for every decade till 76." This was the earliest crude suggestion of a table of mortality, and Graunt's interest in the inquiry was scientific, without definite practical purpose. But a little later the sale of annuities was pressed upon governments as a method of discounting future revenues. In 1671 John de Witt, grand pensionary of Holland, reported to the states general a plan for such sales upon a scientific method, the insight and skill of which, had he possessed proper statistical data, would have anticipated results only reached by later generations. The report, however, was buried in the Dutch archives and forgotten for nearly two centuries. It was unknown in England when, in 1692, the government undertook the sale of annuities. A loan of £1,000,000 was offered, each £100 paid in to purchase a life annuity of £14, without distinction of age. A table accompanied the offer, purporting to show how many of 10,000 persons now living, old and young taken together at random, are likely to die in each year from one to ninety-nine. The purchasers, though without clear understanding of the principle, were instinctively shrewd enough to select healthy young lives for annuitants, and the nation paid enormously for the error. This speculation of the public treasury led the eminent mathematician and astronomer, Dr Edmund Halley, to examine the subject. In 1693 he presented to the Royal Society a study of "The degrees of mortality of mankind." The parish registers of England took no note of age at death, and Halley, perceiving that the average duration of life in large groups of persons can only be determined when ages at death are known, sought in vain a statistical basis for such an inquiry in his own and in many other countries. But it happened that the city of Breslau in Silesia had kept such records, and he succeeded in obtaining the registers for five years, 1687-1691, including 6193 births and 5869 deaths. No census of the city having been taken, Halley made the best estimate he could of the population, and computed how many of a thousand children taken at the age of one year will die in each succeeding year. Arranging the results in three parallel columns, showing in successive lines the age, the number living at that age, and the number of deaths during the year, he formed the first mortality table. The arrangement was itself a discovery, exhibiting at a glance the essential data for valuing life-risks, and suggesting solutions for problems which had puzzled the ablest students. This general form of the mortality table remains in use as the natural and

Halley's Table.

best for such collections of facts. The method of using such a table in calculating the values of life contingencies was also discovered by Dr Halley. He showed that where a payment is to be made at a future date, if a named person be then alive, its present value is the sum which compounded at interest during the interval will amount to that payment multiplied by the fraction representing the probability that the person will survive. These two elements, compound interest and the probability of life or death, are the foundations of the theory of life contingencies.

From Halley's time the progress of the theory has been in three directions: first, in accumulating facts from which averages are deduced, and analysing the data so as to eliminate disturbing influences, that is, in constructing trustworthy tables of mortality; secondly, in extending the inferences from such tables, and multiplying their applications to needs of practical life; and thirdly, in facilitating the calculations which these applications require. But while Halley thus firmly and lastingly drew, in outline, the theory of life contingencies, the numerical results attained by him were grossly imperfect. Forced by the lack of data to assume that the population was stationary, and to rely on a rude estimate of its numbers, he well knew that his conclusions were but provisional. Yet they were far in advance of the general mind of his time. As late as 1694, and even in 1703, parliament substantially re-enacted the old law for valuing leases at seven years for each life. The meagre Breslau Table long remained the only serious attempt to utilize actual observations of mortality for scientific purposes. In 1746 A. de Parcieux (1703-1768), a mathematician of Paris, published an *Essai sur les probabilités de la durée de la vie humaine*, in which he presented mortality tables formed by himself, one from the records of certain Tontine associations, and five others from those of several religious orders in Paris. The Tontine experience table was a much closer approximation to the true course of mortality, as shown by later investigations, than any of its predecessors, and indeed now appears, despite the crude manner in which the materials were treated, to have been more accurate and more trustworthy than the Northampton or even the Carlisle Table of much later date. The essay of de Parcieux was an important source of information to advanced students in France and Germany, but attracted no general or popular interest, nor was it followed up by progressive researches of the same character in continental Europe, while it remained almost unnoticed in England.

Throughout the 18th century the customary treatment of life annuities was as chaotic and fanciful as before, though some writers of eminence, most notably Dr Thomas Simpson of London (1752), treated the theory of the subject with great intelligence, and in 1753 James Dodson of London (great-grandfather of Augustus de Morgan) projected a life insurance company in which the premiums should be accommodated justly to the ages of the insured. But life insurance as a business really began with the Equitable Society of London, founded in 1762. The associates petitioned for a charter, but the law officers of the crown refused it, saying that the scheme depended for success on the truth of certain tables of life and death, "Whereby the Chance of Mortality is attempted to be reduced to a certain standard. This is a mere speculation, never tried in practice." The society was organized as a voluntary association, and began business in 1765. Its premiums were computed from the Breslau Table, with some corrections from the London Bills of Mortality, and were far higher than any now in use. But the managers, in face of actual business, needed more light. Dr Richard Price, a student of the new science of life contingencies, was consulted, and soon devised tests of the society's experience and measures of the financial results, which are in principle those still practised. He also aspired to construct a more accurate table of mortality, and discovered data in certain parish registers of Northampton which promised to represent the average of life in England. From these he formed in 1780 the Northampton Table of Mortality, and computed a new and largely reduced scale of premiums for the society. The historical importance of the Northampton Table lies in the profound impression it made on the general mass of intelligent persons. Although mortality had long been recognized by special inquirers as a promising theme for statistical inquiry, its actual treatment, except in the narrow school founded by Johann Süssmilch in Germany (1746), and in the isolated and almost prophetic work of de Parcieux in France, had been speculative and vague. Demoivre handled it with mathematical acuteness, but framed his scale of mortality (about 1750) on a hypothesis of his own, not on known facts. Out of each group of eighty-six deaths, according to this scale, one dies on the average each year till all are gone; so that x being the present age, the probability of death within a year is always $1/(86-x)$. This conjecture, which, during middle life, served as a rough approximation to the truth, almost as well as some of the early tables of repute, long found remarkable acceptance among men of science. Dr Price's researches first brought to general apprehension the conviction that a large basis of observed facts is the only source of real knowledge. The government of the day felt the influence of the movement. In 1786 Pitt, then chancellor of the exchequer, consulted Dr Price on plans for the conversion of debt, and in 1789 the government first showed knowledge that in granting annuities ages must be distinguished, and that the prospective life at ninety and that at twenty-five are not to be estimated as equal. About 1808 a conversion of 3% into annuities was planned. The Northampton Table was

Northampton Table.

adopted, and Morgan computed rates from it which were used for twenty years. It proved to represent a mortality far in excess of the average, and in 1821 John Finlaison, being made actuary to the debt commissioners, protested against the rates in use. But not until 1828, when the treasury had lost two millions of pounds by selling annuities too cheap, was the law repealed. Finlaison then constructed a new and less wasteful scale for conversions, but singular results followed. At the age of ninety, for instance, £100 would purchase an annuity of £62. Combinations were formed to purchase annuities on the lives of old people selected for their vigour; 675 of these were taken, with a further loss of at least a million to the treasury. The Northampton Table, in fact, like the earlier Breslau Table, was formed without a census, and upon the false assumption that the population was stationary. Dr Price's estimate, founded on the recorded baptisms, was much too low, many of the people being of a sect which rejected infant baptism. His table represents an average life of twenty-four years, whilst subsequent inquiries indicate a true average of about thirty years at that time in the same parishes. The actual mortality in the Equitable Society proved to be less by one-third than that anticipated by the table. The error had consequences of vast moment. The immediate and dazzling prosperity of the societies founding rates on this supposed scientific basis excited the public imagination, stimulated the business exceedingly, and led to many extravagant projects, followed by fluctuations and failures which impaired its healthy growth and usefulness.

In spite of gross defects, the Northampton Table remained for a century by far the most important table of mortality, employed as the basis of calculation by leading companies in Great Britain, and adopted by the courts as practically a part of the common law. Parliament, followed by some state legislatures and many courts in America, even made it the authorized standard for valuing annuity charges and reversionary interests. But in life insurance practice it is now wholly antiquated. Like its most famous successor, the Carlisle Table of Joshua Milne, it rested upon observations of the population of a town. How far this limited and peculiar group represented the nation was still doubtful; no less so how far the rate of mortality among applicants for insurance, accepted by the offices, would correspond with that of the urban citizens or of the whole body. As soon as the companies had sufficient records of their own experience the work began of striving to construct, for business use, tables which should truly express it. This branch of research has ever since been prosecuted with all the resources they could command of industry, practical judgment and mathematical skill; and the successive achievements in it may be accepted as in general the sum and measure of the progress of actuarial science. Now the recognition of an ascertainable uniformity in human mortality has become part of the general stock of thought. But actuarial science, which originated in Great Britain, was long the peculiar and almost exclusive possession of British students, and even till now has been practised most fruitfully in its first home, mainly by the actuaries of life insurance institutions, but with important contributions from other inquirers, especially those in the service of the registrar-general. The most complete storehouse of technical and practical learning on the general theory and on all its applications to life insurance practice is found in the successive volumes of the *Journal of the Institute of Actuaries*. The tables published by the Institute in 1872, founded on the experience to 1863 of twenty companies (see Annuity), still remain the most authoritative expression of the mortality of insured lives, and have largely replaced all earlier standards in the valuations of the British companies, more than three-fourths of which, in their latest returns to the Board of Trade, compute their reinsurance reserves by the $H^{m.}$ and $H^{m.5}$ tables. But for several years a committee of the Institute and of the Scottish Faculty of Actuaries has been engaged in collecting and arranging for investigation the far vaster experience which has now accumulated in the hands of sixty companies, including the records of more than a million policies. The large basis of facts thus obtained will be treated with special reference to different classes of risks, and will throw much light on difficult questions of selection, which have hitherto been treated speculatively, or at least without the conclusive evidence of large averages, and are still more or less in controversy. Some of these will require more detailed notice hereafter.

Recent actuarial progress.

It is only since the middle of the 19th century that actuarial science has rapidly advanced in other countries, chiefly under the stimulus of the extending practice of life insurance. Both in America and upon the continent of Europe the small business transacted by the pioneer companies was largely conducted on empirical and conjectural methods from year to year, English custom being consulted as a guide in fixing premiums. The Gotha Bank, the first institution to insure lives upon business principles in Germany, adopted at its foundation in 1827 a mortality table formed by Charles Babbage upon the basis of the Northampton Table, corrected from cursory notes upon the early experience of the Equitable Society, which had been given by its actuary to a general meeting of its members in 1800. The French companies, and several in Germany of later origin than the Gotha, took as their standard the so-called Table of de Parcieux, previously described; and this table, with modifications dictated by experience, continued until very recently in general use in France. The Seventeen Companies' Table of 1843 was adopted by the Insurance Commissioners of Massachusetts, who in 1859 introduced the methods of state supervision of insurance now generally practised in the United States. This table, though long

superseded in the esteem of actuaries in their ordinary work, is still the standard for official valuations in most states of the union, a fact which has given it undue prominence. The so-called American Table, derived in 1868 from the limited experience of the largest American company during its earliest years, was the first important work of the kind done in America. In view of its narrow basis of facts, it has stood the test of time singularly well, and it is now in wider use than any other for computing the premiums of American companies. Its most marked difference from the standard British tables for insured lives is that it indicates a decidedly lower rate of mortality throughout the period of mature manhood, between the ages of thirty-five and seventy-five, though with a higher rate at the extremes of life; and this peculiarity is also found in American tables deduced from more recent and far larger experience.

Actuarial science has been widely cultivated in the United States of late years, the numbers and zeal of its professional students having kept pace with the extraordinary growth of life insurance. The aggressive activity of the companies has brought the principles of the business home to the popular mind as in no other country, and a large number of periodicals are devoted entirely to the subject. These tendencies have been strengthened by the system of supervision practised by the states, which has also greatly influenced public opinion, directing attention in an extraordinary degree to certain special and technical features, to the neglect of more comprehensive and more useful criticism. In the official work of the state departments the actuary's province appears substantially to begin and end with the valuation of liabilities upon the net premium basis, which is applied with increasing strictness as the sole and final standard of solvency, and the determination by it of the "legal surplus" of each company. But a considerable number of professional actuaries have prosecuted their studies in a scientific spirit, and most of these since 1889 have been associated in the Actuarial Society of America, which has established a high standard of professional competence in its examinations and transactions. The question how far the rate of mortality among insured lives in America is fairly represented by tables drawn from British experience has attracted much inquiry; and many companies have made important contributions to it from their own records, in several instances in the finished form of carefully graduated tables, each with an individual character, but all with some features which distinguish them as a group. By far the most comprehensive effort to establish a standard table for America is that of a committee of actuaries, for which, in 1881, L. W. Meech published the classified experience of thirty offices to the end of 1874, including most of the large companies in the United States, and embracing more than a million policies. The observations collected in this work have furnished materials for many important investigations, but the finished tables have rarely been applied in practice, being drawn from an aggregation of largely incongruous experiences, the influence of each of which upon the general average is indeterminate.

The business of life insurance upon the continent of Europe has given an extraordinary stimulus to actuarial studies. Before 1883 the German companies computed their premiums and reserves by antiquated life tables. The most approved of these, as illustrating the duration of German life, was that prepared by Brune of Berlin in 1837 from the records for seventy years of an annuity society for widows, which practised careful medical selection of the husbands and kept exact mortality registers. In 1883 was published an admirable table founded on the combined experience of twenty-three German companies, which has superseded all other standards for ordinary valuations within the German empire. The French companies generally continued to rely on the tables of de Parcieux, with modifications of their most glaring defects, until a still later date. In 1898 a committee of French actuaries published a new set of tables drawn from the experience of four of the principal offices in France, and these are now accepted as the best basis for life insurance practice by similar companies there. Schools of actuarial science have been opened in both Germany and France, and the professional actuaries of these countries, and of Austria and Belgium, have formed associations for the promotion of their pursuits. Sessions of delegates from the several institutes and societies of actuaries throughout the world meet triennially in general congress in the various capitals. Such sessions do much to broaden and harmonize the scope and aims of the profession.

Rates of mortality.

Elaborate efforts have been made by several governments to employ the machinery of census bureaus for determining the general rate of mortality, and it has been the worthy ambition of able actuaries to devise trustworthy methods of utilizing the census returns for this purpose. The British Statistical Office under Dr William Farr and his successors, and, later, the Swiss Federal Bureau of Statistics have accomplished the best work in this direction, and the series of "English Life Tables," founded on successive decennial censuses, interpreted by the registered deaths during the intervals, are the most useful data now available for the average value of civilized life. But all such general tables are as yet but tentative and provisional. The imperfections of mortuary registries and of census returns are great, and corrections are largely conjectural. Until more complete methods of collecting the facts are practised, the experience of life insurance companies promises to furnish the only mortality tables having claim to authority. It is already becoming evident that the general rate of mortality, and in particular the rate at each age of life, not only differs widely in different communities, but undergoes important changes in successive generations. A multitude of forces are at work in civilized society which must influence the average duration of

life, such as the extension and concentration of many industries, the vast growth of cities, the progress of medical and hygienic science, the increase of wealth, comfort and luxury, the changes in the frequency and destructiveness of war. It is plausibly maintained, on the one hand, that these and other causes have already added some years to the average lifetime of civilized man; and, on the other hand, that their combined effect has been to lessen the sharpness of the struggle for existence, to rescue the weaklings from destruction and enable them to multiply, and so to weaken society at large. The final decision of the question will be found in the gradual modifications of the true table of mortality through successive epochs.

For the purposes of life insurance the future of mortality tables looks to less ambitious problems. The business calls for exact equity in determining the value of all life contingencies, and therefore for the most precise forecast attainable of the dates at which the amounts assured must be paid. Some idea of the historical progress of this inquiry may be gathered from the accompanying table, which epitomizes the general characteristics of a number of typical tables of mortality, showing at ages which are multiples of five years the annual death-rate indicated by each of them. The comparison will be found interesting in many ways, most strikingly, perhaps, as suggesting what is confirmed by a detailed examination of the facts, that insured life on the average in Great Britain is decidedly inferior to that in the United States, but superior to that upon the continent of Europe, and especially in Germany. From a careful investigation of the published experience, Dr McClintock concludes: “It is an ascertained fact that after the first five years of insurance the probability of death,” in Great Britain, “is fully one-fifth greater at any given age than the corresponding probability shown by American experience”; while “the average value of assured life in Germany is as much inferior to that shown in the $H^{m.}$ experience as that in America has been found to be superior.”[1]

Table showing the number of Persons who will die in a year out of 100,000 who have attained the given Age, according to several Tables of Mortality.

Age.	North-ampton.	Carlisle.	Seventeen Offices.	Institute of Actuaries.	Institute of Actuaries.	American Experience.	Thirty American Offices.	Twenty-three German Offices.	Four French Offices.
	1780.	1815.	1843.	$H^{m.}$ 1869.	$H^{m.5}$ 1869.	1868.	1881.	1883.	1895.
10	916	449	676	490	400	749	648	..	364
15	922	619	694	287	325	763	659	..	515
20	1,403	706	729	633	833	780	676	919	690
25	1,575	731	777	663	1,050	806	703	854	628
30	1,710	1,010	842	772	920	843	748	882	698
35	1,870	1,026	929	877	1,000	895	821	999	807
40	2,090	1,300	1,036	1,031	1,132	979	936	1,176	975
45	2,401	1,481	1,221	1,219	1,294	1,116	1,120	1,437	1,236
50	2,835	1,342	1,594	1,595	1,712	1,378	1,417	1,814	1,638
55	3,350	1,792	2,166	2,103	2,219	1,857	1,893	2,506	2,258
60	4,023	3,349	3,034	2,968	3,064	2,669	2,653	3,535	3,213
65	4,902	4,109	4,408	4,343	4,461	4,013	3,864	4,943	4,675
70	6,493	5,164	6,493	6,219	6,284	6,199	5,778	7,276	6,897
75	9,615	9,552	9,556	9,816	9,949	9,437	8,779	10,647	10,241
80	13,433	12,172	14,040	14,465	14,577	14,447	13,407	15,516	15,119
85	22,043	17,528	20,509	20,988	21,010	33,555	20,363	22,211	22,332
90	26,087	26,056	32,373	27,945	28,244	45,455	32,815	32,356	32,225

Problems of selection.

No final explanation has been given, and there is no proof that the average life in America is longer than in England or Germany. Dr McClintock inclines to believe that one potent cause of the great difference in the insured experience is that, while European offices have generally awaited applications, which are commonly prompted by some sense of need for insurance, the custom of American companies is actively to solicit business through agents. On the average, lives which are only induced by persuasion to insure are better than those which voluntarily apply. That this suggestion points out a real and perhaps an important differentiating influence upon groups of risks is not doubted, but the measure of its effects has not yet been determined. The question is one of many which yearly assume more prominence, and which, as a class, are conventionally termed problems of selection. Assuming that the general rate of mortality is precisely known, any deviation from it occurring in a special group of insured lives, as the result of some influence peculiar to that group, is called the effect of selection. If insurance were offered on equal terms to all, the feeble and dying would apply in disproportionate numbers, and the mortality would be excessive. To avoid this danger careful medical examinations are required, excluding risks which appear to be impaired; and this selection by the insurer uniformly reduces the mortality below the general average during the earliest years of insurance. During these years large numbers of the insured withdraw, either from inability or from indisposition to pay their premiums, but the

motive to do so is weakest with lives which have become impaired. The average vitality is lowered by the loss on the whole of a superior class, and the average mortality of those who persist rises. The extent of this influence varies widely with the proportionate number of lapses and the motives which induce them, increasing in a startling degree when lapses multiply in a discredited company, and remaining small, or even at times doubtful, under very favourable conditions; so that the ascertainment of its amount in different circumstances, and for different groups of the insured, is a problem of extreme complication. Its importance is increased by two tendencies which have grown stronger in the practice of recent years: first, to permit at all times the withdrawal by any policyholder of a substantial part of the technical or average reserve upon his assurance, a privilege which legislation and public opinion in the United States have extorted from the companies; and, secondly, the extensive introduction, under competition for public favour, of forms of policies which grant the option, at fixed dates in the future, between withdrawing the entire "accumulations," or technical reserve and surplus, and continuing the insurance. It is well known that at the maturity of these options the motive is strong for impaired lives to remain insured, and that the cash withdrawals are so largely of superior lives that the subsequent rate of mortality is much increased. Other problems in selection arise from varieties in the forms of policies. It is commonly recognized that there are general and marked differences between the mortality experienced upon assurances issued at low and those at high premium rates. Policies for short terms, on which the computed net rates are the lowest, have been found so unprofitable to the insurers that they are rarely granted, and only with a very heavy loading of the tabular value. Upon those insured for life, with annual premiums, there is a large and constant excess of death losses above the endowment assurances, while groups of policies with tontine or cumulative features or reserved bonuses, available only after surviving a term of years, uniformly experience a low mortality.

It is also to be remarked that it is found in general that the average amount of policies matured by death is higher than the average of all policies in force; and some actuaries incline to believe that tables of pecuniary loss might, for practical use, take the place of tables of mortality, since the actual claims are in units of money, not of lives. The vast field of inquiry opened to actuaries by these and many more special questions of selection promises to engross more and more of their attention and labour. The technical methods of reducing and treating the data of mortality have been brought to a high degree of perfection, but the necessity for a better classification of the data themselves, with reference to special groups of lives or policies, differentiated by social or local circumstances, by business methods, by forms of contract, by race or personal characteristics, must assume ever greater prominence. It is conceivable that, at some period hereafter, the practical reliance of the offices will be more upon tables to be computed for such special groups, from select experience, than upon those drawn from vast aggregates without discriminating among their somewhat incongruous divisions.

The mortality tables in common use, however, have been proved by a vast experience to furnish a safe and fairly equitable basis for the business of assuring lives. Assuming that the table shows how many of a large group now assured may be expected to end in each succeeding year, the present value of the claims upon them depends exclusively upon the rate of interest at which funds will accumulate. Exact foresight of this rate being impossible, the insurer must assume a rate which can with certainty be realized. The difficult problem of determining the limits of safety in this assumption attracts the more attention now, because of the recent persistent decline in the average productiveness of invested capital. The actuary is forced to observe that the interest factor in his calculations is much less definitely fixed by known facts than the mortality factor. The longer a contract has to run, the greater the effect of the difference in rate. The value of a payment to be made in thirty years is greater by above one-half with interest taken at 3% than at 4½%, and one to be made in thirty-six years is more than twice as great. Hence the most careful study of the forces determining for long periods the average rate of interest is fundamental in life insurance. The tendency of opinion is to hold that a progressive lowering of interest rates must result from the accumulation of wealth. In support of this belief it is pointed out that from 1872 nearly to the present time there has been a general and somewhat uniform decline in the yield of invested capital, as represented by government stocks, mortgage loans, savings bank deposits and discounts in all commercial nations. The movement has been disguised by wide fluctuations, temporary or local, but has been on the whole world-wide and continuous, when great masses of capital, such as the investments of life companies, are kept in view. The fall has been greatest, too, in countries where rates were formerly highest, suggesting that as the great financial markets of the world become more intimately connected the normal rate of interest assumes a more cosmopolitan character, with an increasing tendency to equality among them. These considerations have had an important influence upon the computations of life insurance companies. In Great Britain, and commonly in continental Europe, the leading offices from the first assumed lower rates of interest than those in America, usually 3½ or 3%; and the reductions in their estimates have as yet been moderate, only thirty-one out of seventy-four British offices having lowered the interest basis in their valuations reported to the Board of

The interest factor.

Trade.

> These returns show that of these companies only twenty-three now compute reserves upon a rate as high as 3½%, while forty-four assume 3% and seven a still lower rate. But in America, when the business first became important 6% was a more frequent rate of investment than 5%, and the laws of New York and of many other states countenanced the confident expectation of a permanent yield of at least 4½%. The rate of 4% adopted by the principal companies, and by the law of Massachusetts from 1861, was regarded as highly conservative. But as early as 1882 one important company began to reserve upon new business at 3%, and since 1895 there has been a gradual change by the leading offices to 3½%, and in a few instances to 3%, as the basis of premiums and of reserves upon new policies. Serious efforts have been made to induce legislation which will gradually establish one of these rates as a test of technical solvency.

There are not wanting, however, indications that the protracted decline in rates of interest in the world's markets may have been checked, and even that a reverse movement has begun. Rates of discount everywhere, interest on government loans except in America, and on mortgage loans in Europe, have on the whole advanced, the minimum average rates having been reached, after twenty-five years of gradual reduction, in 1897. These facts are entirely consistent with the conclusions suggested by the history of the subject. No uniform or secular tendency to reduction in the average rate of interest, which is the index of the average productiveness of capital, not of its amount, can be found to have prevailed. Fluctuations in the average rate are found, quite independent of the local and temporary fluctuations, which are often extreme; and these long tidal waves of change have at times, for generations together, risen and fallen with some approach to periodicity. The prevailing rate has been a little lower on the average in the 19th century than in the 18th, but was lower through the middle decades of the 18th century than through those of the 19th. On the whole, it seems clear that the accumulation of wealth in itself has no necessary tendency to diminish the productiveness of capital; that this productiveness, on the general average, has not materially varied in many generations; but that the promise and expectation of productiveness which prompt the demand for its use depend upon the activity of enterprise, growing out of the prevailing spirit of hope; upon the rapidity with which new inventions are made, industries extended, and floating or loanable capital expended in permanent works. These conditions are subject to fluctuations extending through considerable periods, so that for a number of years the rate may be higher, and then for a similar series of years lower than the normal rate, determined by average productiveness, but always tending to return to this normal rate, as the tide-swept surface of the ocean to its normal level.

> While the excess of the average yield of capital in America, above that of the older nations, is diminished as the facilities of transfer and exchange increase, there is no reason to conclude that it will disappear for generations to come. It seems, therefore, that the general assumption of 3% for the valuation of British offices, and that of 3½% which is becoming the accepted standard for the companies of the United States, should command unquestioned confidence.

Assets and reserve.

The business of life insurance being founded on well-ascertained natural laws, and on principles of finance which in their broad aspect are of the simplest description, there exists no necessity for frequent close scrutiny of the affairs of an insurance office, in so far as the maintenance of a mere standard of solvency is concerned. We have seen that the premiums charged for insurances are based on certain assumptions in regard to (1) the rate of mortality to be experienced, (2) the rate of interest to be earned by the office on its funds, and (3) the proportion of the premiums to be absorbed in expenses and in providing against unforeseen contingencies. If these assumptions are reasonably safe, an insurance office proceeding upon them may be confidently regarded as solvent so long as there is no conspicuously unfavourable deviation from what has been anticipated and provided for, and so long as the funds are not impaired by imprudent investments or otherwise. The ascertainment and division of profits, however, require that the affairs should be looked into periodically; but the fluctuations to which the surplus funds are liable within limited periods of time are generally regarded as furnishing a sufficient reason why such investigations should not take place too frequently. Accordingly in most offices the division of profits takes place only at stated intervals of years—usually five or seven years—when a complete survey is taken of the whole engagements present and future, and of the funds available to meet these. The mode in which the liability of an office under its current policies is estimated requires explanation.

All statistical observations on the duration of human life point to the conclusion that, after the period of extreme youth is past, the death-rate among any given body of persons increases gradually with advancing age. If, therefore, insurance premiums were annually adjusted according to the chances of death corresponding to the current age of the insured, their amount would be at first smaller, but ultimately larger, than the uniform annual payment required to insure a given sum whenever death may occur. This is illustrated by the following figures, calculated from the H^M mortality table at 3% interest. In column 2 is the uniform annual premium at age thirty for a whole-term insurance of £100. In column 3 are shown the premiums

which would be required at the successive ages stated in column 1 to insure £100 in the event of death taking place within a year. Column 4 shows the differences between the figures in column 2 and those in column 3.

From this table it appears that if a number of persons effect, at the age of thirty, whole-term insurances on their lives by annual premiums which are to remain of uniform amount during the subsistence of the insurances, each of them pays for the first year £1.130 more than is required for the risk of that year. The second year the premiums are each £1.111 in excess of that year's risk. The third year the excess Is only £1.093, and so it diminishes from year to year. By the time the individuals who survive have reached the age of fifty-four, their uniform annual premiums are no longer sufficient for the risk of the following year; and this annual deficiency goes on increasing until at the extreme age in the table it amounts to £95.207, the difference between the uniform annual premium (£1.880) and the present value (£97.087) of £100 certain to be paid at the end of a year. Now, since the uniform annual premiums are just sufficient to provide for the ultimate payment of the sums insured, it is obvious that the deficiencies of later years must be made up by the excess of the earlier payments; and, in order that the insurance office may be in a position to meet its engagements, these surplus payments must be kept in hand and accumulated at interest until they are required for the purpose indicated. It is, in effect, the accumulated excess here spoken of which constitutes the measure of the company's liability under its policies, or the sum which it ought to have in hand to be able to meet its engagements. In the individual case this sum is usually called the "reserve value" of a policy.

Age, $30 + n$. (1)	$P_{30\cdot}$ (2)	$\|1A_{30+n\cdot}$ (3)	$P_{30-}\|1A_{30+n\cdot}$ (4)
30	£1.880	£.750	+£1.130
31	1.880	.769	+ 1.111
32	1.880	.787	+ 1.093
..	..	..	..
..	..	..	..
..	..	..	..
53	1.880	1.806	+ .074
54	1.880	1.916	− .036
55	1.880	2.042	− .162
..	..	..	..
..	..	..	..
..	..	..	..
95	1.880	61.848	−59.968
96	1.880	79.265	−77.385
97	1.880	97.087	−95.207

In another view the reserve value of a policy is the difference between the present value of the engagement undertaken by the office and the present value of the premiums to be paid in future by the insured. This view may be regarded as the counterpart of the other. For practical purposes it is to be preferred as it is independent of the variations of past experience, and requires only that a rate of mortality and a rate of interest be assumed for the future.

According to it, the reserve value (${}_nV_x$) of a policy for the sum of 1, effected at age x, and which has been in force for n years—the (n + 1)th premium being just due and unpaid—may be expressed thus, in symbols with which we have already become familiar.

$$ {}_nV_x = A_{x+n} - P_x(1 + a_{x+n}) \qquad (1). $$

If we substitute for A_{x+n} its equivalent $P_{x+n}(1 + a_{x+n})$ this expression becomes

$$ {}_nV_x = (P_{x+n} - P_x)\ (1 + a_{x+n}) \qquad (2); $$

whence we see that the sum to be reserved under a policy after any number of years arises from the difference between the premium actually payable and the premium which would be required to assure the life afresh at the increased age attained. By substituting for P_{x+n} and P_x their equivalents $1/(1 + a_{x+n}) - (1 - v)$ and $1/(1 + a_x) - (1 - v)$, we obtain another useful form of the expression,

$$ V_x = 1 - \frac{1 + a_{x+n}}{1 + a_x} \qquad (3). $$

$$ = \frac{a_x - a_{x+n}}{1 + a_x} \qquad (4). $$

The preceding formulae indicate clearly the nature of the calculations by which an insurance office is able to ascertain the amount of funds which ought to be kept in hand to provide for the liabilities to the assured. In cases other than whole-term insurances by uniform annual

Net liability. premiums, the formulae are subject to appropriate modifications. When there are bonus additions to the sums insured, the value of these must be added, so that by the foregoing formula (1), for example, the value of a policy for 1 with bonus additions B is $(1 + B)A_{x+n} - P(1 + a_{x+n})$. But the general principles of calculation are the same in all cases. The present value of the whole sums undertaken to be paid by the office is ascertained on the one hand, and on the other hand the present value of the premiums to be received in future from the insured. The difference between these (due provision being made for expenses and contingencies, as afterwards explained) represents the "net liability" of the office. Otherwise the net liability is arrived at by calculating separately the value of each policy by an adaptation of one or other of the above formulae. In either case, an adjustment of the annuity-values is made, in order to adapt these to the actual conditions of a valuation, when the next premiums on the various policies are not actually due, but are to become due at various intervals throughout the succeeding year.

Provision for expenses, &c. Net-premium method. So far in regard to the provision for payment of the sums contained in the policies, with their additions. We now come to the provision for future expenses, and for contingencies not embraced in the ordinary calculations. In what is called the "net-premium" method of valuation, this provision is made by throwing off the whole "loading" in estimating the value of the premiums to be received. That is to say, the premiums valued, in order to be set off against the value of the sums engaged to be paid by the office, are not the whole premiums actually receivable, but the net or pure premiums derived from the table employed in the valuation. The practical effect of this is that the amount brought out as the net liability of the office is sufficient, together with the net-premium portion of its future receipts from policyholders, to meet the sums assured under its policies as they mature, thus leaving free the remaining portion —the margin or loading—of each year's premium income to meet expenses and any extra demands. When the margin thus left proves more than sufficient for those purposes, as under ordinary circumstances it always ought to do, the excess falls year by year into the surplus funds of the office, to be dealt with as profit at the next periodical investigation.

Negative values. There appears to be a decided preference among insurance companies for the net-premium method as that which on the whole is best suited for valuing the liabilities of an office transacting a profitable business at a moderate rate of expense, and making investigations with a view to ascertaining the amount of surplus divisible among its constituents. In certain circumstances it may be advisable to depart from a strict application of the characteristic feature of that method, but it must always be borne in mind that any encroachment made upon the "margin" in valuing the premiums is, so far, an anticipation of future profits. Any such encroachment is indeed inadmissible, unless the margin is at least more than sufficient to provide for future expenses, and in any case care must be taken to guard against what are called "negative values." These arise when the valuation of the future premiums is greater than the valuation of the sums engaged to be paid by the office, or when in the expression $(P_{x+n} - P_x)(1 + a_{x+n})$ the value of P_x is increased so as to be greater than that of P_{x+n}. It is evident that any valuation which includes "negative values" must be misleading as policies are thereby treated as assets instead of liabilities, and such fictitious assets may at any time be cut off by the assured electing to drop their policies.

In recognition of the fact that a large proportion of the first year's premiums is in most offices absorbed by the expense of obtaining new business, it has been proposed by some actuaries to treat the first premium in each case as applicable entirely to the risk and expenses of the first year. At a period of valuation the policies are to be dealt with as if effected a year after their actual date, and at the increased age then attained.

Hypothetical method. Another modification of the net-premium method has been advocated for valuing policies entitled to bonus additions. It consists in estimating the value of *future* bonuses (at an assumed rate) in addition to that of the sum assured and *existing* bonuses, and valuing on the other hand so much of the office premiums as would have been required to provide the sum assured and bonuses at the time of effecting the insurance. This tends to secure, to some extent, the maintenance of a tolerably steady rate of bonus.

An essentially different method is employed by some offices, and is not without the support of actuaries whose judgment is entitled to every respect. It has been called the "hypothetical method." By it the office premiums are made the basis of valuation. Hypothetical annuity-values, smaller than those which would be employed in the net-premium method, are deduced from the office premiums by means of the relation $P' = 1/(1 + a') - (1 - v)$ and the policies are valued according to the formula

$$ {}_nV'_x = (P'_{x+n} - P'_x)(1 + a'_{x+n}), $$

where P'_x and P'_{x+n} are the office premiums at ages x and x+n respectively, and a'_{x+n} is the hypothetical annuity-value at the latter age. Mr Sprague has shown (*Ass. Mag.* xi. 90) that the policy-values obtained by this method will be greater or less than, or equal to, those of the net-

premium method according as the “loading” is a constant percentage of the net premium or an equal addition to it at all ages, or of an intermediate character, its elements being so adjusted as to balance each other.

When the net-premium method is employed, it is important that the office premiums be not altogether left out of view, otherwise an imperfect idea will be formed as to the results of the valuation. Suppose two offices, in circumstances as nearly as possible similar, estimate their liabilities by the net-premium method upon the same data, but office A charges premiums which contain a margin of 20% above the net premiums, and office B charges premiums with a margin of 30%. Then, in so far as regards their net liabilities (always supposing the sum set aside in each case to be that required by the valuation), the reserves of those offices will be of equal strength, and if nothing further were taken into account they might be supposed to stand in the same financial position. But it is obvious that office B, which has a margin of income 50% greater than that of office A, is so much better able to bear any unusual strain in addition to the ordinary expenditure, and is likely to realize a larger surplus on its transactions. Hence it appears that in order to obtain an adequate view of the financial position of any office it is necessary to consider, not only the basis upon which its reserves are calculated, but also the proportion of “loading” or “margin” contained in its premiums, and set aside for future expenses and profits.

Valuations may be made on different data as to mortality and interest, and the resulting net liability will be greater or less according to the nature of these. Under any given table of mortality a valuation at a low rate of interest will produce a larger net liability—will require a higher reserve to be made by the office against its future engagements to the insured—than a valuation at a higher rate. The effect of different assumptions in regard to the rates of mortality cannot be expressed in similar terms. A table of mortality showing a high death-rate, and requiring consequently large assurance premiums, does not necessarily produce large reserve values. The contrary, indeed, may be the case, as with the Northampton Table, which requires larger premiums than the more modern tables, but gives on the whole smaller reserve values. The amount of the net liability depends, not on the absolute magnitude of the rates of mortality indicated by the table, but on the ratio in which these increase from age to age.

Effects of different data.

If the values deduced by the net-premium method from any two tables be compared, it will be seen that

$$V'_x >, =, \text{or} < {}_nV_x$$

according as

$$1 - \frac{1 + a'_{x+n}}{1 + a'_x} >, =, \text{or} < 1 - \frac{1 + a_{x+n}}{1 + a_x}$$

i.e. as

$$\frac{1 + a_{x+n}}{1 + a_x} >, =, \text{or} < \frac{1 + a'_{x+n}}{1 + a'_x} \qquad (1),$$

or as

$$\frac{1 + a'_x}{1 + a_x} >, =, \text{or} < \frac{1 + a'_{x+n}}{1 + a_{x+n}} \qquad (2);$$

where the accented symbols throughout refer to one table and the unaccented symbols to the other.

We have thus the means of ascertaining whether the policy-values of any table will be greater or less than, or equal to, those of another, either (1) by calculating for each table separately the ratios of the annuity-values at successive ages, and comparing the results, or (2) by calculating at successive ages the ratios of the annuity-values of one table to those of another, and observing whether these ratios decrease or increase with advancing age or remain stationary throughout. The above relations will subsist whatever may be the differences in the data employed, and whether or not the annuity-values by the different tables are calculated at the same rate of interest. When the same rate of interest is employed, any divergence in the ratios of the annuity-values will of necessity be due to differences in the rates of mortality.

A prevailing fallacy in the popular mind, which has grown out of the practice of net valuations, is the inference that the average technical reserve represents the value of the individual policy. Each risk is properly assumed at its probable or average value at the time. But from that moment its circumstances are constantly changing in directions then unforeseen, and the expectation that such changes will occur is the motive for insuring. To treat them singly as unchanged in value at any later time is as illogical as it would be after some have matured. The actual value of any one risk borne by a company is indeterminate. It may become a claim to-morrow, or not for a generation to come. In the former case the company must now hold funds to pay in full; in the

Fallacy of single-policy reserve.

latter, the future premiums will perhaps more than suffice, so that no present reserve is needed. An entire reserve for the whole body of risks is essential, and its amount is definite, upon the reasonable assumption that the general average remains undisturbed by individual changes. A distinct reserve for a single policy is inconceivable. To recognize it is to deny the first principle of insurance. The average amount by which the reserve of a company must be increased, because of the existence of policies of a given class, is to the actuary an important fact, and is commonly accepted as his best guide in the distribution of surplus. But a popular theory has seized upon the assignment of this average sum to each policy, in the technical shorthand of the actuary, and holds that it is in each case the special property of the owner of that policy. The practical consequences are serious when, as often, many of the insured cease to pay premiums, and each demands the amount of the supposed individual reserve. His right to claim it is countenanced by a widespread public opinion, which has inspired statutes in Massachusetts and some other states, requiring companies to redeem all policies lapsing after the first two or three years of insurance at a price founded on the technical reserve. Yet, in by far the majority of instances, the lapse of policies is of itself a loss to the company. It is deprived of business secured at much expense before it has derived any of the advantage expected from the accession. It is compelled to pay numbers of its profitable contributors for ceasing to contribute. The burden falls in a mutual company upon the insured who fulfil their contracts. Such laws favour those who withdraw after few payments at the cost of those who maintain their insurance to the end, or for many years. The American companies formerly yielded to the pressure of a mistaken public sentiment, and competed for favour by promising excessive values in case of surrender.[2] Similar conditions exist in Switzerland, Austria, and other countries in which the business is minutely regulated by government bureaus. But in Great Britain the companies are largely free from such influences, while an open market exists for policies which have a commercial value, with results on the whole more satisfactory to all parties interested than any rule of compulsory purchase which could be enforced on the companies.

Industrial Insurance.

A special form of life insurance, which has wonderfully developed, is the family insurance of the labouring people by the so-called industrial companies. Until recently this class of people had no satisfactory share in the benefits of insurance, although the friendly societies in Great Britain, and many forms of beneficial associations in the United States, were attempts, often in part successful, to provide for special wants, mainly for maintenance of the sick and for the costs of burial. Most of them, however, lacked a scientific basis and an efficient and permanent organization, while thousands of them were grossly mismanaged. In Germany an elaborate scheme of compulsory insurance for labourers was established by a law of the empire in 1883, and extended in subsequent years; and similar legislation has been enacted in several other countries, most thoroughly in Switzerland and Austria. The ultimate value of this great social experiment cannot yet be determined. That it relieves much want and does a great service in preventing pauperism is not disputed; but that it also undermines the independent spirit of the people, and that it imposes a burden upon the national industry, which not only hampers it in the world’s competition, but reacts with special injury upon the class it aims to benefit, are criticisms not satisfactorily answered. No scheme of government insurance, certainly, is adapted to a people impatient of paternalism in its rulers and thoroughly habituated to voluntary association for all common interests. The solution of the great problem, how to apply the insurance principle to the most pressing needs for protection of the class supported by the wages of labour, is now sought in Great Britain and America mainly in the universal offer to them of industrial insurance. The Prudential Assurance Company of London was the pioneer in this work, beginning it experimentally in 1848, but gradually adapting its methods to the new field, until a generation later they showed themselves so efficient that an extraordinary growth resulted, and has continued without interruption. This company and others upon a similar plan insure whole households together for burial expenses in case of death, and a small provision for dependants or for old age, charging as premiums small fractions of a day’s wages, which must be collected weekly. The great difficulties encountered were the cost of small and frequent collections, and the high rate of mortality, which is from 40 to 90% more than that in the experience of the older companies. This high death-rate is due not so much to the fact that life is shorter in the labouring class as to the lack of efficient medical selection, which would be too costly. The premiums, at best, must be made higher than in offices insuring for annual payments, but the demand for insurance extended as rapidly as the system could be explained, and the Prudential is said to have now in force some 12,000,000 policies, with an average premium of twopence a week, secured by an accumulated insurance fund of £17,000,000. It has superseded a host of petty assessment societies of various classes without scientific basis or business responsibility, which deluded and disappointed the poor. The British government in 1864 undertook to administer a plan for the insurance of working men, but in thirty years accomplished less than the work of one private company in a year. In addition to the many insurance companies which transact industrial business in the United Kingdom, a large number of friendly societies have adopted similar plans.

The system of industrial insurance was introduced into the United States in 1876. Its growth, though much more rapid than in Great Britain, was at first slow compared with that of later years. The following table, condensed from the Insurance Year-Book for 1900, is an interesting exhibit of the character as well as of the extent of this form of insurance among working men:—

Industrial Insurance in the United States.

Year.	No. of Cos.	Insurance written.	Policies in force 31st December.	Insurance in force 31st December.	Premiums received.	Losses paid.
1876	1	$400,000	2,500	$248,342	$14,495	$1,958
1880	3	34,212,131	228,357	19,590,780	1,155,360	430,631
1884	3	89,150,302	1,076,422	108,451,099	4,486,612	1,499,432
1888	7	161,260,335	2,788,000	302,033,066	11,939,540	4,162,745
1892	11	276,893,923	5,118,897	582,710,309	24,352,900	8,847,322
1896	11	360,852,458	7,375,688	886,484,869	40,058,701	13,420,336
1899	16	519,789,085	10,048,625	1,292,805,402	56,159,889	17,023,485

It is remarkable that the average weekly premium in the United States appears to be about 10 cents, or two and a half times as high as in Great Britain. The average policy is also proportionally larger, and the progressive increase in its amount deserves notice. At the rate at which the practice of insurance is extending among working men, it would require but few years for it to become as universal in these countries as any paternal government has aimed to make it by compulsion.

Division of surplus.

There are various sources from which a surplus of funds may arise in an insurance company: (1) from the rate of interest actually earned being higher than that anticipated in the calculations; (2) from the death-rate among the insured being lower than that provided for by the mortality tables; (3) from the expenses and contingent outlay being less than the "loading" provided to meet them; and (4) from miscellaneous sources, such as profitable investments, the cancelment of policies, &c.

Supposing a valuation to have been made on sound data and by a proper method, and to have resulted in showing that the funds in hand exceed the liabilities, the surplus thus ascertained may be regarded as *profit*, and either its amount may be withdrawn from the assets of the office or the liabilities may be increased in a corresponding degree.

Bonuses.

Various methods are employed by insurance companies in distributing their surplus funds among the insured. In some offices the share or "bonus" falling to each policyholder is paid to him in cash; in others it is applied in providing a reversionary sum which is added to the amount assured by the policy; in others it goes to reduce the annual contributions payable by the policyholder. A method of more recent introduction is to apply the earlier bonuses on a policy to limit the term for which premiums may be payable, thus relieving the policyholder of his annual payments after a certain period. Another method is to apply the bonuses towards making the sum insured payable in the lifetime of the policyholder. The plan of reversionary bonus additions is most common, and when it is followed the option is usually given of exchanging the bonuses for their value in cash or of having them applied in the reduction of premiums.

Not only are there different modes of applying surplus, but the basis on which it is divided among the insured also varies in different offices. In some the reversionary bonus is calculated as an equal percentage per annum of the sum insured, reckoning back either to the commencement of the policy in every case, or (more commonly) to the preceding division of profits. In others the rate is calculated, not only on the original sums insured, but also on previous bonus additions. In others the ratio of distribution is applied to the cash surplus, and the share allotted to each policy is dealt with in one or other of the ways above indicated. The following are some of the ratios employed by different offices in the allocation of profits: (1) in proportion to the amount of premiums paid (with or without accumulated interest) since the last preceding valuation; (2) in proportion to the accumulated "loading" of the premiums so paid; (3) in proportion to the reserve values of the policies; (4) in proportion to the difference between the accumulated premiums and the reserve value of the policy in each case.

Some offices have a special system of dealing with surplus, reserving it for those policyholders who survive the ordinary "expectation of life," or whose premiums paid, with accumulated interest, amount to the sums insured by their policies. This system is usually connected with specially low rates of premium.

In the United States the so-called "contribution plan" has been accepted in theory by many

companies, though carried out with many variations in detail by different actuaries. The principle is, that since each of the insured is charged in his premium a safe margin above all probable outlays, when the necessary amount under each head becomes determinate the several excesses should be returned to him. It is therefore sought to calculate what each member would have been charged for net premium and loading had the mortality, rate of interest, and expenses been precisely known beforehand, and to credit him with the balance of his payments. As a corollary of the theory of net valuations, which regards every life insured as an average life until its end, and assumes the rigid accuracy and equity of all the formulas employed to represent business facts, it is consistent and complete. But many minds find it more curious than practical, and prefer to seek equity in faithfulness to contract rights rather than in adjustments which they deem too refined, if not fanciful. The plan has met with little favour in England, where surplus is more commonly distributed on general business principles. Enormous bonuses were saved by the British offices out of the excessive premiums at first collected, and by the American companies during the epoch of high interest rates. But the use of more accurate tables, the decline in interest, and the increased expenses of later years, have vastly reduced the apparent profits. Former methods of distributing surplus, when ascertained, have largely given way in America to novel and more complex plans. The Tontine idea, historically familiar, was for many years imitated by some offices in their insurance contracts. All premiums above outlay, in a company or a class of policies, were accumulated, only stipulated amounts being paid on death claims meanwhile maturing, with no compensation to its members withdrawing, until the end of a fixed term, when the whole fund was apportioned to the survivors. Large returns were sometimes made, but many who could not maintain their policies were dissatisfied. “Semi-tontines” followed, partly meeting the difficulty by pooling only the surplus, and allowing some return in case of withdrawal. But these cruder forms of contract are now largely superseded by various “reserve-dividend,” “accumulation,” “bond,” and “investment” policies, with options at stated periods between cash withdrawals and continued insurance, the simple inducement to provide against death being more or less merged in that of making a profitable investment of capital.

Surrender values.

In those branches of insurance where the contract is one of indemnity against loss, the risk remaining the same from year to year—and where the consent of both parties, insurer and insured, is required at each periodical renewal—no question of allowance in respect of past payments can arise when one party or the other determines to drop the contract. It is quite recognized that the premiums are simply an equivalent for the risk undertaken during the period to which they apply, with a certain margin for expenses and for profit to the insurer, and that therefore a favourable issue of the particular contract supplies no argument for a return of any part of the sums paid. In life insurance, however, we have shown that the premiums contain a third element, namely, the portion that is set aside and accumulated to meet the risk of the insurance when the premium payable is no longer sufficient of itself for that purpose.

When a policyholder withdraws from his contract with a life insurance office, the provision made for the future in respect of his particular insurance is no longer required, and out of it a surrender value may be allowed him for giving up his right to the policy. If there were no reasons to the contrary, the office might hand over the whole of this provision, which is in fact the reserve value of the policy. No more could be given without encroaching upon the provision necessary for the remaining policies. But the policyholder in withdrawing is exercising a power which circumstances give to him only and not to the other party in the contract. The office is bound by the policy so long as the premiums are duly paid and the other conditions of insurance are not infringed. It has no opportunity of reviewing its position and withdrawing from the bargain should that appear likely to be a losing one. The policyholder, however, is free to continue or to drop the insurance as he pleases, and it may fairly be presumed that he will take whichever course will best serve his own interest. The tendency obviously is that policies on deteriorated and unhealthy lives are kept in force, while those on lives having good prospects of longevity are more readily given up. Again, the retiring policyholder, by withdrawing his annual contribution, not only diminishes the fund from which expenses are met, but lessens the area over which these are spread, and so increases the burden for those who remain. Considerations like these point to the conclusion that, in fairness to the remaining constituents of the office, the surrender value to be allowed for a policy which is to be given up should be less than the reserve value. The common practice is to allow a proportion only of the reserve value. Some offices have adopted the plan of allowing a specified proportion of the amount of premiums paid. This plan is not defended on any ground of principle, but is followed for its simplicity and as a concession to a popular demand for fixed surrender values.

Non-forfeiture system.

Another mode of securing to retiring policyholders the benefit of the reserve values of their insurances is that known as the *non-forfeiture system*. This system was first introduced in America, whence it found its way to the United Kingdom, where it was gradually adopted by a large proportion of the insurance companies. In its original form it was known as the “ten years non-forfeiture plan.” The policies were effected by premiums payable during ten years only, the rates being of course correspondingly high. If during those ten years the policyholder wished to

discontinue his payments, he was entitled to a free “paid-up policy” for as many tenth parts of the original sum insured as he had paid premiums. The system, once introduced, was gradually extended first to insurances effected by premiums payable during longer fixed periods, and ultimately, by some offices, to insurances bearing annual premiums during the whole of life. The methods of fixing the amount of paid-up policy in the last-mentioned class of cases vary in different offices, but the principle underlying them all is that of applying the reserve value to the purchase of a new insurance of reduced amount.

Conditions of insurance.

An office, in entering on a contract of life insurance, does so in the faith that all circumstances material to be known in order to a proper estimate of the risk have been disclosed. These circumstances are beyond its own knowledge, and as the office for the most part (except as regards the result of the medical examination, which may reveal features of the case unknown to the proposer himself) is dependent on the information furnished by the party seeking to effect the insurance, it is proper that the latter be made responsible for the correctness of such information. Accordingly it is made a stipulation, preliminary to the issue of every policy, that all the required information bearing upon the risk shall have been truly and fairly stated, and that in case of any misrepresentation, or any concealment of material facts, the insurance shall be forfeited. In practice, however, this forfeiture is rarely insisted on unless there has been an evident intention to deceive. Other systems and conditions of life insurance policies may be shortly noticed.

The usual division of policies is into “non-participating” and “participating.” Non-participating policies are contracts for the payment on death of a certain fixed sum in consideration of a given premium, and these amounts are not affected by the profit made by the company. Participating policies entitle the holders to a share in the profits of the company. These profits are applied in various ways, as described above. A policy may be a whole life one, that is, the policyholder may pay a periodical premium throughout life, or it may be a limited payment one (the holder paying a premium for a limited number of years), or an endowment policy, under which the insurer receives the amount he has insured for at a given age, say fifty-five or sixty; or if death occur previously, the sum is paid to his representatives. There are also endowment policies for children, under which parents or others receive a specified sum on a child attaining a given age, the premiums being returnable if the child dies before the specified age.

As to Payment of Premiums.—A certain period of grace is allowed, most commonly thirty days, after each premium falls due. If payment is not made within that time, the presumption is that the policyholder intends to drop the contract, and the risk of the office comes to an end. It may, however, be revived on certain conditions, usually the production of evidence of health and payment of a fine in addition to the premium. An impression used to prevail among the public that the offices were interested in encouraging the forfeiture of policies. If any such impression was ever shared by the offices themselves it must have long since passed away, every reasonable effort being now made on their part, not only to secure insurances but to retain them, and to afford all the facilities that can be extended to policyholders with that object.

As to Foreign Travel and Residence, and as to Hazardous Occupations.—When Babbage wrote his *Comparative View of Assurance Institutions* in 1826, voyaging abroad was scarcely permitted under a British life policy. The Elbe and the Garonne, Texel and Havre, Texel and Brest, the Elbe and Brest were the limits prescribed by most of the English offices. Even at a much later period the extra premiums charged for leave to travel or reside abroad were very heavy. But improved means of conveyance—in some places better sanitary appliances, and habits of living more suited to the climatic conditions—and, more than all perhaps, the knowledge that has been gained by experience as to the extent of the extra risks involved and the relative salubrity of foreign climates—have enabled the offices to modify their terms very considerably. The limits of free residence and travel have been greatly widened, and where extra premiums are still required these are, as a rule, much lower than formerly. The assured are now commonly permitted to reside anywhere within such limits as north of 35° N. lat. (except in Asia) or south of 30° S. lat., and to travel to and from any places within those limits, without extra premium.

Military men (when on active service) and seafaring men are usually charged extra rates, as are also persons following specially dangerous or unhealthy occupations at home.

As to Suicide.—The policies of most companies used to contain a proviso that the insurance shall be void in case the person whose life is insured dies by his own hand, but it is now seldom inserted. Some offices, acting on a sound principle, limit its operation to a fixed period, the extent of which varies in different offices from six months to seven years from the date of issue of the policy.

The practice of rendering policies *indisputable* and free from restriction as to foreign travel or residence, after a certain period, has tended greatly to simplify the contract between the office and the insured. A declaration of indisputability covers any inaccuracies in the original documents on which a policy was granted, unless these inaccuracies amount to fraud, which the law will not condone under any circumstances.

A remarkable difference in the development of life insurance between Great Britain and the

United States is, that among the British companies only one-third of the insurances in force is in purely mutual institutions, while in America the proportion exceeds four-fifths. In both countries there are also “mixed” companies, in which policyholders receive a fixed percentage of the realized surplus, often from three-fourths to nine-tenths of the whole, but the control and management are in the hands of shareholders. These form the great majority of the proprietary offices in the United Kingdom, and the profits of the business have been large. The amount of capital paid in by shareholders of forty-one joint-stock companies was £5,931,000, but the capital authorized and subscribed was much more, and the subscriptions have often been paid, wholly or in part, by credits from surplus. The shares of these companies, at market prices, represent a value of at least £50,000,000, but the dividends upon these shares are drawn largely from other business, many of the largest and most prosperous corporations conducting also fire insurance, and some of them marine or casualty insurance.

No branch of social statistics has been more diligently studied than life insurance, and several governments publish classified accounts of corporations insuring lives within their jurisdiction. But the reports are not uniform in method and in periods covered, and aggregates derived from them must be used with reserve. By the Life Assurance Companies Act 1870, and amendments made in later years, each company issuing policies in the United Kingdom must deposit with the Board of Trade every year its revenue account and balance-sheet for the preceding year, and must at fixed intervals cause an investigation of its financial condition to be made by an actuary, and furnish the public through the Board of Trade with the detailed results, in forms prescribed by the act. Thus these returns are the highest authority for the conditions and operations of the offices, which often supplement or anticipate them by voluntary publications. In the United States the laws exact still more minute and much prompter reports to the insurance departments of the states; and every annual statement is required to show the results of an actuarial investigation. All these facts are collected, classified and compared by statisticians for several standard annuals in both countries, especially the *Post Magazine Almanack*, *Bourne’s Directory* and *Manual* and the *Insurance Blue Book* in London, and *The Insurance Year-Book* of the Spectator Company in New York.

The reports of the insurance department of New York cover more companies than those of any other state. The institutions not included in them are about thirty-five in number, mostly small and local. The New York reports represent very nearly 95% of the entire business of the United States. While the amount of life assurance done by British and other foreign offices in the United States is insignificant, fourteen companies of the United States have agencies in Canada (ten for new business), and four transact business in Europe and in other parts of the world. The home business of the American companies is in the aggregate about 87½% of the whole.

In the principal countries of continental Europe life assurance is offered by the chief international institutions of Great Britain and the United States, and their policies are in force probably to the aggregate amount of £140,000,000. The domestic companies have been stimulated to increased activity by the aggressive canvassing of the foreign agencies, and the business in recent years has grown rapidly, until now the total sum insured upon lives on the continent of Europe is little less than a milliard of pounds sterling. Much information about life assurance in the different countries of Europe will be found in Ehrenzweig’s *Assekuranzjahrbuch* (Vienna).

(C. T. L.; T. A. I.)

V. British Post Office Insurance

In 1864 Mr Gladstone, then chancellor of the exchequer, advocated the extension of life insurance amongst persons of small means, and, encouraged by the remarkable success of the Post Office Savings Bank, then recently established, proposed that the services of the postmaster-general should be enlisted in the promotion of insurance. The result was the passing of the Government Annuities Act 1864. This act authorized the commissioners for the reduction of the national debt, for the first time, to insure a life without granting an annuity upon it, and enabled the postmaster-general to act as the agent of the commissioners in the issue of life policies and the grant of annuities. The limits of insurance were fixed at £20 and £100, and of annuities at £4 and £50; and the purchase of deferred annuities or old-age pay, by monthly, or even more frequent instalments, was sanctioned. The work was eagerly accepted by Lord Stanley of Alderley, the postmaster-general of the day, and the machinery for putting the act in action was elaborated by Frank Ives Scudamore of the Post Office and Sir Alexander Spearman of the National Debt office. The business was commenced on the 17th of April 1865. By the end of the year 560 policies of insurance had been issued, and 94 immediate and 54 deferred annuities granted. In the first twelve months these figures had increased to 809 policies and 230 annuities. The opportunity thus given of insuring through the Post Office with government security was not, however, embraced with the warmth which had been anticipated. In 1882, when Mr Henry Fawcett, then in office, examined the subject, he found that the average number of policies of insurance granted annually during the seventeen years which had elapsed was under 400—less, in fact, than during the first twelve months of the system. The purchase of

annuities had increased slightly, but the business was transacted chiefly in immediate annuities, and hardly indicated any progress in provision for old age by means of early savings. Mr Fawcett procured a Select Committee of the House of Commons on the subject. Before this committee Mr James Cardin, then assistant receiver and accountant-general of the Post Office, propounded a scheme for combining the annuity and insurance business of the Post Office with that of the savings bank. The Committee recommended the adoption of this scheme, together with some enlargement of range and some relaxation of conditions. The recommendations of the Committee were embodied in the Government Annuities Act 1882, which came into operation on the 3rd of June 1884, and which forms the basis of the present system.

Any person between 14 and 65 can now insure through the medium of the Post Office Savings Bank for any amount from £5 to £100; and the life of a young person between 8 and 14 can be insured for £5. Through the same channel can be purchased annuities, immediate or deferred, from £1 to £100, on the life of any person from 5 years old upwards. Old-age policies, that is, policies securing payment of a specific sum either at the expiration of a fixed period (varying from 10 to 40 years), or upon the attainment of a certain age, or sooner in case of death, can also be obtained. Policies for a fixed period can only be purchased by a single payment, but in all other cases the purchase can be effected by payment either of a lump sum or of annual instalments. Further, all purchases are effected through the Post Office Savings Bank. As soon as a contract is completed, the purchaser is required to pay the first instalment to his account in the bank, or, if he has no account already, to open an account for the purpose. This and all further instalments are then transferred by the postmaster-general, as they become due, to the credit of the National Debt Commissioners; all the purchaser has to do is to keep his banking account in funds; he can pay his savings into the bank when and as he pleases. So, also, when old-age pay, secured either by a deferred annuity or an endowment policy, becomes due, it is paid to the account of the purchaser; and, if it does not cause the sum standing to his credit to exceed the statutory limits, it can remain there earning interest, and be drawn out in such amounts as may be convenient from time to time. The purchaser has also the advantage of the ubiquity of the Post Office Savings Bank. He can make his deposits, and can draw out his old-age pay when it becomes due, at any one of the 13,000 odd post offices where savings bank business is transacted. He can even, if his savings are made from day to day, use the penny stamp slips introduced by Mr Fawcett, affixing a stamp whenever he has a penny to spare, and paying in the slip when it is worth a shilling. In short, every advantage open to the ordinary depositor in the Savings Bank is placed at the service of the working man or woman who wishes to secure old-age pay, or to have a small sum to aid those who may suffer pecuniarily from his or her death. Even the reluctance of many persons to submit themselves to medical examination is tenderly regarded. A policy for any sum up to £25 may, if the information afforded is satisfactory, be obtained without a doctor’s certificate, on condition that, if death happens during the first year, only the premium paid is returned, and if during the second year, only half the sum insured is paid. As regards old-age pay, a purchaser can, by adopting a slightly higher scale of payment, secure the return of his purchase money if at any time before the annuity falls in he repents of his bargain. Further, employers of labour and friendly societies can, on behalf of their workmen or members, make all the payments necessary to buy an insurance or annuity, and recoup themselves out of wages or members’ contributions.

The act of 1882 directed that the tables upon which annuities and policies of insurance are granted should be revised from time to time; and in February 1896 new tables reducing the rates of annual premiums, and giving greater facilities for old-age insurance, were issued. The rates are now but very slightly (less than 3%) higher than the average rates of the larger insurance offices. But the expense of small insurance business must necessarily be above the average, and it is fairer to compare the Post Office rates with those of the office which stands pre-eminent in the insurance of the working classes. Such a comparison shows that up to the age of 40 a life insurance can be effected with the Post Office at a cheaper rate than with the Prudential Insurance Company; between 40 and 60 the advantage is slightly on the side of the company.

In 1885, the first complete year after Mr Fawcett’s improvement took effect, 103 deferred annuities and 457 insurance policies were granted; in 1905, 158 deferred annuities and 741 policies. The increase of business, measured in percentages, is no doubt appreciable, but the figures themselves are so small as to make such a comparison trivial. If we compare the two periods, before and after Mr Fawcett’s reforms, we find that between the 17th of April 1865 and the 2nd of June 1884 (about nineteen years) 7064 policies of insurance, amounting to £557,625, were issued, and between the latter date and the end of 1905, 16,577 policies, amounting to £875,496. For the whole period the figures are 23,641 policies for £1,433,121. During the same time 3144 contracts for old-age pay, amounting in all to £64,378, were made. When we contrast with this sum total the fact that in 1905 alone 1,435,329 new accounts were opened in the Post Office Savings Bank, and more than £42,000,000 deposited in the bank in the course of the year, it becomes apparent that, while the Savings Bank has reached the mass of the population, insurance against old age and death through the Post Office has not.

In 1894 Mr C. D. Lang, the Controller of the Post Office Savings Bank, and Mr Cardin, giving evidence before the Commission on Old-Age Pensions, ascribed the small insurance and annuity business of the Post Office to the want of a personal canvass. They pointed out that there had

been some temporary increase in insurance, through an appeal to the Post Office employés themselves, and they suggested that something might be done if the masters of the elementary schools could be induced to interest themselves in recommending to their scholars and the parents of their scholars the advantages offered by the Post Office. It was also pointed out that the friendly societies might, if they were so disposed, act as intermediaries between their members and the Post Office, and thereby, as it were, reinsure their risks with the government; but it was added that all overtures of this nature to the societies had failed, apparently from the fear—quite groundless—of introducing government control of the societies' affairs. There may, indeed, be another reason for the failure of the deferred annuity system. The insurance of old-age pay is not popular even amongst the members of friendly societies, or even in Germany, where it has been given to the workmen largely at the expense of other people. Insurance against death, sickness and accidents appeals to the young working man; but old age is too far off to be an object of solicitude, especially since the grant of old-age pensions by the state has made the future secure from destitution at least. However, if at any time opinion changes, the Post Office stands ready to make foresight or philanthropy easy. Though no great results have been achieved, a machinery has been established which works with perfect smoothness, and which may some day be of service to the nation.

VI. Marine Insurance

Marine insurance long antedates the kindred businesses of fire and life insurance. Villani, a 14th-century Florentine historian, speaks of marine insurance as having originated in Lombardy in 1182. This proves, at least, that in his day it was no novelty. It is mentioned in a Pisan ordinance of 1318, and in Venetian public documents of the early years of the 15th century. The earliest form of policy known is that given in the Florentine statute of 1523. It is uncertain whether insurance was introduced into England directly from Italy or by way of Flanders. The earliest policies issued in England which have yet been discovered are in Italian, but the subscriptions are in English ("Santa Maria di Venetia," Cadiz to London, 1547, "Santa Maria de Porto Salvo," Hampton to Messina, 1548).

History.

The earliest known policies in English are one of 1555 on the "Sancta Crux" "from any porte of the Isles of Indea of Calicut unto Lixborne," and one of 1557 on the "Ele" from Velis Maliga to Antwerp. The authority for this statement is Mr R. G. Marsden, who edited for the Selden Society the records of the Admiralty Court; nothing earlier had been found at the Record Office down to May 1907. In the "Sancta Crux" policy there is no detailed statement of perils insured against, or of risks undertaken by the underwriter; the whole obligation of the underwriter to the assured is embodied in the following words: "We will that this assurans shall be so strong and good as the most ample writinge of assurans, which is used to be maid in the strete of London, or in the burse of Andwerp, or in any other forme that shulde have more force." This reference to Antwerp usage is 67 years before the date of C. Malynes' statement that all Antwerp policies contained a clause providing that they should in all things be the same as policies made in Lombard Street of London. The wording of the English policies written in Italian is very much simpler than the Florentine form of 1523, from which it almost seems that the wording used in England followed an earlier Italian form. But even the Italian policies in the two "Santa Marias" mention the uses and customs of "*questa strada Lombarda di Londra*" as the standard of the assurance they afford. The next most ancient policy we possess is dated 1613; it covers goods on the "Tiger" from London to "Zante, Petrasse and Saphalonia." The "Tiger" policy is interesting in another connexion. It recalls Shakespeare's *Macbeth* I. iii. 7 (written about 1605):— 675

"Her husband's to Aleppo gone, master of the 'Tiger.'"

Clark & Wright's note (in the "Clarendon Press" series edition) cites Sir Kenelm Digby's journal of 1628 mentioning "the 'Tyger' of London going for Scanderone" (Alexandretta). Hakluyt (*Voyages*) gives letters and journals of a voyage of the "Tyger of London" to Tripolis in 1583. Shakespeare again mentions a ship called the "Tiger" in *Twelfth Night*, V. iii. 63:—

"And this is he that did the 'Tiger' board."

The policy by the "Tiger" is much more ample than any of those already mentioned; it details the perils insured against in words closely resembling the Florentine formula of 1523, and differing only slightly from the form adopted by Lloyd's at a general meeting held in 1779, and afterwards incorporated in the Sea Insurance Stamp Act of 1795, which is the stem form of all modern British and American marine insurance policies.

While the form of the insurance policy was thus developing, there was a singular absence of legislation (and, as far as we can yet trace, of litigation) on the subject. Till 1601 differences seem to have been generally settled by arbitration. This accounts for the poverty of the British Admiralty records in matters of marine insurance. In 1601 a special tribunal was established by statute for summary trial of disputes arising on insurance policies; but, owing mainly to the opposition of the common-law judges, the new court languished, and by 1720 it had fallen into utter disuse. J. A. Park states that not more than sixty insurance cases were reported between 1603 and 1756. Consequently, when Lord Mansfield came to the court of king's bench in the

latter year, he found a clear field. He practically created the insurance law of England. He made use of all the continental ordinances and codes extant in his day, taking his legal principles largely from them; the customs of trade he learnt from mercantile special jurors. Subsequent legislation referred solely to the prohibiting of certain insurances (wager policies, &c.), the naming in the policy of parties interested therein, and the stamp duty levied on marine insurances. In 1894 Lord Herschell introduced his Marine Insurance Bill, which endeavoured "to reproduce as exactly as possible the existing law relating to marine insurance." After Lord Herschell's death, Lord Chancellor Halsbury took up the bill, introducing it in the House of Lords in 1899 and again in 1900; he appointed a committee on which underwriters, shipowners and average adjusters were represented, and, presiding himself, went through the bill with them clause by clause. The bill was then passed by the Lords, but was always blocked in the House of Commons till 1906, when it was taken up by Lord Chancellor Loreburn in conjunction with Lord Halsbury. After some amendment and modification it was finally passed by both Houses and became law on the 1st of January 1907 (6 Ed. VII., c. 41).[3] In America a less happy fate has attended the insurance code, forming part of the proposed civil code of New York, completed and published in 1865, of which a very slightly altered version was adopted in California and has been in effect there since the 1st of January 1873. On the continent of Europe legislation at first took the form of local ordinances of commercial cities, such as Barcelona (1434-1484), Florence (1523), Burgos (1538), Bilbao (1560), Middelburg (1600), Rotterdam (1604-1655). In the third quarter of the 16th century Rouen produced a handy guide to marine insurance, *Le Guidon de la mer*; and in 1656 Étienne Cleirac published there his *Us et coutumes de la mer*. This was followed in 1681 by the *Ordonnance de la marine*, which, through Lord Mansfield, had a great effect on English case law. In 1807 France produced the *Code de commerce*, on the model of which nearly every European nation has issued a similar code. Probably the "best considered" (Willes, J.) of these, and the most adequate as regards marine insurance, is that of the German empire; but Hamburg and Bremen still preserve many of their local conditions by special contract in their policies. In fact it is doubtful whether the German Code could have been produced without the previous elaboration of the Conditions of Hamburg and of Bremen. The Hamburg Conditions of 1847, revised 1867, constitute an admirable compendium of marine insurance as practised in that city.

Marine insurance being peculiarly an international business, being a factor in 95% of the operations of oversea trade, it is natural that those engaged in this business or making use of marine insurance in their business should experience the difficulty and hardship arising from the differences between the marine insurance law of different states, and should attempt to find a remedy. Such an attempt was made at the Buffalo conference of the International Law Association in 1899 to prepare a body of rules dealing with those parts of marine insurance on which the laws of maritime countries differ. This undertaking was of the same nature as the earlier efforts of the same association which resulted in the formulation of the York-Antwerp rules of general average. There are four important subjects on which great divergence prevails: (*a*) Constructive total loss; (*b*) Deductions from costs of repairs, new from old; (*c*) Effect of unseaworthiness and negligence; (*d*) Double insurance.

Conflict of laws.

(*a*) Constructive total loss results, according to the law of France, Italy, Spain, Belgium, Holland, in case of loss or deterioration of the things insured amounting to not less than three-quarters; in German law a ship is considered to be "unworthy of repair" when the cost of the repair, without deductions new for old, would amount to over three-fourths of the ship's former value (no similar provision seems to exist in Germany for goods); in the law of America a damage over 50% of the value of the vessel when repaired is a constructive total loss of the vessel, in case of the policy containing no express provision to the contrary. None of these varying systems appears to be so equitable to all concerned as the British rule, which was for this reason suggested to the Buffalo conference for international adoption. As regards the time when the test for constructive total loss should be applied, it was suggested to reject the British rule, prescribing that it shall be the time of commencing action against underwriters, and to adopt the continental and American rule referring to the facts as they existed at the time of abandonment. Then, as respects the effect of a valid abandonment on the rights in the property insured, the conference proposed to adopt the British and American rule of making the abandonment refer back to the time of the loss, as against the continental European system of making the transfer operative only from the date of the notice of abandonment. Finally, as to the freight of a properly-abandoned ship, it was proposed to follow for international purposes the American rule of dividing the freight of the voyage between shipowner and underwriter in the proportion of the distances run before the disaster and to be run thereafter, rejecting the British rule of complete transfer to the underwriter and the various continental rules of proportional division between shipowner and underwriter.

(*b*) It was proposed to adopt the deductions set forth in the York-Antwerp rules as being suitable for international adoption in marine insurance contracts.

(*c*) As regards unseaworthiness and its effect on insurances on ships and goods, it was proposed in the case of ships to reduce materially the obligations of the insured as required by English and American law; to diminish the requirement from the absolute attainment of

seaworthiness to the mere exercise of all reasonable care to make the vessel seaworthy. Even this attenuation did not appear sufficient, as it was proposed to degrade the performance of the already minimized warranty from being a condition of the insurance, and its non-performance from invalidating the policy. As to goods, they were proposed to be exempted from any warranty of seaworthiness of ship. Concerning negligence, it was proposed to hold the underwriter liable (subject to the new seaworthiness warranty) for any loss caused proximately by a peril insured against, although wholly or partly the result of the neglect of the insured, or his servants or agents, or by the wilful act of his servants or agents, or the inherent nature or unsoundness of the article insured.

(*d*) In case of double or multiple insurance, the conference proposed to adopt the British rule of making all the policies effectual, independently of the order in which they were effected, and of making all the underwriters entitled to contributions *inter se*. As regards the premium, it was proposed that no premium should be returnable, where the risk has attached.

With the exception of those embodying the two suggestions named in par. (*a*), all the resolutions proposed were accepted by the conference. But it appears extremely unlikely that British and American underwriters will voluntarily consent to the practical annihilation of the seaworthiness warranty, and no less improbable that American and continental assured will voluntarily accept the stricter rule of constructive total loss embodied in English law, when their national law enforces on the underwriter terms more favourable to the assured. The fewness of the international insurance markets of the world diminishes the need for uniform international regulations in this matter. The matter may be one for adjustment by variation in the rate of premium, but this is not certain.

The Glasgow conference of 1901 adopted the rules, after excepting time policies from the scope of the rule respecting seaworthiness. The rules are known as the Glasgow Marine Insurance Rules. The writer knows of no instance in which they have been adopted in practice.

Returning to marine insurance in the United Kingdom, it is to be observed that the passing of the Marine Insurance Act of 1906 sharply marks an important change in the nature of the law of the subject. Till then it was based almost entirely on common law, only a few disconnected points having been dealt with by statute. The reported cases were thus of great importance, and being about 2000 in number (*teste* Sir M. D. Chalmers) were not easy to master. No doubt many of them referred to commercial conditions no longer prevalent; still they could not be entirely ignored. But the original introducer of the bill described it as an endeavour “to reproduce as exactly as possible the existing law relating to marine insurance,” and as by being made law the language of the act has become authoritative, insured and insurers have now no call to go behind the wording of the act in any matter with which it deals. It thus appears that the case law of the subject existing before the 1st of January 1907 may be left aside, unless, perhaps, for use as affording examples of the way in which the provisions of the act work.

Definition.

A contract of marine insurance is a contract of indemnity whereby the insurer undertakes to indemnify the insured, in the manner and to the extent agreed, against marine losses, *i.e.* the losses incident to marine adventure. The contract may by its express terms or by usage be extended to cover risks on inland waters or land risks incidental to any sea voyage. There is a “maritime adventure,” where any ship, goods or other movables are exposed to maritime perils, such property being termed “insurable property”; also where the earning of any freight, hire or other pecuniary profit or benefit, or the security for any loan or expenditure, is endangered by the exposure of insurable property to maritime perils; and where any liability to a third party may be incurred by the person interested in or responsible for insurable property by reason of its exposure to maritime perils. By “maritime perils” are meant the perils consequent on or incidental to the navigation of the sea, *i.e.* perils of the seas, fire, war perils, pirates, rovers, thieves, captures, seizures and restraints, and detainments of princes and peoples, jettisons, barratry, and any other perils, either of the like kind or which may be designated by the policy.

The contract being one of indemnity against maritime perils, it is evident that no one can derive benefit from it who has not some interest exposed to these perils. Consequently while, subject to the provisions of the act, every lawful marine adventure may be insured, all contracts of marine insurance are void when (1) the assured has no insurable interest, and has entered into the contract without expectation of acquiring such interest; (2) when the policy is a “wager” policy, being made “interest or no interest,” “without further proof of interest than the policy itself,” “without benefit of salvage to the insurer,” or subject to any similar terms. But if there is no possibility of salvage a policy “without benefit of salvage to the insurer” is legally valid. Wager policies are illegal only in the sense of being void to all legal purposes. They cannot be sued upon, hence they are known as “honour” policies. They are of frequent use, generally for the protection of interests which, though real, are not easily defined, or are of pecuniary value hard to determine. But they are ignored by the courts. The essential of insurable interest is the pecuniary advantage seen at the time of insurance as arising to the assured from the safety or due arrival of the adventure, or the pecuniary disadvantage similarly arising from its loss or deterioration. But such interest may lapse before arrival or destruction of the venture, and with the interest lapses the right of the assured to recover from the underwriter. Without interest at

the time of the loss there is no right to recover from the underwriter. Should the assured simply transfer his interest to another, *e.g.* by sale, he can assign his policy to the party who acquires his interest—unless, of course, the policy contains terms expressly prohibiting assignment. The customary form of assignment is endorsement of the policy either in blank or to a specified party. Within the limits already named, interests are insurable whether complete or partial, defeasible or contingent; similarly loans on bottomry or respondentia, advance freight not repayable in case of loss, charges of insurance, also shipmaster's, officers' and seamen's wages.

Value.

The owner of insurable property may insure its full value even though some third party have agreed or become liable to indemnify him in case of loss: a mortgagor has the same right of insuring to full value; while a mortgagee may insure only up to the sum due or to become due to him under the mortgage, unless the mortgagee is insuring for the benefit of the mortgagor as well as for himself, in which case, even though he insure in his own name only, he may insure up to the full value. A consignee may insure in his own name the total amount of his interest and that of others for whose benefit he insures. Where no special contract is made between insured and underwriter, the insurable value of certain matters of insurance is ascertained as follows:—*Ship*—Her value at the commencement of the risk, including outfit, provisions, stores, advances of wages, and any other outlays expended to make the ship fit for the voyage or period of navigation covered, *plus* cost of insurance upon the whole. In the case of a steamship, the word "ship" includes machinery, boilers, coals and engine stores. In the case of a vessel engaged in a special trade, the word "ship" includes the ordinary fittings necessary for that trade. *Freight* (whether paid in advance or not)—The gross amount of freight at the risk of the assured, *plus* cost of insurance. *Goods*—The prime cost, *plus* expenses of and incidental to shipping and cost of insurance. *Other interests*—The amount at the insured's risk when the policy attaches, *plus* cost of insurance.

Policy.

To be admissible in evidence a contract of marine insurance must be embodied in a document called a policy, which must specify the name of the assured (or of his agent in the effecting of the policy), the objects insured, and the risk insured against, the voyage or time (or both) covered, the sum insured, the name of the assurers. The signature of the assurer is necessary; it is found at the end of the policy, and the assurer is often on this account called the *underwriter*. The objects insured must be designated with reasonable certainty, regard being had to customary usage. The undertaking to insure is usually expressed by saying that the insured or his agent "doth make assurance and cause himself to be insured." The risks are either the whole body of maritime perils detailed above, or any one or set of these, or any other named peril against which the assured desires protection. There is no restriction by law of the length of voyage that may be insured, but time policies are, subject to the Finance Act 1901, invalid if made for more than one year; a voyage and a period of time may be covered on one policy. Policies are classed as "time" or "voyage" policies. It is not necessary to state in the policy the value of the objects insured, but generally the value is given; policies are therefore classed as "valued" or "unvalued," the latter being often called "open" policies. The values of objects insured under open or unvalued policies are the insurable values given above. As it frequently happens that merchants desire to have all their shipments of whatever nature covered, by whatever vessel they may come, they require insurance in general terms; such a policy is termed a "floating" policy. It states the limits of voyage and value covered by the underwriter, and the class of ships to be employed. The particulars of each shipment are declared as the shipments occur, and in the order of despatch or shipment, the declarations being usually endorsed on the policy. All shipments within the terms of the policy must be declared at their honest value, or in accordance with the special provisions of the policy, if any. An omission or erroneous declaration may be corrected even after loss or arrival, provided it was made in good faith.

The consideration paid by the insured to the underwriter in return for the protection granted by the latter is called the *premium*. Until payment be made or tendered the policy is not ordinarily issuable, *i.e.* unless otherwise agreed. When the insured effects insurance with an underwriter through a broker, then, unless otherwise agreed, the broker is liable for the premium to the underwriter, who is, however, directly responsible to the assured for losses or liabilities falling on the policy and for returnable premium. But the broker has a lien on the policy for the premium and for his brokerage, and in case he has had dealings as a principal with the insured, he has a lien on the policy for any balance due to himself in insurance transactions, unless he should have known that in these transactions the insured was merely an agent. Some policy forms state definitely that the premium has been paid; when such a form is used and no fraud is proved, this receipt is binding between assured and underwriter, but not between broker and underwriter. If an insurance is effected at a premium "to be arranged," and no arrangement is made, then a reasonable premium is payable. The same holds where additional premiums have to be charged at a rate to be arranged and no arrangement is made.

It is evident that in nearly all the particulars of any adventure insured by an underwriter he is entirely dependent upon the insured for correct information. It is therefore the law that an insurance contract can be avoided and broken by either of the parties to it if the utmost good

faith (*uberrima fides*) be not observed by the other. The obligation of perfect good faith is thus made reciprocal. Bad faith may show itself either in *concealment* or in *misrepresentation*. It is therefore made essential to the stability of any insurance contract that the insured must disclose before conclusion of the contract every material circumstance known by him, failing which the underwriter may avoid the contract. The insured is deemed to know every circumstance which in the ordinary course of business ought to be known by him. Every circumstance is deemed material which would influence the underwriter in his decision as to acceptance of the risk or the fixing of the rate of premium. Consequently the insured is not bound, unless specially asked by the underwriter, to disclose the favourable features of the risk offered, or matters known or presumably known by the underwriter (matters which are of common knowledge, and such as an underwriter ought in his usual business to be aware of), or matters respecting which the underwriter waives or declines information, or which any express or implied warranty renders superfluous. An agent effecting an insurance must, in addition to his principal's material knowledge, disclose everything material known to *himself*, or that *he* should know in the ordinary conduct of *his* business. Every representation of material fact made to an underwriter before conclusion of a contract by the insured or his agent must be true, or the underwriter may avoid the contract. Every representation is material which would influence the underwriter in his decision as to acceptance of the risk or to fixing the rate of premium. A representation of fact is regarded as true if it be substantially correct; literal correctness is not essential. A representation of expectation or belief is true if it is made in good faith. A representation may be withdrawn or corrected before the contract is concluded. The contract is deemed to be concluded when the underwriter accepts the risk, whether the policy be then issued or not.

Voyage insured.

It frequently happens that before a vessel has completed the venture on which she is engaged arrangements have already been made for her future employment. Where a vessel is insured on time, this is of no moment as respects her insurance. It has likewise been decided that where any insurable object is covered by a voyage policy "from" or "at and from" a named place, the policy is not rendered invalid by her not being at that place when the insurance is concluded; but, on the other hand, there is an implied condition that she will begin the venture within a reasonable time, and that if she fails in this the underwriter may avoid the contract. If the delay springs from circumstances known to the underwriter at the time of conclusion of the contract, or if the underwriter then acquiesces in it, the implied condition is nullified. If the insured abandons the venture insured, the contract expires; *e.g.* if, before the risk commences, the vessel's destination is changed to one not covered by the policy. Where the policy specifies a place of departure, and the ship does not sail from that place, the risk does not attach. If, however, the vessel actually starts from her intended port of departure, and commences the venture, and thereafter it is decided to change her destination, this decision constitutes a *change of voyage*. In default of provision to the contrary, the underwriter may elect to avoid his insurance from the time of that decision, although the ship be still in the course she would have followed in her originally intended venture.

Should a ship depart from the proper course of the voyage she starts upon, and for which she is insured, such departure, when made without lawful excuse or justification, is termed *deviation*. From the moment it occurs, even though she subsequently return to her proper course without loss or injury, the underwriter may avoid his contract; but the mere intention to deviate is immaterial. Deviation occurs (1) when in a policy a course is definitely specified and the vessel departs from it; (2) when, in absence of such definite specification in the policy, the vessel departs from the course usually and customarily followed in the voyage insured. If a policy provides for several named ports of discharge, the vessel may, without committing deviation, omit to proceed to one or more; but whether she goes to all or to some she must (in absence of usage or sufficient cause to the contrary) take them in the order in which they appear in the policy, if not there is a deviation. If the policy provides for "ports of discharge" in a given district, then (in absence of usage or sufficient cause to the contrary) unless the vessel proceeds to them in their geographical order she makes a deviation. Similarly, in the case of a voyage policy, the want of reasonable despatch throughout, unless lawful excuse or justification exists, entitles the underwriter to avoid the contract from the time that the delay becomes unreasonable. As excuses for deviation or delay on the voyage contemplated by the policy, the following are regarded as valid: authorization by licence or other provision in the policy, *force majeure*, compliance with express or implied conditions of the policy (*e.g.* warranties, see below), reasonable steps taken for the safety of the ship or other objects insured, saving life, helping a ship in such distress that life may be in danger, or obtaining medical or surgical aid for some person on board. If barratry is insured against, delay arising from barratrous conduct of master or crew does not avoid the policy. A deviation ceases to be excusable unless the ship resumes her proper course and proceeds on her voyage with reasonable promptitude after the cause of the excusable deviation or delay ceases to be effective.

Warranties.

In every contract of insurance there are certain conditions precedent to the liability of the underwriter and incumbent on the insured, which must be fully and literally complied with, whether material to the risk or not. These conditions are known in insurance as *warranties*. The name is unfortunate, as in every other branch of the law of

contract it bears another meaning; still it is convenient, and its insurance signification is now firmly established. Failure on the part of the insured to fulfil a warranty *literally* entitles the underwriter to avoid his contract as from the moment of breach,[4] but it does not limit his obligation up to that moment. Breach of warranty is not nullified by subsequent remedy of the breach, consequently loss occurring after breach of warranty is not at the charge of the underwriter, even although before the loss the insured has again complied with the warranty. But breach of warranty may be waived by the insurer. Breach of warranty is excused in two cases only: (*a*) when by change of circumstances the warranty ceases to be applicable to the contract, (*b*) when by subsequent legislation the warranty becomes unlawful.

Warranties are of two classes: (1) express (2) implied. Express warranties must be written or printed on the policy, or contained in some document explicitly referred to in the policy, and so regarded as incorporated in the contract. No special form of words is essential to the validity of a warranty if the intention to warrant can be inferred. Express warranties may refer to anything which the parties to the contract choose, *e.g.* the nationality of the vessel, her sailing on a named day, proceeding under convoy, being excluded from certain voyages or trades or the carriage of certain cargoes, being “well” or “in good safety” on a named day (in which case the warranty is fulfilled if she be safe at any time of that day). As regards *nationality*, if no express warranty be given there is no undertaking on the part of the insured that the vessel is of any particular nationality or that she will not change it while the risk lasts. The warranty of *neutrality* in case of insurance of ship or goods means that at the beginning of the risk the property concerned is actually neutral, and that as far as the insured can control the matter it shall so continue during the whole course of the risk. It is also an implied condition of the ship being warranted neutral that to the utmost of the insured’s power she must carry the papers necessary to establish her neutrality, must not falsify or suppress these papers, or use simulated papers; if this condition is broken the insurer can avoid the contract. The words of an express warranty are always to be taken in their commercial sense; within that sense they are to be strictly and literally taken. An “express” warranty does not exclude an “implied” warranty (see below) unless it be inconsistent therewith.

In addition to these expressed conditions, there are also certain essential factors or conditions inherent in each and every contract of marine insurance without exception; these are *implied* warranties, which are presumed from the very fact of the making of the insurance. They are (*a*) completion of the prescribed venture without *deviation*, (*b*) *legality* of the venture (viz. that the adventure insured is a lawful one, and that, so far as the insured can control it, it shall be carried out in a lawful manner), (*c*) *seaworthiness* of the ship. In a voyage policy it is an implied warranty that at the commencement of the voyage the ship shall be seaworthy for the particular venture insured. If the risk commences when the ship is in port, then she must in addition be reasonably fit to stand the ordinary dangers of the port. If the voyage insured is one in which different degrees of peril are to be encountered, or for which the ship needs different kinds of outfit at different stages, then she must be seaworthy for each stage at its commencement, and the warranty will be fulfilled if she is at the beginning of each stage seaworthy for that stage. The warranty of seaworthiness is held to be fulfilled when the ship is reasonably fit in every respect to meet the ordinary marine dangers of the venture insured; that is to say, the mere loss of a vessel by perils of the sea is not a proof of unseaworthiness in the sense of this warranty. The only ship policies not subject to the warranty of seaworthiness are policies on time (the reason given being that there is nothing to prevent a time policy lapsing and a new one commencing when the vessel is at sea beyond her owner’s control as to seaworthiness); but where the insured knowingly sends a ship to sea in an unfit state and a loss is attributable to that unseaworthiness, the underwriter is not liable for such loss. It is not implied in a policy on goods or movables that these goods, &c., are seaworthy, but it is implied that at the beginning of the voyage the carrying vessel is not only seaworthy as a ship but reasonably fit to carry the goods to the destination named in the policy.

When the main points of the preceding particulars of the contract of insurance are summarized it may be said that the transaction is (1) a contract of indemnity reduced to written or printed words, (2) made in good faith, (3) referring to a defined proportion or amount, (4) of a genuine interest in a named object, (5) being against contingencies definitely expressed, to which that object is actually exposed, and (6) in return for a fixed and determined consideration.

Multiple Insurance.

It may happen by accident or by design that an insurance object has been covered twice or more times, and that in consequence the sum of the insurance effected exceeds the value in the policy or the insurable value, if an unvalued policy has been employed. This occurrence involves a new set of relations between the insured and his various underwriters; the underwriters themselves are brought into relation to one another. As regards the insured, he may, in the absence of agreement to the contrary, claim payment from whomsoever of the underwriters he may select, but he is not entitled to receive in all more than his proper indemnity. Each underwriter, whether his policy be valued or unvalued, is entitled to receive credit for his proper proportion of the sum obtained by the insured under any other policy. If the insured does obtain any sum in excess of indemnity, he is regarded as holding it in trust for his whole body of underwriters. It thus appears that in

case of multiple insurance each underwriter is bound, as between himself and the other underwriters, to contribute to the loss rateably in proportion to the amount of his liability under the policy; and if any one pays more than his proper share, he is entitled to sue the rest for contribution. Should the insured get any of his premium back? It would not be equitable to enforce a return from any underwriter who has at any time stood alone so as to be liable to the full extent of his policy; but if overlapping policies were accidentally effected all at the same time, the case is rather different. This leads to the general question of *return of premium*. Such return may be claimed under the terms of the policy, in which case the claim for return is simply the carrying out of the agreement between the parties; it may refer to the whole or to a part of the interest insured. But there are other circumstances in which returns can legally be claimed. For instance, it may turn out that interest insured by a particular vessel and for a particular voyage is never shipped in that vessel for that voyage; the underwriter has in this case run no risk, and therefore the consideration for which he received the premium totally fails, and the premium is properly returnable to the intending insured, unless there has been fraud or illegality on the part of the insured. Similarly, in the case of part of the interest insured on a policy, if that part is distinguishable in the policy or by custom of trade. But the interest might have made the voyage in the vessel, and the intending insured might yet remain without insurable interest. In this case, in absence of fraud or illegality, and if the policy is not merely a gaming or wagering contract, the insured is entitled to return of his premium. Similarly, in the absence of fraud or illegality, if the underwriter legally voids his policy from the beginning of the risk; as he runs no risk, he receives no premium. The only cases, except those of fraud and illegality, in which the underwriter can retain his premium without running risk, are those of risks underwritten “lost or not lost,” and arrived safely without the underwriter’s knowledge, in which the underwriter takes his chance as to the condition and situation of the ship when he assumes the risk. But this is practically a case of agreement that there shall be no return.

When the insured has overinsured on an unvalued policy, a proportionate part of the premium is returnable. But where double insurance has been knowingly effected by the insured or any earlier policy has at any time borne the entire risk or a claim has been paid on a policy in respect of its full value, no premium is returnable.

The policy issued by the underwriter to the insured makes mention of certain perils against which the insurance is granted, and unless the policy otherwise provides, the underwriter is liable for any loss proximately caused by any of these perils, but is not liable for any loss not proximately caused by a peril insured against. He is not responsible for any loss due to the wilful misconduct of the insured but, unless the policy otherwise provides, he is liable for any loss proximately caused by a peril insured against even though it would not have happened but for the misconduct or negligence of master or crew. Nor is he responsible for any loss caused by delay, although the delay be caused by a peril insured against; nor for ordinary wear and tear, ordinary leakage or breakage, inherent vice or character of objects insured, loss from rats or vermin, or injury to machinery not proximately caused by sea-perils.

Total loss.

Losses are divided into “total” and “partial.” A “total” loss may be (1) actual, or (2) constructive; and an insurance against total loss covers the insured against both, unless a different intention appears from the terms of the policy. It is an “actual” total loss when the object insured is destroyed or damaged so as to cease to be of the denomination of goods to which it belonged when insured, or when the insured is irretrievably deprived of the property insured. In the case of an actual total loss no notice of abandonment need be given. In the case of a missing ship after the lapse of a reasonable time without news, an “actual” total loss may be presumed. There is a “constructive” total loss when the interest insured has been abandoned on account of what appears inevitable actual total loss, or because the cost of preventing such loss would exceed the value after such expenditure. E.g. if ship or merchandise is in such a position that recovery is unlikely or the cost of recovery would exceed the value recovered, there is constructive total loss; likewise in the case of a damaged ship, if the cost of repair would exceed the repaired value of the ship. (In making the estimate of cost of repairs no deduction is to be made for the share of them payable in general average by other interests, but account is to be taken of the cost of later salvage operations and of the ship’s proportion of any later general averages.) Similarly for damaged goods, there is constructive total loss if the cost of repair and of forwarding to destination exceeds the arrived value. The insured may either treat constructive total loss as a partial loss or as an actual total loss, in which latter case he abandons his insured interest to the underwriter. If he decides to abandon he must give notice of abandonment, else he will recover only for a partial loss. This notice may be wholly or partly written or oral, and in any terms if only they indicate the intention to transfer unconditionally all interest to the underwriter. The refusal of abandonment by the underwriter does not prejudice the assured’s rights. Abandonment may either be expressly accepted by the underwriter or may be implied from his conduct, but his mere silence does not imply acceptance. When notice is accepted, abandonment is irrevocable. Notice may be waived by the underwriter. Notice is unnecessary where, when the news reaches the insured, there would be no benefit to the underwriter if notice were given to him. On valid abandonment the underwriter adopts the

Abandonment.

interest of the insured in the subject insured, or what remains of it, and all incidental proprietary rights, *e.g.* in the case of a ship he is entitled to any freight in the course of being earned and which is earned by her subsequent to the accident causing the loss, less the expenses incurred after the accident; and if the cargo is on owner's account, the underwriter is entitled to reasonable freight from the place of casualty to destination.

Partial loss.

General average.

Any loss other than a total loss, as defined and described above, is a "partial" loss. As such are classed general average, salvage charges, particular average, particular charges. "General average" is really an outlying branch of the law of affreightment (see AVERAGE and AFFREIGHTMENT): its connexion with insurance is merely secondary, arising out of the underwriter's contract to pay losses generally and this special liability in accordance with definite provisions of the policy. Any extraordinary sacrifice or expenditure voluntarily and reasonably made in a moment of peril in order to preserve all the property in the venture, is a general average act and the loss arising therefrom is a general average loss. The party on whom it falls is entitled to a rateable contribution from the others. These rateable contributions are repayable by the respective underwriters subject to the special provisions of their policies, unless the sacrifice or expenditure was made to avert a peril not covered by the policies, when there is no liability. The party originally incurring a general average sacrifice may recover from his underwriter the whole loss without having enforced his right of contribution from the others concerned in the venture. When ship, freight and cargo, or any two of them, belong to one person, the underwriter's liability is determined as if these interests were each owned by separate persons.

Salvage charges.

Particular average.

"Salvage charges" are the charges recoverable under maritime law by a salvor independently of contract: if incurred in averting perils insured against, and if not otherwise provided in the policy, they are recovered as a loss from these perils. The cost of similar services of the insured or his agents or hired employees are recovered as a general average loss when the cost fulfils the character of general average expenditure, or in all other cases as "particular charges." Thus all expenses by or on behalf of the insured to save or preserve the interest insured are either general average, salvage charges or particular charges. Particular charges are not included in "particular average," which may now be defined as a partial loss of the subject insured, caused by a peril insured against, and not being a general average loss.

Measure of indemnity.

The nature of the liability for loss of the underwriter having been determined, it remains to fix its extent, or in other words the "measure of indemnity"; each underwriter bears that proportion of the loss which his subscription bears in the case of a valued policy to the insured value, and in the case of an unvalued policy to the insurable value. In the case of a total loss, the measure of indemnity is the sum fixed by the policy if valued, or the insurable value of the object insured if the policy be unvalued. When the insured fails in an action for total loss, he is not precluded from recovering a partial loss if the policy insures him against partial loss. In the case of damage to a ship not amounting to a total loss the insured is, subject to the terms of his policy, entitled to recover the reasonable cost of repairs less customary deductions, but not exceeding for any one casualty the sum insured. If the repairs are only partial he is in addition entitled to an allowance for unrepaired damage, but the aggregate must not exceed the cost of complete repairs, less customary deductions. If the damaged ship has neither been repaired nor sold during the risk, the insured is entitled to reasonable depreciation but not exceeding the reasonable cost of repairs, less customary deductions. As regards freight, the underwriter's liability for partial loss is, subject to the terms of the policy, the proportion of the policy value, or (in case of an unvalued policy) of the insurable value, which the freight lost bears to the whole freight at risk of the insured under the policy. When there is liability under a policy for total loss of part of the goods insured its amount is determined as follows: on an unvalued policy, it is the insurable value of the portion lost, ascertained as in case of total loss; on a valued policy, it is the proportion of the sum insured which the insurable value of the portion lost bears to that of the whole. Subject to any express provision of the policy, when goods are delivered at destination damaged throughout or in part, the liability is for the same proportion of the sum insured (or, in an unvalued policy, of the insurable value) that the difference between gross sound and gross damaged values at destination bears to the gross sound value there. Gross sound value means the wholesale price including freight, landing charges and duty; gross damaged value means the actual price obtained at a sale when all charges on sale are paid by the sellers. In case of goods customarily sold in bond, the bonded price is taken to be the gross value. When different kinds of property are insured under a single valuation, that valuation is apportioned over them in proportion to the respective insurable values they would have on an unvalued policy, but when the prime cost cannot be ascertained the division is made over the net arrived sound values of the different kinds of property. The liability for general average contribution and salvage charges is, for anything insured for its full contributing value, the full amount of the contribution; but in case of insurance not attaining the full contributing value there is a reduction in proportion to the under insurance; and where a particular average is payable on the contributing goods, its amount must be deducted from the insured value when the underwriter's liability is being ascertained. On policies covering liabilities to third parties, the measure of indemnity, subject to the condition of the policy, is the amount paid or payable to the third party. When property is insured "free of

particular average" (f.p.a.), then unless the policy is apportionable, as above, there is no liability for loss of part with exception of loss of part occasioned by a general average sacrifice, but there is liability for total loss of an apportionable part. The underwriter on f.p.a. terms is liable for salvage charges, particular charges and charges incurred under the "sue and labour" clause of the policy to avert a loss insured against. Unless otherwise provided in the policy when goods are insured f.p.a. under a certain named percentage, a general average loss cannot be added to a particular average loss to make up the specified percentage; nor may particular charges nor the expenses of ascertaining and proving the loss; in fact only the actual loss suffered by the object insured may be taken into account. The engagement evidenced by the "sue and labour" clause of a policy is regarded as supplementary to the contract of insurance, and the expenses incurred under it are recoverable from the underwriter, even if he has paid a total loss or has insured the goods f.p.a. with or without any franchise being specified. General average losses and contributions are not "sue and labour" expenses, nor are salvage charges, as defined above. The expenses of averting a loss not covered by the policy cannot be recovered under the "sue and labour" clause. The Marine Insurance Act specially declares that "It is the duty of the insured and his agents, in all cases, to take such measures as may be reasonable for the purpose of averting or minimizing a loss."

F.P.A. liabilities.

Unless otherwise provided, and subject to the provisions of the law, the underwriter is liable for successive losses, even though their aggregate amount exceeds the sum insured. But where, under one policy, an unrepaired or uncompensated partial loss is followed by a total loss, the insured can only recover the total loss. These provisions do not affect the underwriter's liability under the "sue and labour" clause, for, as explained above, the "sue and labour" clause is a contract supplementary to the insurance contract contained in the policy.

The payment of a total loss of the whole or of an apportionable portion of the object insured entitles the underwriter to take over the insured's interest in all that remains of the same, the underwriter becoming subrogated to all the rights and remedies of the insured in and regarding the interest insured as from the time of the accident occasioning the loss. The payment of a partial loss gives the underwriter a similar subrogation but only in so far as the insured has been indemnified in accordance with law by such payment for the loss.

Subrogation.

In case of double (or multiple) insurance each underwriter is bound to contribute, as between himself and the other underwriters, rateably to loss in proportion to the amount for which his policy makes him liable; for any excess of this amount he may maintain action against the coinsurers and may obtain the same remedy as a surety who has paid more than his proportion of a debt.

Coinsurance.

Where the object is insured for less than the insurable value, as defined above, the insured is deemed to be his own underwriter for the balance.

Recent extensions of marine insurance in England have mostly been in the direction of giving to shipowners protection against liabilities to third parties. The first addition was the running down clause (r.d.c.) by which underwriters take burden of a proportion, usually three-quarters, of the damage inflicted on other vessels by collision for which the insured vessel is held to blame. The rapid increase in the use and size of steamships was accompanied by an equally rapid increase in the frequency of collisions at sea, tending to make the shipowner desirous of insuring himself against the balance of his collision liability, and against whatever other liabilities to third parties might be imposed upon him. There was a hesitation on the part of underwriters to meet these wants and the result is that in Great Britain most liability insurances are effected in mutual insurance societies. The insurance of such liabilities is perhaps simpler in Great Britain than in other countries, as the amount for which a shipowner can be liable is limited by law, although, of course, none but English tribunals are bound by that law. A new and extensive set of liabilities has been thrown on shipowners by the Workmen's Compensation Act of 1906; the liabilities in this case vary with the wages of the workmen concerned. Another interesting class of insurances has received much attention, namely, those against the risks of capture, seizure and detention by a hostile power, generally described briefly as *war risks*. But the difficulties connected with such risks probably lie more in determining the legal position of the owners of the property, and the obligations under which they lie, than in settling those of their underwriters. Such questions concern *blockade*, *contraband*, *domicile*, *nationality*, *neutrality*, &c.

Liabilities.

The usual procedure in the offer and acceptance of a risk is as follows: The intending insured (principal or broker) offers the risk by showing to the underwriter a brief description of the venture in question, called in Great Britain a slip, in America an application. The underwriter signifies his acceptance of the whole or of a part of the value exposed to perils by signing or initialling the slip, putting down the amount for which he accepts liability. Or he may sign and issue to the insured (principal or broker) a similar document made out in his own office, called a covering note or insurance note. These documents are simply first sketches of the contract, *mémoires pour servir*, so imperfect that they can be explained only in conjunction with the contract in its completed form (the

Course of business.

policy). In America it is not at all rare for insurances to be effected through applications alone without any policy existing. In Great Britain the existence of a policy is essential, slips and covering notes being merely provisional agreements, binding in honour only, to issue policies on certain terms and conditions on receipt of the necessary information. One reason for insisting on a policy being issued for every risk is that a means of raising revenue by stamp taxes is thus created. In Great Britain the stamp duties under the Stamp Act 1891 are as follows:—

Where the premium does not exceed ⅛% of the amount insured	1d.
Where the premium exceeds ⅛% of amount insured:—	
(*a*) On any voyage, per £100 or per any fractional part of £100	1d.
(*b*) For any time not exceeding six months, per £100, &c., as above	3d.
(*c*) For any time exceeding six months, and not exceeding twelve months, per £100, &c., as above	6d.

In consequence of this regulation, no time policy can be issued for a period exceeding twelve months. Policies or certificates of insurance coming from abroad are subject to the same duties, which should be paid within ten days after receipt in the United Kingdom. The shortness of the time allowed for stamping often prevents payment of the tax. These stamp regulations are very troublesome, and produce only a comparatively insignificant revenue. On small premium insurances the tax is so excessive that it drives business out of the country. A uniform tax per policy has been several times suggested, but these proposals have not yet been accepted by the Treasury.

The documents required to establish a claim for total loss are: (1) Protest of master. (2) Set of bills of lading (endorsed if necessary, so as to be available to the underwriter). (3) Policy or certificate of insurance (endorsed if necessary). (4) In the United States: Statement of loss in detail. In the United States certified copies of Nos. (1), (2), and (3) are taken; but as none of these copy-documents can transfer possession to the underwriter, there is necessary for that purpose another document, viz. (5) Bill of sale and abandonment with subrogation to underwriter —that is, an assignment of all interest to the underwriter. In the absence of the *full* set of bills of lading, a similar document should be taken in Great Britain, especially in all cases in which salvage operations are likely to be undertaken. Such a document handed to a salvage association or a manager of salvage (whether acting for shipowner or for underwriter) settles the ownership of salved goods, and ensures that any claim for salvage expenses will be sent directly to the underwriter. This is from the insured’s point of view desirable, and it greatly simplifies the management of salvage cases. As a claim for total loss cannot extend beyond the full amount insured in the policy, it follows that the documents required to substantiate such a claim must be supplied to the underwriter free of charge.

For the substantiation of a claim for particular average the following documents are required: (1) Protest of master or logbook. (2) Set of bills of lading (cargo claims). (3) Policy or certificate of insurance (endorsed if necessary). (4) Certified statements in detail of actual cash value at destination of goods in *damaged* state, all charges paid. Certified statements in detail of sound value at destination of goods on same day, all charges paid. Or original vouchers of costs of repair of ship, all discounts, rebates, allowances and returns deducted. (5) In the United States, subrogation to underwriters of damaged goods.

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Denis Weil, *Des assurances maritimes et des avaries* (Paris, 1879).

(W. Go.)

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1 *On the Effects of Selection*, by Emory McClintock (New York, 1892), p. 94.

2 As a result of investigation into the affairs of various American insurance companies in 1905 by a committee appointed by the state legislature of New York, a new law regulating life insurance down to the minutest details was passed in 1906 (ch. 326). The surrender value of a policy is to be the amount of insurance which the reserve, computed on the 4½% mortality table, standing to its credit, will purchase as a single premium. Other important features of the legislation are that no New York company may hold a contingency reserve beyond a fixed proportion of the net value of its policies; the limiting of types of policies permitted, the defining of the nature of investments permitted, and provisions for state supervision, valuation, and annual division of profits.

3 An important addition to the marine insurance law of the United Kingdom was made by the Marine Insurance (Gambling Policies) Act 1909, which made void policies taken out by persons uninterested in ships or cargo, who only gain by the loss of the vessel. Such policies are known as "policies proof of interest."

(P. P. I.)

4 Lord Mansfield expressed it: "The warranty in a contract of insurance is a condition or a contingency, and unless that be performed there is no contract" (*Hibbert* v. *Pigou*, *apud* Marshall, 3rd ed., p. 375).

INTAGLIO (an Ital. word, from *intagliare*, to incise, cut into), a form of engraving or carving, in which the pattern or design is sunk below the surface of the material thus treated, opposed to "cameo" or "relievo"—carving or engraving where the design is raised. Intaglio is thus applied to incised gems, as cameo (*q.v.*) to gems cut in relief (see Gems).

INTELLECT (Lat. *intellectus*, from *intelligere*, to understand), the general term for the mind in reference to its capacity for knowing or understanding. It is very vaguely used in common language. A man is described as "intellectual" generally because he is occupied with theory and principles rather than with practice, often with the further implication that his theories are concerned mainly with abstract matters: he is aloof from the world, and especially is a man of training and culture who cares little for the ordinary pleasures of sense. "Intellect" is thus distinguished from "intelligence" by the field of its operations, "intelligence" being used in the practical sphere for readiness to grasp a situation. (The employment of the word as a synonym for "news" is mere journalese; such phrases as "Intelligence Department" in connexion with newspapers and public offices are more justifiable.) In philosophy the "intellect" is contrasted with the senses and the will; it sifts and combines sense-given data, which otherwise would be only momentary, lasting practically only as long as the stimuli continued to operate. It thus includes the cognitive processes, and is the source of all real knowledge. Various attempts have been made to narrow the use of the term, *e.g.* to the higher regions of knowledge entirely above the region of sense (so Kant), or to conceptual processes; but no agreement has been reached. "Intellection" (*i.e.* the process as opposed to the capacity) has similarly been narrowed (*e.g.* by Professor James Ward) to the sphere of concepts; other writers, however, give it a much wider meaning. "Intellectualism" is a term given to any system which emphasizes the cognitive function; thus aesthetic intellectualism is that view of aesthetics which subordinates the sensual gratification or the delight in purely formal beauty to what may be called the ideal content.

INTELLIGENCE IN ANIMALS.[1] Professor G. J. Romanes, in his work on *Animal Intelligence* (1881), used the term "intelligence" as synonymous with "reason," and defined it as follows: "Reason or intelligence is the faculty which is concerned in the intentional adaptation of means to ends. It therefore implies the conscious knowledge of the relation between means employed and ends attained, and may be exercised in adaptation to circumstances novel alike to the

experience of the individual and that of the species." There is here some ambiguity as to the exact psychological significance of the words "intentional adaptation" and of the phrase "conscious knowledge of the relation between the means employed and the ends attained." A chick a day or two old learns to leave untouched nauseous caterpillars, and Romanes would certainly have regarded this as a case of intelligent profiting by experience; but how far there is intentional adaptation and whether the chick has conscious knowledge of the relation of means to ends, is doubtful, and, to say the least of it, open to discussion. St George Mivart, the acute dialectical opponent of Romanes, denied that animals are capable of the exercise of reason or intelligence. He urged that according to traditional views reason should denote and include all intellectual perception, whether it be direct and intuitive or indirect and inferential (*sensu stricto*), and contended that under neither head are to be included the sensuous perceptions and merely practical inferences of animals. Wasmann, who argues on similar grounds, regards such behaviour as that of the chicken as instinctive in the wider sense (see INSTINCT) and not intelligent; man alone, he contends, is intelligent, that is to say has the power of perceiving the relations of concepts to each other, and of drawing conclusions therefrom. It is clear that the discussion largely turns on the definition of terms; but more than this lies behind it. Both Mivart and Wasmann are emphatic in their assertions that instinctive modes of behaviour in the wider sense or the sensuous perceptions and practical inferences of animals differ fundamentally in kind from the rational or intelligent conduct of human folk, and that by no conceivable process of evolution could the one pass upwards into the other.

Wasmann regards the inclusion of those activities which result from sense-experience under the term "intelligence" as pseudo-psychological. To modern psychologists of standing we must therefore turn. Under the heading "Intellect or Intelligence," in the *Dictionary of Philosophy and Psychology*, G. F. Stout and J. Mark Baldwin say: "There is a tendency to apply the term intellect more especially to the capacity for conceptual thinking. This does not hold in the same degree of the connected word intelligence. We speak freely of 'animal intelligence,' but the phrase 'animal intellect' is unusual. However, the restriction of the term to conceptual process is by no means so fixed and definite as to justify us in including it in the definition." With respect to the word intellection again: "There is a tendency to restrict the term to conceptual thinking. Ward does so definitely and consistently. Croom-Robertson, on the other hand, gives the word the widest possible application, making it cover all forms of cognitive process. On the whole, if the term is to be employed at all, Robertson's usage appears preferable, as corresponding better to the generality of the words intellect and intelligence." It does not seem to be pseudo-psychological, therefore, to apply the term intelligence to the capacity, unquestionably possessed by animals, of profiting by sensory experience. The present writer has suggested that the term may be conveniently restricted to the capacity of guiding behaviour through perceptual process, reserving the terms intellect and reason for the so-called faculties which involve conceptual process. There are, however, advantages, as Stout and Baldwin contend, in employing the word in a somewhat wide and general sense. It is probably best for strictly psychological purposes to define somewhat strictly perceptual and conceptual (or ideational) process and to leave to intelligence the comparative freedom of a word to be used in general literature and therein defined by its context. It may be helpful, however, to place in tabular form the different uses above indicated:—

Psychological definition.

Perceptual Process.		*Conceptual Process.*
1. Instinct (wider sense).		Intelligence (*e.g.* Wasmann).
2. Sense-perception		Intelligence (*e.g.* Mivart).
3.	Intelligence	(*e.g.* Stout and Baldwin).
4. Intelligence.		Intellect and Reason (*e.g.* Lloyd Morgan).

From this table it may be seen at a glance that, with such divergence of usage, the application of the word "intelligent" to any given case of animal behaviour has in itself little psychological significance. If the psychological status of the animal is to be seriously discussed, the question to be answered is this: Are the observed activities explainable in terms of perceptual process only, or do they demand also a supplementary exercise of conceptual process? Granting that they are intelligent in the broad acceptation of the word, are they only perceptually intelligent or also conceptually intelligent?

It would require more space than is at our command to make the distinction which is drawn by those who use these terms clear and distinct; but enough may perhaps be said to enable the general reader to grasp the salient points. It will be convenient to take a concrete case. A chick in the performance of its truly instinctive activities pecks at all sorts of small objects. In doing so it gains a certain amount of initial experience. Very soon it may be observed that some grubs and caterpillars are seized with avidity whenever occasion offers; while others are after a few trials let alone.

Perceptual process.

Broadly speaking, we have here intelligent selection and rejection. Psychologically interpreted what is believed to take place is somewhat as follows. Each grub or caterpillar affords a visual impression or sensation. This as such is just a presentation to sight and nothing more. But in virtue of previous experience it suggests what was formerly presented to consciousness in that experience. It has meaning. An impression which carries meaning begotten of previous experience is raised to the level of a percept; and behaviour which is influenced and guided by such percepts, that is to say by impressions *and* the meaning for behaviour they suggest, is the outcome of perceptual process. If a dog learns to open a gate by lifting the latch, this may be due to perceptual process. Through previous experience the sight of the latch may suggest meaning for practical behaviour. His action may be simply due to the fact that the visual presentation has been directly associated with the appropriate bodily activities, and now by suggestion reinstates like activities; he may not, though on the other hand he may, exercise conceptual thought. Let us suppose that the chick which selects certain caterpillars and rejects others does form concepts. What does this imply from the standpoint of psychology? Stout and Baldwin define conception as the "cognition of a universal as distinguished from the particulars which it unifies. The universal apprehended in this way is called a concept." If then the chick apprehends the universal "good-for-eating" as exemplified in the particular maggot, and the maggot as a concrete case of the abstract and universal "good-for-eating," it has a capacity for conceptual thought. "There is one point in our definition," say Stout and Baldwin, "which requires to be specially emphasized. Conception is the cognition of a universal as distinguished from the particulars which it unifies. The words "as distinguished from" are of essential importance. The mere presence of a universal element in cognition does not constitute a concept. Otherwise all cognition would be conceptual. The simplest perception includes a universal.... The universal must be apprehended in antithesis to the particulars which it unifies." The general, or in technical phraseology, the universal characteristic "good-for-eating" is present in all that the chick practically finds to be edible; but the chick may just eat the nice caterpillars without thinking for a moment of edibility.

Conceptual process.

Few would dream of contending that the chick a few days old is capable of conceptual thought. Naïve perceptual process pretty obviously suffices for an explanation of the behaviour of the little bird. But so too, it may be said, does it suffice for the explanation of much of the practical behaviour of men. If a great number of the actions of animals are only perceptually intelligent, so too are a great number of the actions of men and women. This is unquestionably the case; and it serves to bring out the distinction in value which may be assigned to the percept and the concept respectively. The value of the percept is for simple direct practical behaviour; the value of the concept is for the elaboration of systematic knowledge. Any given impression may have meaning for behaviour in a given situation which is like that which has previously developed in a certain manner; but it may also have significance for the interpretation of such situations in a conceptual scheme of thought. The sight of the sage-blossom may have meaning for the bee which has sucked the sweets contained in such flowers; the sight of the bee in this situation may have significance for scientific interpretation as an example of the fertilization of flowers by insects. The bee may be only perceptually intelligent; the man who observes its action may or may not be conceptually intelligent.

Their value.

A good deal of human behaviour may be interpreted in terms of perceptual intelligence, and a far larger proportion of animal behaviour may be so interpreted. But some human conduct cannot be explained save as the outcome of conceptual intelligence. The question is, whether any carefully observed and well-authenticated cases of animal procedure are inexplicable in the absence of conceptual thought, and if so what concepts are necessarily involved? It is now conceded that the mere collection of anecdotes which result from casual as opposed to systematic observation can afford no satisfactory basis for an answer to this question. A solution can only be obtained by well-planned observations conducted by those who have an adequate psychological training. Even under these conditions a criterion of the presence or absence of conceptual factors is needed; and such a criterion is not easy to formulate or to apply.

If we institute inquiries with a view to ascertaining how the conceptual factor originates, it appears to be the result of analysis and abstraction, and to be reached by a process of comparison which becomes intentional and deliberate. If, for example, in educational procedure, we seek to assist children in forming concepts of colour, shape and material, we place before them a number of objects, some round, some square, some triangular; some red, some yellow, some blue; some made of paper, some of wood, some of flannel. Any given object is both red and square and made of flannel, blue and round and made of wood, and so on. We teach the child to group the objects, to put all the blues, yellows and reds together irrespective of shape or material; then all the rounds, squares and triangles together; then all which are made of like material. We thus help the children to grasp that though shape, colour and material are combined in each object, yet for the immediate purpose in hand one matters and the others do not matter. That which does matter is abstracted from the rest. The child has to analyse his experience and fix his attention

Development of concept.

on some given factor therein. He has to compare the objects intentionally, that is, for a definite end. He reaches, for example, the concept “blue” and realizes that the word may be applied to a number of particular objects differing in other respects, and that each is an example of what he understands by the word blue. Whether he could reach the concept without words is a question on which opinions differ.

Locke held that animals are incapable of the abstraction which is implied in such procedure. Dr Stout considers that observation of their behaviour shows little if any evidence of intentional comparison. And it is open to discussion whether they are able to analyse the situations opened up by their perceptual behaviour. The matter cannot be fully considered here. It must suffice if enough has been said to show the nature of the distinction between perceptual and conceptual process.

Are animals conceptually intelligent?

An example may, however, be given of the kind of observation which, since it was carefully planned and carried out, is of evidential value. Dr Alexander Hill’s fox terrier was “taught” to open the side door of a large box by lifting a projecting latch. When the door swung open he was never allowed to find anything in the box, but was given a piece of biscuit from the hand. Then a warm chop-bone was put inside the box, which was placed in a courtyard so that the dog would pass it when no one was near, though he could be watched from the window. Details of the terrier’s behaviour are given by Dr Hill in *Nature* (lxvii. 558, April 1903). The net result was that the dog failed to apply at once his quite familiar experience of lifting the latch in the usual way. Here two situations were presented; first the box with people around and a piece of biscuit to be obtained from one of them by lifting the latch; secondly the box with no one near and a redolent chop-bone inside. To us it is obvious enough that the lifted latch is the key to the development of both situations; we analyse them so as to get the essential factor which matters. The dog apparently did not do so. He seemingly was incapable of this modest amount of analysis and abstraction.

We can now see more clearly what was meant by saying that Romanes’ phrase (that intelligence “implies a conscious knowledge of the relation between means employed and ends attained”) is ambiguous. The dog which lifts the latch of a gate and goes out when the gate swings open undoubtedly employs means to reach an end; he need not analytically think the means as conducive to the end and the end as reached by the means; he need not conceive this relationship as exemplified in a number of particular cases; he need not cognize the universal as distinguished from the particulars. Perceptual experience, therefore, does not imply what Romanes states if his words are interpreted in terms of conception; it does, however, imply that the relationship is contained within the unanalysed whole of experience and is a factor contributing to an acquired mode of behaviour.

Ambiguity of phrase “conscious knowledge of means.”

Opinions differ as to how far, if at all, animals show what we are bound to interpret as the rudiments of conceptual thinking. It is perhaps best to regard the question as still *sub judice*. The evolutionist school, but not without exception, incline to the view that we find in animals the beginnings of conceptual experience; some are, however, of opinion that, in the absence of language, conceptual analysis is well-nigh impossible, and in any case cannot be carried far. To an evolutionist the assertion that conceptual intelligence could not conceivably have had a natural genesis from perceptual experience, appears to be made on grounds other than scientific. Few if any psychologists contend, on strictly psychological grounds, for a distinction of kind such as Mivart and Wasmann postulate. Conscious experience is indeed *sui generis* and is distinct in kind from the energy with which the physicist or the physiologist has to deal; but within conscious experience from its earliest manifestation to its latest development scientific psychology only recognizes differences of mode.

In individual development the earliest manifestation of experience is the conscious accompaniment or concomitant of that type of organic behaviour which includes all reflex and instinctive acts. This affords the primordial tissue of experience, including a conscious awareness of the stimulating presentations which initiate organic behaviour and the kinaesthetic presentations which accompany it. Thus arises an awareness of the development of the instinctive situation. Perceptual intelligence depends upon associative re-presentation—the earlier phases of a presented situation calling up a revival of the whole previous experience before its later phases are again actually presented. Through the process of inhibition, to the clearer understanding of which physiology is daily contributing fresh data, the actual development through behaviour of the later phases of the situation is checked, and an acquired modification of the behaviour results. The whole range of perceptual intelligence in animals illustrates the manner in which accommodation to varied circumstances is reached. On these foundations in varied experience conceptual intelligence is developed. The early stages of its development, whether in the child, in whom it unquestionably occurs, or in the higher animals, in which it is not improbably incipient, are difficult to determine on the basis of observation of its expression in behaviour or conduct. But the distinguishing features of conceptual as contrasted with perceptual intelligence

Stages of development.

are the comparison of situations with a view to their analysis, the disentangling of factors which are of importance for some purpose of interpretation or of conduct, and the attitude of mind which is expressed by saying that the particular case is an example of what experience has shown to be, in technical phrase, universal, and is realized as such. Under the comprehensive phrase, intelligence in animals, this may or may not be included.

For literature, see under INSTINCT.

(C. LL. M.)

1 For a discussion of human intelligence, see PSYCHOLOGY.

INTENDANT (from Lat. *intendens*, pres. part. of *intendere*, to apply the mind to, to watch over; cf. "superintendent"), the name used in early times in France to designate a functionary invested by the king with an important and durable commission.[1] As early as the 14th century the title of *intendentes* or *superintendentes financiarum* was given to the commissaries appointed by the king to levy the *aides*, or temporary subsidies. In the 16th century Francis I. created the *intendants des finances*, permanent functionaries who formed the central and superior administration in financial matters. They took the place of the *généraux des finances* and the "treasurers of France," who became provincial functionaries in the various *généralités*. The *intendants des finances* existed until the end of the *ancien régime*; they were at first under the authority of the *surintendant*, and subsequently under that of the *contrôleur général des finances*. The *intendants des provinces* date from the last thirty years of the 16th century. They were commissaries sent by the king with wide powers to restore order in the provinces after the civil wars. Their functions were at first extraordinary and temporary, but a few were retained as permanent state officials, and in course of time they came to be fairly generally distributed over the whole kingdom. The existing territorial divisions were not disturbed, each *intendant* being placed over a *généralité*, save in some cases where slight modifications were necessary for administrative purposes. In their functions, however, there is another element worthy of notice. In the 13th and 14th centuries the monarchy had organized a species of inspection (*chevauchée*) over the provincial functionaries, which was performed by the *maîtres des requêtes*, and this the reform ordinances of the 16th century sought to revive. This inspectorate passed to the *intendant*, who became the resident local inspector and supervisor of all the other functionaries in his district; its connexion with the old *chevauchée* is plainly shown by the fact that the intendants were almost invariably selected from the *maîtres des requêtes*. The early intendants had naturally been largely concerned with the troops; eventually special military intendants (the only ones that exist in modern French law) were created, but the *intendants des provinces* retained certain military duties, notably those relating to the housing of the troops.

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The early intendants were called indifferently *intendants de justice* or *intendants de finances*, their full official title being *intendants de justice, police et finances, et commissaires, départis dans les généralités du royaume pour l'exécution des ordres de Sa Majesté*. This title shows the wide range of their duties, the word "*police*" in this connexion connoting general administration. Not being officers of the king, but merely commissaries, they could always be recalled, and their powers were fixed by the commission they received from the king. As their functions became pre-eminently administrative the laws of the 17th and 18th centuries referred many questions to their decision, and, in this respect, their powers were determined by law. They became the direct general representatives of the king in each *généralité*, with authority over the other officials, whom they were empowered to censure, suspend or sometimes even replace. They were in constant touch with the king's council, with which they were connected by their original rights as *maîtres des requêtes*. In the first half of the 17th century they encountered some opposition from the governors of provinces, who had formerly been the direct political representatives of the crown, and also from the parliaments, which traditionally intervened in the administration, especially by means of *arrêts de règlement* (decisions, from which there was no appeal, regulating questions of procedure, civil law or custom). The intendants, however, were energetically supported, and so complete was their triumph that in the 18th century governors of provinces could not enter upon their duties without formal *lettres de résidence*.

The intendants had wide powers in the drawing by lot of the militia and in the royal *corvées* for the making and repair of the high roads, and were largely concerned with the administration of the *taille*, in which they effected useful reforms. They were the sole administrators of the principal direct and indirect imposts created in the second half of the 17th century and in the 18th century, and had full powers to settle disputes arising out of these taxes. Owing to the vast size of the districts allotted to the intendants (there were no more than thirty-two intendants in 1788), they often felt the need of assistants. As commissaries of the king, they could delegate

their powers to *sub-délégués*, who were, however, not royal officials, but merely mandatories of the intendant. Decisions of the intendant could be carried to the king's council, and those of the *sub-délégué* to the intendant.

See Gabriel Hanotaux, *Origines de l'institution des intendants des provinces* (1884); D'Arbois de Jubainville, *L'Administration des intendants d'après les archives de l'Aube* (1880); P. Ardascheff, *Provintzalnaya administratsiya vo Frantsii ve poshednoyo porou starago poryadka: provintsialny Intendanty* (St Petersburg, 1900-1906).

(J. P. E.)

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1 In Germany the title *Intendant* is applied to the head of public institutions, more particularly to the high officials in charge of court theatres, royal gardens, palaces and the like. The director of certain civic theatres is now also sometimes styled Intendant. The title *Generalintendant* implies the same official duties, but higher rank. In the German army the *Intendantur* corresponds to the British quartermaster-general's and financial departments of the War Office, the French *intendance militaire*. Subordinate to these are the *intendances* (*Intendanturen*) under general officers commanding, the heads of which are in Germany called *Korpsintendanten*, and in France *intendants-généraux*, *intendants militaires*, &c. (see Army, § 58).

INTENT (from Lat. *intendere*, to stretch out, extend, particularly in the phrase *intendere animum*, to turn one's mind to, purpose), in law, the purpose or object with which an act is done. The question of intent is important with reference both to civil and criminal responsibility. Briefly, it may be said that in criminal law the constituent element of an offence is the *mens rea* or the guilty intent. The commission of an act without the intent is not, as a general rule, sufficient to constitute a crime, nor, on the other hand, does the existence of a guilty intent without commission of the act amount to the legal conception of a crime (see Criminal Law). In the case of civil wrongs, in general, the opposite holds good. A wrongful act done to the person or property of another carries with it legal liability, irrespective of the motive with which the act was done (see Tort). In reference to the construction of contracts, wills and other documents, the question of intention is material as showing the sense and meaning of the words used, and what they were intended to effect.

INTERAMNA LIRENAS, an ancient town of Italy in the Volscian territory near the modern Pignataro Interamna, 5 m. S.E. of Aquinum; the additional name distinguishes it from Interamna Praetuttianorum (mod. Teramo) and Interamna Nahartium (mod. Terni). It was founded by the Romans as a Latin colony in 312 B.C. as a military base in the war against Samnium, no fewer than 4000 colonists being sent thither. It was among the Latin colonies which in 209 B.C. refused to supply further contingents or money for the Hannibalic war. It became a *municipium* with the other Latin colonies, but we hear no more of it—mainly, no doubt, because it lay off the Via Latina. Livy's description of it as on the Via Latina is not strictly accurate, and cannot be used as an indication that the former course of the Via Latina was through Interamna. The city lay on a hill on the N. bank of the Liris, between two of its tributaries, thus lacking natural defences on the N. side alone. Many inscriptions have been found, and there are considerable remains of antiquity. One inscription bears the date A.D. 408, and the site was occupied in the middle ages by a castle called Terame or Termine.

(T. As.)

INTERCALARY (from Lat. *intercalare*, to proclaim, *calare*, the insertion of a day in the calendar), a term applied to a month, day or days inserted between other months or days in order to adjust the reckoning of time, based on the revolution of the earth round the sun, the day, and of the moon round the earth, the lunar month, to the revolution of the earth round the sun, the solar year (see Calendar). From the meaning of something inserted or placed between, intercalary is used for something which interrupts a series, or comes between two types. In botany, the term is used of growth which is not apical but somewhere between the apex and

base of an organ, such as the growth in length of an Iris leaf, or of the internode of a grass-haulm.

INTERCOLUMNIATION, in architecture, the distance between the columns of a peristyle, generally referred to in terms of the lower diameter of the column. They are thus set forth by Vitruvius (iii. 2): (*a*) Pycnostyle, equal to 1½ diameters; (*b*) Systyle, 2 diameters; (*c*) Eustyle, 2¼ diameters (which was the proportion preferred by him); (*d*) Diastyle, 3 diameters; and (*e*) Araeostyle or wide spaced, 4 diameters, a span only possible when the architrave was in wood. Vitruvius's definition would seem to apply only to examples with which he was acquainted in Rome, or to Greek temples described by authors he had studied. In the earlier Doric temples the intercolumniation is sometimes less than one diameter, and it increases gradually as the style developed; thus in the Parthenon it is 1¼, in the Temple of Diana Propylaea at Eleusis, 1¼; and in the portico at Delos, 2½. The intercolumniations of the columns of the Ionic Order are greater, averaging 2 diameters, but then the relative proportion of height to diameter in the column has to be taken into account, as also the width of the peristyle. Thus in the temple of Apollo Branchidae, where the columns are slender and over 10 diameters in height, the intercolumniation is 1¾, notwithstanding its late date, and in the Temple of Apollo Smintheus in Asia Minor, in which the peristyle is pseudodipteral, or double width, the intercolumniation is just over 1½. Temples of the Corinthian Order follow the proportions of those of the Ionic Order.

INTERDICT (Lat. *interdictum*, from *interdicere*, to forbid by decree, lit., interpose by speech), in its full technical sense as an ecclesiastical term, a sentence by a competent ecclesiastical authority forbidding all celebration of public worship, the administration of some sacraments (baptism, confirmation and penance are permitted) and ecclesiastical burial. From general interdicts, however, are excepted the feast days of Christmas, Easter, Whitsunday, the Assumption and Corpus Christi. An interdict may be either local, personal or mixed, according as it applies to a locality, to a particular person or class of persons, or to a particular locality as long as it shall be the residence of a particular person or class of persons. Local interdicts again may be either general or particular; in the latter instance they refer only to particular buildings set apart for religious services. An interdict is a measure which seeks to punish a population or a religious body (*e.g.* a chapter) for the fault of some only of its members, who cannot be reached separately. It is a penalty directed against society rather than against individuals. In 869 Hincmar of Laon laid his entire diocese under an interdict, a proceeding for which he was severely censured by Hincmar of Reims. In the *Chronicle* of Ademar of Limoges (*ad ann.* 994) it is stated that Bishop Alduin introduced there "a new plan for punishing the wickedness of his people; he ordered the churches and monasteries to cease from divine worship and the people to abstain from divine praise, and this he called excommunication" (see Gieseler, *Kirchengesch*. iii. 342, where also the text is given of a proposal to a similar effect made by Odolric, abbot of St Martial, at the council of Limoges in 1031). It was not until the 11th century that the use of the interdict obtained a recognized place among the means of discipline at the disposal of the Roman hierarchy, which used it, without great success, to bring back the secular authorities to obedience. Important historical instances of the use of the interdict occur in the cases of Scotland under Pope Alexander III. in 1181, of France under Innocent III. in 1200, and of England under the same pope in 1209. So far as the interdict is "personal," that is to say, applied to a particular individual, it may be regarded as a kind of partial excommunication; for instance, a bishop may, for certain faults, be interdicted from entering the church (*ab ingressu ecclesiae*), that is, without being excommunicated, he must not celebrate or assist at the celebration of divine offices. Interdicts cease at the expiration of the term, or by removal (*relaxatio*). General and local interdicts are no longer in use.

See the canonists in tit. 39 *lib.* v., *De sententia excommun.*, &c.; L. Ferraris, *Prompta bibliotheca canonica*, &c., s.v. "Interdictum."

Interdict, in Scots law, is an order of court pronounced on cause shown for stopping any proceedings complained of as illegal or wrongful. It may be resorted to as a remedy against all encroachments either on property or possession. For the analogous English practice see INJUNCTION.

INTERDICTION, in Scots law, a process of restraint applied to prodigals and others who, "from weakness, facility or profusion, are liable to imposition." It is either voluntary or judicial. Voluntary interdiction is effected by the prodigal himself, who executes a bond obliging himself to do no deed which may affect his estate without the assent of certain persons called the "interdictors." This may be removed by the court of session, by the joint act of the interdictors and the interdicted, and by the number of interdictors being reduced below the number constituting a quorum. Judicial interdiction is imposed by order of the court, either moved by an interested party or acting in the exercise of its *nobile officium*, and can only be removed by a similar order. Deeds done by the interdicted person, so far as they affect or purport to affect his heritable estate, are reducible, unless they have been done with the consent of the interdictors. Interdiction has no effect, however, on movable property.

INTERESSE TERMINI (Lat. for "interest in a term"), in law, an executory interest, being the right of entry which the grant of a lease confers upon a lessee. Actual entry on the lands by the lessor converts the right into an estate. If the lease, however, has been created by a bargain and sale or by any other conveyance under the Statute of Uses, which does not require an entry, the term vests in the lessee at once. An *interesse termini* gives a cause of action against any person through whose action entry by the lessee or delivery of possession to him may have been prevented. An *interesse termini* is a right *in rem*, alienable at common law, and transmissible to the executors of the lessee.

INTEREST, etymologically a state or condition of being concerned in or having a share in anything, hence a legal or other claim to or share in property, benefits or advantages. Further developments of meaning are found in the application of the word to the benefits, advantages, matters of importance, &c., in which "interest" or concern can be felt, and to the feeling of concern so excited; hence also the word is used of the persons who have a concern in some common "interest," *e.g.* the trading or commercial interest, and of the personal or other influence due to a connexion with specific "interests." The word is derived from the Latin *interesse* (literally "to be between"), to make a difference, to concern, be of importance. The form which the word takes in English is a substantival use of the 3rd person singular of the present indicative of the Latin verb, and is due to a similar use in French of the older *interest*, modern *intérêt*. The earlier English word was *interess*, which survived till the end of the 17th century; the earliest example of "interest" in the *New English Dictionary* is from the *Rolls of Parliament* of 1450.

These meanings of "interest" are plainly derived from the ordinary uses of the Latin *interesse*. The origin of the application of the word to the compensation paid for the use of money or for the forbearance of a debt, with which, as far as present English law is concerned, this article deals, forms part of the history of Usury and Money-Lending (*q.v.*). By Roman law, where one party to a contract made default, the other could enforce, over and above the fulfilment of the agreement, compensation based on the difference (*id quod interest*) to the creditor's position caused by the default of the debtor, which was technically known as *mora*, delay. This difference could be reckoned according as actual loss had accrued, and also on a calculation of the profit that might have been made had performance been carried out. Now this developed the canonist doctrine of *damnum emergens* and *lucrum cessans* respectively, which played a considerable part in the breaking down of the ecclesiastical prohibition of the taking of usury. The medieval lawyers used the phrase *damna et interesse* (in French *dommages et intérêts*) for such compensation by way of damages for the non-fulfilment of a contract, and for damages and indemnity generally. Thus *interesse* and *intérêt* came to be particularly applied to the charge for the use of money disguised by a legal fiction under the form of an indemnity for the failure to perform a contract.

At English common law an agreement to pay interest is not implied unless in the case of negotiable instruments, when it is supported by mercantile usage. As a general rule therefore

debts certain, payable at a specified time, do not carry interest from that time unless there has been an express agreement that they should do so. But when it has been the constant practice of a trade or business to charge interest, or where as between the parties interest has been always charged and paid, a contract to pay interest is implied. It is now provided by the Civil Procedure Act 1833 that, “upon all debts or sums certain payable at a certain time or otherwise, the jury on the trial of any issue or in any inquisition of damages *may* if they shall think fit allow interest to the creditor at a rate not exceeding the current rate of interest, from the time when such debts or sums certain were payable, if such debts or sums be payable by virtue of some written instrument at a certain time; or if payable otherwise, then from the time when demand of payment shall have been made in writing, so as such demand shall give notice to the debtor that interest will be claimed from the date of such demand until the term of payment: provided that interest shall be payable in all cases in which it is now payable by law.” Compound interest requires to be supported by positive proof that it was agreed to by the parties; an established practice to account in this manner will be evidence of such an agreement. When interest is awarded by a court it is generally at the rate of 4%; under special circumstances 5% has been allowed.

INTERFERENCE OF LIGHT. § 1. This term[1] and the ideas underlying it were introduced into optics by Thomas Young. His Bakerian lecture on “The Theory of Light and Colours” (*Phil. Trans.*, 1801) formulated the following hypotheses and propositions, and thereby laid the foundations of the wave theory:—

Hypotheses.

(i.) A luminiferous aether pervades the universe, rare and elastic in a high degree.

(ii.) Undulations are excited in this aether whenever a body becomes luminous.

(iii.) The sensation of different colours depends on the different frequency of vibrations excited by the light in the retina.

(iv.) All material bodies have an attraction for the aethereal medium, by means of which it is accumulated in their substance, and for a small distance around them, in a state of greater density but not of greater elasticity.

Propositions.

(i.) All impulses are propagated in a homogeneous elastic medium with an equable velocity.

(ii.) An undulation conceived to originate from the vibration of a single particle must expand through a homogeneous medium in a spherical form, but with different quantities of motion in different parts.

(iii.) A portion of a spherical undulation, admitted through an aperture into a quiescent medium, will proceed to be further propagated rectilinearly in concentric superfices, terminated laterally by weak and irregular portions of newly diverging undulations.

(iv.) When an undulation arrives at a surface which is the limit of mediums of different densities, a partial reflection takes place, proportionate in force to the difference of the densities.

(v.) When an undulation is transmitted through a surface terminating different mediums, it proceeds in such a direction that the sines of the angles of incidence and refraction are in the constant ratio of the velocity of propagation in the two mediums.

(vi.) When an undulation falls on the surface of a rarer medium, so obliquely that it cannot be regularly refracted, it is totally reflected at an angle equal to that of its incidence.

(vii.) If equidistant undulations be supposed to pass through a medium, of which the parts are susceptible of permanent vibrations somewhat slower than the undulations, their velocity will be somewhat lessened by this vibratory tendency; and, in the same medium, the more, as the undulations are more frequent.

(viii.) When two undulations, from different origins, coincide either perfectly or very nearly in direction, their joint effect is a combination of the motions belonging to each.

(ix.) Radiant light consists in undulations of the luminiferous aether.

In the *Philosophical Transactions* for 1802, Young refers to his discovery of "a simple and general law." The law is that "wherever two portions of the same light arrive at the eye by different routes, either exactly or very nearly in the same direction, the light becomes most intense where the difference of the routes is a multiple of a certain length, and least intense in the intermediate state of the interfering portions; and this length is different for light of different colours."

This appears to be the first use of the word *interfering* or *interference* as applied to light. When two portions of light by their co-operation cause darkness, there is certainly "interference" in the popular sense; but from a mechanical or mathematical point of view, the superposition contemplated in proposition viii. would more naturally be regarded as taking place without interference. Young applied his principle to the explanation of colours of striated surfaces (gratings), to the colours of thin plates, and to an experiment which we shall discuss later in the improved form given to it by Fresnel, where a screen is illuminated simultaneously by light proceeding from two similar sources. As a preliminary to these explanations we require an analytical expression for waves of simple type, and an examination of the effects of compounding them.

§ 2. *Plane Waves of Simple Type.*—Whatever may be the character of the medium and of its vibration, the analytical expression for an infinite train of plane waves is

$$A\cos\left\{\frac{2\pi}{\lambda}(Vt-x)+\alpha\right\} \tag{1},$$

in which λ represents the wave-length, and V the corresponding velocity of propagation. The coefficient A is called the amplitude, and its nature depends upon the medium and may here be left an open question. The phase of the wave at a given time and place is represented by α. The expression retains the same value whatever integral number of wave-lengths be added to or subtracted from x. It is also periodic with respect to t, and the period is

$$\tau = \lambda/V \tag{2}.$$

In experimenting upon sound we are able to determine independently τ, λ, and V; but on account of its smallness the periodic time of luminous vibrations eludes altogether our means of observation, and is only known indirectly from λ and V by means of (2).

There is nothing arbitrary in the use of a circular function to represent the waves. As a general rule this is the only kind of wave which can be propagated without a change of form; and, even in the exceptional cases where the velocity is independent of wave-length, no generality is really lost by this procedure, because in accordance with Fourier's theorem any kind of periodic wave may be regarded as compounded of a series of such as (1), with wave-lengths in harmonical progression.

A well-known characteristic of waves of type (1) is that any number of trains of various amplitudes and phases, but of the *same wave-length*, are equivalent to a single train of the same type. Thus

$$\begin{aligned}\Sigma A\cos\left\{\frac{2\pi}{\lambda}(Vt-x)+\alpha\right\} &= \Sigma A\cos\alpha\cdot\cos\frac{2\pi}{\lambda}(Vt-x)-\Sigma A\sin\alpha\cdot\sin\frac{2\pi}{\lambda}(Vt-x)\\ &= P\cos\left\{\frac{2\pi}{\lambda}(Vt-x)+\varphi\right\}\end{aligned} \tag{3},$$

where

$$P^2 = (\Sigma A\cos\alpha)^2 = \Sigma(A\sin\alpha)^2 \tag{4},$$

$$\tan\varphi = \frac{\Sigma(A\sin\alpha)}{\Sigma(A\cos\alpha)} \tag{5}.$$

An important particular case is that of two component trains only.

$$\begin{aligned}A\cos\left\{\frac{2\pi}{\lambda}(Vt-x)+\alpha\right\} + A'\cos\left\{\frac{2\pi}{\lambda}(Vt-x)+\alpha'\right\}\\ = P\cos\left\{\frac{2\pi}{\lambda}(Vt-x)+\varphi\right\},\end{aligned}$$

where

$$P^2 = A^2 + A'^2 + 2AA'\cos(\alpha-\alpha') \tag{6}.$$

The composition of vibrations of the same period is precisely analogous, as was pointed out by Fresnel, to the composition of forces, or indeed of any other two-dimensional vector quantities. The magnitude of the force corresponds to the amplitude of the vibration, and the inclination of the force corresponds to the phase. A group of forces, of equal intensity, represented by lines drawn from the centre to the angular points of a regular polygon, constitute a system in

equilibrium. Consequently, a system of vibrations of equal amplitude and of phases symmetrically distributed round the period has a zero resultant.

According to the phase-relation, determined by $(\alpha - \alpha')$, the amplitude of the resultant may vary from $(A - A')$ to $(A + A')$. If A' and A are equal, the minimum resultant is zero, showing that two equal trains of waves may neutralize one another. This happens when the phases are opposite, or differ by half a (complete) period, and the effect is that described by Young as "interference."

§ 3. *Intensity.*—The intensity of light of given wave-length must depend upon the amplitude, but the precise nature of the relation is not at once apparent. We are not able to appreciate by simple inspection the relative intensities of two unequal lights; and, when we say, for example, that one candle is twice as bright as another, we mean that two of the latter burning independently would give us the same light as one of the former. This may be regarded as the definition; and then experiment may be appealed to to prove that the intensity of light from a given source varies inversely as the square of the distance. But our conviction of the truth of the law is perhaps founded quite as much upon the idea that something not liable to loss is radiated outwards, and is distributed in succession over the surfaces of spheres concentric with the source, whose areas are as the squares of the radii. The something can only be energy; and thus we are led to regard the rate at which energy is propagated across a given area parallel to the waves as the measure of intensity; and this is proportional, not to the first power, but to the *square* of the amplitude.

§ 4. *Resultant of a Large Number of Vibrations of Arbitrary Phase.*—We have seen that the resultant of two vibrations of equal amplitude is wholly dependent upon their phase-relation, and it is of interest to inquire what we are to expect from the composition of a large number (n) of equal vibrations of amplitude unity, and of arbitrary phases. The intensity of the resultant will of course depend upon the precise manner in which the phases are distributed, and may vary from n^2 to zero. But is there a definite intensity which becomes more and more probable as n is increased without limit?

The nature of the question here raised is well illustrated by the special case in which the possible phases are restricted to two *opposite* phases. We may then conveniently discard the idea of phase, and regard the amplitudes as at random *positive or negative*. If all the signs are the same, the intensity is n^2; if, on the other hand, there are as many positive as negative, the result is zero. But, although the intensity may range from 0 to n^2, the smaller values are much more probable than the greater.

The simplest part of the problem relates to what is called in the theory of probabilities the "expectation" of intensity, that is, the mean intensity to be expected after a great number of trials, in each of which the phases are taken at random. The chance that all the vibrations arc positive is 2^{-n}, and thus the expectation of intensity corresponding to this contingency is $2^{-n} \cdot n^2$. In like manner the expectation corresponding to the number of positive vibrations being $(n - 1)$ is

$$2^{-n} \cdot n \cdot (n - 2)^2,$$

and so on. The whole expectation of intensity is thus

$$\frac{1}{2^n} \left\{ 1 \cdot n^2 + n \cdot (n - 2)^2 + \frac{n(n-1)}{1 \cdot 2} (n - 4)^2 + \frac{n\,(n-1)\,(n-2)}{1 \cdot 2 \cdot 3} (n - 6)^2 + \ldots \right\} \qquad (1).$$

Now the sum of the $(n + 1)$ terms of this series is simply n, as may be proved by comparison of coefficients of x^2 in the equivalent forms

$$(e^x + e^{-x})^n = 2^n \left(1 + \tfrac{1}{2}\, x^2 + \ldots\right)^n$$

$$= e^{nx} + n e^{(n-2)x} + \frac{n\,(n-1)}{1 \cdot 2}\, e^{(n-4)x} + \ldots$$

The expectation of intensity is therefore n, and this whether n be great or small.

The same conclusion holds good when the phases are unrestricted. From (4), § 2, if $A = 1$,

$$P^2 = n + 2\Sigma \cos(\alpha_2 - \alpha_1) \qquad (2),$$

where under the sign of summation are to be included the cosines of the $\tfrac{1}{2}\, n(n - 1)$ differences of phase. When the phases are arbitrary, this sum is as likely to be positive as negative, and thus the mean value of P^2 is n.

The reader must be on his guard here against a fallacy which has misled some high authorities. We have not proved that when n is large there is any tendency for a single combination to give the intensity equal to n, but the quite different proposition that in a large number of trials, in each of which the phases are rearranged arbitrarily, the *mean* intensity will tend more and more

to the value n. It is true that even in a single combination there is no reason why any of the cosines in (2) should be positive rather than negative, and from this we may infer that when n is increased the sum of the terms tends to vanish in comparison with the number of terms. But, the number of terms being of the order n^2, we can infer nothing as to the value of the sum of the series in comparison with n.

Indeed it is not true that the intensity in a single combination approximates to n, when n is large. It can be proved (*Phil. Mag.*, 1880, 10, p. 73; 1899, 47. p. 246) that the probability of a resultant intermediate in amplitude between r and r + dr is

$$\frac{2}{n} e^{-r^2/n} r\, dr \qquad (3).$$

The probability of an amplitude less than r is thus

$$\frac{2}{n} \int_0^r e^{-r^2/n} r\, dr = 1 - e^{-r^2/n} \qquad (4),$$

or, which is the same thing, the probability of an amplitude greater than r is

$$e^{-r^2/n} \qquad (5).$$

The accompanying table gives the probabilities of intensities less than the fractions of n named in the first column. For example, the probability of intensity less than n is .6321.

.05	.0488	.80	.5506
.10	.0952	1.00	.6321
.20	.1813	1.50	.7768
.40	.3296	2.00	.8647
.60	.4512	3.00	.9502

It will be seen that, however great n may be, there is a fair chance of considerable relative fluctuations of intensity in consecutive combinations.

The *mean* intensity, expressed by

$$\frac{2}{n} \int_0^\infty e^{-r^2/n} \cdot r^2 \cdot r\, dr,$$

is, as we have already seen, equal to n.

It is with this mean intensity only that we are concerned in ordinary photometry. A source of light, such as a candle or even a soda flame, may be regarded as composed of a very large number of luminous centres disposed throughout a very sensible space; and, even though it be true that the intensity at a particular point of a screen illuminated by it and at a particular moment of time is a matter of chance, further processes of averaging must be gone through before anything is arrived at of which our senses could ordinarily take cognizance. In the smallest interval of time during which the eye could be impressed, there would be opportunity for any number of rearrangements of phase, due either to motions of the particles or to irregularities in their modes of vibration. And even if we supposed that each luminous centre was fixed, and emitted perfectly regular vibrations, the manner of composition and consequent intensity would vary rapidly from point to point of the screen, and in ordinary cases the mean illumination over the smallest appreciable area would correspond to a thorough averaging of the phase-relationships. In this way the idea of the intensity of a luminous source, independently of any questions of phase, is seen to be justified, and we may properly say that two candles are twice as bright as one.

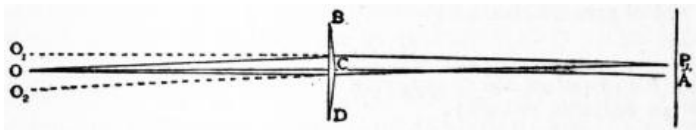

FIG. 1.

§ 5. *Interference Fringes.*—In Fresnel's fundamental experiment light from a point O (fig. 1) falls upon an isosceles prism of glass BCD, with the angle at C very little less than two right angles. The source of light may be a pin-hole through which sunlight enters a dark room, or, more conveniently, the image of the sun formed by a lens of short focus (1 or 2 in.). For actual experiment when, as usually happens, it is desirable to economize light, the *point* may be replaced by a *line* of light perpendicular to the plane of the diagram, obtained either from a linear source, such as the filament of an incandescent electric lamp, or by admitting light through a narrow vertical slit.

If homogeneous light be used, the light which passes through the prism will consist of two parts, diverging as if from points O_1 and O_2 symmetrically situated on opposite sides of the line CO. Suppose a sheet of paper to be placed at A with its plane perpendicular to the line OCA, and let us consider what illumination will be produced at different parts of this paper. As O_1 and O_2 are images of O, crests of waves must be supposed to start from them simultaneously. Hence they will arrive simultaneously at A, which is equidistant from them, and there they will reinforce one another. Thus there will be a bright band on the paper parallel to the edges of the prism. If P_1 be chosen so that the difference between P_1O_2 and P_1O_1 is half a wave-length (*i.e.* half the distance between two successive crests), the two streams of light will constantly meet in such relative conditions as to destroy one another. Hence there will be a line of darkness on the paper, through P_1, parallel to the edges of the prism. At P_2, where O_2P_2 exceeds O_1P_2 by a whole wave-length, we have another bright band; and at P_3, where O_2P_3 exceeds O_1P_3 by a wave-length and a half, another dark band; and so on. Hence, as everything is symmetrical about the bright band through A, the screen will be illuminated by a series of bright and dark bands, gradually shading into one another. If the paper screen be moved parallel to itself to or from the prism, the locus of all the successive positions of any one band will (by the nature of the curve) obviously be an hyperbola whose foci are O_1 and O_2. Thus the interval between any two bands will increase in a more rapid ratio than does the distance of the screen from the source of light. But the intensity of the bright bands diminishes rapidly as the screen moves farther off; so that, in order to measure their distance from A, it is better to substitute the eye (furnished with a convex lens) for the screen. If we thus measure the distance AP_1 between A and the nearest bright band, measure also AO, and calculate (from the known material and form of the prism, and the distance CO) the distance O_1O_2, it is obvious that we can deduce from them the lengths of O_1P_2 and O_2P_2. Their difference is the *length of a wave* of the homogeneous light experimented with. Though this is not the method actually employed for the purpose (as it admits of little precision), it has been thus fully explained here because it shows in a very simple way the possibility of measuring a wave-length.

The difference between O_1P_1 and O_2P_1 becomes greater as AP_1 is greater. Thus it is clear that the bands are *more widely separated the longer the wave-length of the homogeneous light employed*. Hence when we use white light, and thus have systems of bands of every visible wave- 687
length superposed, the band A will be red at its edges, the next bright bands will be blue at their inner edges and red at their outer edges. But, after a few bands are passed, the bright bands due to one kind of light will gradually fill up the dark bands due to another; so that, while we may count hundreds of successive bright and dark bars when homogeneous light is used, with white light the bars become gradually less and less defined as they are farther from A, and finally merge into an almost uniform white illumination of the screen.

If D be the distance from O to A, and P be a point on the screen in the neighbourhood of A, then approximately

$$O_1P - O_2P = \sqrt{\{ D^2 + (u + \tfrac{1}{2}b)^2 \}} - \sqrt{\{ D^2 + (u - \tfrac{1}{2}b)^2 \}} = ub / D,$$

where $O_1O_2 = b$, $AP = u$.

Thus, if λ be the wave-length, the places where the phases are accordant are given by

$$u = n\lambda D / b \qquad (1),$$

n being an integer.

If the light were really homogeneous, the successive fringes would be similar to one another and unlimited in number; moreover there would be no place that could be picked out by inspection as the centre of the system. In practice λ varies, and (as we have seen) the only place of complete accordance for all kinds of light is at A, where $u = 0$. Theoretically, there is no place of complete discordance for all kinds of light, and consequently no complete blackness. In consequence, however, of the fact that the range of sensitiveness of the eye is limited to less than an “octave,” the centre of the first dark band (on either side) is sensibly black, even when white light is employed; but it should be carefully remarked that the existence of even one band is due to selection, and that the formation of several visible bands is favoured by the capability of the retina to make chromatic distinctions within the visible range.

The number of perceptible bands increases *pari passu* with the approach of the light to homogeneity. For this purpose there are two methods that may be used.

We may employ light, such as that from the soda flame, which possesses *ab initio* a rather high degree of homogeneity. If the range of wave-length included be $\frac{1}{50000}$, a corresponding number of interference fringes may be made visible. The above was the number obtained by A. H. L. Fizeau. Using vacuum tubes containing, for example, mercury or cadmium vapour, A. A. Michelson has been able to go much farther. The narrowness of the bright line of light seen in the spectroscope, and the possibility of a large number of Fresnel’s bands, depend upon precisely the same conditions; the one is in truth as much an interference phenomenon as the other.

In the second method the original light may be highly composite, and homogeneity is brought

about with the aid of a spectroscope. The analogy with the first method is closest if we use the spectroscope to give us a line of homogeneous light in simple substitution for the artificial flame. Or, following J. B. L. Foucault and Fizeau, we may allow the white light to pass, and subsequently analyse the mixture transmitted by a narrow slit in the screen upon which the interference bands are thrown. In the latter case we observe a channelled spectrum, with maxima of brightness corresponding to the wave-lengths bu/(nD). In either case the number of bands observable is limited solely by the resolving power of the spectroscope, and proves nothing with respect to the regularity, or otherwise, of the vibrations of the original light.

In lieu of the biprism, reflectors may be invoked to double the original source of light. In one arrangement two reflected images are employed, obtained from two reflecting surfaces nearly parallel and in the same plane. Glass, preferably blackened behind, may be used, provided the incidence be made sufficiently oblique. In another arrangement, due to H. Lloyd, interference takes place between light proceeding directly from the original source, and from one reflected image. Lloyd's experiment deserves to be better known, as it may be performed with great facility and without special apparatus. Sunlight is admitted horizontally into a darkened room through a slit situated in a window-shutter, and, at a distance of 15 to 20 ft., is received at nearly grazing incidence upon a vertical slab of plate glass. The length of the slab in the direction of the light should not be less than 2 or 3 in., and for some special observations may advantageously be much increased. The bands are observed on a plane through the hinder vertical edge of the slab by means of a hand-magnifying glass of from 1 to 2 in. focus. The obliquity of the reflector is, of course, to be adjusted according to the fineness of the bands required.

From the manner of their formation it might appear that under no circumstances could more than half the system be visible. But according to Sir G. B. Airy's principle (see below) the bands may be displaced if examined through a prism. In practice all that is necessary is to hold the magnifier somewhat excentrically. The bands may then be observed gradually to detach themselves from the mirror, until at last the complete system is seen, as in Fresnel's form of the experiment.

The fringes now under discussion are those which arise from the superposition of two simple and equal trains of waves whose directions are not quite parallel. If the two directions of propagation are inclined on opposite sides of the axis of x at small angles α, the expressions for two components of equal amplitude are

$$\cos \frac{2\pi}{\lambda} \{Vt - x \cos \alpha - y \sin \alpha\},$$

and

$$\cos \frac{2\pi}{\lambda} \{Vt - x \cos \alpha + y \sin \alpha\},$$

so that the resultant is expressed by

$$2 \cos \frac{2\pi y \sin \alpha}{\lambda} \cos \frac{2\pi}{\lambda} \{Vt - x \cos \alpha\},$$

from which it appears that the vibrations advance parallel to the axis of x, unchanged in type, and with a uniform velocity V/cos α. Considered as depending on y, the vibration is a maximum when y sin α is equal to O, λ, 2λ, 3λ, &c., corresponding to the centres of the bright bands, while for intermediate values ½λ, ³⁄₂λ, &c., there is no vibration.

From (1) we see that the linear width Λ of the bands, reckoned from bright to bright or dark to dark, is

$$\Lambda = \lambda D / b \qquad (2).$$

The degree of homogeneity necessary for the approximate perfection of the n^{th} Fresnel's band may be found at once from (1) and (2). For if du be the change in u corresponding to the change dλ, then

$$du / \Lambda = nd\lambda / \lambda \qquad (3).$$

Now clearly du must be a small fraction of Λ, so that dλ/λ must be many times smaller than 1/n, if the darkest places are to be sensibly black. But the phenomenon will be tolerably well marked if the proportional range of wave-length do not exceed 1/2n, provided, that is, that the distribution of illumination over this range be not concentrated towards the extreme parts.

So far we have supposed the sources at O_1, O_2 to be mathematically small. In practice, the source is an elongated slit, whose direction requires to be carefully adjusted to parallelism with the reflecting surface or surfaces. By this means an important advantage is gained in respect of brightness without loss of definition, as the various parts of the aperture give rise to coincident systems of bands.

The question of the admissible *width* of the slit requires consideration. We will suppose that the light issuing from various parts of the aperture is without permanent phase-relations, as when the slit is backed immediately by a flame, or by an incandescent filament. Regular interference can then only take place between light coming from *corresponding* parts of the two images, and a distinction must be drawn between the two ways in which the images may be situated relatively to one another. In Fresnel's experiment, whether carried out with the mirrors or with the biprism, the corresponding parts of the images are on the same side; that is, the right of one corresponds to the right of the other, and the left of the one to the left of the other. On the other hand, in Lloyd's arrangement the reflected image is reversed relatively to the original source; the two outer edges corresponding, as also the two inner. Thus in the first arrangement the bands due to various parts of the slit differ merely by a lateral shift, and the condition of distinctness is simply that the projection of the width of the slit be a small fraction of the width of the bands. From this it follows as a corollary that the limiting width is independent of the order of the bands under examination. It is otherwise in Lloyd's method. In this case the centres of the systems of bands are the same, whatever part of the slit is supposed to be operative, and it is the distance apart of the images (*b*) that varies. The bands corresponding to the various parts of the slit are thus upon different scales, and the resulting confusion must increase with the order of the bands. From (1) the corresponding changes in u and b are given by

$$du = -n\lambda D\, db/b^2;$$

so that

$$du/\Lambda = -n\, db/b \qquad (4).$$

If db represents twice the width of the slit, (4) gives a measure of the resulting confusion in the bands. The important point is that the slit must be made narrower as n increases if the bands are to retain the same degree of distinctness.

§ 6. *Achromatic Interference Bands.*—We have already seen that in the ordinary arrangement, where the source is of white light entering through a narrow slit, the heterogeneity of the light forbids the visibility of more than a few bands. The scale of the various band-systems is proportional to λ. But this condition of things, as we recognize from (2) (see § 5), depends upon the constancy of b, *i.e.* upon the supposition that the various kinds of light all come from the same place. Now there is no reason why such a limitation need be imposed. If we regard b as variable, we see that we have only to take b proportional to λ, in order to render the band-interval Λ independent of colour. In such a case the system of bands is *achromatic*, and the heterogeneity of the light is no obstacle to the formation of visible bands of high order. 688

These requirements are very easily met by the use of Lloyd's mirrors, and of a diffraction grating (see DIFFRACTION) with which to form a spectrum. White light enters the dark room through a slit in the window-shutter, and falls in succession upon a grating and an achromatic lens, so as to form a real diffraction spectrum, or rather a series of such, in the focal plane. The central image and all the lateral coloured images except one are intercepted by a screen. The spectrum which is allowed to pass is the proximate source of light in the interference experiment, and since the deviation of any colour from the central white image is proportional to λ, it is only necessary to arrange the mirror so that its plane passes through the white image in order to realize the conditions for the formation of achromatic bands.

When a suitable grating is at hand, the experiment in this form succeeds very well. If we are satisfied with a less perfect fulfilment of the achromatic conditions, the diffraction spectrum may be replaced by a prismatic one, so arranged that $d(\lambda/b) = 0$ for the most luminous rays. The bands are then achromatic in the sense that the ordinary telescope is so. In this case there is no objection to a merely virtual spectrum, and the experiment may be very simply executed with Lloyd's mirror and a prism of (say) 20° held just in front of it.

The number of black and white bands shown by the prism is not so great as might be expected. The lack of contrast that soon supervenes can only be due to imperfect superposition of the various component systems. That the fact is so is at once proved by observing according to the method of Fizeau; for the spectrum from a slit at a very moderate distance out is seen to be traversed by bands. If the adjustment has been properly made, a certain region in the yellow-green is uninterrupted, while the closeness of the bands increases towards the other end of the spectrum. So far as regards the red and blue rays, the original bands may be considered to be already obliterated, but so far as regards the central rays, to be still fairly defined. Under these circumstances it is remarkable that so little colour should be apparent on direct inspection of the bands. It would seem that the eye is but little sensitive to colours thus presented, perhaps on account of its own want of achromatism.

§ 7. *Airy's Theory of the White Centre.*—If a system of Fresnel's bands be examined through a prism, the central white band undergoes an abnormal displacement, which has been supposed to be inconsistent with theory. The explanation has been shown by Airy (*Phil. Mag.*, 1833, 2, p. 161) to depend upon the peculiar manner in which the white band is in general formed.

"Any one of the kinds of homogeneous light composing the incident heterogeneous light will

produce a series of bright and dark bars, unlimited in number as far as the mixture of light from the two pencils extends, and undistinguishable in quality. The consideration, therefore, of homogeneous light will never enable us to determine which is the point that the eye immediately turns to as the centre of the fringes. What then is the physical circumstance that determines the centre of the fringes?

"The answer is very easy. For different colours the bars have different breadths. If then the bars of all colours coincide at one part of the mixture of light, they will not coincide at any other part; but at equal distances on both sides from that place of coincidence they will be equally far from a state of coincidence. If then we can find where the bars of all colours coincide, that point is the centre of the fringes.

"It appears then that the centre of the fringes is not necessarily the point where the two pencils of light have described equal paths, but is determined by considerations of a perfectly different kind.... The distinction is important in this and in other experiments."

The effect in question depends upon the dispersive power of the prism. If v be the linear shifting due to the prism of the originally central band, v must be regarded as a function of λ. Measured from the original centre, the position of the n^{th} bar is now

$$v + n\lambda D / b.$$

The coincidence of the various bright bands occurs when this quantity is as independent as possible of λ, that is, when n is the nearest integer to

$$n = -\frac{b}{D}\frac{dv}{d\lambda} \qquad (1);$$

or, as Airy expresses it in terms of the width of a band (Λ), $n = -dv/d\Lambda$.

The apparent displacement of the white band is thus not v simply, but

$$v - \Lambda dv / d\Lambda \qquad (2).$$

The signs of dv and dΛ being opposite, the abnormal displacement is in addition to the normal effect of the prism. But, since dv/dΛ, or dv/dλ, is not constant, the achromatism of the white band is less perfect than when no prism is used.

If a grating were substituted for the prism, v would vary as Λ, and (2) would vanish, so that in all orders of spectra the white band would be seen undisplaced.

In optical experiments two trains of waves can interfere only when they have their origin in the same source. Otherwise, as it is usually put, there can be no permanent phase-relation, and therefore no regular interference. It should be understood, however, that this is only because trains of optical waves are never absolutely homogeneous. A really homogeneous train could maintain a permanent phase-relation with another such train, and, it may be added, would of necessity be polarized in its character. The peculiarities of polarized light with respect to interference are treated under Polarization of Light.

In a classical experiment interference-bands were employed to examine whether light moved faster or slower in glass than in air. For this purpose a very thin piece of glass may be interposed in the path of one of the interfering rays, and the resulting displacement of the bands is such as to indicate that the light passing through the glass is *retarded*. In a better form of the experiment two pieces of parallel glass cut from the same plate are interposed between the prism and the screen, so that the rays from O_1 (fig. 1) pass through one part and those from O_2 through the other. So long as these pieces are parallel, no shifting takes place, but if one be slightly turned, the bands are at once displaced. In the absence of dispersion the retardation R due to the plate would be independent of λ, and therefore completely compensated at the point determined by u = DR/b; but when there is dispersion it is accompanied by a fictitious displacement of the fringes on the principle explained by Airy, as was shown by Stokes.

Before quitting this subject it is proper to remark that Fresnel's bands are more influenced by diffraction than their discoverer supposed. On this account the fringes are often unequally broad and undergo fluctuations of brightness. A more precise calculation has been given by H. F. Weber and by H. Struve, but the matter is too complicated to be further considered here. The observations of Struve appear to agree well with the corrected theory.

§ 8. *Colours of Thin Plates.*—These colours, familiarly known as those of the soap-bubble, are seen under a variety of conditions and were studied with some success by Robert Hooke under the name of "fantastical colours" (*Micrographia*, 1664). The inquiry was resumed by Sir Isaac Newton with his accustomed power ("Discourse on Light and Colours," 1675, *Opticks*, book ii.), and by him most of the laws regulating these phenomena were discovered. Newton experimented especially with thin plates of air enclosed by slightly curved glasses, and the coloured rings so exhibited are usually called after him "Newton's rings."

The colours are manifested in the greatest purity when the reflecting surfaces are limited to

those which bound the thin film. This is the case of the soap-bubble. When, as is in other respects more convenient, two glass plates enclosing a film of air are substituted, the light under examination is liable to be contaminated by that reflected from the outer surfaces. A remedy may be found in the use of wedge-shaped glasses so applied that the outer surfaces, though parallel to one another, are inclined to the inner operating surfaces. By suitable optical arrangements the two portions of light, desired and undesired, may then be separated.

In his first essay upon this subject Thomas Young was able to trace the formation of these colours as due to the interference of light reflected from the two surfaces of the plate; or, as it would be preferable to say, to the superposition of the two reflected vibrations giving resultants of variable magnitude according to the phase-relation. A difficulty here presents itself which might have proved insurmountable to a less acute inquirer. The luminous vibration reflected at the second surface travels a distance increased by twice the thickness of the plate, and it might naturally be supposed that the relative retardation would be measured by this quantity. If this were so, the two vibrations reflected from the surfaces of an infinitely thin plate would be in accordance, and the intensity of the resultant a maximum. The facts were notoriously the reverse. At the place of contact of Newton's glasses, or at the thinnest part of a soap-film just before it bursts, the colour is black and not white as the explanation seems to require. Young saw that the reconciliation lies in the circumstance that the two reflections occur under different conditions, one, for example, as the light passes from air to water, and the second as it passes from water to air. According to mechanical principles the second reflection involves a change of sign, equivalent to a gain or loss of half an undulation. When a series of waves constituting any particular coloured light is reflected from an infinitely thin plate, the two partial reflections are in absolute discordance and, if of equal intensity, must give on superposition complete darkness. With the aid of this principle the sequence of colours in Newton's rings is explained in much the same way as that of interference fringes (above, § 5).

The complete theory of the colours of thin plates requires us to take account not merely of the two reflections already mentioned but of an infinite series of such reflections. This was first effected by S. D. Poisson for the case of retardations which are exact multiples of the half wave-length, and afterwards more generally by Sir G. B. Airy (*Camb. Phil. Trans.*, 1832, 4, p. 409).

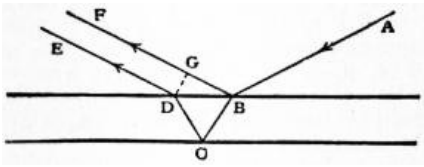

FIG. 2.

In fig. 2, ABF is the ray, perpendicular to the wave-front, reflected at the upper surface, ABCDE the ray transmitted at B, reflected at C and transmitted at D; and these are accompanied by other rays reflected internally 3, 5, &c., times. The first step is to calculate the retardation δ between the first and second waves, so far as it depends on the distances travelled in the plate (of index μ) and in air.

If the angle ABF = 2α, angle BCD = 2α′ and the thickness of plate = t, we have

$$\begin{aligned}\delta &= \mu\,(BC + CD) - BG \\ &= 2\mu BC - 2BC \sin\alpha \sin\alpha' = 2\mu BC\,(1 - \sin^2\alpha') \\ &= 2\mu t \cos\alpha'\end{aligned} \qquad (1).$$

In (1) α′ is the angle of refraction, and we see that, contrary to what might at first have been expected, the retardation is least when the obliquity is greatest, and reaches a maximum when the obliquity is zero or the incidence normal. If we represent all the vibrations by complex quantities, from which finally the imaginary parts are rejected, the retardation δ may be expressed by the introduction of the factor $\varepsilon^{-i\kappa\delta}$, where $i = \sqrt{(-1)}$, and $\kappa = 2\pi/\lambda$.

At each reflection or refraction the amplitude of the incident wave must be supposed to be altered by a certain factor which allows room for the reversal postulated by Young. When the light proceeds from the surrounding medium to the plate, the factor for reflection will be supposed to be b, and for refraction c; the corresponding quantities when the progress is from the plate to the surrounding medium will be denoted by e, f. Denoting the incident vibration by unity, we have then for the first component of the reflected wave b, for the second $cef\varepsilon^{-i\kappa\delta}$, for the third $ce^3f\varepsilon^{-2i\kappa\delta}$, and so on. Adding these together, and summing the geometric series, we find

$$b + \frac{cef\,\varepsilon^{-i\kappa\delta}}{1 - e^2\,\varepsilon^{-i\kappa\delta}} \qquad (2).$$

In like manner for the wave transmitted through the plate we get

$$\frac{cf}{1 - e^2\,\varepsilon^{-i\kappa\delta}} \qquad (3).$$

The quantities b, c, e, f are not independent. The simplest way to find the relations between them is to trace the consequences of supposing δ = 0 in (2) and (3). This may be regarded as a development from Young's point of view. A plate of vanishing thickness is ultimately no obstacle

at all. In the nature of things a *surface* cannot reflect. Hence with a plate of vanishing thickness there must be a vanishing reflection and a total transmission, and accordingly

$$b + e = 0, \qquad cf = 1 - e^2 \tag{4},$$

the first of which embodies Arago's law of the equality of reflections, as well as the famous "loss of half an undulation." Using these we find for the reflected vibration,

$$-\frac{e(1 - \varepsilon^{-i\kappa\delta})}{1 - e^2\,\varepsilon^{-i\kappa\delta}} \tag{5},$$

and for the transmitted vibration

$$\frac{1 - e^2}{1 - e^2\,\varepsilon^{-i\kappa\delta}} \tag{6}.$$

The intensities of the reflected and transmitted lights are the squares of the moduli of these expressions. Thus

$$\text{Intensity of reflected light} = e^2\,\frac{(1 - \cos\kappa\delta)^2 + \sin^2\kappa\delta}{(1 - e^2\cos\kappa\delta)^2 + e^4\sin^2\kappa\delta} = \frac{4e^2\sin^2(\tfrac{1}{2}\kappa\delta)}{1 - 2e^2\cos\kappa\delta + e^4} \tag{7};$$

$$\text{Intensity of transmitted light} = \frac{(1 - e^2)^2}{1 - 2e^2\cos\kappa\delta + e^4} \tag{8},$$

the sum of the two expressions being unity.

According to (7) not only does the reflected light vanish completely when $\delta = o$, but also whenever $\tfrac{1}{2}\kappa\delta = n\pi$, n being an integer, that is, whenever $\delta = n\lambda$. When the first and third mediums are the same, as we have here supposed, the central spot in the system of Newton's ring is *black*, even though the original light contain a mixture of all wave-lengths. If the light reflected from a plate of any thickness be examined with a spectroscope of sufficient resolving power, the spectrum will be traversed by dark bands, of which the centre corresponds to those wave-lengths which the plate is incompetent to reflect. It is obvious that there is no limit to the fineness of the bands which may be thus impressed upon a spectrum, whatever may be the character of the original mixed light.

The relations between the factors b, c, e, f have been proved, independently of the theory of thin plates, in a general manner by Stokes, who called to his aid the general mechanical principle of *reversibility*. If the motions constituting the reflected and refracted rays to which an incident ray gives rise be supposed to be reversed, they will reconstitute a reversed incident ray. This gives one relation; and another is obtained from the consideration that there is no ray in the second medium, such as would be generated by the operation alone of either the reversed reflected or refracted rays. Space does not allow of the reproduction of the argument at length, but a few words may perhaps give the reader an idea of how the conclusions are arrived at. The incident ray (IA) (fig. 3) being 1, the reflected (AR) and refracted (AF) rays are denoted by b and c. When b is reversed, it gives rise to a reflected ray b^2 along AI, and a refracted ray bc along AG (say). When c is reversed, it gives rise to cf along AI, and ce along AG. Hence $bc + ce = 0$, $b^2 + cf = 1$, which agree with (4). It is here assumed that there is no change of phase in the act of reflection or refraction, except such as can be represented by a change of sign.

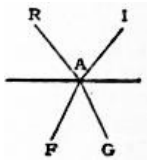

FIG. 3.

When the third medium differs from the first, the theory of thin plates is more complicated, and need not here be discussed. One particular case, however, may be mentioned. When a thin transparent film is backed by a perfect reflector, no colours should be visible, all the light being ultimately reflected, whatever the wave-length may be. The experiment may be tried with a thin layer of gelatin on a polished silver plate. In other cases where a different result is observed, the inference is that either the metal does not reflect perfectly, or else that the material of which the film is composed is not sufficiently transparent. Some apparent exceptions to the above rule, exhibited by thin films of collodion resting upon silver surfaces, have been described by R. W. Wood (*Physical Optics*, p. 143), who attributes the very curious effects observed to *frilling* of the collodion film.

For study of the colours of thin plates there are no more interesting subjects than the soap-film. For projection the films may be stretched across vertical rings of iron wire coated with paraffin. In their undisturbed condition they thin from the top, and the colours are disposed in horizontal bands. If, as suggested by Brewster, a jet of wind issuing from a small nozzle and supplied from a well-regulated bellows be allowed to impinge obliquely, parts of the film are set in rotation, and displays of colours may be exhibited to a large audience, astonishing by their brilliance and by the rapidity with which they change. Permanent films, analogous to soap-films, are best obtained by Glew's method. A few drops of celluloid varnish are poured upon the

surface of water contained in a large dish. After evaporation of the solvent, the films may be picked up upon rings of iron wire.

As a variant upon Newton's rings, interesting effects may be obtained by the partial etching of the surfaces of picked pieces of plate-glass. A surface is coated in parallel stripes with paraffin wax and treated with dilute hydrofluoric acid for such a time (found by preliminary trials) as is required to eat away the exposed portions to a depth of one quarter of the mean wave-length of light. Two such prepared surfaces pressed in the crossed position into suitable contact exhibit a chess-board pattern. Where two uncorroded, or where two corroded, parts overlap, the colours are nearly the same; but where a corroded and an uncorroded surface meet, a strongly contrasted colour is developed. The combination lends itself to projection and the pattern seen upon the screen is very beautiful if proper precautions are taken to eliminate the white light reflected from the first and fourth surfaces of the plates (see *Nature*, 1901, 64, 385).

Theory and observation alike show that the transmitted colours of a thin plate, *e.g.* a soap film or a layer of air, are very inferior to those reflected. Specimens of ancient glass, which have undergone superficial decomposition, on the other hand, sometimes show transmitted colours of remarkable brilliancy. The probable explanation, suggested by Brewster, is that we have here to deal not merely with one, but with a series of thin plates of not very different thicknesses. It is evident that with such a series the transmitted colours would be much purer, and the reflected much brighter, than usual. If the thicknesses are strictly equal, certain wave-lengths must still be absolutely missing in the reflected light; while on the other hand a constancy of the interval between the plates will in general lead to a special preponderance of light of some other wave-length for which all the component parts as they ultimately emerge are in agreement as to phase.

On the same principle are doubtless to be explained the colours of fiery opals, and, more remarkable still, the iridescence of certain crystals of potassium chlorate. Stokes showed that the reflected light is often in a high degree monochromatic, and that it is connected with the existence of twin planes. A closer discussion appears to show that the twin planes must be repeated in a periodic manner (*Phil. Mag.*, 1888, 26, 241, 256; also see R. W. Wood, *Phil. Mag.*, 1906).

A beautiful example of a similar effect is presented by G. Lippmann's coloured photographs. In this case the periodic structure is actually the product of the action of light. The plate is exposed to stationary waves, resulting from the incidence of light upon a reflecting surface (see PHOTOGRAPHY).

All that can be expected from a physical theory is the determination of the composition of the light reflected from or transmitted by a thin plate in terms of the composition of the incident light. The further question of the chromatic character of the mixtures thus obtained belongs rather to physiological optics, and cannot be answered without a complete knowledge of the chromatic relations of the spectral colours themselves. Experiments upon this subject have been made by various observers, and especially by J. Clerk Maxwell (*Phil. Trans.*, 1860), who has exhibited his results on a colour diagram as used by Newton. A calculation of the colours of thin plates, based upon Maxwell's data, and accompanied by a drawing showing the curve representative of the entire series up to the fifth order, has been given by Rayleigh (*Edin. Trans.*, 1887). The colours of Newton's scale are met with also in the light transmitted by a somewhat thin plate of doubly-refracting material, such as mica, the plane of analysis being perpendicular to that of primitive polarization.

The same series of colours occur also in other optical experiments, *e.g.* at the centre of the illuminated area when light issuing from a point passes through a small round aperture in an otherwise opaque screen.

The colours of which we have been speaking are those formed at nearly perpendicular incidence, so that the retardation (reckoned as a distance), viz. $2\mu t \cos \alpha'$, as sensibly independent of λ. This state of things may be greatly departed from when the thin plate is rarer than its surroundings, and the incidence is such that α' is nearly equal to 90°, for then, in consequence of the powerful dispersion, $\cos \alpha'$ may vary greatly as we pass from one colour to another. Under these circumstances the series of colours entirely alters its character, and the bands (corresponding to a graduated thickness) may even lose their coloration, becoming sensibly black and white through many alternations (Newton's *Opticks*, bk. ii.; Fox-Talbot, *Phil. Mag.*, 1836, 9, p. 40l). The general explanation of this remarkable phenomenon was suggested by Newton.

Let us suppose that plane waves of white light travelling in glass are incident at angle α upon a plate of air, which is bounded again on the other side by glass. If μ be the index of the *glass*, α' the angle of refraction, then $\sin \alpha' = \mu \sin \alpha$; and the retardation, expressed by the equivalent distance in air, is

$$2t \sec \alpha' - \mu \cdot 2t \tan \alpha' \sin \alpha = 2t \cos \alpha';$$

and the retardation in *phase* is $2t \cos \alpha'/\lambda$, λ being as usual the wave-length in air.

The first thing to be noticed is that, when α approaches the critical angle, $\cos\alpha'$ becomes as

small as we please, and that consequently the retardation corresponding to a given thickness is very much less than at perpendicular incidence. Hence the glass surfaces need not be so close as usual.

A second feature is the increased brilliancy of the light. According to (7) the intensity of the reflected light when at a maximum ($\sin \frac{1}{2}\kappa\gamma = 1$) is $4e^2/(1 + e^2)^2$. At perpendicular incidence e is about $\frac{1}{5}$, and the intensity is somewhat small; but, as $\cos \alpha'$ approaches zero, e approaches unity, and the brilliancy is much increased.

But the peculiarity which most demands attention is the lessened influence of a variation in λ upon the phase-retardation. A diminution of λ of itself increases the retardation of phase, but, since waves of shorter wave-length are more refrangible, this effect may be more or less perfectly compensated by the greater obliquity, and consequent diminution in the value of $\cos \alpha'$. We will investigate the conditions under which the retardation of phase is stationary in spite of a variation of λ.

In order that $\lambda^{-1} \cos \alpha'$ may be stationary, we must have

$$\lambda \sin \alpha' \, d\alpha' + \cos \alpha' \, d\lambda = 0,$$

where (α being constant)

$$\cos \alpha' \, d\alpha' = \sin \alpha \, d\mu.$$

Thus

$$\cot^2 \alpha' = \frac{\lambda}{\mu} \frac{d\mu}{d\lambda} \qquad (9),$$

giving α' when the relation between μ and λ is known.

According to A. L. Cauchy's formula, which represents the facts very well throughout most of the visible spectrum,

$$\mu = A + B\lambda^{-2} \qquad (10),$$

so that

$$\cot^2 \alpha' = \frac{2B}{\lambda^2 \mu} = \frac{2(\mu - A)}{\mu} \qquad (11).$$

If we take, as for Chance's "extra-dense flint," $B = .984 \times 10^{-10}$, and as for the soda lines, $\mu = 1.65$, $\lambda = 5.89 \times 10^{-6}$, we get

$$\alpha' = 79°30'.$$

At this angle of refraction, and with this kind of glass, the retardation of phase is accordingly nearly independent of wave-length, and therefore the bands formed, as the thickness varies, are approximately achromatic. Perfect achromatism would be possible only under a law of dispersion

$$\mu^2 = A' - B'\lambda^2.$$

If the source of light be distant and very small, the black bands are wonderfully fine and numerous. The experiment is best made (after Newton) with a right-angled prism, whose hypothenusal surface may be brought into approximate contact with a plate of black glass. The bands should be observed with a convex lens, of about 8 in. focus. If the eye be at twice this distance from the prism, and the lens be held midway between, the advantages are combined of a large field and of maximum distinctness.

If Newton's rings are examined through a prism, some very remarkable phenomena are exhibited, described in his twenty-fourth observation (*Opticks*; see also Place, *Pogg. Ann.*, 1861, 114, 504). "When the two object-glasses are laid upon one another, so as to make the rings of the colours appear, though with my naked eye I could not discern above eight or nine of those rings, yet by viewing them through a prism I could see a far greater multitude, insomuch that I could number more than forty.... And I believe that the experiment may be improved to the discovery of far greater numbers.... But it was on but one side of these rings, namely, that towards which the refraction was made, which by the refraction was rendered distinct, and the other side became more confused than when viewed with the naked eye....

"I have sometimes so laid one object-glass upon the other that to the naked eye they have all over seemed uniformly white, without the least appearance of any of the coloured rings; and yet by viewing them through a prism great multitudes of those rings have discovered themselves."

Newton was evidently much struck with these "so odd circumstances"; and he explains the occurrence of the rings at unusual thicknesses as due to the dispersing power of the prism. The blue system being more refracted than the red, it is possible under certain conditions that the n^{th} blue ring may be so much displaced relatively to the corresponding red ring as *at one part of the circumference* to compensate for the different diameters. A white stripe may thus be formed in a

situation where without the prism the mixture of colours would be complete, so far as could be judged by the eye.

The simplest case that can be considered is when the “thin plate” is bounded by plane surfaces inclined to one another at a small angle. By drawing back the prism (whose edge is parallel to the intersection of the above-mentioned planes) it will always be possible so to adjust the effective dispersing power as to bring the n^{th} bars to coincidence for any two assigned colours, and therefore approximately for the entire spectrum. The formation of the achromatic band, or rather central black band, depends indeed upon the same principles as the fictitious shifting of the centre of a system of Fresnel’s bands when viewed through a prism.

But neither Newton nor, as would appear, any of his successors has explained why the bands should be more numerous than usual, and under certain conditions sensibly achromatic for a large number of alternations. It is evident that, in the particular case of the wedge-shaped plate above specified, such a result would not occur. The width of the bands for any colour would be proportional to λ, as well after the displacement by the prism as before; and the succession of colours formed in white light and the number of perceptible bands would be much as usual.

The peculiarity to be explained appears to depend upon the *curvature* of the surfaces bounding the plate. For simplicity suppose that the lower surface is plane (y = 0), and that the approximate equation of the upper surface is $y = a + bx^2$, a being thus the least distance between the plates. The black of the n^{th} order for wave-length λ occurs when

$$½n\lambda = a + bx^2 \tag{12};$$

and thus the width (δx) at this place of the band is given by

$$½\lambda = 2bx\delta x \tag{13};$$

or

$$\delta x = \frac{\lambda}{4bx} = \frac{\lambda}{4\sqrt{b}\cdot\sqrt{(½n\lambda - a)}} \tag{14}.$$

If the glasses be in contact, as is usually supposed in the theory of Newton’s rings, a = 0, and $\delta x \propto \lambda^{1/2}$, or the width of the band of the n^{th} order varies as the square root of the wave-length, instead of as the first power. Even in this case the overlapping and subsequent obliteration of the bands is greatly retarded by the use of the prism, but the full development of the phenomenon requires that α should be finite. Let us inquire what is the condition in order that the width of the band of the n^{th} order may be stationary, as λ varies. By (14) it is necessary that the variation of $\lambda^2/(½n\lambda - a)$ should vanish. Hence a = ¼nλ, so that the interval between the surfaces at the place where the n^{th} band is formed should be half due to curvature and half to imperfect contact at the place of closest approach. If this condition be satisfied, the achromatism of the n^{th} band, effected by the prism, carries with it the achromatism of a large number of neighbouring bands, and thus gives rise to the remarkable effects described by Newton. Further developments are given by Lord Rayleigh in a paper “On Achromatic Interference Bands” (*Phil. Mag.*, 1889, 28, pp. 77, 189); see also E. Mascart, *Traité d’optique*.

In Newton’s rings the variable element is the thickness of the plate, to which the retardation is directly proportional, and in the ideal case the angle of incidence is constant. To observe them the eye is focused upon the thin plate itself, and if the plate is very thin no particular precautions are necessary. As the plate thickens and the order of interference increases, there is more and more demand for homogeneity in the light, and we may have recourse to a sodium-flame or a helium vacuum tube. At the same time the disturbing influence of obliquity increases. Unless the aperture of the eye is reduced, the rays reaching it from even the same point of the plate are differently affected, and complications ensue tending to impair the distinctness of the bands. To obviate this disturbance it is best to work at incidences as nearly as possible perpendicular.

The bands seen when light from a soda flame falls upon nearly parallel surfaces are often employed as a test of flatness. Two flat surfaces can be made to fit, and then the bands are few and broad, if not entirely absent; and, however the surfaces may be presented to one another, the bands should be straight, parallel and equidistant. If this condition be violated, one or other of the surfaces deviates from flatness. In fig. 4, A and B represent the glasses to be tested, and C is a lens of 2 or 3 ft. focal length. Rays diverging from a soda flame at E are rendered parallel by the lens, and after reflection from the

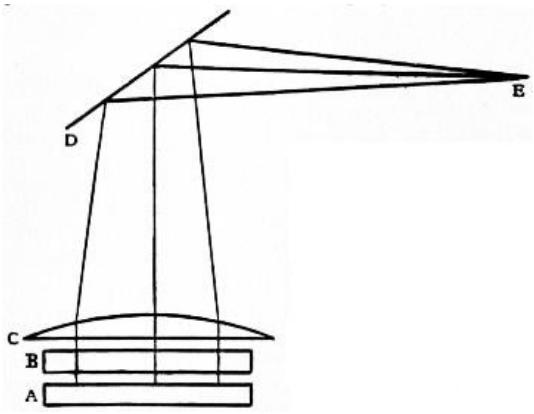

Fig. 4.

surfaces are recombined by the lens at E.

To make an observation, the coincidence of the radiant point and its image must be somewhat disturbed, the one being displaced to a position a little beyond, and the other to a position a little in front of the diagram. The eye, protected from the flame by a suitable screen, is placed at the image, and being focused upon AB, sees the field traversed by bands. The reflector D is introduced as a matter of convenience to make the line of vision horizontal.

These bands may be photographed. The lens of the camera takes the place of the eye, and should be as close to the flame as possible. With suitable plates, sensitized by cyanin, the exposure required may vary from ten minutes to an hour. To get the best results, the hinder surface of A should be blackened, and the front surface of B should be thrown out of action by the superposition of a wedge-shaped plate of glass, the intervening space being filled with oil of turpentine or other fluid having nearly the same refraction as glass. Moreover, the light should be purified from blue rays by a trough containing solution of bichromate of potash. With these precautions the dark parts of the bands are very black, and the exposure may be prolonged much beyond what would otherwise be admissible.

By this method it is easy to compare one flat with another, and thus, if the first be known to be free from error, to determine the errors of the second. But how are we to obtain and verify a standard? The plan usually followed is to bring *three* surfaces into comparison. The fact that two surfaces can be made to fit another in all azimuths proves that they are spherical and of equal curvatures, but one convex and the other concave, the case of perfect flatness not being excluded. If A and B fit one another, and also A and C, it follows that B and C must be similar. Hence, if B and C also fit one another, all three surfaces must be flat. By an extension of this process the errors of three surfaces which are not flat can be found from a consideration of the interference bands which they present when combined in three pairs.

The free surface of undisturbed water is almost ideally flat, and, as Lord Rayleigh (*Nature*, 1893, 48, 212) has shown, there is no great difficulty in using it as a standard of comparison. Following the same idea we may construct a parallel plate by superposing a layer of water upon mercury. If desired, the superior reflecting power of the mercury may be compensated by the addition of colouring matter to the water.

Haidinger's Rings dependent on Obliquity.—It is remarkable that the well-known theoretical investigation, undertaken with the view of explaining Newton's rings, applies more directly to a different system of rings discovered at a later date.

The results embodied in equations (1) to (8) have application in the first instance to plates whose surfaces are absolutely parallel, though doubtless they may be employed with fair accuracy when the thickness varies but slowly.

We have now to consider t constant and α′ variable in (1). If α′ be small,

$$\delta = 2\mu t\,(1 - \tfrac{1}{2}\alpha'^2) = 2\mu t - t\alpha^2 / \mu \qquad (15);$$

and since the differences of δ are proportional to α^2, the law of formation is the same as for Newton's rings, where α′ is constant and t proportional to the square of the distance from the point of contact. In order to see these rings distinctly the eye must be focused, not upon the plate, but for infinitely distant objects.

The earliest observation of rings dependent upon obliquity appears to have been made by W. von Haidinger (*Pogg. Ann.*, 1849, 77, p. 219; 1855, 96, p. 453), who employed sodium light reflected from a plate of mica (*e.g.* 0.2 mm. thick). The transmitted rays are the easier to see in their completeness, though they are necessarily somewhat faint. For this purpose it is sufficient to look through the mica, held close to the eye and perpendicular to the line of vision, at a sheet of white paper or card illuminated by a sodium flame. Although Haidinger omitted to consider the double refraction of the mica and gave formulae not quite correct for even singly refracting plates, he fully appreciated the distinctive character of the rings, contrasting *Berührungsringe und Plattenringe*. The latter may appropriately be named after him. Their tardy discovery may be attributed to the technical difficulty of obtaining sufficiently parallel plates, unless it be by the use of mica or by the device of pouring water upon mercury. Haidinger's rings were rediscovered by O. R. Lummer (*Wied. Ann.*, 1884, 23, p. 49), who pointed out the advantages they offer in the examination of plates intended to be parallel.

The illumination depends upon the intensity of the monochromatic source of light, and upon the reflecting power of the surfaces. If R be the intensity of the reflected light we have from (7)

$$\frac{1}{R} = 1 + \frac{(1 - e^2)^2}{4e^2 \sin^2(\tfrac{1}{2}\kappa\delta)};$$

from which we see that if e = 1 absolutely, 1/R = R = 1 for all values of δ. If e = 1 very nearly, R = 1 nearly for all values of δ for which $\sin^2(\tfrac{1}{2}\kappa\delta)$ is not very small. In the light reflected from an extended source, the ground will be of full brightness corresponding to the source, but it will be traversed by *narrow* dark lines. By transmitted light the ground, corresponding to general values

of the obliquity, will be dark, but will be interrupted by narrow bright rings, whose position is determined by sin ½(κδ) = 0. In permitting for certain directions a complete transmission in spite of a high reflecting power (*e*) of the surfaces, the plate acts the part of a resonator.

There is no transparent material for which, unless at high obliquity, e approaches unity. In C. Fabry and A. Pérot's apparatus the reflections at nearly perpendicular incidence are enhanced by lightly silvering the surfaces. In this way the advantage of narrowing the bright rings is attained in great measure without too heavy a sacrifice of light. The plate in the optical sense is one of air, and is bounded by plates of glass whose inner silvered surfaces are accurately flat and parallel. The outer surfaces need only ordinary flatness, and it is best that they be not quite parallel to the inner ones. The arrangement constitutes a *spectroscope*, inasmuch as it allows the structure of a complex spectrum line to be directly observed. If, for example, we look at a sodium flame, we see in general two distinct systems of narrow bright circles corresponding to the two D-lines. With particular values of the thickness of the plate of air the two systems may coincide so as to be seen as a single system, but a slight alteration of thickness will cause a separation.

It will be seen that in this apparatus the optical parts are themselves of extreme simplicity; but they require accuracy of construction and adjustment, and the demand in these respects is the more severe the further the ideal is pursued of narrowing the rings by increase of reflecting power. Two forms of mounting are employed. In one instrument, called the *interferometer*, the distance between the surfaces—the thickness of the plate—is adjustable over a wide range. In its complete development this instrument is elaborate and costly. The actual measurements of wave-lengths by Fabry and Pérot were for the most part effected by another form of instrument called an *étalon* or interference-gauge. The thickness of the optical plate is here fixed; the glasses are held up to metal knobs, acting as distance-pieces, by adjustable springs, and the final adjustment to parallelism is effected by regulating the pressure exerted by these springs. The distance between the surfaces may be 5 or 10 mm.

The theory of the comparison of wave-lengths by means of this apparatus is very simple, and it may be well to give it, following closely the statement of Fabry and Pérot (*Ann. chim. phys.*, 1902, 25, p. 110). Consider first the cadmium radiation λ treated as a standard. It gives a system of rings. Let P be the ordinal number of one of these rings, for example the first counting from the centre. This integer is supposed known. The order of interference at the centre will be p = P + ε. We have to determine this number ε, lying ordinarily between 0 and 1. The diameter of the ring under consideration increases with ε; so that a measure of the diameter allows us to determine the latter. Let t be the thickness of the plate of air. The order of interference at the centre is p = 2t/λ. This corresponds to normal passage. At an obliquity i the order of interference is p cos i. Thus if x be the angular diameter of the ring P, p cos ½x = P; or since x is small,

$$p = P\,(1 + \tfrac{1}{8}x^2).$$

In like manner, from observations upon another radiation λ′ to be compared with λ, we have

$$p' = P'\,(1 + \tfrac{1}{8}x'^2);$$

whence if t be treated as an absolute constant,

$$\frac{\lambda'}{\lambda} = \frac{P}{P'}\left(1 + \frac{x^2}{8} - \frac{x'^2}{8}\right) \qquad (16).$$

The ratio λ/λ′ is thus determined as a function of the angular diameters x, x′ and of the integers P, P′. If P, say for the cadmium red line, is known, an approximate value of λ/λ′ will usually suffice to determine what integral value must be assigned to P′, and thence by (16) to allow of the calculation of the corrected ratio λ′/λ.

In order to find P we may employ a modified form of (16), viz.,

$$\frac{P'}{P} = \frac{\lambda}{\lambda'}\left(1 + \frac{x^2}{8} - \frac{x'^2}{8}\right) \qquad (17),$$

using spectrum lines, such as the cadmium red and the cadmium green, for which the relative wave-lengths are already known with accuracy from A. A. Michelson's work. To test a proposed integral value of P (cadmium red), we calculate P′ (cadmium green) from (17), using the observed values of x, x′. If the result deviates from an integer by more than a small amount (depending upon the accuracy of the observations), the proposed value of P is to be rejected. In this way by a process of exclusion the true value is ultimately arrived at (Rayleigh, *Phil. Mag.*, 1906, 685). It appears that by Fabry and Pérot's method comparisons of wave-lengths may be made accurate to about one-millionth part; but it is necessary to take account of the circumstance that the effective thickness t of the plate is not exactly the same for various wave-lengths as assumed in (16).

§ 9. *Newton's Diffusion Rings.*—In the fourth part of the second book of his *Opticks* Newton investigates another series of rings, usually (though not very appropriately) known as the colours of thick plates. The fundamental experiment is as follows. At the centre of curvature of a concave looking-glass, quicksilvered behind, is placed an opaque card, perforated by a small

hole through which sunlight is admitted. The main body of the light returns through the aperture; but a series of concentric rings are seen upon the card, the formation of which was proved by Newton to require the co-operation of the two surfaces of the mirror. Thus the diameters of the rings depend upon the thickness of the glass, and none are formed when the glass is replaced by a metallic speculum. The brilliancy of the rings depends upon imperfect polish of the anterior surface of the glass, and may be augmented by a coat of diluted milk, a device used by Michel Ferdinand, duc de Chaulnes. The rings may also be well observed without a screen in the manner recommended by Stokes. For this purpose all that is required is to place a *small* flame at the centre of curvature of the prepared glass, so as to coincide with its image. The rings are then seen surrounding the flame and occupying a definite position in space.

The explanation of the rings, suggested by Young, and developed by Herschel, refers them to interference between one portion of light scattered or diffracted by a particle of dust, and then regularly refracted and reflected, and another portion first regularly refracted and reflected and then diffracted at emergence by the same particle. It has been shown by Stokes (*Camb. Trans.*, 1851, 9, p. 147) that no regular interference is to be expected between portions of light diffracted by different particles of dust.

In the memoir of Stokes will be found a very complete discussion of the whole subject, and to this the reader must be referred who desires a fuller knowledge. Our limits will not allow us to do more than touch upon one or two points. The condition of fixity of the rings when observed in air, and of distinctness when a screen is used, is that the systems due to all parts of the diffusing surface should coincide; and it is fulfilled only when, as in Newton's experiments, the source and screen are in the plane passing through the centre of curvature of the glass.

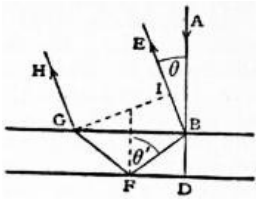

FIG. 5.

As the simplest for actual calculation, we will consider a little further the case where the glass is plane and parallel, of thickness t and index μ, and is supplemented by a lens at whose focus the source of light is placed. This lens acts both as collimator and as object-glass, so that the combination of lens and plane mirror replaces the concave mirror of Newton's experiment. The retardation is calculated in the same way as for thin plates. In fig. 5 the diffracting particle is situated at B, and we have to find the relative retardation of the two rays which emerge finally at inclination θ, the one diffracted at emergence following the path ABDBIE, and the other diffracted at entrance and following the path ABFGH. The retardation of the former from B to I is 2μt + BI, and of the latter from B to the equivalent place G is 2μBF. Now FB = t sec θ′, θ′ being the angle of refraction; BI = 2t tan θ′sin θ; so that the relative retardation F is given by

$$R = 2\mu t \{1 + \mu^{-1} \tan\theta' \sin\theta - \sec\theta') = 2\mu t (1 - \cos\theta').$$

If θ, θ′ be small, we may take

$$R = 2t\theta^2 / \mu \qquad (1).$$

as sufficiently approximate.

The condition of distinctness is here satisfied, since R is the same for every ray emergent parallel to a given one. The rays of one parallel system are collected by the lens to a focus at a definite point in the neighbourhood of the original source.

The formula (1) was discussed by Herschel, and shown to agree with Newton's measures. The law of formation of the rings follows immediately from the expression for the retardation, the radius of the ring of n^{th} order being proportional to n and to the square root of the wave-length.

§ 10. *Interferometer.*—In many cases it is necessary that the two rays ultimately brought to interference should be sufficiently separated over a part of their course to undergo a different treatment; for example, it may be desired to pass them through different gases.

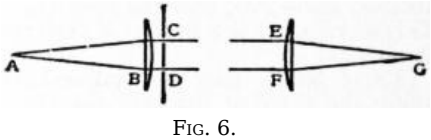

FIG. 6.

A simple modification of Young's original experiment suffices to solve this problem. Light proceeding from a slit at A (fig. 6) perpendicular to the plane of the paper, falls upon a collimating lens B whose aperture is limited by two parallel and rather narrow slits of equal width. The parallel rays CE, DF (shown broken in the figure) transmitted by these slits are brought to a focus at G by the lens EF where they form an image of the original slit A. This image is examined with an eye-piece of high magnifying power. The interference bands at G undergo displacement if the rays CE, DF are subjected to a relative retardation. Consider what happens at the point G, which is the geometrical image of A. If all is symmetrical so that the paths CE, DF are

equal, there is brightness. But if, for example, CE be subjected to a relative retardation of half a wave-length, the brightness is replaced by darkness, and the bands are shifted through half a band-interval.

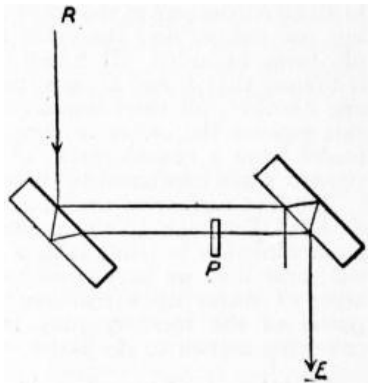

Fig. 7.

An apparatus of this kind has been found suitable for determining the refractivity of gases, especially of gases available only in small quantities (*Proc. Roy. Soc.*, 1896, 59, p. 198; 1898, 64, p. 95). There is great advantage in replacing the ordinary eye-piece by a simple cylindrical magnifier formed of a glass rod 4 mm. in diameter. Under these conditions a paraffin lamp sufficed to illuminate the slit at A, and allowed the refractivities of gases to be compared to about one-thousandth part.

If the object be to merely see the bands in full development the lenses of the above apparatus may be dispensed with. A metal or pasteboard tube 10 in. long carries at one end a single slit (analogous to A) and at the other a double slit (analogous to C, D). This double slit, which requires to be very fine, may be made by scraping two parallel lines with a knife on a piece of silvered glass. The tube is pointed to a bright light, and the eye, held close behind the double slit, is focused upon the far slit.

§ 11. *Other Refractometers.*—In another form of refractometer, employed by J. C. Jamin, the separations are effected by reflections at the surfaces of thick plates. Two thick glass mirrors, exactly the same in all respects, are arranged as in fig. 7. The first of the two interfering rays is that which is reflected at the first surface of the first reflector and at the second surface of the second reflector. The second ray undergoes reflection at the second surface of the first reflector and at the first surface of the second reflector. Upon the supposition that the plates are parallel and equally thick, the paths pursued by these two rays are equal. P represents a thin plate of glass interposed in the path of one ray, by which the bands are shifted.

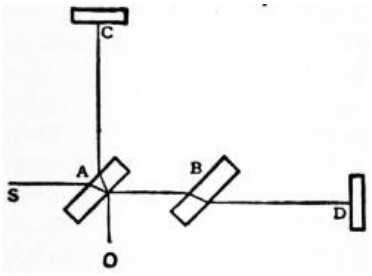

Fig. 8.

In Jamin's apparatus the two rays which produce interference are separated by a distance proportional to the thickness of the mirrors, and since there is a practical limit to this thickness, it is not possible to separate the two rays very far. In A. A. Michelson's interferometer there is no such restriction. "The light starts from source S (fig. 8) and separates at the rear of plate A, part of it being reflected to the plane mirror C, returning exactly, on its path through A, to O, where it may be observed by a telescope or received upon a screen. The other part of the ray goes through the glass plate A, passes through B, and is reflected by the plane mirror D, returns on its path to the starting point A, where it is reflected so as nearly to coincide with the first ray. The plane parallel glass B is introduced to compensate for the extra thickness of glass which the first ray has traversed in passing twice through the plate A. Without it the two paths would not be optically identical, because the first would contain more glass than the second. Some light is reflected from the front surface of the plate A, but its effect may be rendered insignificant by covering the rear surface of A with a coating of silver of such thickness that about equal portions of the incident light are reflected and transmitted. The plane parallel plates A and B are worked originally in one piece, which is afterwards cut in two. The two pieces are placed parallel to one another, thus ensuring exact equality in the two optical paths AC and AD" (see Michelson, *Light-Waves and their Uses*, Chicago, 1903).

The adjustments of this apparatus are very delicate. Of the fully silvered mirrors C, D, the latter must be accurately parallel to the image of the former. For many purposes one of the mirrors, C, must be capable of movement parallel to itself, usually requiring the use of very truly constructed ways. An escape from this difficulty may be found in the employment of a layer of mercury, standing on copper, the surface of which automatically assumes the horizontal position.

Michelson's apparatus, employed to view an extended field of homogeneous light, exhibits Haidinger's rings, and if all is in good order the dark parts are sensibly black. As the order of interference increases, greater and greater demand is made upon the homogeneity of the light. Thus, if the illumination be from a sodium flame, the rings are at first distinct, but as the difference of path increases the duplicity of the bright sodium line begins to produce complications. After 500 rings, the bright parts of one system coincide with the dark parts of the other (Fizeau), and if the two systems were equally bright all trace of rings would disappear. A little later the rings would again manifest themselves and, after 1000 had gone by, would be nearly or quite as distinct as at first. And these alternations of distinctness and indistinctness would persist until the point was reached at which even a single sodium line was insufficiently homogeneous. Conversely, the changes of *visibility* of the rings as the difference of path increases give evidence as to the duplicity of the line. In this way Michelson obtained important

information as to the constitution of the approximately homogeneous lines obtained from electrical discharge through attenuated metallic vapours. Especially valuable is the vacuum tube containing cadmium. The red line proved itself to be single and narrow in a high degree, and the green line was not far behind.

But although in Michelson's hands the apparatus has done excellent spectroscopic work, it is not without its weak points. A good deal of labour is required to interpret the visibility curves, and in some cases the indications are actually ambiguous. For instance, it is usually impossible to tell on which side of the principal component a feebler companion lies. It would seem that for spectroscopic purposes this apparatus must yield to that of Fabry and Pérot, in which multiple reflections are utilized; this is a spectroscope in the literal sense, inasmuch as the constitution of a spectrum line is seen by simple inspection.

(R.)

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1 The word "interference" as formed, on the false analogy of such words as "difference," from "to interfere," which originally was applied to a horse striking (Lat. *ferire*) one foot or leg against the other.

INTERIM, originally a Latin word for "in the meantime." The word was hence applied to certain edicts and decrees passed by the emperor and the diets during the reformation in Germany with the object of *temporarily* settling a controversy. These "interims" regulated points of religious and ecclesiastical difference until they could be decided by a general council. The best example of such a *modus vivendi* is the Augsburg Interim of 1548, drawn up by Michael Helding, Julius von Pflug and John Agricola (a medievalist, an Erasmian, and a conservative Lutheran) at the bidding of Charles V., and accepted by the diet. It was an ambiguous document, teaching from the Roman Catholic side transubstantiation, the seven sacraments, adoration of the Virgin and saints, and papal headship, and from the Protestant, justification by faith, marriage of priests, the use of the cup by the laity. Maurice of Saxony was permitted to vary the interim for his dominions, and his edition was called the Leipzig Interim. An earlier interim was that of Regensburg, 1541.

INTERLACED ARCHES, the term for a scheme of decoration employed in Romanesque and Gothic architecture, where arches are thrown from alternate piers, interlacing or intersecting one another. In the former case, the first arch mould is carried alternately over and under the second, in the latter the mouldings actually intersect and stop one another. An example of the former exists in St Peter's in the East, Oxford, and of the latter in St Joseph's chapel, Glastonbury, and in the cathedral of Bristol.

INTERLAKEN, a Swiss town (1864 ft.) in the canton of Berne, situated on the flat plain (*Bödeli*) between the lakes of Brienz (E.) and of Thun (W.), and connected by steamer, as well as by railway (17½ m.) with the town of Thun. It is built on the left bank of the Aar, and grew up around the religious house of Austin Canons, founded about 1130 and suppressed in 1528. In the surviving buildings of the convent religious services (Anglican, Scottish Presbyterian and French Protestant) are now held, while the more modern castle is occupied by offices of the Cantonal Government. The fine and well-shaded avenue called the *Höheweg* runs through the main portion of the town, and is lined on the north side by a succession of huge hotels and the large Kursaal. Interlaken is much frequented in summer, partly because of the glorious view of the Jungfrau (13,669 ft.) which it commands to the south, and partly because it is the best starting-point for many excursions, as to Schynige Platte, Lauterbrunnen and Grindelwald. The lines serving these places all start from the eastern railway station (that from Thun reaches the western or main railway station), whence steamers depart for the Giessbach Falls, Brienz and Meiringen, on the way to Lucerne or to the Grimsel Pass. In 1900 the population of Interlaken was 2962 (mainly Protestant and German-speaking). Opposite Interlaken, and on the right bank

of the Aar is Unterseen (in 1900, 2607 inhabitants), which was built in 1280 by Berthold von Eschenbach.

See *Fontes rerum Bernensium* (original documents up to 1366) (8 vols., Berne, 1883-1903); *Die Regesten des Klosters zu Interlaken* (Coire, 1849); E. Tatarinoff, *Die Entwickelung der Probstei Interlaken im XIII. Jahrhundert* (Schaffhausen, 1892).

(W. A. B. C.)

INTERLOPER, one who interferes in affairs in which he has no concern. This word, with the verbal form "to interlope," first appears at the end of the 16th and beginning of the 17th century in connexion with the interference of unauthorized persons in the trading monopoly of the Russia Company and later of the East India Company. The *New English Dictionary* quotes from H. Lane (1590), *Hakluyt's Voyages*, "From those parts the Muscovites were furnished out of Dutchland by enterlopers with all arts and artificers and had few or none by us," and also from the *Minutes of the Court of the East India Company*, 22nd of February 1615, "to examine all suspected personnes that intend interlopinge into the East Indies or Muscovy." Edward Phillips (*New World of Words*, 1658) defines interlopers at common law as those "that without legal authority intercept the trade of a company, as it were Interleapers." The word appears to be of English origin, for the Dutch *enterlooper*, smuggler, often given as the source, was taken from English, as was the French *interlope*. The word is a compound of *inter*, between, and *lope*, a dialectal variant of "leap." A common word for a vagrant, or "straggler," as it is defined, was till 1580 "landloper," and the combination of "straggler" and "interloper" is found in *Horsey's Travels* (Hakluyt Soc.), 1603-1627, "all interlopers and straglyng Englishmene lyving in that country."

INTERNATIONAL, THE. The International Working Men's Association, commonly called "The International," was formed at London in 1864. It was a society of working men of all nations, somewhat like a cosmopolitan trades union, but bearing a still closer resemblance to an international social science association for discussing and furthering the rights of labour. The occasion of its formation was the visit of some French workmen to the London Exhibition of 1862. In the course of their visit the labour question was discussed, and a desire for the further interchange of ideas expressed. Nothing decisive was done till 1864, when a great public meeting of working men of all nations was held at St Martin's Hall, London, and a provisional committee was appointed to draft the constitution of the new association.

The first four congresses of the International, held at Geneva (September 1866), Lausanne (1867), Brussels (1868), and Basel (1869), marked the rapid development of the association. It gained its first triumph in the effectual support of the bronze-workers at Paris during their lock-out in 1867; and it repeatedly aided the English unionists by preventing the importation of cheap labour from the continent. It soon spread as far east as Poland and Hungary, and it had affiliated societies with journals devoted to its cause in every country of western Europe.

It was supposed to be concerned in all the revolutionary movements and agitations of Europe, gaining notoriety as the rallying point of social overthrow and ruin. Its prestige, however, was always based more on the vast possibilities of the cause it represented than on its actual power. Its organization was loose, its financial resources insignificant; the continental unionists joined it more in the hope of borrowing than of contributing support. At the successive congresses its socialistic tendencies became more and more pronounced; it declared its opposition to private property not only in railways but in mines and the soil, holding that these should revert to the community. Even the principle of inheritance was saved only by a narrow majority. In 1869 M. Bakunin, the Russian socialist or nihilist, with his party joined the association, and at once asserted his character as the "apostle of universal destruction."

The relation of the association to the communal rising at Paris in the spring of 1871 has been the subject of much dispute. It is now agreed that the International as such had no part either in originating or conducting it; some of its French members joined it, but only on their individual responsibility. Its complicity after the event is equally clear. After the fall of the commune the general council of London, Karl Marx included, issued a long and trenchant manifesto, approving its action and extolling the "glorious vanquished." From this point the decline and fall of the

association is to be dated. The English unionists, intent on more practical concerns at home, never took a deep interest in its proceedings; the German socialists were hindered by law from corporate action; America was too remote. But it found its worst enemies amongst its own friends; the views of Marx and his school were too moderate for the universally subversive principles of M. Bakunin and the radical Swiss federation of the Jura. It came to a rupture at the congress of 1872, held at the Hague, when Bakunin, being outvoted and "excommunicated" by the Marx party, formed a rival International, which found its chief support in Spain and Italy. Wearied of its European contentions and desirous to form a basis of operation in America, the Marx International now transferred the seat of its general council to New York; but it survived just long enough to hold another congress at Geneva in 1874, and then quietly expired.

The party of destruction styling themselves "autonomists" had a bloodier history. The programme of this party was to overturn all existing institutions, with the view to reconstructing them on some vague communal basis such as had been tried at Paris in 1871. It endeavoured to realize this in the great communal risings in southern Spain in 1873, when its adherents set up their peculiar form of government at Barcelona, Seville, Cadiz and Cartagena—at the last-mentioned place also seizing part of the ironclad fleet of Spain. As at Paris, they failed in leadership and organization, and were suppressed, though not without difficulty, by the national troops. The "autonomists" lingered on till 1879. The collapse was complete of an association which once extended from Hungary to San Francisco, and alarmed the minds of men with visions of universal ruin.

See Villetard, *Histoire de l'Internationale* (Paris, 1871); Testut, *L'Internationale* (Paris, 1871); Onslow Yorke, *Secret History of the International* (London, 1871); J. Rae, *Contemporary Socialism*; also the articles MARX and SOCIALISM.

INTERNATIONAL LAW, the general term for the law governing the relations and intercourse of states with one another. The parties in its application are states (see STATE) and not nations, so that the word "international" does not accurately limit the scope of the subject. Nor do authors always confine themselves to its proper limitation. Thus the rules relating to nationality and naturalization, extradition, patents, trade marks, &c., which affect states on the one side and foreign persons on the other, are generally included among the subject-matter of International Law. There is a special branch of International Law known as Private International Law (see INTERNATIONAL LAW, PRIVATE) which deals exclusively with the relations of persons belonging to different states, in which states as such are not parties.

The term "international" was first used by Bentham. His explanation of the new term was as follows:—

> "The word *international*, it must be acknowledged, is a new one; though, it is hoped, sufficiently analogous and intelligible. It is calculated to express, in a more significant way, the branch of law which goes commonly under the name of "law of nations," an appellation so uncharacteristic that, were it not for the force of custom, it would seem rather to refer to internal jurisprudence. The chancellor d'Aguesseau has already made, I find, a similar remark; he says that what is commonly called *droit des gens* ought rather to be termed *droit entre les gens*. There remain then the mutual transactions between sovereigns as such, for the subject of that branch of jurisprudence which may be properly and exclusively termed international."[1]

There has been much controversy as to the aptness of the use of the word "law" in this connexion. "International law," said the 3rd marquess of Salisbury in a speech on the establishment of a Court of International Arbitration, "has no existence in the sense in which the term 'law' is usually understood. It depends generally upon the prejudices of writers of text-books. It can be enforced by no tribunal, and therefore to apply to it the phrase 'law' is to some extent misleading."[2] This has been more or less the view not only of most British statesmen but also of many practical English jurists. It found one of its most emphatic exponents in Lord Chief-Justice Coleridge. "Strictly speaking," he observed in his judgment on the Franconia case,[3] "international law is an inexact expression, and it is apt to mislead, if its inexactness is not kept in mind. Law implies a lawgiver and a tribunal capable of enforcing it and coercing its transgressors, but there is no common lawgiver to sovereign states, and no tribunal has the power to bind them by decrees or coerce them if they transgress. The law of nations is that collection of usages which civilized states have agreed to observe in their dealings with one another. What these usages are, whether a particular one has or has not been agreed to, must be matter of evidence. Treaties and acts of states are but evidence of the agreement of nations, and do not, in England at least, *per se* bind the tribunals. Neither certainly does a consensus of jurists, but it is evidence of the agreement of nations on international points, and on such points,

when they arise, the English courts give effect as part of English law to such agreement."

In opposition to this view may be cited the more recent one expressed by Lord Russell of Killowen, who challenged Lord Coleridge's view as "based on too narrow a definition of law, a definition which relies too much on force as the governing idea." "If," he added, "the development of law is historically considered it will be found to exclude that body of customary law which in early stages of society precedes law. As government becomes more frankly democratic, laws bear less and less the character of commands imposed by a coercive authority, and acquire more and more the character of customary law founded on consent.... I claim that the aggregate of the rules to which nations have agreed to conform in their conduct towards one another are properly to be designated International Law."[4] This recalls Blackstone's definition: "The law of nations is a system of rules, deducible by natural reason, and established by universal consent among the civilized inhabitants of the world, in order to decide all disputes, to regulate all ceremonies and civilities, and to ensure the observance of justice and good faith in that intercourse which must frequently occur between two or more independent states, and the individuals belonging to each."[5] The current English narrower view owes its origin chiefly to the influence of John Austin, and the current broader one to that of Sir Henry Maine.[6] The increasing popularity of references to international arbitration (see Arbitration, International), the adoption of a large number of special treaties making such references compulsory in certain cases, the establishment of and increasing recourse to the court for the decision of difficulties between states created by The Hague "Convention for the pacific settlement of disputes between States" of 1899 (see Peace), the adoption of fixed rules of law in the international conventions in 1899, 1907 and 1909 dealing with many of the most controversial questions of international usage, have so transformed the subject that if, as Lord Coleridge said, law implies a lawgiver and a tribunal capable of enforcing it, these conditions are now at any rate partly fulfilled. We shall see below to what extent it may be necessary to regard power of enforcement against transgressors as requisite to give international law the character of law properly so-called.

Sanctions.—The subject of the enforcement of International Law, or its "sanctions," has given rise to much controversy. The word "sanction" is derived from the Lat. *sanctio*, which in turn is derived from *sancire*, to consecrate. In its original sense *sanctio* means consecration. From this followed the sense of religious obligation. Thus *sancire legem* is used by Roman writers as meaning that observance was made obligatory, but without reference to the idea of there being a remedy or penalty for non-observance. With the development of an organized judicial system the religious or moral obligation was displaced by the growth of remedial procedure. Cicero observes of some legal restrictions, *hoc non sancitur lege civili* (this is not consecrated by the civil law, *i.e.* with penalties). A collateral sense of the word grew up which meant ratification, as where Cicero speaks of *sancire acta Caesaris* or of *sancire foedus*.

Bentham, who worked out the theory of legal sanctions as applied to modern law, describes them as equivalent to pleasures and pains derived from four different sources. These are physical, political, moral and religious. The first three belong to experience in the present life, the fourth to that in the present life or hereafter.[7]

Austin's analysis of this vague subdivision led him to a more precise determination of the relationship of sanctions to law, viz. that a law properly so-called is a command and its sanction is the power to enforce obedience to it. Stated briefly, any other kind of law according to Austin is not positive law but merely called so by analogy. Applying this test to International Law he concludes that the law obtaining between nations is not positive law; for every positive law is set by a given sovereign to a person or persons in a state of subjection to its author. The law obtaining between nations is only law set by general opinion, with duties which are only enforced by moral sanction; by fear on the part of nations, or by fear on the part of a sovereign, of provoking general hostility, and incurring its probable evils, in case they should violate maxims generally respected.[8]

Sir H. Maine's somewhat indirect answer to Austin may now be taken as the view held at least by British theoretical writers. "Austin," he said, "has shown, though not without some straining of language, that the sanction is found everywhere, in positive law, civil and criminal. This is, in fact, the great feat which he performed, but some of his disciples seem to me to draw the inference from his language that men always obey rules from fear of punishment. As a matter of fact this is quite untrue, for the largest number of rules which men obey are obeyed unconsciously, from a mere habit of mind. Men do sometimes obey rules for fear of the punishment which will be inflicted if they are violated, but, compared with the mass of men in each community, this class is but small; probably it is substantially confined to what are called the criminal classes, and for one man who refrains from stealing or murdering because he fears the penalty there must be hundreds of thousands who refrain without a thought on the subject."[9]

The view, however, that a law is not devoid of binding character because there is no authority to enforce its observance hardly requires justification at the present day. The fact that any well-established international usage is observed, and that states invariably endeavour to answer any

reproach of departing from such usage by explanations showing that the incriminated act is justified by recognized rules of International Law, is evidence of its binding character. As the late Professor Rivier, one of the leading authorities on Roman Law, as well as an international jurist of eminence, has expressed it: “The law of nations is positive law because states wish it to be so. They recognize its compulsory character and proclaim it. As they are their own legislators and make their common laws by express or tacit consent, they attest explicitly and implicitly their conviction that its principles are binding upon them, as judicial principles, as law. Innumerable public acts, affirmations, declarations and conventions are there to prove it. On the other hand, never in any published official act of the present age, verbal or written, has a state dared to declare that it did not consider itself bound by the law of nations and its principles.”[10] States, as Professor Rivier says, have again and again solemnly declared their determination to abide by the principles of International Law. Witness the Declaration of Aix-la-Chapelle of November 15, 1818, in which the representatives of five powers, Austria, France, Great Britain, Russia and Prussia, solemnly stated that “the sovereigns in forming this august union have regarded as its fundamental basis their unchangeable resolution never to depart, either amongst themselves or in their relations with other states, from the strictest observance of the principles of the law of nations, principles which, in their application to a permanent state of peace, can alone effectively guarantee the independence of each government and the stability of the general association.” In the negotiations for the Treaty of London concerning the Black Sea (March 13, 1871), at which seven powers were represented, Austria-Hungary, France, Germany, Great Britain, Italy, Russia and Turkey, a resolution on the sanctity of treaties was annexed to the first protocol, stating that the plenipotentiaries recognize that it is an essential principle of the law of nations that “no power can liberate itself from the engagements of a treaty, nor modify the stipulations thereof, unless with the consent of the contracting powers by means of an amicable arrangement.” Even in 1908, when Austria-Hungary proceeded to the annexation of Bosnia-Herzegovina without obtaining the prior assent of the high contracting powers, who under the treaty of Berlin of 1878 had granted her temporary occupation of the annexed provinces, the protests of the powers concerned were answered by Austria-Hungary declaring that she had done nothing contrary to the law of nations or affecting the sanctity of treaties, because the powers had given their tacit consent to the practical transformation of her temporary into a permanent occupation.

The public opinion of the civilized world, in fact, plays in an ever-increasing degree the part of a sanctioning authority. With the growth of international intercourse and international interdependence the danger of isolation or of discredit or even of “boycotting” becomes a matter of increasing importance in the conduct of states. The national press and periodical literature, with exceptions no doubt, are among the chief factors in the development of this public opinion, but it is by no means dependent upon them. Personal intercourse among citizens of the same country, and between statesmen, politicians and citizens of different countries has a still greater effect in the creation of the mental attitude of nations towards each other. This exposes any departure from recognized usage or any disregard for international obligations to such reprobation throughout the whole world, that, far from taking advantage of the absence of any coercive method of enforcing obedience to the principles of international law, states compete with each other in asserting their strict fidelity to such principles. And now successive diplomatic conferences have codified many of the chief branches of international usage, thus diminishing the possible cases in which states can take advantage of the uncertainty of the law and, by quibbling over its interpretation, escape from its obligations.

Sources and Foundations.—It is usual, following Wheaton’s classification,[11] to enumerate the sources of International Law in the following groups: text-writers of authority as witnesses of usage; treaties of peace, alliance and commerce; ordinances of particular states, prescribing rules for the conduct of their commissioned cruisers and prize tribunals; adjudications of international tribunals; written opinions of official jurists given confidentially to their own government; history of wars, negotiations, treaties and other transactions relating to the public intercourse of nations. It is in these different classes of opinions and precedents that writers have been in the habit of searching for those arguments and analogies on which have been built up the system and principles called International Law.

Wheaton, it is seen, regarded text-writers as witnesses of the usage of nations. He explains his meaning as follows: “Without wishing to exaggerate the importance of these writers, or to substitute in any case their authority for the principles of reason, it may be affirmed that they are generally impartial in their judgment. They are witnesses of the sentiments and usages of civilized nations, and the weight of their testimony increases every time that their authority is invoked by statesmen, and every year that passes without the rules laid down in their works being impugned by the avowal of contrary principles.” This distinguished writer’s quasi-explanation of the sources of International Law is extremely vague. He masses together cause and effect, private and public opinions, usage and exceptions. Professor Oppenheim has endeavoured to give a more scientific explanation of the growth and development of International Law, and objects to calling sources of International Law what are mere factors

influencing its growth:—

> "... Custom and treaties," he observes, "are the two exclusive sources of the Law of Nations. When writers on International Law frequently enumerate other sources besides custom and treaties they confound the term 'source' with that of 'cause'[12] by calling sources of International Law such factors as influence the gradual growth of new rules of International Law without, however, being the historical facts out of which these rules receive their legal force. Important factors of this kind are: Opinions of famous writers on International Law, decisions of prize courts, arbitral awards, instructions issued by the different states for the guidance of their diplomatic and other organs, state papers concerning foreign politics, certain municipal laws, decisions of municipal courts. All these and other factors may influence the growth of International Law either by creating usages which gradually turn into custom, or by inducing the members of the Family of Nations to conclude such treaties as stipulate legal rules for future international conduct.
>
> "A factor of the special kind which also influences the growth of International Law is the so-called comity (*Comitas gentium, Convenance et courtoisie internationale, Staatengunst*). In their intercourse with one another states do observe not only legally binding rules and such rules as have the character of usages, but also rules of politeness, convenience and goodwill. Such rules of international conduct are no rules of law, but of comity. The Comity of Nations is certainly not a source of International Law, as it is distinctly the contrast to the Law of Nations. But there can be no doubt that many a rule which formerly was a rule of International Comity only is nowadays a rule of International Law. And it is certainly to be expected that this development will go on in future also, and that thereby many a rule of present International Comity will in future become one of International Law."[13]

Precedents.

We prefer to regard International Law as deriving the rules composing it from practically the same sources as domestic law, and to attribute to text-writers more or less the same value in its development as in that of the private law of nations. The same primary rules of conduct are appealed to between states as between individuals, and precedents play exactly the same part wherever human actions are concerned. In both cases what has been done before commends itself when the responsibility of taking steps pledging the future is concerned. Statesmen on whom great responsibility impends, on whom the conduct of momentous negotiations has devolved, and who will have to render an account of their work to the sovereign or nation they represent, preserve an argument in their own favour in departing as little as possible from any course taken in previous similar circumstances. Precedents, moreover, are arguments for acceptance by their adversaries or counter-negotiators. In fact, in diplomacy even more than in matters of domestic government precedents play a dominant part in the growth of usage. These precedents are often in themselves originally local usages, such as grew up in the intercourse of the Italian communities.

Italian influence.

Italy, in fact, served as a laboratory for early diplomatists and writers. It was in the intercourse of these active and ambitious states that grew up the very notion of a foreign diplomacy and the necessity of rules of conduct in this miniature Europe, with its perpetual antagonisms and jealousies, its balance of power, its idea of a state distinct from a nation and of a community of states elbowing each other in their daily contact. It was there that grew up the institution of passports, the distinction between armed forces and civilians, international comity, and in fact the very notion that states have an interest in the observance of law and order among them. In the same way the active commercial intercourse in the Mediterranean led, in the common interest, to the development of rules of the sea in time of peace, and later to others in time of war.

Thirty Years' War.

In the north of Europe, again, out of the active commercial intercourse among the Baltic and North Sea communities grew rules of the sea in the same common interest. It was the Thirty Years' War, with its revolting cruelty, which brought out the contrast between the more humane practice of war as an art in Italy and the mere bludgeonry which prevailed in the brutal struggle which disgraced the first half of the 17th century. The brutality of the struggle turned thinkers' attention to the need of formulating rules for the protection in time of war of non-combatants and the innocent subjects of absolute sovereigns, the treatment of the sick and wounded, the prohibition of wanton pillage and the other horrors which shocked the awakening conscience of northern Europe. It was the starting-point of the age of text-books.

Grotius.

Pufendorf.

The first effective work, the one which was the first to influence sovereigns and statesmen, was Grotius's *De jure belli ac pacis* (Paris, 1625), which practically exhausted the theoretical arguments in favour of the new subject. Nobody has in fact since brought to light any new conception of the foundations of international law. An exhaustive and masterly treatise having been published, no further subsequent treatise was necessary to show what all men were beginning to feel. He sublimated the feelings of his age, and having arrived at the pure substance, the work of proving the need of his subject was disposed of for all time. Pufendorf (1632-1697), who, in the

sequence of effective text-writers, succeeded Grotius, endeavoured to base international law on an ethical basis accepted by all peoples without necessity for a common creed or standard of morals, but it is doubtful, whatever may have been the extent to which he stimulated the study of jurisprudence, whether he did much in advancing the practical development of the law of nations. His book *De jure naturae et gentium* (1672), as its name indicates, based international law on what he called the law of nature, a subject which has much exercised the minds of jurists searching for an ethical basis for existing law.

Leibnitz.

The scientific mind of Leibnitz (1646-1716) revolted against this theoretical and doctrinaire tendency of Pufendorf and other writers, who were following with feeble tread in the giant footsteps of Grotius. He saw that the practice of nations was taking a course dictated by the current moral standards of civilized society, and that the philosophizing of the text-book writers was leading them away from that actual practice which they should use as data for their conclusions. Natural science, moreover, had taught him the risk of theorizing on imperfect data, and while writing a history of Brunswick it occurred to him that treaties and diplomatic documents generally were the substances and tests of the publicist's laboratory. His *codex juris gentium diplomaticus* (1693-1700) gave a more precise direction to speculations on the subject.

Bynkershoek.

The next great writer of authority united all the qualities of a practical lawyer and jurist. This was Bynkershoek (1673-1743). He was the first writer on international law who dealt with public maritime law as a matter demanding special treatment and involving a set of principles not called into action in territorial warfare. A magistrate administering the law in a great commercial country, whose interests were on or across the high seas rather than within the narrow European limits of Holland, Bynkershoek, like Leibnitz, searched for his data in the actual practice of nations in their intercourse with one another. He applied his clear legally trained mind to deriving principles from practice instead of endeavouring to build up a practice on abstract principles. It was he who first generalized the different isolated usages which had grown up at different spots in northern Europe in the interest of maritime defence, and evolved from practice the principle that dominion seawards was limited to the extent to which it was possible to enforce it (cannon-shot range), a principle which not only created the legal institution of territorial waters, but has since been imported into other branches of International Law, and has indirectly influenced the suppression of fictitious blockades and more recently of fictitious occupations of territory.

C. de Wolff.

A contemporary of Bynkershoek was Christian de Wolff (1679-1754), a philosopher, mathematician, theologian, lawyer and disciple of Leibnitz. Wolff's great work on the *Institutions of the Law of Nature and Nations* is a learned and accurate treatise drawn from all the well-known sources of knowledge, and, just as Grotius based his demonstrations on the then imperfect knowledge of public events of his time, Wolff based his on the more accurate sources of information which had grown up under the influence of Leibnitz, and created a connected system out of the scattered fragments available. But his book was written in Latin at a period when scholarship had declined, and its influence was only felt after Vattel (1714-1767) wrote his *Droit des gens, ou principes de la loi naturelle appliquées à la conduite et aux affaires des nations et des souverains* (1758). His book had all the charm, although Vattel was a Neufchatelois, of the French writers of his time, and he it was who popularized the study of International Law. His book was based chiefly on the work of Wolff, but in it he gave what was best amongst his predecessors without attempting to add anything original of his own. It became the handbook of statesmen and jurists, and has never ceased to be quoted by them down to the present day.

Vattel.

But the opinions of jurists in International Law can have little more than the value of criticism and co-ordination. They have seldom served to make law, though they have the weight of all statements made by those who have made a special study of any branch of law, as to what they had gathered to be the existing practice at the time when they wrote, or as to the trend which they showed that practice might be taking. Great lawyers and writers like those we have mentioned, and such as Lord Mansfield, Sir William Scott, Chief-Justice Marshall and others, have done the work of classifying facts, deducing conclusions from them and connecting rules with psychological and ethical motives, and have thus sent a current of higher intelligence through the subject which has raised it to its present methodical form. Still International Law remained a wide field for controversy. Authors were agreed on general principles, but when these general principles were applied in practice, the shortcomings of unwritten usage often caused as much difficulty as that which the appeal to principles was intended to overcome.

Hague and

What may be called the first enactment of rules of International Law was the Declaration of Paris of 1856, but the great work of codification, or rather of reducing into writing the rules which had been floating as an unwritten law in the conscience of Europe, was undertaken by the Hague Conferences, which may be said to be and to have created an entirely new factor in the domain of International Law. Two of the

London Conferences. conventions adopted in 1899 completed work which had already been commenced long before, viz. those on the usages of war and on the adaptation of the Geneva Convention to naval war. The third established methods for the pacific settlement of international difficulties, including the formation of the Hague Court of Arbitration. Recourse to the latter was purely optional, but the other two conventions have been absorbed into the national law of the ratifying countries, and thus have also the domestic sanction states give to their own laws. The work of the Conference of 1907 was of a much wider and more exhaustive character than that of 1899. It comprised, besides revised conventions on the matters dealt with in 1899, new Conventions on the following subjects: Opening of hostilities; Position in naval war of enemy's merchant ships at beginning of hostilities; Conversion of merchant vessels into warships; Rights and duties of neutral states in naval war; The laying of automatic submarine contact mines; The bombardment of undefended places by naval forces; Treatment of fishing vessels, postal correspondence and capture generally in maritime war; and Recovery by force of contract debts. It also adopted a convention for the creation of an International Prize Court of Appeal, which led to the calling of a fresh Conference on Prize Law. This conference sat in London from December 4, 1908, to February 26, 1909, and was confined to representatives of the following countries: Great Britain, France, Germany, United States of America, Italy, Austria-Hungary, Russia, Japan, Holland and Spain. It adopted a series of rules on naval warfare relating to Blockade in time of war; Contraband of war; Unneutral service; Destruction of neutral prizes; Transfer to neutral flag; Enemy character; Convoy; and Resistance to search and Compensation.

The revolution effected in the relations of states by the Hague and London Conferences, however, is not confined to the reduction into writing of more or less vague usages nor to the elaboration of details which no usage can possibly determine. Until a machinery was provided for the reform of the law it was futile to speculate on the advantages or disadvantages of any rule admitted by the majority of civilized nations. The territorial waters 3 m. limit, for instance, had its origin in the distance seawards of cannon-range in a past period. Its almost universal recognition only came long after the range of coast-guns had far exceeded this distance. This superannuated rule has now no legal basis at all except the so-called "common consent of nations," a boon no doubt which outweighs any consideration of absolute fitness still unrecognized, but of which the learned Barbeyrac truly said,[14] "Ce commun consentement des peuples que l'on suppose avoir force de loi est une chose qu'on ne prouvera jamais." The institution of the Hague Conferences has now provided a method of obtaining the consent of nations, not only to existing rules, but to their reform and to the introduction of new rules. It is now an understanding among the states of the world, that these conferences shall be held periodically. It is, of course, possible for one great state to hold aloof and thus wreck the chances of universal agreement, but even then we have the power of the majority as against that of the minority. A case actually arose in a recent war between non-signatories of the declaration of Paris of 1856. Neither the United States nor Spain was a party to that declaration, yet neither ventured to disregard it.

The chief source of International Law will, therefore, in all probability for the future be that "Parliament of mankind," the Hague Conferences. The Hague Court and its adjunct in time of war, the proposed International Prize Court of Appeal, will form the Judicature applying and construing the enactments of the Conferences acting as a sort of international Legislature.

Fundamental Principles.—Underlying the details of both the new International Legislature and the new International Judicature are certain principles which may some day have to be officially defined. These principles have necessarily fluctuated with the standard of morals of each period. With the contemporary development of the public conscience, they are undergoing changes and a betterment which it is not desirable to check by yet nailing them up as immutable articles of faith. Till quite recently it was usual to speak of the common standard of right conduct prevailing throughout the Christian world, a standard to which responsible statesmen tried to adjust their direction of the affairs of state. The admission of Japan into the councils of the great powers has introduced a non-Christian element whose standard of conduct was not identical with nor based upon Christian morals. Turkey, though admitted in 1856 to European Councils, remained rather the occasion of their deliberations than a deliberating party. Her new position as a constitutional state, with a code of morals at any rate in some essentials distinct from that of Christian peoples, will add a further new non-Christian element into the moral foundations of international conduct. The influence of western Europe, however, in both Japan and Turkey, has hitherto in all external development been paramount. Japan, after examining all the existing systems, has even adopted the best she found in Western morals, and in her schools inculcates Christian ethics as a subject *per se* without reference to divine revelation or authority. Turkey too has the advantage of possessing a code of morals which produces so high a standard of right conduct in private life that very little in the way of moral lessons will have to be learned by the Ottomans from Western civilization. As regards practice, it is unreasonable to expect that the high estimate of the moral standard of west European civilization, which is cherished by those

Standard of right conduct.

who profess its principles, should be accepted by other peoples with unqualified assent. Are not the nations of western Europe still vaguely influenced by the instincts of their conquering ancestors, and by the traditions of—

> "... the good old rule,
> ... The simple plan,
> That they should take who have the power
> And they should keep who can"?

There is nothing essentially different between many recent wars and military enterprises undertaken by Western nations against heathen peoples, and wars and conquering enterprises undertaken by the Northmen of a thousand years ago. In his *Northern Antiquities* Mallet[15] describes the primitive feeling of the Northmen in the following passages:—

> "The rules of justice, far from checking their prejudices, had been themselves warped and adapted to their bias. It is no exaggeration to say that all the Teutonic nations entertained opinions on this subject quite opposite to the theory of our times. They looked upon war as a real act of justice, and esteemed it an incontestable title over the weak, a visible mark that God had intended to subject them to the strong. They had no doubt but the intentions of this divinity had been to establish the same dependence among men which there is among animals, and setting out from the principle of the inequality of men, as our modern civilians do, from that of their equality, they inferred thence that the weak had no right to what they could not defend. This maxim which formed the basis of the law of Nations among the ancient inhabitants of Europe being dictated by their most darling passion, we cannot wonder that they should so steadily act up to it in practice. And, which after all is worst, to act and think as they did, or, like the moderns, with better principles, to act as ill? As to the ancient nations, we attribute nothing to them here but what is justified to them by a thousand facts. They adopted the above maxim in all its rigour and gave the name of Divine Judgment not only to the Judiciary Combat, but to conflicts and battles of all sorts: victory being in their opinion the only certain mark by which Providence enables us to distinguish those which it has appointed to command others."

The very notion of the "right of conquest," and that the victorious are entitled to an indemnity without reference to any question of right and wrong or of justice and injustice, shows that there are principles in actual practice which lie outside and have no analogy in the principles of private law. In the partition of Africa native states have been treated as non-existent except as local bodies. They have been annexed to European states without reference to their will or consent. Treaties have indeed been made with them, but they have rather been regarded as evidence of prior occupation than as involving any question of native right. The test in the distinction between civilized and uncivilized states which is regarded as warranting exclusion from enjoyment of the right to consideration as independent states, and admission to the community of the civilized world, is in practice the possession of a regular government sufficient to ensure to Europeans who settle among them safety of life and property. Every country, in principle, possessing such a government has prima facie the rank of a state and is entitled to treatment as a civilized community. Treaties made with it for the purpose of extra-territorial jurisdiction are intended merely to take into account a difference of judicial institutions but are not supposed to detract otherwise from the possession of such equality and independence. This principle has no analogy in private morals, and has been, slight as it is, more honoured in the breach than the observance. If indifference to native right has provoked reaction, it has been on the part rather of philanthropists than of statesmen. Their movement for the protection of African aborigines has, however, resulted in at least one great international charter for the prevention of the further degradation of African aborigines, viz. the General Act of Brussels of 1885. A vigorous outcry has also been raised against the methods of the government of the Congo State. But the agitation ought not to be confined to this part of Central Africa. Other governments are also in fault. In fact, the contact of the European with Central Africa has, throughout, with few exceptions, been one of barbarous practice quite inconsistent with the principles which Christian missionaries have been sent to teach the African native.

What is a civilized state?

In the case of European enterprise in Asia, the "good old rule" has had still less justification. The action taken for the repression of the Boxer movement in China, like previous European incursions, had no essential characteristic distinguishing it from the expeditions of the Northmen described by Mallet in the above-quoted passage. The Japanese took part in the "Boxer" expedition, and the example of respect for native right and of orderly self-restraint they set has been universally acknowledged. But the lesson is one of greater significance than one of comparative ethics. The rise of the power of Japan and her obvious determination to constitute herself the champion of the races of eastern Asia has widened the scope of International Law, and we may now regard China as henceforth under the protection of the same principles as European states.

The three chief principles of interstate intercourse, those, in fact, on which International Law

is based are:—

1. Recognition of each other's existence and integrity as states.
2. Recognition of each other's independence.
3. Recognition of equality, one with another, of all independent states.

As regards the first o£ these principles see State. From the principle of independence it follows that every state has a right to change its form of government and to enjoy the free exercise o£ its internal energies. This is subject only to the limitation that in the exercise of this right other states or their subjects shall not be molested or otherwise suffer. The equality of all independent states entitles them to respect by other states of all the forms of ceremonial and to the same treatment by others, where their interests are identical, whether they are strong or weak. This principle has often been violated, but it is, nevertheless, acknowledged wherever possible, as in diplomatic conferences relating to all matters of an economic, hygienic, industrial or social character. Even at the Conference of Algeciras, though the powers immediately concerned from a political point of view were only Great Britain, France, Germany and Spain, the following were also represented as having economic interests in Morocco, Austria-Hungary, Italy, Russia, Belgium, Holland, Portugal and Sweden.

Chief principles.

Ships on the high sea being regarded as detached portions of the national territory, there is also the derived principle of the freedom of the high sea, of the independence and equality upon it of the ships of all nations, subject only to due respect being paid to the independence and equality of all others and to such conventional restrictions as states may impose upon themselves (see Territorial Waters). This principle is re-enunciated in the preamble to the Convention of 1907 on the laying of automatic submarine contact mines (see Peace Conferences).

High sea.

The Hague Conventions are based on these principles, to which there is a tendency to add another, viz. the right to arbitration in certain cases. This principle is set out more or less tentatively, it is true, but it is being completed by separate treaties of compulsory arbitration in connexion with the cases referred to. It is enunciated in the following article of the Convention of 1907 for the pacific settlement of International disputes:—

The right to arbitration.

> "In questions of a legal nature, and especially in the interpretation or application of International Conventions, arbitration is recognized by the contracting powers as the most effective, and, at the same time, the most equitable means of arranging disputes which diplomacy has failed to settle. Consequently, it is desirable that, in disputes regarding the above-mentioned questions, the contracting powers should, if need be, have recourse to arbitration, in so far as circumstances permit" (Art. 28).

The principle of arbitration has also been adopted in reference to the recovery of contract debts under the following article of the "Convention respecting the limitation of the employment of force for the recovery of contract debts":—

> "The contracting powers agree not to have recourse to armed force for the recovery of contract debts claimed from the government of one country by the government of another country as being due to its subjects or citizens. This undertaking is, however, not applicable when the debtor state refuses or neglects to reply to an offer of arbitration, or, after accepting the offer, renders the settlement of the *Compromis* impossible, or, after the arbitration, fails to comply with the award" (Art. 1).

The codification of International Law itself, begun at the Hague and London Conferences, is an admission of the binding character of the primary principles set out above.

One of the chief tendencies of contemporary reform is also to restrict the effect of fictions and reduce rights to the limits of their practical application. Between two alternatives, the one to assert rights which cannot possibly be maintained by force such as claims to dominion over portions of the high sea (see High Sea, Territorial Waters), "paper blockades" (see Blockade) and fictitious occupations of territory (see Occupation), and the other to require actual physical assertion, a medium course is growing up, viz. that of recognizing potential assertion, that is assertion limited to physical possibilities.[16] With the aid of the Institute o£ International Law, the International Law Association and other reforming agencies (see Peace), expert opinion in these matters is becoming homogeneous throughout the civilized world, and the ground is being prepared for a clearer understanding of these fundamental principles by the statesmen and state officials who have to apply them in practice.

Restriction of effect of fictions.

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(T. Ba.)

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1 Introduction to the *Principles of Morals and Legislation* (Clarendon Press edition of 1879).

2 *The Times*, July 26, 1887.

3 *R.* v. *Keyn*, 2, Ex.D. 63.

4 Address at Saratoga Springs, N.Y., 1896 (*Law Quarterly Review*, October 1896).

5 *Commentaries on the Law of England*, 4th ed., iv. 66.

6 Austin's view, as set out in the *Province of Jurisprudence Determined*, is that laws proper, or properly so-called, are commands; laws which are not commands are laws improper or improperly so-called. A command implies a definite superior in a position to enforce the command. Where there is no superior to impose obedience there is no law. Rules which "are imposed among nations or sovereigns by opinions current among nations are usually styled the law of nations or international law. Now, a law set or imposed by public opinion is a law improperly so-called" (p. 147). For Sir H. Maine's views see below.

7 Introduction to the *Principles of Morals and Legislation* (Oxford, 1879), pp. 24 et seq.

8 *Province of Jurisprudence Determined* (1861), p. 177; Austin explains his view more fully at p. 127.

9 *International Law*, p. 50.

10 *Droit des gens* (1896), i. 22. Compare Savigny: "A community of judicial conscience can be formed among nations like that which positive law creates in the bosom of one people. The foundations of that intellectual community are constituted partly by a community of race, partly and especially by a community of religious convictions. Such is the basis of the law of nations which exists principally among European Christian states, but which was not known to the peoples of antiquity. We are entitled to look upon this law as a positive law, although it is an incomplete judicial formation" (eine unvollendete Rechtsbildung), *System des heutigen römischen Rechts* (1840), i. § 11.

11 *Elements* (London, 1885), pp. 22 et seq.

12 "It seems to me," says Professor L. Oppenheim, "that most writers confound the conception of 'source' with that of 'cause,' and through this mistake come to a standpoint from which certain factors which influence the growth of International Law appear as sources of rules of the Law of Nations. This mistake can be avoided by going back to the meaning of the term 'source' in general. Source means a spring or well, and has to be defined as the rising from the ground of a stream of water; and, wanting to know whence it comes, we follow the stream upwards until we come to the spot where it rises naturally from the ground. On that spot, we say, is the source of the stream of water. We know very well that this source is not the cause of the existence of the stream of water. 'Source' signifies only the natural rising of water from a certain spot of the ground, whatever natural causes there may be for that rising. If we apply the conception of source in this meaning to the term 'source of law' the confusion of source with cause cannot arise. Just as we see streams of water running over the surface of the earth, so we see, as it were, streams of rules running over the area of law. And if we want to know whence these rules come, we have to follow these streams upwards until we come to their beginning. Where we find that such rules rise into existence there is the source of them. Of course, rules of law do not rise from a spot on the ground as water does; they rise from facts in the historical development of a community. Thus a good many rules of law rise every year from the Acts of Parliament. Source of Law is therefore the name for an historical fact out of which rules of conduct rise into existence and legal force" (International Law, London, 1905, sec. 15.).

13 *International Law* (London, 1905) sec. 19.

14 Note 8 to Grotius, L., ii. c. iii. § 3.

15 Bishop Percy's translation (1847), p. 138.

16 We have seen this in the progress made in the three instances given above at the Congress of Paris (1856), the Conference of Berlin (1878) and the Hague Conference of 1907.

INTERNATIONAL LAW (PRIVATE). There is in every territory the law of the land, or territorial law, by which the courts decide all cases that include no circumstances connected with any foreign territory. Often, however, such a circumstance suggests the question whether justice does not require that the law of some other territory shall be applied. Thus the Gretna Green marriages, by which English minors escaped the necessity of banns or the consent of parents or guardians, suggested the question, which was answered in the affirmative, whether even in England their validity ought not to be tried by the law of Scotland, where they were celebrated. Often, again, the question is suggested whether justice does not require that the courts of law should allow some effect to foreign legal proceedings, such as a judgment obtained or litigation pending abroad. Such questions as these are answered by private international law, which, since both laws and legal proceedings are emanations of public authority, may be defined as the department of legal science which is concerned with the effect to be given in the courts of law of any territory to public authority of another territory. The extradition of criminals is also an effect given to foreign public authority, but rather by the government which surrenders the criminal (see EXTRADITION) than by the courts of law, whose only function is to check the surrender so far as the domestic legislation allows them to do so. If private international law were defined as the effect to be given by any mode in one territory to the public authority of another, extradition would be included in it, as is often done; but since the principles governing extradition have little to do with those applicable to other cases, it seems best to treat it as a separate department of law, as is generally done in England.

Comity of Nations.—In the 17th century the Dutch jurists Paul and John Voet and Huber brought forward a view which has since been largely adopted in England and the United States, namely, that the effect given by courts of law to foreign public authority is only due to the comity of nations, but for which every possible question before them would have to be decided by the law of the land. Comity, in that phrase, may only be intended to express the truth that foreign public authority has no inherent effect, without denying that the effect which domestic public authority allows to it is dictated by justice. But the limitations implied in the popular meaning of comity have sometimes been made the ground for deciding questions of private international law in the manner supposed to be most for the interest of litigants belonging to the territory; the phrase is consequently reprobated by most European continental writers, and had better be dropped. The justice on which private international law is founded acknowledges no interest but the general one of intercourse between persons sharing a common civilization in different countries. This interest, as manifesting itself in the domain of law, it seeks to satisfy and it is therefore a true legal justice, rightly classed under *law*, *droit*, *recht*, *diritto*, *derecho* and other corresponding terms.

Of the two words which, together with *law*, make up the title of our subject, *private* is justified by the fact that its application is between litigants in courts of law, and not between governments except so far as they may be such litigants. *International* (although *interterritorial* would be better) is justified by the facts that public authority, which may be internationally 702
foreign, has to be considered, and that governments display a great interest in the question by concluding treaties about it, and occasionally even by suspending diplomatic relations when a court of one country has applied to the subjects of another a rule which the government of the latter deems unjust. But those who think that the primary division of law should be into public and private, and not into international (or interterritorial) and territorial, object to the order in which the three words of the name are usually placed, and call the subject "international private law."

Conflict of Laws.—This is another name for our subject, and indeed an older one than "private international law," besides being still much used. But although laws may differ, they cannot properly be said to conflict, unless each can lay a just claim to application in the same circumstances. Now this does not happen. The justice which points out that in certain cases effect ought to be given in one territory to the laws or legal proceedings of another really traces the limits of laws and legal proceedings in space; and the tracing of limits is rather the prevention of conflict than its solution. Savigny has well pointed out that our subject is analogous to the determination of the limits of laws in time, which has to be made when the just

application of a new enactment is to be distinguished from the *ex post facto* application which cannot justly be allowed it. The truth which is aimed at in the phrase "conflict of laws" is that the main problem of our subject is the selection of a law for each given case; but different laws are candidates for selection, not from anything in them as laws, but from differing opinions about the justice of the case. From this selection, again, will be seen the contrast between private international law and attempts at the assimilation of the laws of different countries. To a great extent such assimilation is desirable, especially in mercantile law, but it must always be limited by different views of social order and differences in national habits of thought and action. So far as it is realized, private international law comes to an end with the occasion for selection.

Territory.—This word, as entering into the definition of private international law, does not imply a separate state, whether sovereign or semi-sovereign; it includes every geographical area having a separate legal system, England and Scotland, as well as France or Germany. The case of the Gretna Green marriages illustrates the necessity of rules of private international law between all such, as well as between areas internationally foreign to one another; and indeed the rules are so applied, and in the language of our subject, the area of every separate legal system is foreign to every other such area. Only where a rule contemplates a person as attached more or less permanently to a particular territory, the tie which so attaches him to it may be either nationality or domicile if the territory is a separate state, as France; but it can only be domicile if the territory is combined with others in one state. Nothing but domicile can distinguish British subjects as belonging to England, Scotland or Jamaica, or citizens of the United States as belonging to New York or Pennsylvania.

Legal rules must have relation to the physical and mental characters, and the consequent habits of action, of the populations for which they are intended; they would not satisfy legal justice if they endangered social order as understood and desired by those populations, or if they failed to give due effect to the expectations of parties. This must be true for the rules of private international law as well as for those of any territorial law, and it leads us to ask whether the differences which preclude the universal identity of the latter must not also preclude the existence of the former. The answer is: (1) That where circumstances connected with different territories are concerned, wise rules for the selection of a law will generally give better effect to the expectations of the parties than an exclusive adherence to the territorial law of the court; (2) That the circumstances in which a foreign law is held to apply are exceptional as compared with those in which the domestic law applies, and naturally occur oftenest among the persons and in the affairs having most of a cosmopolitan character, so that the moral shock of applying to them a law founded on a foreign social order is greatly attenuated; (3) That throughout Christendom (to which Japan has now been added for legal purposes) there does exist, though not an identity, yet a considerable similarity in views of social order and prevalent habits of thought and action. Within the same geographical limits there also exists another requisite for the working of a system of private international law, namely, a mutual confidence between countries in the enlightenment and purity of their respective judicatures, to whose proceedings the respect enjoined by the rules of our subject is to be mutually given.

Even within the geographical limits just mentioned there are certain differences on points of social order, especially on marriage or divorce, which have hitherto prevented a complete agreement being attained in the rules of private international law. But no attempt has ever been made to establish any system of the kind as between Christian communities and Mahommedan or other polygamous ones, or between countries enjoying a Christian standard of civilization and those, of which China may be taken as an example, which, whether polygamous or not, do not inspire the necessary confidence in their judicatures. In Turkey and other Eastern countries (in which designation Japan is no longer included for purposes of law) Christians are placed by treaty under the jurisdiction in civil matters of their respective consuls. When in the courts of Christian countries Eastern persons or circumstances connected with Eastern laws have to be dealt with, the peculiar institutions of those countries are not enforced; and while in other respects the judges may be assisted by some of the rules of private international law, especially such as have for their object to carry into effect the reasonable intentions of parties, yet those rules are not applied as parts of an authoritative system.

Rules for the selection of the territorial law to be applied in the different classes of cases, or for the recognition of foreign legal proceedings, have sometimes been made the subject of international treaties, and have often been enacted by territorial legislatures. England possesses a few such enactments, as in the Bills of Exchange Act 1882, and many other countries possess them to a much larger extent in their codes. Where such enactments exist, or where treaty stipulations have been entered into, and the territorial law makes such stipulations binding on the judges, the courts of law must obey and apply them as they must obey and apply any other part of the law of the land. If, as in England, judicial precedents are held to be binding, so that the law of the land consists in part of judge-made law, a similar result is produced; an English court must follow English precedents on the application of foreign law or the refusal to apply it, to the same extent to which it would be bound to follow them on any other point. So far as our

matter remains open for a judge, he has, to assist him towards a just decision, the treaties, written laws and judicial precedents of other countries as examples, and a vast literature which has grown up in all Christian countries. That this apparatus is far from having furnished concordant results is due, not only to the divergences on points of social order referred to, but also to the different bases of the legal systems with which the respective governments and writers have been familiar. The legal systems of different countries have been founded on Roman law, feudal law, English common law and still other bases. The arguments of lawyers are affected by the prepossessions thence arising, and they have consequently failed to arrive by their unaided efforts at so much agreement on the rules of private international law as would have been compatible with the conditions and modes of life and action surrounding them. But the general acceptance of a complete body of rules on private international law is a goal which for other countries than England is well within sight by the road of international treaties concluded under the joint direction of professional and non-professional minds.

The most remarkable steps taken in or towards the conclusion of such treaties are those initiated, to its high credit, by the government of the Netherlands. That government first moved 703
in the matter in 1874, and has succeeded in assembling at the Hague the official representatives of nearly all European powers in conferences held in 1893, 1894, 1900 and 1904. At these conferences rules on many branches of private international law were agreed on for submission to the respective governments, which has led to conventions, one of the 14th of November 1896, three of the 12th of June 1902, and four of the 19th of July 1905, regulating the selection of the laws for determining the validity of marriage and of contracts made on the occasion of marriage, their effects on property and on the status of the wife and children, divorce and judicial separation, the guardianship of minors and of interdicted persons, the validity of testamentary dispositions and the rules of intestate succession, and many points of judicial procedure. These conventions may be found at length in the *Revue de droit international et de legislation comparée*, t. 28, pp. 574-579; 2^{e} série, t. 4, pp. 485-500; and 2^{e} série, t. 7, pp. 646-678. A draft relating to bankruptcy was also prepared at the conference of 1904, but was intended to serve, not as a general convention, but as the base of separate conventions to be concluded between particular states. The extent to which the continent has become united with regard to private international law appears from the fact that France, Germany, Italy, the Netherlands, Portugal, Rumania and Sweden are parties to all the conventions—that Luxemburg, Russia and Spain are parties to those relating to judicial procedure—and that all the ten except Russia, but with the addition of Austria, Belgium and Switzerland, are parties to those on the validity of marriage, divorce and judicial separation, and the guardianship of minors; while all remain open to adhesion by other powers. It is much to be regretted that the British government has declined all invitations to take part in this great international work. The fact must in part be ascribed to the hindrance which the difference between the English common law and the Roman law places, even for lawyers, in the way of joint action with the continent, and in part to the necessity that the rules laid down in any convention should be enacted for the United Kingdom by parliament, the leaders of which belonging to either party take no interest in any such matters.

Next in importance among combined official efforts should be mentioned the congress of seven South American states at Montevideo in 1888-1889, which on many branches of private international law drew up rules intended for adoption by treaty on that continent.

Nationality: Domicile.—Coming now to the particular rules of private international law which are received in England, or have been most widely received elsewhere, the most obvious cases which present themselves for admitting foreign circumstances to influence the decision of a judge are those in which rights are so connected with the person of an individual that the justice of deciding on them by a law having relation to his person speaks almost for itself. Hence arises the notion of a personal law, which must be that either of the person’s political nationality or of his domicile, these being the only circumstances that for the time being are fixed for the individual, irrespectively of the spot where he may happen to be, and of the transaction in which he may happen to engage. We have seen in the article on Domicile what is the legal meaning of that term, how its existence is ascertained, that in and long after the middle ages it was the usual criterion of the personal law, and that in modern times political nationality has largely replaced it as such criterion on the continent of Europe. Thus as well by the conventions mentioned as by the codes of many states—France, Italy and Germany among the number—the capacity and status of persons is now governed by the law of their political nationality. In Latin America the criterion of the personal law is still generally held to be domicile, which is among the reasons why the South American states prefer to pursue the codification of private international law independently of European conferences and conventions.

The English courts were slow to recognize a personal law at all and as late as Lord Eldon’s time they held that the competency of a person to contract depended on the law of the place where the contract was made. Their decisions have since come into line with the continental decisions so far as to make capacity and status depend on a personal law, but not so far as to make nationality its criterion. Hence in England, and in a minority of European continental

countries, of which Denmark is an example, the capacity of a party to enter into a contract, whether it be disputed on the ground of his age, or, in the case of the contract of marriage, on the ground of his consanguinity or affinity with the other party, will be decided by the law of his domicile. Guardians, curators and committees of foreign minors or lunatics, deriving their authority from the law or jurisdiction of the latter's domicile or nationality, can sue and give receipts for their personal property. A court will not decree the divorce of persons not domiciled within its jurisdiction, and it will recognize foreign divorces if, and only if, they have been decreed by a jurisdiction to which the parties were subject by domicile or nationality. And the legitimation of a child by the subsequent marriage of its parents will be held to depend on the law of its father's domicile or nationality. But the reference to the place of contract, carried to North America with the rest of the English jurisprudence of that date, still maintains in the courts of the United States a struggle with the doctrine of personal law as governing capacity and status.

Here must be noticed a difficulty which arises about the application of any foreign law to the capacity for contracting. It will be understood by the German provision intended to meet it, namely, that "if a foreigner enters in Germany into a transaction for which he is incapable or has only a restricted capacity, he is to be treated for that transaction as being so far capable as he would be by the German legislation. This, however, does not apply to transactions with regard to rights of family or of succession, or to those disposing of foreign immovable property" (Art. 7 of the statute enacting the code). In a spirit similar to that which dictated the German enactment, the French courts have not generally allowed a Frenchman to suffer from the incapacity, by his personal law, of a foreigner who contracts in France, when the foreigner would have been capable by French law, and the Frenchman was in good faith and without great imprudence ignorant of his incapacity. Lately a disposition has been shown to limit this protection of nationals to the case in which the foreigner has been guilty of fraud. English courts usually hold themselves to be more stringently bound by rules, whether those enacted by parliament or those adopted for themselves; and if they should continue to profess the doctrine that capacity depends on the law of the domicile, it is not probable that they will deem themselves entitled to make exceptions for the protection of persons contracting in England with foreigners not enjoying such capacity. The point furnishes an illustration of the fact that to deal satisfactorily with so complex a subject as private international law requires the assistance of the legislature, which again cannot be given with full utility unless uniform provisions, to be enacted in different countries, are settled by international convention.

Another ground for the application of a personal law is furnished by the cases in which masses of property and rights have to be dealt with collectively, by reason of their being grouped around persons. The principal instances of that kind are when it is necessary to determine the validity and operation of a marriage settlement or contract, or the effect of marriage on the property of the husband and wife in the absence of any express settlement or contract, and when property passes on death, either by a will or by intestate succession.

> These matters, at least when the property concerned is movable, are generally referred to the personal law of the husband at the time of the marriage, or to that of the deceased respectively; but about them, besides the question between domicile and nationality, there arises the question whether immovable property is to be included in the mass governed by the personal law, or is to follow the territorial law of its own situation (*lex situs*). Here we touch the distinction between *real* and *personal* statutes which arose in the middle ages, when the local legislation of the free cities was contrasted, under the name of statutes, with the general Roman law. That distinction did not bear the same character at all times, but in the 16th century, under d'Argentré, it acquired its most developed form, absorbing all laws into one or other of the two classes, and giving a vast extension to the real class, for which was claimed exclusive application to immovables situate in the territory of the law. In accordance with this system, the highly feudal character of which was very sympathetic to English jurisprudence, English practice has refused to include English immovables in the mass to be dealt with as a unit on marriage or death. But it refers the validity and operation of a marriage settlement, at least as to movables, and the effect of marriage, in the absence of express contract, on the movable property of the husband and wife, to the law of the husband's domicile at the time of the marriage, called the matrimonial domicile. And with regard to the succession to movables on death, it adopts the principle of massing them irrespectively of their situation, so far as is permitted by the peculiar system under which the property in movables situate in England does not pass directly to the legatees or next of kin, but to the executors or administrators, who are charged with the duty of paying the debts of the deceased and distributing the beneficial surplus. The validity of a will of movables, otherwise than in respect of form (about which more hereafter), and the rights, whether under a will or under an intestacy, in the beneficial surplus arising from them, are determined in England by the law of the testator's last domicile. On the points glanced at in this paragraph the decisions in the United States generally agree with those in England, only allowing the pecuniary relations of a married couple, in the absence of express contract, to be varied by a change of domicile, notwithstanding that such change is in the husband's exclusive power, instead of maintaining them as fixed by the matrimonial domicile. On the continent of Europe partisans of a variation

after the marriage are scarcely to be found; but as between the nationality and the domicile of the husband or of the deceased, and on the question whether the mass to be governed either by nationality or domicile, on marriage or on death, includes immovables situate under a different law, the division of opinion, legislation and practice is considerable and intricate.

Lex situs, *lex loci actus*, *lex loci contractus*, *lex fori*.—The law of the territory in which they are situate (*lex situs*) is generally applied to the property in particular things, whether movable or immovable, so far as they are not included in any mass grouped round a person; in England, therefore, always to immovables. In drawing up documents and conducting ceremonies public functionaries must necessarily follow the law from which they derive their authority, wherefore the law of the place where any public document is entered into, or any public ceremony performed (*lex loci actus*), is the only one that can be followed in its external form. This maxim applies to the forms of notarial acts, and to that of marriage celebrated with the official concurrence of clergymen, registrars and so forth. And since documents and ceremonies entered into without official concurrence are rarer on the continent of Europe than in England, the inevitableness of the form of the *lex actus*, when such concurrence is had, has generally led to that form being also held sufficient whenever the affair comes to be inquired into later. Nor in England has the sufficiency of the form of the *lex loci actus* for the celebration of marriage ever been doubted, but a will made by a notarial act in accordance with that law was not admitted. Disregarding the distinction between external form and internal validity and operation, a will of English land could not take effect unless made in English form (that is, since the Wills Act of 1837, with two witnesses), and a will of personal estate could not be admitted in England to probate unless made in the form of the law of the testator's last domicile. But now, by Lord Kingsdown's Act, passed in 1861, there are given for wills of personal property made by British subjects, besides the form of their last domicile, three alternative forms, namely, the form of the place of making the will, that of the testator's domicile at the time when it was made, and that of the part of the British dominions where he had his domicile of origin—only the first of the three, however, being offered when the will is made in the United Kingdom; and no will is to be revoked or invalidated by a change of the testator's domicile after making it.

The law of the place of contract *lex loci contractus*, is distinguished into that of the place where the contract is entered into, *lex loci contractus celebrati*, and that of the place where it is to be performed, which, from the particular case in which the performance consists only in a payment, is called *lex loci solutionis*. To the first of these is generally referred the formal validity of a contract, so far as entered into without the intervention of a functionary, and therefore not covered by the principle of the *lex loci actus*, and so far also as the performance is not tied to any particular place. For example, the form for contracting marriage, whether with official intervention as in England, or by private and even oral contract as in Scotland, depends, both as to necessity and as to sufficiency, on the law of the place of contracting it. But as to the internal validity, interpretation and operation of a contract, there has been and still remains much difference of opinion between the laws of the place of contracting and of that of stipulated performance; the former being supported, among other grounds, on some texts of Roman law which Savigny has shown to have been misunderstood, while the latter agrees much oftener with the intention of the parties. The English decisions do not adhere closely to either of those laws, but while repeating much of the traditional language about the *lex loci contractus*, they aim at doing substantial justice by referring a contract to that place with which its matter has the closest connexion, or which the intention of the parties points out.

In matters of legal procedure every court follows its own practice exclusively (*lex fori*), as, for instance, whether the remedy on a contract shall be damages or specific performance, and whether a judgment may be executed against the person or only against the property of a party. A point much disputed under this head is whether the time of limitation of actions shall, as held in the United Kingdom, be decided by the *lex fori*, as an incident to the procedure, or by the *lex loci contractus* in one of its varieties, as an essential modality of the obligation.

Renvoi.—We will now suppose that the rules of private international law, as practised in any country (A), refer a case arising in its courts to the law of another country (B), as being that of the domicile or nationality of a person, and that those rules as practised in (B) in turn refer (*renvoient*) the same case to the law of (A), as being that of the nationality or domicile or perhaps of the *locus actus*: what are the courts of (A) to decide? This question, which involves nothing less than that of the meaning in which the reference to a law is to be understood in our subject, has during recent years excited great discussion both among the jurists and in the courts of all nations. It is answered by the English courts to the effect that (B) by its reference back (*renvoi*) has disclaimed the control of the case, which must therefore be decided without regard to (B)'s particular laws. See *In re Trufort*, 36 Ch. D. 600, and *In re Johnson*, 1903, 1 Ch. 821. This principle practically gives efficacy to the renvoi, and coincides with the express provisions both of the above-mentioned convention of the 12th of June 1902, Art. 1, as to the right of contracting marriage, and of the statute enacting the German code, Art. 27, as to capacity generally. The English law agrees in opinion, and is supported by a numerical preponderance of the judicial precedents in France and Belgium; but it must be admitted that a

numerical preponderance of the jurists who have declared themselves hold that the courts of (A) ought to apply the particular laws of (B).

Public Order.—It must not be supposed that the law of the land, the proper territorial law of the court which has to deal with a case in which foreign circumstances arise, always gives way to the foreign law pointed out by the general maxims which even that particular court accepts. All rules for the application of foreign laws are subject to an exception commonly called that of public order, *i.e.* where such application would interfere with essential principles of morality or policy received in the territory. This reservation is usually made in general terms where legislation on private international law is attempted, as in Article 6 of the Code Napoleon, and preliminary Article 12 of the Italian code; but the courts have to administer it, as they have also in England and other countries where it rests only on judicial practice, and the greater or less extent given to it is one of the causes of the uncertainty and want of uniformity in our subject. One example often quoted is the refusal of the courts in all Christian countries to give effect to polygamous marriage, but this case goes deeper still, for none of the countries in which polygamous marriage exists is allowed to enter at all into the communion of private international law. All, so far as Great Britain has settled legal relations with them, are among those in which British subjects live under consular protection and jurisdiction, or (in Egypt) under that of the Mixed Courts. A better instance is afforded by the refusal of courts, normally within the pale of European legal communion, to recognize divorce as dissolving a marriage, notwithstanding that it has been decreed under the personal law. As another instance, there can be little doubt that 705
an incapacity to marry imposed by the personal law in virtue of religious vows or orders would be disregarded by the English courts in the case of a person marrying in England. Again, it is established in England that damages cannot be recovered for a tort unless the act complained of was a wrong both by the law of the country where it was done and by the law of England; and Article 12 of the statute enacting the German code is in accordance with that doctrine. Now the law of the country where the act is done would naturally give the standard for measuring its legal consequences, and it seems to be due to the connexion which laws qualifying acts as wrongs have with public order that respect for that law is tempered by respect for the law of the countries in which it is invoked; but Article 8 of the Belgian code refers the liability for torts to the former law without any restriction.

Foreign Judgments.—In the rules which have passed before us in the foregoing general review it is easy to perceive a leading motive—that of securing, so far as public order allows, the certainty and stability both of personal and of business relations in the international or interterritorial intercourse which has always accompanied civilization, but is now especially frequent and extensive. It has been attempted to erect this motive into a guiding principle of law, laying down that rights once accrued in any territory, or sometimes, it is said, by virtue of any territorial law, are to be recognized and enforced, subject to the requirements of public order, in any other territory in which they may be invoked before a court of justice. From this, which may be called the principle of the acceptance of foreign rights, it is claimed that the rules of private international law are to be deduced, and that by their consonance with it any such rules are to be tested when proposed. The difficulties of the subject, however, do not admit of being unlocked by so simple a key. They meet us again when we inquire in what territory, or by virtue of what territorial law, a particular alleged right has accrued. Persons belonging by domicile or nationality to A enter in B into a contract to be performed in C; where and by virtue of what law does either acquire a right against the other? Is it to be in or by the law of their homes, where they are normally, though not always necessarily, to be sued? Or of the country where they contract, which for various purposes, as those of police, but not for all purposes, has the control of them when they contract? Or of the country where their contract is to be performed, under a similar control by which, perhaps extending to the very acts of performance, they or their agents may be brought by the operation of their contract? Evidently we cannot apply the principle to guide us in our choice of a law till the very problem which that choice presents has first been solved. There is, however, one case in which the principle of the acceptance of foreign rights leads to a conclusion, namely, where the right has been declared by the judgment of a competent court, which may have been given in an ordinary case, presenting no question of private international law, but in which, if such a question arose, it has been solved by choosing the law and basing the judgment on it. The rule in England and in many other countries as to foreign judgments is that the judgments of competent courts in other territories (foreign in the sense of civil law, whether politically foreign or not) are to be enforced without reopening the merits of the questions disposed of by them. In some countries, however, a foreign judgment is examinable on its merits before being enforced. This was formerly the unquestioned rule in France, though the practice there seems to be now turning the other way. In the system adopted in England everything turns on the competence. For judgments *in rem*, declaring or disposing of the property in a thing, the test of competence is that the thing, whether movable or immovable, was within the territory of the court. Judgments which declare the status of a person, as with regard to marriage or majority, are competent if the person was subject to the jurisdiction by nationality or domicile. The property or the status is treated as being what has

been so declared or decreed. For judgments *in personam*, decreeing the payment of a certain sum, the test of competence for the present purpose is again that the person against whom it was pronounced was subject to the jurisdiction by nationality or domicile; the judgment may then be sued on as giving of itself a good title to the sum decreed by it to be paid. For domestic purposes the competence may exist on quite other grounds. By its own territorial law a court may be authorized to entertain a suit *in personam* because the plaintiff possesses its nationality, as by Article 14 of the code Napoleon, or because the contract sued on was made or was to be performed in the territory, and so forth. But judgments based on these grounds will not be enforceable outside the territory. Here we touch the root principles of our subject. The distinction between domestic and international grounds of competence can only be explained by the history of law, and we come in sight of the fact that the rules of private international law rest finally on conventions which could not have existed if the civilization of different countries had not so much that was common in its origin and in the course which it has followed, but which suit the life of those countries just because that life is itself another outcome of those common antecedents.

AUTHORITIES.—The best authority on the history of private international law to the end of the 18th century is Lainé, *Introduction au droit international privé* (2 vols., Paris, 1888). For modern progress the most copious materials are to be found in the *Revue de droit international et de législation comparée* (Brussels, from 1869); the *Journal du droit international privé et de la jurisprudence comparée* (Paris, from 1874); and the *Annuaire de l'institut de droit international* (Paris, from 1877). The most comprehensive general treatise is that of von Bar, of which the 2nd edition appeared at Göttingen in 1889, and has been translated: *The Theory and Practice of Private International Law*, by L. v. Bar, 2nd ed., translated, by Gillespie (Edinburgh, 1892). Other works, many of great merit, are numerous in all languages; but in this, as in every department of law, the first place for England and the United States must be given to the different Law Reports, since in those countries it is not in the study but on the bench that the highest legal intellect is usually displayed, and the judgments delivered are often essays on the points involved. The following works, however, among others, treat the subject from the English or United States point of view: Story, *Commentaries on the Conflict of Laws, Foreign and Domestic*, 8th ed., by Bigelow (Boston, 1883); Wharton, *A Treatise on the Conflict of Laws or Private International Law* (2nd ed., Philadelphia, 1881); J. Westlake, *A Treatise on Private International Law, with Principal Reference to its Practice in England* (4th ed., London, 1905); Foote, *A Concise Treatise on Private International Jurisprudence, based on the Decisions in the English Courts* (3rd ed., London, 1904); A. V. Dicey, *A Digest of the Law of England with Reference to the Conflict of Laws* (2nd ed., London, 1908); Beale, *A Selection of Cases on the Conflict of Laws, with Notes and Summary* (Cambridge, Mass., 1900-1903); Bate, *Notes on the Doctrine of Renvoi* (1904). (Jno. W.)

INTERPELLATION (from Lat. *interpellare*, to interrupt), a term meaning, in general, an interruption, more particularly used of a method of procedure adopted in some of the legislative chambers of continental Europe, especially those of France and Italy, and somewhat similar to that of a motion to adjourn the House in the British parliament. It was originally confined to the asking of a question, after due notice, on some affair of state. It is now, however, the chief means by which the policy or action of the ministry of the day is challenged. An interpellation can be brought on without the consent of the minister to be attacked; it is usually made the subject of a general debate, and generally ends with a vote of confidence or want of confidence in the ministry. The right of permitting or vetoing an interpellation rests with the chamber. In France a tendency has been growing among deputies to use the interpellation as a method of attack on or accusation against individual colleagues.

INTERPLEADER, in English law, the form of action by which a person who is sued at law by two or more parties claiming adversely to each other for the recovery of money or goods wherein he has no interest, obtains relief by procuring the rival claimants to try their rights between or among themselves only. Originally the only relief available to the possessor against such adverse claims was by means of a bill of interpleader in equity. The Interpleader Act 1831 enabled the defendant in such cases, on application to the court, to have the original action stayed and converted into a trial between the two claimants. The Common Law Procedure Act of 1860 further extended the power of the common law courts in interpleader; and the Judicature

Act 1875 enacted that the practice and procedure under these two statutes should apply to all divisions of the High Court of Justice. The Judicature Act also extended the remedy of interpleader to a debtor or other person liable in respect of a debt alleged to be assigned, when the assignment was disputed. In 1883 the acts of 1831 and 1860 were embodied in the form of rules by the *Rules of the Supreme Courts* (1883), O. lvii. by reference to which all questions of interpleader in the High Court of Justice are now determined. The acts themselves were repealed by the Statute Law Revision Act of the same year. Interpleader is the equivalent of multiplepoinding in Scots law.

INTERPOLATION (from Lat. *interpolare*, to alter, or insert something fresh, connected with *polire*, a polish), in mathematics, the process of obtaining intermediate terms of a series of which particular terms only are given. The cubes, for instance, shown in the second column of the accompanying table, may be regarded as terms of a series, and the cube of a fractional number, not exceeding the last number in the first column, may be found by interpolation. The process of obtaining the cube of a number exceeding the last number in the first column would be *extrapolation*; the formulae which apply to interpolation apply in theory to extrapolation, but in practice special precautions as to accuracy are necessary. The present article deals only with interpolation.

Number.	Cube of Number.
0	0
1	1
2	8
3	27
4	64
5	125
6	216
.	.
.	.
.	.

The term is usually limited to those cases in which there are two quantities, x and u, which are so related that when x has any arbitrary value, lying perhaps between certain limits, the value of u is determinate. There is a given series of associated values of u and of x, and interpolation consists in determining the value of u for any arbitrary value of x, or the value of x for any arbitrary value of u, lying between two of the values in the series. Either of the two quantities may be regarded as a function of the other; it is convenient to treat one, x, as the “independent variable,” the other, u, being treated as the “dependent variable,” *i.e.* as a function of x. If, as is usually the case, the successive values of one of the quantities proceed by a constant increment, this quantity is to be regarded as the independent variable. The two series of values may be tabulated, those of x being placed in a column (or row), and those of u in a parallel column (or row); u is then said to be *tabulated in terms of* x. The independent variable x is called the *argument*, and the dependent variable u is called the *entry*. Interpolation, in the ordinary sense, consists in determining the value of u for a value of x intermediate between two values appearing in the table. This may be described as *direct interpolation*, to distinguish it from *inverse interpolation*, which consists in determining the value of x for a value of u intermediate between two in the table. The methods employed can be extended to cases in which the value of u depends on the values of two or more independent quantities x, y,...

In the ordinary case we may regard the values of x as measured along a straight line OX from a fixed point O, so that to any value of x there corresponds a point on the line. If we represent the corresponding value of u by an ordinate drawn from the line, the extremities of all such ordinates will lie on a curve which will be the graph of u with regard to x. Interpolation therefore consists in determining the length of the ordinate of a curve occupying a particular position, when the lengths of ordinates occupying certain specified positions are known. If u is a function of two variables, x and y, we may similarly represent it by the ordinate of a surface, the position of the ordinate being determined by the values of x and of y jointly.

The series or tables to which interpolation has to be applied may for convenience be regarded as falling into two main groups. The first group comprises mathematical tables, *i.e.* tables of mathematical functions; in the case of such a table the value of the function u for each tabulated value of x is calculated to a known degree of accuracy, and the degree of accuracy of an interpolated value of u can be estimated. The second group comprises tables of values which are found experimentally, *e.g.* values of a physical quantity or of a statistical ratio; these values are usually subject to certain “errors” of observation or of random selection (see PROBABILITY). The

methods of interpolation are usually the same in the two groups of cases, but special considerations have to be taken into account in the second group. The line of demarcation of the two groups is not absolutely fixed; the tables used by actuaries, for instance, which are of great importance in practical life, are based on statistical observations, but the tables formed directly from the observations have been "smoothed" so as to obtain series which correspond in form to the series of values of mathematical functions.

It must be assumed, at any rate in the case of a mathematical function, that the "entry" u varies continuously with the "argument" x, *i.e.* that there are no sudden breaks, changes of direction, &c., in the curve which is the graph of u.

Various methods of interpolation are described below. The simplest is that which uses the *principle of proportional parts*; and mathematical tables are usually arranged so as to enable this method to be employed. Where this is not possible, the methods are based either on the use of Taylor's Theorem, which gives a formula involving differential coefficients (see INFINITESIMAL CALCULUS), or on the properties of finite differences (see DIFFERENCES, CALCULUS OF). Taylor's Theorem can only be applied directly to a known mathematical function; but it can be applied indirectly, by means of finite differences, in various cases where the form of the function expressing u in terms of x is unknown; and even where the form of this function is known it is sometimes more convenient to determine the differential coefficients by means of the differences than to calculate them directly from their mathematical expressions. Finally, there are cases where we cannot even employ finite-difference formulae directly. In these cases we must adopt some special method; *e.g.* we may instead of u tabulate some function of u, such as its logarithm, which is found to be amenable to ordinary processes, then determine the value of this function corresponding to the particular value of x, and thence determine the corresponding value of u itself.

In considering methods of interpolation, it will be assumed, unless the contrary is stated, that the values of x proceed by a constant increment, which will be denoted by h.

In order to see what method is to be employed, it is usually necessary to arrange the given series of values of u in the form of a table, as explained above, and then to take the successive *differences* of u. The differences of the successive values of u are called its *first differences*; these form a new series, the first differences of which are the *second differences* of u; and so on. The systems of notation of the differences are explained briefly below. For the fuller discussion, reference should be made to DIFFERENCES, CALCULUS OF.

I. INTERPOLATION FROM MATHEMATICAL TABLES

A. Direct Interpolation.

1. *Interpolation by First Differences.*—The simplest cases are those in which the first difference in u is constant, or nearly so. For example:—

Example 1.—($u = \log_{10} x$).

x.	u.	1st Diff.
		+
4.341	.6375898	
		1000
4.342	.6376898	
		1000
4.343	.6377898	
		1000
4.344	.6378898	
		1000
4.345	.6379898	

Example 2.—($u = \log_{10} x$).

x.	u.	1st Diff.
		+
7.40	.86923	
		59
7.41	.86982	
		58
7.42	.87040	
		59
7.43	.87099	
		58
7.44	.87157	

In Example 1 the first difference of u corresponding to a difference of h ≡ .001 in x is .0001000; but, since we are working throughout to seven places of decimals, it is more convenient to write it 1000. This system of ignoring the decimal point in dealing with differences will be adopted throughout this article. To find u for an intermediate value of x we assume the principle of proportional parts, *i.e.* we assume that the difference in u is proportional to the difference in x. Thus for x = 4.342945 the difference in u is .945 of 1000 = 945, so that u is .6376898 + .0000945 = .6377843. For x = 4.34294482 the difference in u would be 944.82, so that the value of u would apparently be .6376898 + .000094482 = .637784282. This, however, would be incorrect. It must be remembered that the values of u are only given "correct to seven places of decimals," *i.e.* each tabulated value differs from the corresponding true value by a *tabular error* which may have any value up to ± ½ of .0000001; and we cannot therefore by interpolation obtain a result which is correct to nine places. If the interpolated value of u has to be used in calculations for which it is important that this value should be as accurate as possible,

it may be convenient to retain it temporarily in the form .6376898 + 944 82 = .6377842 82 or $.6376898 + 944^{82} = .6377842^{82}$; but we must ultimately return to the seven-place arrangement and write it as .6377843. The result of interpolation by first difference is thus usually subject to two inaccuracies, the first being the tabular error of u itself, and the second being due to the necessity of adjusting the final figure of the added (proportional) difference. If the tabulated values are correct to seven places of decimals, the interpolated value, with the final figure adjusted, will be within .0000001 of its true value.

In Example 2 the differences do not at first sight appear to run regularly, but this is only due to the fact that the final figure in each value of u represents, as explained in the last paragraph, an approximation to the true value. The general principle on which we proceed is the same; but we use the actual difference corresponding to the interval in which the value of x lies. Thus for x = 7.41373 we should have u = .86982 + (.373 of 58) = .87004; this result being correct within .00001.

2. *Interpolation by Second Differences.*—If the consecutive first differences of u are not approximately equal, we must take account of the next order of differences. For example:—

Example 3.—($u = \log_{10} x$).

x.	u.	1st Diff.	2nd Diff.
6.0	.77815		
		+718	
6.1	.78533		−12
		+706	
6.2	.79239		−11
		+695	
6.3	.79934		−11
		+684	
6.4	.80618		−11
		+673	
6.5	.81291		

In such a case the *advancing-difference* formula is generally used. The notation is as follows. The series of values of x and of u are respectively x_0, x_1, x_2, ... and u_0, u_1, u_2, ... ; and the successive differences of u are denoted by Δu, $\Delta^2 u$, ... Thus Δu_0 denotes $u_1 - u_0$, and $\Delta^2 u_0$ denotes $\Delta u_1 - \Delta u_0 = u_2 - 2u_1 + u_0$. The value of x for which u is sought is supposed to lie between x_0 and x_1. If we write it equal to $x_0 + \theta(x_1 - x_0) = x_0 + \theta h$, so that θ lies between 0 and 1, we may denote it by x_θ, and the corresponding value of u by u_θ. We have then

$$u\theta = u_0 + \theta \Delta u_0 - \frac{\theta\,(1-\theta)}{2!}\,\Delta^2 u_0 + \frac{\theta\,(1-\theta)\,(2-\theta)}{3!}\,\Delta^3 u_0 - \ldots \qquad (1).$$

Tables of the values of the coefficients of $\Delta^2 u_0$ and $\Delta^3 u_0$ to three places of decimals for various values of θ from 0 to 1 are given in the ordinary collections of mathematical tables; but the formula is not really convenient if we have to go beyond $\Delta^2 u_0$, or if $\Delta^2 u_0$ itself contains more than two significant figures.

To apply the formula to Example 3 for x = 6.277, we have θ = .77, so that u_θ = .79239 + (.77 of 695) − (.089 of −11) = .79239 + 535 15 + 0 98 = .79775.

Here, as elsewhere, we use two extra figures in the intermediate calculations, for the purpose of adjusting the final figure in the ultimate result.

3. *Taylor's Theorem.*—Where differences beyond the second are involved, Taylor's Theorem is useful. This theorem (see INFINITESIMAL CALCULUS) gives the formula

$$u_\theta = u_0 + c_1\theta + c_2\,\frac{\theta^2}{2!} + \frac{\theta^3}{3!} + \ldots \qquad (2),$$

where, c_1, c_2, c_3, ... are the values for $x = x_0$ of the first, second, third, ... differential coefficients of u with regard to x. The values of c_1, c_2, ... can occasionally be calculated from the analytical expressions for the differential coefficients of u; but more generally they have to be calculated from the tabulated differences. For this purpose *central-difference* formulae are the best. If we write

$$\begin{aligned} \mu\delta u_0 &= \tfrac{1}{2}\,(\Delta u_0 + \Delta u_{-1}) \\ \delta^2 u_0 &= \Delta^2 u_{-1} \\ \mu\delta^3 u_0 &= \tfrac{1}{2}\,(\Delta^3 u_{-1} + \Delta^3 u_{-2}) \end{aligned}$$

&c.

(3),

so that, if (as in §§ 1 and 2) each difference is placed opposite the space between the two quantities of which it is the difference, the expressions $\delta^2 u_0$, $\delta^4 u_0$, ... denote the differences of even order in a horizontal line with u_0, and $\mu\delta u_0$, $\mu\delta^3 u_0$, ... denote the means of the differences of odd order immediately below and above this line, then (see DIFFERENCES, CALCULUS OF) the values of c_1, c_2, ... are given by

$$
\begin{aligned}
c_1 &= \mu\delta u_0 - \tfrac{1}{6}\mu\delta^3 u_0 + \tfrac{1}{30}\mu\delta^5 u_0 - \tfrac{1}{140}\mu\delta^7 u_0 + \ldots \\
c_2 &= \delta^2 u_0 - \tfrac{1}{12}\delta^4 u_0 + \tfrac{1}{90}\delta^6 u_0 - \tfrac{1}{560}\delta^8 u_0 + \ldots \\
c_3 &= \mu\delta^3 u_0 - \tfrac{1}{4}\mu\delta^5 u_0 + \tfrac{7}{120}\mu\delta^7 u_0 - \ldots \\
c_4 &= \delta^4 u_0 - \tfrac{1}{6}\delta^6 u_0 + \tfrac{7}{240}\delta^8 u_0 - \ldots \\
c_5 &= \mu\delta^5 u_0 - \tfrac{1}{3}\mu\delta^7 u_0 + \ldots \\
c_6 &= \delta^6 u_0 - \tfrac{1}{4}\delta^8 u_0 + \ldots \\
&\ \ .\quad\ . \\
&\ \ .\quad\ . \\
&\ \ .\quad\ .
\end{aligned}
\qquad (4).
$$

If a calculating machine is used, the formula (2) is most conveniently written

$$
\begin{aligned}
u_\theta &= u_0 + P_1\theta \\
P_1 &= c_1 + \tfrac{1}{2}P_2\theta \\
P_2 &= c_2 + \tfrac{1}{3}P_3\theta \\
&\ \ .\quad . \\
&\ \ .\quad . \\
&\ \ .\quad .
\end{aligned}
\qquad (5).
$$

Using θ as the multiplicand in each case, the successive expressions ... P_3, P_2, P_1, u_θ are easily calculated.

As an example, take $u = \tan x$ to five places of decimals, the values of x proceeding by a difference of 1°. It will be found that the following is part of the table:—

Example 4.—($u = \tan x$).

x.	u.	1st Diff.	2nd Diff.	3rd Diff.	4th Diff.
		+	+	+	+
65°	2.14451		732		16
		10153		96	
66°	2.24604		828		19
		10981		115	
67°	2.35585		943		18

To find u for x = 66° 23′, we have $\theta = 23/60 = .3833333$. The following shows the full working: in actual practice it would be abbreviated. The operations commence on the right-hand side. It will be noticed that two extra figures are retained throughout.

u_0.	$\mu\delta u_0$.	$\delta^2 u_0$.	$\mu\delta^3 u_0$.	$\delta^4 u_0$.
2.24604	$+10567^{00}$	$+828^{00}$	$+105^{50}$	$+19^{00}$
	$-\ \ 17^{58}$	$-\ \ 1^{58}$		
	———	———	———	———
	$c_1 = +10549^{42}$	$c_2 = +826^{42}$	$c_3 = +105^{50}$	$c_4 = +19^{00}$
$P_1\theta = +4105^{67}$	$\tfrac{1}{2}P_2\theta = +\ \ 161^{02}$	$\tfrac{1}{3}P_3\theta = +\ 13^{71}$	$\tfrac{1}{8}c_4\theta = +\ \ 1^{82}$	
———	———	———	———	
$u_\theta = 2.28710$	$P_1 = +10710^{44}$	$P_2 = +840^{13}$	$P_3 = +107^{32}$	

The value 2.2870967, obtained by retaining the extra figures, is correct within .7 of .00001 (§ 8), so that 2.28710 is correct within .00001 1.

In applying this method to mathematical tables, it is desirable, on account of the tabular error, that the differences taken into account in (4) should end with a difference of even order. If, *e.g.* we use $\mu\delta^3 u_0$ in calculating c_1 and c_3, we ought also to use $\delta^4 u_0$ for calculating c_2 and c_4, even though the term due to $\delta^4 u_0$ would be negligible if $\delta^4 u_0$ were known exactly.

4. *Geometrical and Algebraical Interpretation.*—In applying the principle of proportional parts, in such a case as that of Example 1, we in effect treat the graph of u as a straight line. We see

that the extremities of a number of consecutive ordinates lie approximately in a straight line: *i.e.* that, if the values are correct within ±½ρ, a straight line passes through points which are within a corresponding distance of the actual extremities of the ordinates; and we assume that this is true for intermediate ordinates. Algebraically we treat u as being of the form A + Bx, where A and B are constants determined by the values of u at the extremities of the interval through which we interpolate. In using first and second differences we treat u as being of the form A + Bx + Cx^2; *i.e.* we pass a parabola (with axis vertical) through the extremities of three consecutive ordinates, and consider that this is the graph of u, to the degree of accuracy given by the data. Similarly in using differences of a higher order we replace the graph by a curve whose equation is of the form u = A + Bx + Cx^2 + Dx^3 + ... The various forms that interpolation-formulae take are due to the various principles on which ordinates are selected for determining the values of A, B, C ...

B. *Inverse Interpolation.*

5. To find the value of x when u is given, *i.e.* to find the value of θ when u_θ is given, we use the same formula as for direct interpolation, but proceed (if differences beyond the first are involved) by successive approximation. Taylor's Theorem, for instance, gives

$$\theta = (u_\theta - u_0) \div (c_1 + c_2 \frac{\theta}{2!} + \ldots)$$

$$= (u_\theta - u_0) \div P_1 \qquad (6),$$

We first find an approximate value for θ: then calculate P_1, and find by (6) a more accurate value of θ; then, if necessary, recalculate P_1, and thence θ, and so on.

II. Construction of Tables by Subdivision of Intervals

6. When the values of u have been tabulated for values of x proceeding by a difference h, it is often desirable to deduce a table in which the differences of x are h/n, where n is an integer.

If n is even it may be advisable to form an intermediate table in which the intervals are ½h. For this purpose we have

$$u_{1/2} = ½ (U_0 + U_1) \qquad (7),$$

where

$$U = u - ⅛\delta^2 u + {}^3⁄_{128}\delta^4 u - {}^5⁄_{1024}\delta^6 u + \ldots$$
$$= u - ⅛[\delta^2 u - {}^3⁄_{16} \{\delta^4 u - {}^5⁄_{24} (\delta^6 u - \ldots) \}] \qquad (8).$$

The following is an example; the data are the values of tan x to five places of decimals, the interval in x being 1°. The differences of odd order are omitted for convenience of printing.

Example 5.

x.	u ≡ tan x.	δ^2u.	δ^4u.	δ^6u.	U.	u = mean of values of U.	x.
		+	+	+			
73°	3.27085	2339	100	5	3.26794 95		
						3.37594	73½°
74°	3.48741	2808	132	23	3.48392 98		
						3.60588	74½°
75°	3.73205	3409	187	18	3.72783 17		
						3.86671	75½°
76°	4.01078	4197	260	51	4.00559 22		
						4.16530	76½°
77°	4.33148	5245	384	64	4.32501 07		

If a new table is formed from these values, the intervals being ½°, it will be found that differences beyond the fourth are negligible.

To subdivide h into smaller intervals than ½h, various methods may be used. One is to calculate the sets of quantities which in the new table will be the successive differences, corresponding to u_0, u_1, ... and to find the intermediate terms by successive additions. A better method is to use a formula due to J. D. Everett. If we write φ = 1 − θ, Everett's formula is, in its most symmetrical form,

$$(\theta + 1)\,\theta\,(\theta - 1) \qquad (\theta + 2)\,(\theta + 1)\,\theta\,(\theta - 1)\,(\theta - 2)$$

$$u_\theta = \theta u_1 + \frac{}{3!}\delta^2 u_1 + \frac{}{5!}\delta^4 u_1 + \ldots$$

$$+ \varphi u_0 + \frac{(\varphi+1)\,\varphi\,(\varphi-1)}{3!}\delta^2 u_0 + \frac{(\varphi+2)\,(\varphi+1)\,\varphi\,(\varphi-1)\,(\varphi-2)}{5!}\delta^4 u_0 + \ldots \quad (9).$$

For actual calculations a less symmetrical form may be used. Denoting

$$\frac{(\theta+1)\,\theta\,(\theta-1)}{3!}\delta^2 u_1 + \frac{(\theta+2)\,(\theta+1)\,\theta\,(\theta-1)\,(\theta-2)}{5!}\delta^4 u_1 + \ldots \quad (10)$$

by ${}_\theta V_1$, we have, for interpolation between u_0 and u_1,

$$u_\theta = u_0 + \theta\Delta u_0 + {}_\theta V_1 + {}_{1-\theta}V_0 \quad (11),$$

the successive values of θ being 1/n, 2/n, ... (n − 1)/n. For interpolation between u_1 and u_2 we have, with the same succession of values of θ,

$$u_{1+\theta} = u_1 + {}_\theta V_1, \qquad V_2 + {}_{1-\theta}V_1 \quad (12).$$

The values of ${}_{1-\theta}V_1$ in (12) are exactly the same as those of ${}_\theta V_1$ in (11), but in the reverse order. The process is therefore that (i.) we find the successive values of $u_0 + \theta\Delta u_0$, &c., *i.e.* we construct a table, with the required intervals of x, as if we had only to take first differences into account; (ii.) we construct, in a parallel column, a table giving the values of ${}_\theta V_1$, &c.; (iii.) we repeat these latter values, placing the set belonging to each interval h in the interval next following it, and writing the values in the reverse order; and (iv.) by adding horizontally we get the final values for the new table.

As an example, take the values of tan x by intervals of ½° in x, as found above (Ex. 5). The first diagram below is a portion of this table, with the differences, and the second shows the calculation of the terms of (11) so as to get a table in which the intervals are 0.1 of 1°. The last column but one in the second diagram is introduced for convenience of calculation.

Example 6.

x.	u = tan x.	δu.	δ^2u.	δ^3u.	δ^4u.
		+	+	+	+
		11147		62	
74°.0	3.48741		700		8
		11847		70	
74°.5	3.60588		770		9
		12617		79	

x	$u_0 + \theta\Delta u_0$.	${}_\theta V_1$.	${}_{1-\theta}V_0$.	${}_\theta V_1 + {}_{1-\theta}V_0$.	u.
73°.6	·	−22 35	·	·	·
73°.7	·	−39 11	·	·	·
73°.8	·	−44 71	·	·	·
73°.9	·	−33 54	·	·	·
74°.0	3.48741 00				3.48741
74°.1	3.51110 40	−24 58	−33 54	−58 12	3.51052
74°.2	3.53479 80	−43 02	−44 71	−87 73	3.53392
74°.3	3.55849 20	−49 18	−39 11	−88 29	3.55761
74°.4	3.58218 60	−36 89	−22 35	−59 24	3.58159
74°.5	3.60588 00				3.60588

The following are the values of the coefficients of u_1, $\delta^2 u_1$, $\delta^4 u_1$, and $\delta^6 u_1$ in (9) for certain values of n. For calculating the four terms due to $\delta^2 u_1$ in the case of n = 5 it should be noticed that the third term is twice the first, the fourth is the mean of the first and the third, and the second is the mean of the third and the fourth. In table 3, and in the last column of table 2, the coefficients are corrected in the last figure.

TABLE 1.—n = 5.

co. u.	co. δ^2u.	co. δ^4u.	co. δ^6u.
+	−	+	−
.2	.032	.006336	.00135168 = 1/740 approx.
.4	.056	.010752	.00226304 = 1/442 ”
.6	.064	.011648	.00239616 = 1/417 ”
.8	.048	.008064	.00160512 = 1/623 ”

TABLE 2.—n = 10.

co. u.	co. $\delta^2 u$.	co. $\delta^4 u$.	co. $\delta^6 u$.
+	−	+	−
.1	.0165	.00329175	.000704591
.2	.0320	.00633600	.001351680
.3	.0455	.00889525	.001887064
.4	.0560	.01075200	.002263040
.5	.0625	.01171875	.002441406
.6	.0640	.01164800	.002396160
.7	.0595	.01044225	.002115799
.8	.0480	.00806400	.001605120
.9	.0285	.00454575	.000886421

TABLE 3.—n = 12.

co. u.	co. $\delta^2 u$.	co. $\delta^4 u$.	co. $\delta^6 u$.
+	−	+	−
1/12	.013792438	.002753699	.000589623
2/12	.027006173	.005363726	.001145822
3/12	.039062500	.007690430	.001636505
4/12	.049382716	.009602195	.002032211
5/12	.057388117	.010979463	.002307357
6/12	.062500000	.011718750	.002441406
7/12	.064139660	.011736667	.002419911
8/12	.061728395	.010973937	.002235432
9/12	.054687500	.009399414	.001888275
10/12	.042438272	.007014103	.001387048
11/12	.024402006	.003855178	.000748981

III. GENERAL OBSERVATIONS

7. *Derivation of Formulae.*—The advancing-difference formula (1) may be written, in the symbolical notation of finite differences,

$$u_\theta = (1 + \Delta)^\theta u_0 = E^\theta u_0 \tag{13};$$

and it is an extension of the theorem that if n is a positive integer

$$u_n = u_0 + n\Delta u_0 + \frac{n(n-1)}{2!}\Delta^2 u_0 + \ldots \tag{14},$$

the series being continued until the terms vanish. The formula (14) is identically true: the formula (13) or (1) is only formally true, but its applicability to concrete cases is due to the fact that the series in (1), when taken for a definite number of terms, differs from the true value of u_θ by a "remainder" which in most cases is very small when this definite number of terms is properly chosen.

Everett's formula (9), and the central-difference formula obtained by substituting from (4) in (2), are modifications of a standard formula

$$u_\theta = u_0 + \theta\delta u_{1/2} + \frac{\theta(\theta-1)}{2!}\delta^2 u_0 + \frac{(\theta+1)\theta(\theta-1)}{3!}\delta^3 u_{1/2} + \frac{(\theta+1)\theta(\theta-1)(\theta-2)}{4!}\delta^4 u_0 + \ldots \tag{15},$$

which may similarly be regarded as an extension of the theorem that, if n is a positive integer,

$$u_n = u_0 + n\delta u_{1/2} + \frac{n(n-1)}{2!}\delta^2 u_0 + \frac{(n+1)n(n-1)}{3!}\delta^3 u_{1/2} + \ldots \tag{16}.$$

There are other central-difference formulae besides those mentioned above; the general symbolical expression is

$$u_\theta = (\cosh \theta hD + \sinh \theta hD)\, u_0 \tag{17},$$

where

$$\cosh \tfrac{1}{2}hD = \mu, \quad \sinh \tfrac{1}{2}hD = \tfrac{1}{2}\delta \tag{18}.$$

8. *Comparative Accuracy.*—Central-difference formulae are usually more accurate than advancing-difference formulae, whether we consider the inaccuracy due to omission of the "remainder" mentioned in the last paragraph or the error due to the approximative character of the tabulated values. The latter is the more important. If each tabulated value of u is within ±½ρ of the corresponding true value, and if the differences used in the formulae are the tabular differences, *i.e.* the actual successive differences of the tabulated values of u, then the ratio of the limit of error of u_θ, as calculated from the first r terms of the series in (1), to ½ρ is the sum of the first r terms of the series

$$1 + o + \theta(1-\theta) + \theta(1-\theta)(2-\theta) + \tfrac{7}{12}\theta(1-\theta)(2-\theta)(3-\theta) + \tfrac{1}{4}\theta(1-\theta)(2-\theta)(3-\theta)(4-\theta) + \tfrac{31}{360}\theta(1-\theta)\ldots(5-\theta) + \ldots,$$

while the corresponding ratio for the use of differences up to $\delta^{2p}u_0$ inclusive in (4) or up to $\delta^{2p}u_1$ and $o^{2p}u_0$ in (9) (*i.e.* in effect, up to $\delta^{2p+1}u_{1/2}$) is the sum of the first p + 1 terms of the series

$$1 + \frac{\theta(1-\theta)}{1.1} + \frac{(1+\theta)\theta(1-\theta)(2-\theta)}{(2!)^2} + \frac{(2+\theta)(1+\theta)\theta(1-\theta)(2-\theta)(3-\theta)}{(3!)^2} + \ldots,$$

it being supposed in each case that θ lies between 0 and 1. The following table gives a comparison of the respective limits of error; the lines I. and II. give the errors due to the advancing-difference and the central-difference formulae, and the coefficient ρ is omitted throughout.

TABLE 4.

		Error due to use of Differences up to and including						
		1st.	2nd.	3rd.	4th.	5th.	6th.	7th.
.5	I.	.500	.625	.813	1.086	1.497	2.132	3.147
	II.	.500	.625	.625	.696	.696	.745	.745
.2	I.	.500	.580	.724	.960	1.343	1.976	3.042
	II.	.500	.580	.580	.624	.624	.653	.653
.4	I.	.500	.620	.812	1.104	1.553	2.265	3.422
	II.	.500	.620	.620	.688	.688	.734	.734
.6	I.	.500	.620	.788	1.024	1.366	1.886	2.700
	II.	.500	.620	.620	.688	.688	.734	.734
.8	I.	.500	.580	.676	.800	.969	1.213	1.582
	II.	.500	.580	.580	.624	.624	.653	.653

In some cases the differences tabulated are not the tabular differences, but the corrected differences; *i.e.* each difference, like each value of u, is correct within ±½ρ. It does not follow that these differences should be used for interpolation. Whatever formula is employed, the first difference should always be the tabular first difference, not the corrected first difference; and, further, if a central-difference formula is used, each difference of odd order should be the tabular difference of the corrected differences of the next lower order. (This last result is indirectly achieved if Everett's formula is used.) With these precautions (i.) the central-difference formula is slightly improved by using corrected instead of tabular differences, and (ii.) the advancing-difference formula is greatly improved, being better than the central-difference formula with tabular differences, but still not so good as the latter with corrected differences. For θ = .5, for instance, supposing we have to go to fifth differences, the limits ±1.497 and ±.696, as given above, become ±.627 and ±.575 respectively.

9. *Completion of Table of Differences.*—If no values of u outside the range within which we have to interpolate are given, the series of differences will be incomplete at both ends. It may be continued in each direction by treating as constant the extreme difference of the highest order involved; and central-difference formulae can then be employed uniformly throughout the whole range.

Suppose, for instance, that the values of tan x in § 6 extended only from x = 60° to x = 80°, we could then complete the table of differences by making the entries shown in italics below.

Example 7.

x.	u = tan x.	δu.	δ^2u.	δ^3u.	δ^4u.	δ^5u.	δ^6u.
		+	+	+	+	+	+
		6775		*34*			
60°	1.73205		*425*		*9*		
		7200		*43*			
61°	1.80405		468		*9*		

		7668		52			
62°	1.88073		520		9		
		8188		61			
63°	1.96261		581		10		
		8769		71			
64°	2.05030	·	652	·	9		
·	·	·	·	·	·	·	·
·	·	·	·	·	·	·	·
·	·	·	·	·	·	·	·
75°	3.73205	·	3409	·	187	·	18
		27873		788		73	
76°	4.01078		4197		260		51
		32070		1048		124	
77°	4.33148		5245		384		64
		37315		1432		188	
78°	4.70463		6677		572		*64*
		43992		2004		*252*	
79°	5.14455		8681		*824*		*64*
		52673		*2828*		*316*	
80°	5.67128		*11509*		*1140*		*64*
		64182		*3968*		*380*	

For interpolating between x = 60° and x = 61° we should obtain the same result by applying Everett's formula to this table as by using the advancing-difference formula; and similarly at the other end for the receding differences.

Interpolation by Substituted Tabulation.

10. The relation of u to x may be such that the successive differences of u increase rapidly, so that interpolation-formulae cannot be employed directly. Other methods have then to be used. The best method is to replace u by some expression v which is a function of u such that (i.) the value of v or of u can be determined for any given value of u or of v, and (ii.) when v is tabulated in terms of x the differences decrease rapidly. We can then calculate v, and thence u, for any intermediate value of x.

If, for instance, we require tan x for a value of x which is nearly 90°, it will be found that the table of tangents is not suitable for interpolation. We can, however, convert it into a table of cotangents to about the same number of significant figures; from this we can easily calculate cot x, and thence tan x.

11. This method is specially suitable for statistical data, where the successive values of u represent the area of a figure of frequency up to successive ordinates. We have first to determine, by inspection, a curve which bears a general similarity to the unknown curve of frequency, and whose area and abscissa are so related that either can be readily calculated when the other is known. This may be called the *auxiliary curve*. Denoting by ξ the abscissa of this curve which corresponds to area u, we find the value of ξ corresponding to each of the given values of u. Then, tabulating ξ in terms of x, we have a table in which, if the auxiliary curve has been well chosen, differences of ξ after the first or second are negligible. We can therefore find ξ, and thence u, for any intermediate value of x.

Extensions.

12. *Construction of Formulae.*—Any difference of u of the rth order involves r + 1 consecutive values of u, and it might be expressed by the suffixes which indicate these values. Thus we might write the table of differences

x.	u.	1st Diff.	2nd Diff.	3rd Diff.	4th Diff.
·	·	·	·	·	·
·	·	·	·	·	·
·	·	·	·	·	·
·	·	(−1, 0)	·	(−2, −1, 0, 1)	·
x_0	u_0		(−1, 0, 1)		(−2, −1, 0, 1, 2)
		(0, 1)		(−1, 0, 1, 2)	
x_1	u_1		(0, 1, 2)		(−1, 0, 1, 2, 3)
		(1, 2)		(0, 1, 2, 3)	
x_2	u_2		(1, 2, 3)		(0, 1, 2, 3, 4)
·	·	(2, 3)	·	(1, 2, 3, 4)	·
·	·	·	·	·	·
·	·	·	·	·	·
·	·	·	·	·	·

The formulae (1) and (15) might then be written

$$u = u_0 + \frac{x - x_0}{h}(0, 1) + \frac{x - x_0}{h}\cdot\frac{x - x_1}{2h}(0, 1, 2) + \frac{x - x_0}{h}\cdot\frac{x - x_1}{2h}\cdot\frac{x - x_2}{3h}(0, 1, 2, 3) + \ldots \quad (19),$$

$$u = u_0\,\frac{x - x_0}{h}(0, 1) + \frac{x - x_0}{h}\cdot\frac{x - x_1}{2h}(-1, 0, 1) + \frac{x - x_0}{h}\cdot\frac{x - x_1}{2h}\cdot\frac{x - x_{-1}}{3h}(-1, 0, 1, 2) + \ldots \quad (20).$$

The general principle on which these formulae are constructed, and which may be used to construct other formulae, is that (i.) we start with any tabulated value of u, (ii.) we pass to the successive differences by steps, each of which may be either downwards or upwards, and (iii.) the new suffix which is introduced at each step determines the new factor (involving x) for use in the next term. For any particular value of x, however, all formulae which end with the same difference of the *r*th order give the same result, provided tabular differences are used. If, for instance, we go only to first differences, we have

$$u_0 + \frac{x - x_0}{h}(0, 1) = u_1 + \frac{x - x_1}{h}(0, 1)$$

identically.

13. *Ordinates not Equidistant.*—When the successive ordinates in the graph of u are not equidistant, *i.e.* when the differences of successive values of x are not equal, the above principle still applies, provided the differences are adjusted in a particular way. Let the values of x for which u is tabulated be $a = x_0 + \alpha h$, $b = x_0 + \beta h$, $c = x_0 + \gamma h$,... Then the table becomes

x.	u.	Adjusted Differences		
		1st Diff.	2nd Diff.	&c.
.	.	.	.	
.	.	.	.	
.	.	.	.	
$a = x_\alpha$	u_α	.	.	
		(α, β)		
$b = x_\beta$	u_β		(α, β, γ)	
		(β, γ)		
$c = x_\gamma$	u_γ	.	.	
.	.	.	.	
.	.	.	.	
.	.	.	.	

In this table, however, (α, β) does not mean $u_\beta - u_\alpha$, but $u_\beta - u_\alpha \div (\beta - \alpha)$; (α, β, γ) means $\{(\beta, \gamma) - (\alpha, \beta)\} \div \frac{1}{2}(\gamma - \alpha)$; and, generally any quantity $(\eta, \ldots \varphi)$ in the column headed "rth diff." is obtained by dividing the difference of the adjoining quantities in the preceding column by $(\varphi - \eta)/r$. If the table is formed in this way, we may apply the principle of § 12 so as to obtain formulae such as

$$u = u_\alpha + \frac{x - c}{h}\cdot(\alpha, \beta) + \frac{x - a}{h}\cdot\frac{x - b}{2h}\cdot(\alpha, \beta, \gamma) + \ldots \quad (21),$$

$$u = u_\gamma + \frac{x - a}{h}\cdot(\beta, \gamma) + \frac{x - c}{h}\cdot\frac{x - b}{2h}\cdot(\alpha, \beta, \gamma) + \ldots \quad (22).$$

The following example illustrates the method, h being taken to be 1°:—

Example 8.

x.	u = sin x.	1st Diff. (adjusted).	2nd Diff. (adjusted).	3rd Diff. (adjusted).
		+	−	−
20°	.3420201			
		162932 50		
22°	.3746066		1125 00	
		161245 00		48 75
23°	.3907311		1222 50	
		158800 00		48 30
26°	.4383711		1303 00	
		156194 00		47 49
27°	.4539905		1445 47	
		151857 60		46 00
32°	.5299193		1583 48	
		145523 67		
35°	.5735764			

To find u for x = 31°, we use the values for 26°, 27°, 32° and 35°, and obtain

$$u = .4383711\ 00 + \frac{5}{1}(156194\ 00) + \frac{5}{1}\cdot\frac{4}{2}(-1445\ 47) + \frac{5}{1}\cdot\frac{4}{2}\cdot\frac{-1}{3}(-46\ 00) = .5150380,$$

which is only wrong in the last figure.

If the values of u occurring in (21) or (22) are u_{alpha}, u_{beta}, u_{gamma}, ... u_{lambda}, corresponding to values a, b, c, ... l of x, the formula may be more symmetrically written

$$u = \frac{(x-b)(x-c)\ldots(x-l)}{(a-b)(a-c)\ldots(a-l)}u_{\alpha} + \frac{(x-a)(x-c)\ldots(x-l)}{(b-a)(b-c)\ldots(b-l)}u_{\beta} + \ldots$$
$$\ldots + \frac{(x-a)(x-b)(x-c)\ldots}{(l-a)(l-b)(l-c)\ldots}u_{\lambda} \qquad (23).$$

This is known as *Lagrange's formula*, but it is said to be due to Euler. It is not convenient for practical use, since it does not show how many terms have to be taken in any particular case.

14. *Interpolation from Tables of Double Entry.*—When u is a function of x and y, and is tabulated in terms of x and of y jointly, its calculation for a pair of values not given in the table may be effected either directly or by first forming a table of values of u in terms of y for the particular value of x and then determining u from this table for the particular value of y. For direct interpolation, consider that Δ represents differencing by changing x into x + 1, and Δ′ differencing by changing y into y + 1. Then the formula is

$$u_{x,\,y} = (1 + Delta)^{x}\,(1 + \Delta')^{y}\,u_{0,0};$$

and the right-hand side can be developed in whatever form is most convenient for the particular case.

References.—For general formulae, with particular applications, see the *Text-book of the Institute of Actuaries*, part ii. (1st ed. 1887, 2nd ed. 1902), p. 434; H. L. Rice, *Theory and Practice of Interpolation* (1899). Some historical references are given by C. W. Merrifield, "On Quadratures and Interpolation," *Brit. Assoc. Report* (1880), p. 321; see also *Encycl. der math. Wiss.* vol. i. pt. 2, pp. 800-819. For J. D. Everett's formula, see *Quar. Jour. Pure and Applied Maths.*, No. 128 (1901), and *Jour. Inst. Actuaries*, vol. xxxv. (1901), p. 452. As to relative accuracy of different formulae, see *Proc. Lon. Math. Soc.* (2) vol. iv. p. 320. Examples of interpolation by means of auxiliary curves will be found in *Jour. Royal Stat. Soc.* vol. lxiii. pp. 433, 637. See also Differences, Calculus of.

(W. F. Sh.)

INTERPRETATION (from Lat. *interpretari*, to expound, explain, *interpres*, an agent, go-between, interpreter; *inter*, between, and the root *pret-*, possibly connected with that seen either in Greek φράζειν, to speak, or πράττειν, to do), in general, the action of explaining, or rendering the sense of an obscure form of words or an unknown tongue into a language comprehended by the person addressed. In legal use the word "interpretation" is employed in the sense of ascertaining the meaning of the language of a document, as well as its relation to facts. It is also applied to acts of parliament, as pointing out the sense in which particular words used therein are to be understood. The interpretation of documents and statutes is subject to definite legal rules, the more important of which will be found in the articles Contract, Statute, Will, &c.

INTERREGNUM (Lat. *inter*, between, and *regnum*, reign), strictly a period during which the normal constituted authority is in abeyance, and government is carried on by a temporary authority specially appointed. Though originally and specifically confined to the sphere of sovereign authority, the term is commonly used by analogy in other connexions for any suspension of authority, during which affairs are carried on by specially appointed persons. The term originated in Rome during the regal period when an *interrex* was appointed (traditionally by the senate) to carry on the government between the death of one king and the election of his successor (see Rome: *History, ad init.*). It was subsequently used in Republican times of an officer appointed to hold the *comitia* for the election of the consuls when for some reason the retiring consuls had not done so. In the regal period when the senate, instead of appointing a king,

decided to appoint *interreges*, it divided itself into ten decuries from each of which one senator was selected. Each of these ten acted as king for five days, and if, at the end of fifty days, no king had been elected, the rotation was renewed. It was their duty to nominate a king, whose appointment was then ratified or refused by the *curiae*. Under the Republic similarly *interreges* acted for five days each. When the first consuls were elected (according to Dionysius iv. 84 and Livy i. 60), Spurius Lucretius held the comitia as interrex, and from that time down to the Second Punic War such officers were from time to time appointed. Thenceforward there is no record of the office till 82 B.C., when the senate appointed an *interrex* to hold the *comitia* which made Sulla dictator (Appian, *Bell. civ.* i. 98). In 55, 53 and 52 *interreges* are again found, the last-mentioned being on the occasion when Pompey was elected sole consul.

The most noteworthy use of the term "Interregnum" in post-classical times is that of the Great Interregnum in German history between the death of Conrad IV. (1254) and the election of Rudolf of Habsburg (1273). See GERMANY: *History*.

INTERSTATE COMMERCE. The phrase "interstate commerce," as used in the United States, denotes commerce between the citizens of different states of the Union. The words "interstate" and "intrastate" are not found in the constitution nor, until comparatively recently, in decisions of the courts or in legislative acts (probably being first used officially in 1887 in the Interstate Commerce Act). The constitution of 1789 uses the phrase "commerce among the states," and the first official decision interpreting the phrase says that "it may very properly be restricted to that commerce which concerns more states than one" (Chief Justice Marshall in *Gibbons* v. *Ogden*, 9 *Wheaton* 194). Commerce among the states is there distinguished from "commerce which is completely internal, which is carried on between man and man in a state, or between parts of the same state, and which does not extend to or affect other states." It was declared (*Lehigh* case, 145 *U.S.* 192) that commerce between two persons in the same state is not interstate even when there is a temporary deviation to the soil of another state; but later (*Hanley* case, 187 *U.S.* 617, distinguishing the *Lehigh* case) it was declared that as to transportation, such commerce is interstate. The courts have interpreted commerce to denote not merely a mutual selling or traffic, but as "a term of the largest import," including intercourse for the purposes of trade in any and all its forms (*Gibbons* v. *Ogden*, 9 *Wheaton* 194, and *Welton* v. *Missouri*, 91 *U.S.* 280). Thus have been included not only the actions of trading, navigation, transportation, and communication, but also the instruments and agents employed, including even telegraph messages and, in the extremest cases, lottery tickets.[1]

The decision of the question where federal control of interstate traffic ends and state control begins has been one of great practical difficulty. In general it has been held that whenever a commodity begins to move as an article of trade from one state to another, commerce in that commodity between the states has begun. Mere intention to ship goods does not make them subjects of interstate commerce, but they must actually be put in motion or committed to the carrier for that purpose (*Coe* v. *Errol*, 116 *U.S.* 517). As a practical guide in deciding when state control should be resumed, the court as early as 1827 (*Brown* v. *Maryland*) laid down the "original package rule," that the taxing power of the state should begin when the original package in which the goods had been imported into the state had been broken up or sold. The injustice of allowing goods to be held thus, for long periods escaping local taxation, led to a modification of the rule in 1868 (*Woodruff* v. *Parkham*, 8 *Wall.* 123), and such goods after reaching their destination may be taxed as property in common with other property in the state.[2]

Reason for Federal Control of Interstate Commerce.—Immediately after the close of the War of American Independence in 1783 appeared the separatist tendencies and local jealousies usual in a confederation. The Congress of the Confederation had no power to levy tariff duties or to regulate commerce between the states, and the separate states freely and recklessly exercised their rights in this matter. Though commerce at that time was comparatively unimportant, the results of this restrictive policy were most unfortunate. The Annapolis Convention of 1786 was called by the Virginia legislature to take into consideration the trade of the United States and to consider how far a uniform system in their commercial relations might be necessary to the common interests and their permanent harmony. This conference resulted in the call of the Philadelphia Convention of 1787, which framed the present Constitution. Chief Justice Marshall, in one of the early cases on this subject (*Brown* v. *Maryland*, 12 *Wheaton* 419, in 1827), said in words often since quoted: "It may be doubted whether any of the evils proceeding from the feebleness of the federal government contributed more to that great revolution which introduced the present system than the deep and general conviction that commerce ought to be regulated by Congress."

Every year has increased the importance of the congressional power of regulating commerce. At the time of the adoption of the Constitution, each neighbourhood supplied nearly all its needs by its own industry, but improving means of transportation and communication have multiplied the commercial ties between the citizens of the various states. This change went on slowly until 1830, more rapidly between 1830 and 1860, and at an ever-hastening pace after the Civil War. Until 1824 no case involving directly the consideration of this power reached the United States Supreme Court. From 1824 to 1840 the Supreme Court decided an average of one-third of a case a year; from 1841 to 1860, an average of three-fourths of a case; from 1861 to 1870, an average of one case; from 1871 to 1880, an average of nearly six cases; from 1881 to 1890, an average of more than seven cases; and from 1891 to 1900, an average of more than ten cases. The decisions have not been entirely uniform, and there were some decisions too contradictory to be explained by any ingenuity. The Supreme Court itself has said (*Fargo* v. *Michigan*, 121 *U.S.* 230) that "it may be admitted that the court has not always employed the same language, and that all of the judges of the court who have written opinions for it may not have meant precisely the same thing." Though in the period just preceding the Civil War the doctrine of states' rights tended to weaken somewhat the federal power, the broad outlines of the interpretation by Chief Justice Marshall laid down in 1824 in *Gibbons* v. *Ogden* remain to-day almost undimmed.

Interstate Commerce in the Federal Constitution.—Freedom of trade, without discrimination, between the citizens of all the states was in the main ensured by one brief sentence, usually called the "commerce clause" of the federal constitution:—"The Congress shall have power ... to regulate commerce with foreign nations, and among the several states, and with the Indian tribes" (Art. 1, sec. 8, clause 3). Hardly less important is the power "to make all laws which shall be necessary and proper for carrying into execution the foregoing powers, and all other powers vested by this Constitution in the government of the United States, or in any department or officer thereof" (Art. 1, sec. 8, clause 18). To the same end of freedom of commerce, Congress is limited in that "no tax or duty shall be laid on articles exported from any state," and "no preference shall be given by any regulation of commerce or revenue to the ports of one state over those of another; nor shall vessels bound to or from one state be obliged to enter, clear, or pay duties in another" (Art. 1, sec. 9, clauses 5 and 6). Directly and by implication, Congress was granted a number of other powers over commerce, in that it may coin money, establish uniform laws of bankruptcy, establish post-offices and post roads, regulate weights and measures, exercise admiralty jurisdiction (now interpreted to extend to all public waterways accessible to the traffic of more than one state), grant patents and copyrights, and use the power of taxation to protect, repress or even destroy the agencies of commerce (*e.g.* state bank notes). But these powers can be exercised only in ways which favour and make free the intercourse among all parts of the nation.

Even if the commerce clause had been omitted from the Constitution, a large part of its object would have been attained by certain prohibitions upon the states as follows: "The citizens of each state shall be entitled to all privileges and immunities of citizens in the several states" (Art. 4, sec. 2). "No state shall, without the consent of the Congress, lay any impost or duties on imports or exports, except what may be absolutely necessary for executing its inspection laws; and the net produce of all duties and impost, laid by any state on imports or exports, shall be for the use of the treasury of the United States, and all such laws shall be subject to the revision and control of the Congress" (Art. 1, sec. 10, clause 2). "No state shall, without the consent of Congress, lay any duty of tonnage" (Art. 1, sec. 10, clause 3). Thus by threefold measures of precaution was ensured domestic freedom of trade from every point in the land to its farthest frontiers.

Negative Working of the Commerce Provisions.—For nearly a hundred years these provisions were important only in their negative effects of preventing the states from granting special privileges to their citizens or taxing unequally the citizens of other states. The decision in 1824 of *Gibbons* v. *Ogden* stopped the attempt of the state of New York to grant the monopoly of steamboat traffic on the waters of that state. Had the clear and unequivocal opinion in that case been different, local ingenuity doubtless would have devised a multitude of discriminations. "The power to tax involves the power to destroy," and ever since the decision of *McCulloch* v. *Maryland* in 1819 it has been held that no agencies created by the federal government, such as banks or legal tender notes, are subject to state taxation, and the rule has also been laid down repeatedly by the Supreme Court (for the first time in 1886) that no burden can be laid upon the act of taking goods into or out of the state, of soliciting sales, or of delivering goods even though the tax is without discrimination as between the state's own citizens and others; that is, interstate commerce "cannot be taxed at all" (*Robbins* v. *Shelby County Taxing District*, 120 *U.S.* 489).[3] Federal control of interstate commerce has been interpreted by the courts to be exclusive of any control by the states. This is not self-evident in the clause, "Congress shall have power to regulate commerce among the several states." Over some other subjects the power of the federal and state governments is concurrent, the state being able to act until Congress enacts some conflicting legislation. Although the early decisions suggested that the power of Congress was exclusive, yet for nearly a century no positive decision was rendered and no positive action

was taken by Congress. Between 1870 and 1886 the states made great progress in the regulation of railways on the assumption that until Congress had acted the states were free to act. The question was put beyond doubt in a series of decisions establishing the principle that the non-action of Congress indicates its will that commerce shall be free and untrammelled and that the states cannot interfere either through their police power or their taxing power.[4]

Positive Federal Regulation.—Though the regulation of interstate commerce up to the Civil War was mainly negative, some positive actions of the federal government had indirect effects on commerce, as, for example, the coinage of money, the establishment of post-offices, the charter of the first and second United States banks, and the charter of the Pacific Railroad. The power to do these things was conferred by the Constitution in some cases directly, in other cases by implication in that any means appropriate to lawful ends might be employed (as in case of charter of the United States Bank, *McCulloch* v. *Maryland*). From 1850 to 1862 the federal government had made numerous land grants in aid of railways, but always to the states, not directly to the corporations, and it had never until 1862 granted a charter to a railway, canal, turnpike or transportation company. In 1866 Congress passed an act authorizing railway companies whose roads were operated by steam to carry passengers, freight, &c., "on their way from any state to another state and to receive compensation therefor and to connect with roads of other states so as to form continuous lines for the transportation of the same to the place of destination."[5] This act, so vague and general in its terms, had very little effect, though it has been the occasion of considerable litigation to determine its influence upon existing police laws of the states. In 1884 Congress established the Bureau of Animal Industry for preventing the exportation of diseased cattle and for the extirpation of disease among domestic animals. This had little significance at the time for interstate commerce, its purpose being to meet the objections of foreign countries to the importation of American meat. In 1887 was passed the Interstate Commerce Act, providing a national commission to supervise interstate railways. In 1888 was passed an Arbitration Act, replaced in 1898 by an act which provides that in case of disputes between common carriers subject to the Interstate Commerce Act and their employees, conciliation shall be tried, and, in case this should fail, indicates the methods that may be used for the voluntary submission of the dispute to a board of arbitration. In 1890 was passed the Sherman Anti-Trust Act, making illegal every contract and combination in restraint of trade or commerce among the several states or with foreign nations. In 1893 a Safety Appliance Act, the administration of which was put into the hands of the Interstate Commerce Commission, promoted the safety of employees and travellers, and required the roads engaged in interstate commerce to equip their cars and locomotives with automatic couplers and brakes. In 1895 was prohibited the interstate carriage of condemned carcasses of animals, and of lottery tickets (see above reference to the interpretation of the Lottery Act), in 1897 of obscene literature, and in 1900 of game killed in violation of state laws. In 1901 carriers engaged in interstate commerce were required to make full reports of all accidents to the Interstate Commerce Commission. In 1902 was prohibited the interstate carriage of dairy products falsely labelled or branded as to the state or territory in which produced, and in 1903 the Secretary of Agriculture was empowered to establish rules concerning importation and transportation of live stock. In 1903 the Bureau of Corporations was established with power to investigate the conduct of corporations engaged in interstate and foreign commerce, excepting common carriers subject to the Interstate Commerce Act. In 1903 the Interstate Commerce Act was amended by the Elkins Act, making much more difficult the granting of rebates. In 1905 the President was authorized to grant medals of honour to persons who by their daring save life or prevent accident on railways. In 1906 the Interstate Commerce Act was amended in important particulars (specified below). In 1906 were passed pure food laws, greatly enlarging the duties of the Department of Agriculture in reference to inspection of foods prepared for interstate commerce.

The Interstate Commerce Act.—The period of positive action by Congress in the regulating of interstate commerce practically begins, therefore, with the enactment of the Interstate Commerce Act of February 1887, the outcome of fully seventeen years of agitation and discussion. The law was modelled in large part upon English acts. It applied to common carriers wholly by railway, and partly by railway and partly by water when both are used under a common arrangement for continuous shipment; forbade unjust discrimination and undue and unreasonable preference; made it unlawful to charge more for a shorter than for a longer distance over the same line in the same direction, the shorter being included within the longer distance (though a carrier might be freed by the Commission from the working of this provision); and forbade pooling and division of earnings. The administration of the law was entrusted to a Commission of five members, appointed by the President. From this act much was expected, but eighteen years of its operation gave as net results little more than a greater uniformity of railway accounting and much better understanding by the public of the nature of the railway problem. Discrimination and secret rebates continued. The anti-pooling clause (pretty generally recognized by the well-informed to be a mistake) prevented open but not secret agreements between carriers, and probably hastened the movement toward consolidation. The long and short haul clause was made meaningless by the judicial interpretation that any competition, even

that of other carriers subject to the act, justified the railway in charging more for a shorter than for a longer haul. The effectiveness of the Commission was destroyed by the judicial decision that it had no power to fix rates for the future. Until 1897, the Commission, when it adjudged a rate unreasonable, usually declared what rate was reasonable, and directed the carrier to reduce the rate by a given date to the designated maximum. Of 135 orders made in decisions rendered in the first ten years of the Commission, 68 prescribed a maximum rate for the future. In 1897 it was finally decided in the *Cincinnati Freight Bureau Case* (167 *U.S.* 479) that Congress had not conferred upon the Commission the power to prescribe any rate for the future. The court said that Congress might fix the rate itself or authorize a sub-tribunal to do so, but that Congress had not yet given that authority.

The need of further legislation had been felt from the beginning by many, and after 1903 the agitation became very active. The position taken by President Roosevelt in his message to Congress in 1904 made the amendment of the Interstate Commerce Act the principal political issue before Congress in the sessions of 1905 and of 1906. After the most remarkable senatorial debates heard at Washington in years, followed with close interest by the country, a number of amendments became law on the 29th of June 1906. The act was strengthened to a degree hardly expected by the most earnest advocates of revision. A number of minor changes made in the light of experience were: increasing the number of commissioners to seven and their pay to $10,000; facilitating procedure and the taking of evidence; requiring thirty days notice of a change of rates; requiring appeal from the Commission's decision to be taken within thirty days; empowering the Commission to establish joint rates and to order switches to be built. The following are generally thought to be still more important changes: (1) Including within the application of the act pipe lines (particularly for oil), express and sleeping car companies, and all the facilities and services in connexion with goods transported; (2) giving publicity to railway business by empowering the Commission to prescribe all forms of accounts and to examine the books at all times, and by forbidding any other accounts or memoranda to be kept by the companies; and (3) empowering the Commission to prescribe reasonable maximum rates to take effect within not less than thirty days and to continue not over two years unless set aside by the courts.

The Anti-Trust Act of 1890.—The growth of large corporations with some degree of monopoly power, the so-called trusts, had called forth in a number of the states anti-trust laws before 1890. When it became evident that the states were not succeeding in dealing with the problem, public sentiment found expression in the Sherman Anti-Trust Act, approved on the 2nd of July 1890. This act declared illegal and criminal, punishable by fine or imprisonment or both, every contract in restraint of trade or commerce among the several states or with foreign nations. The statute thus changed the common law wherein such contracts were merely unenforceable but not criminal. This act was at first construed by the Supreme Court as applying to any contract in restraint of interstate commerce, whether reasonable or unreasonable (*Trans-Missouri Freight Association*, 166 *U.S.* 331), but later, in 1905 (*Stock Yards case*, 25 *Supreme Court Reporter* 276) it was held that the act did not apply to agreements for the better conduct of business which incidentally affected interstate commerce.[6] The act has been interpreted to apply to transportation (*Freight Association case*, 166 *U.S.* 290, and *Northern Securities case*), with results felt even by some of the advocates of railway regulation to be unfortunate. It applies to unlawful combinations of manufacturers to divide the territory and regulate the prices (*Addyston Pipe Trust Case*, 175 *U.S.* 211). In the Sugar Trust case (1895 *U.S.* v. *Knight Co.* 156 *U.S.*) it was declared that the statute did not apply to a manufacturing company which had acquired nearly complete control of the manufacture of refined sugar by means of the purchase of stock of other refining companies.

The Attorney-General submitted to the Senate, in June 1906, a statement of the results of all suits instituted by the Department of Justice under the anti-trust law, the Interstate Commerce Act and the Elkins Act, in the period from 1887 to June 1906 inclusive. Thirty-six suits were still pending; of the 250 which had been disposed of in some manner 186 ended in dismissal, non-prosecution or acquittal, and 64 were successful in securing in whole or in large part the object of the suit (in 30 cases conviction, in 34 cases the granting of a petition or an injunction, &c.). In addition to these results of federal efforts to regulate industry must be counted the cases in which carriers complied with the orders of the Interstate Commerce Commission without suit; but even then the total by 1906 was somewhat meagre.

The establishment of the Bureau of Corporations in 1903, and the considerable extension of the powers of inspection of the Department of Agriculture are recent changes of which the results cannot yet be fairly judged. The aim of the Bureau of Corporations is to ensure publicity in the management of corporations engaged in interstate and foreign commerce. The first commissioner, Mr James R. Garfield, showed much activity in pursuing the purposes of the act, and published informing reports upon the beef trust (1905), and upon the Standard Oil Company (1906). But the effect and possible extension of federal interference became from this time burning political questions of far-reaching importance of too recent a date to be dealt with

historically in this article.

See also the *Annual Reports* of the Interstate Commerce Commission since 1887, and decisions; Prentice and Egan, *The Commerce Clause of the Federal Constitution* (Chicago, 1898); *Reports* of the Commissioner of Corporations on the Beef Industry (1905), on the Transportation of Petroleum (1906); W. Z. Ripley (ed.). *Trusts, Pools and Corporations* (1905), containing leading cases and analyses of the voluminous "trust" literature; F. N. Judson, *The Law of Interstate Commerce and its Federal Regulation* (Chicago, 1905); Beale and Wyman, *Railroad Rate Regulation* (Boston, 1906); Frank Hendrick, *The Power to Regulate Corporations and Commerce* (New York, 1906), favouring less of new legislation.

(F. A. F.)

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1 The lottery tickets were included only by a divided court (*Lottery Cases*, 188 U.S. 321) four judges emphatically dissenting. The moral issue doubtless influenced a decision so difficult to reconcile with other opinions of the court, which otherwise had held regularly that commerce involves the physical movement of persons or things and does not include the contractual relations between citizens incident to commercial intercourse. Not all things incidental to commerce are included in it, and it has been held that the following are not included: bills of exchange (in 1850, *Nathan* v. *Louisiana*, 8 *How.* 73), trade marks (in 1879, *trade mark cases*, 100 *U.S.* 82), insurance (in 1869, *Paul* v. *Virginia*, 8 *Wall.* 168), and manufacturing (in 1895, *U.S.* v. *Knight Co.*, 156 *U.S.* 1). In the last-named case, which concerned a combination of sugar refineries controlling a large proportion of the product of the country, it was said that commerce succeeds manufacture and is not a part of it. The relation of the manufacturer to interstate and foreign commerce being thus only incidental and indirect, the business is subject to state control. By a series of decisions the transportation of persons has been decided to be commerce. (In 1848, *passenger cases*, 7 *How.* 283. In 1867, *Crandall* v. *Nevada* 6, *Wall.* 35. In 1875, *Henderson* v. the *Mayor of New York*, *92 U.S.* 259, &c.).

2 The question arose with reference to the police power of the state in those states prohibiting the liquor traffic, and in 1889 it was held (Leisy *v.* Hardin) that, in the absence of legislation by Congress, the right to sell goods taken into a state was unrestricted. This made it impossible for a state to exclude the importation of liquors to be sold within its territory, but this difficulty was remedied by the Wilson Original Package Bill of 1890, which made liquor subject to the police powers of the state to which it was carried.

3 However, a very important distinction is drawn between taxing the commerce and taxing property employed in commerce. With the increase of interstate commerce, the states have been hard pushed to find sources of revenue adequate to their increasing needs. The courts, therefore, have sought to draw a line between taxes on the privilege of carrying on interstate commerce and taxes on the property employed in carrying on such commerce as a part of the general body of property in the state. Thus it has been held in the case of *State Freight Tax* (1872, 15 *Wall.* 232) that a state could not lay a tax on freight transported from one state to another, and yet the same year the court held in *State Tax on Gross Receipts* (15 *Wall.* 284) that a tax was valid when laid upon the receipts of railways organized under the laws of the state, as upon a fund which had become incorporated with the general mass of property. This latter decision was by a divided court (three of the nine judges dissenting), but it has since been frequently confirmed. The tax on gross receipts of all railway companies doing business in the state has been supported when levied in proportion to the mileage within as compared with the total within and without the state (*Erie Ry.* v. *Pa.*, 21 *Wall.* 492). This so-called "unit rule," as applied either to gross receipts or to the entire value of an interstate railway, has been upheld in a number of decisions. The method of taxation by gross receipts, however, has not tended to increase of late, but the unit rule, as applied to *ad valorem* taxes on property, is more and more being applied. Every case involving the distinction between a tax on commerce and a tax on property employed in commerce presents its own difficulties, yet a practical way is thus found to prevent discriminating action by the several states, while leaving to them adequate sources of revenue.

4 1873, *State Freight Tax*, 15 *Wall.* 232; 1887, *Robbins* v. *Shelby County Taxing District*, 120 *U.S.* 489; *Wabash R. R. Company* v. *Illinois*, 118 *U.S.* 557. The last-named case arose out of the attempts of the state of Illinois to prevent discrimination between two shippers, both being its own citizens and within its own borders, one of whom was being charged more than the other for a shorter shipment on the same line and in the same direction, from a point outside the state. The court, applying the established definition of interstate commerce with verbal formality of logic, decided that the state could do nothing, for even in such a case all regulation of interstate commerce, from the beginning to the end of a shipment, was confided to Congress exclusively. Thus a clause whose clear purpose was to prevent one state from burdening unequally the citizens of other states was successfully invoked by a private corporation to forbid the state securing equality of treatment for its own citizens as regards such parts of shipments as lay within its own borders. Most railway traffic was by this decision declared to be subject to legislation by Congress but Congress had not acted. The impossibility of this situation was so evident that the Interstate Commerce Act, long under discussion, became a law a few months later.

5 This was probably aimed at the discriminating between New York and Philadelphia (see speech of Charles Sumner on the railroad usurpation of New Jersey in U.S. Senate, February 14, 1865).

6 In the Northern Securities case, Justice Brewer, who had concurred in the opinion in the Trans-Missouri Freight Association case, took occasion to say that while he still believed the former case had been correctly decided, he thought that the reasons given for the judgment were in some respects faulty, and that the ruling should have been that the contracts there considered were unreasonable

restraints and as such were forbidden by the act.

INTERVAL, a space left between the component parts of a continuous series, a pause in continuous action, a period of time intervening between two other points of time or chronological sequence of events. The Lat. *intervallum*, from which the English word has come through the French, originally meant a space between the palisades on a rampart (*vallum*), or between the rampart and the tents of the legionaries. In medical language "interval" is used of the intervening periods between attacks or paroxysms of a disease, particularly of the periods of a rational or normal condition of mind sometimes experienced by an insane person, a "lucid interval"; this phrase frequently occurs in legal documents from the 13th to the 15th centuries, *non compos mentis sed gaudet lucidis intervallis*. In music "interval" expresses the distance in pitch between two or more musical sounds (see Music). Interval, or more commonly "intervale," is used, particularly in North America, as a geographical term for a low-lying tract of land along the banks of rivers, frequently overflowed by freshets, or more loosely for any low level land shut in by hills. This particular application, as also the form "intervale," is due to a confusion of the termination of the word with "vale," valley.

INTESTACY (Lat. *intestatus*, one who has not made a will, from testari, to bear witness), the condition of the property of a person who dies without making a will. Here the law of England distinguishes sharply between his real and his personal property. The devolution of the former is regulated by the rules of inheritance (*q.v.*). The destination of the latter is marked out by the Statute of Distributions. The proper conditions of a testamentary disposition of property will be found under the heading Will.

The distribution of an intestate's personal property is carried out under the authority of administrators, whose duties are generally the same as those of executors under a will. Administration was until 1857 a matter cognizable by the ecclesiastical courts, and the ordinary was in fact the administrator until the passing of an act of Edward III. for administration upon intestacy (1357). An earlier statute (Westminster 2, 1275), directed against the abuses of the system, required the ordinary, instead of applying the residue of the estate to "pious uses," to pay the debts of the intestate. The act of Edward III. went further in providing that "in case where a man dieth intestate, the ordinaries shall depute of the next and most lawful friends of the dead person intestate to administer his goods," with power to sue for debts due to the deceased, and under obligation to pay debts due by him, and to answer to the ordinary like executors in the case of testament. Administrators remained on this footing of deputies appointed by the ordinary until the Probate Act 1857 transferred the jurisdiction in administration of the ecclesiastical courts to the new court of probate.

The courts of law having held that by the grant of administration the authority of the ecclesiastical courts was exhausted, the administrator became entitled to the privilege, similar to that formerly enjoyed by the ordinary, of dealing as he pleased with residue of the property. The next of kin of the same degree of relationship to the deceased were thus aggrieved by the preference of the administrator, and it was to remedy this grievance that the Statute of Distributions 1670/1 was passed. It empowered the ordinary to take a bond from the administrator binding him to make a fair and complete distribution of the property among the next of kin. Such distribution is to be in the following manner: one-third to the wife of the intestate, and all the residue by equal portions to and amongst the children, and their representatives if any of such children be dead, exclusive of children who shall have any estate by the settlement of the intestate, or shall be advanced by the intestate in his lifetime by portions equal to the shares allotted to the other children under the distribution. If such advancement should be less than the share of the other children in distribution, then it shall be made equal thereto. But the "heir-at-law, notwithstanding any land that he shall have by descent or otherwise from the intestate, is to have an equal part in distribution with the rest of the children" (§ 5). By § 6, if there be no children nor any legal representatives of children, one moiety of the property is to be allotted to the wife of the intestate, the residue "to be distributed equally to any of the next of kindred of the intestate who are equal in degree and those who legally represent them." By § 7 there shall "be no representation admitted among collaterals after brothers' and sisters' children; and in case there be no wife, then all the said estate to be

distributed equally to and among the children; and in case there be no child, then to the next of kindred in equal degree of or unto the intestate and their legal representatives as aforesaid, and in no other manner whatsoever." For the protection of creditors it is enacted that there shall be no distribution till a full year after the intestate's death, and if any debts should be discovered after distribution, the persons sharing the estate shall refund the amount of the same ratably. With reference to the above rules the following points may be observed: (1) The husband's absolute right to administer his wife's estate is not affected by the act. This was made clear by a later act of the same reign. (The Statute of Frauds 1677). Administration is now granted to the representatives of the husband where he has died without taking out administration to his wife, unless it can be shown that the wife's next of kin are beneficially interested. (2) The widow, in the event of there being no children or next of kin, takes only her half. The other half goes to the crown. The widow's rights, however, have been enlarged by the Intestate Estates Act 1890. By this act where a man dies wholly intestate and without issue, his property, both real and personal, shall, if it does not exceed £500 in net value, belong to his widow absolutely. If the estate exceeds £500 net, the widow is entitled to £500 out of the estate and has a charge for that amount upon the real and personal property of the deceased. (3) The child or children take equally, two-thirds if the widow be alive, and the whole if she be dead. If some of the children be alive and some dead having issue, then such issue will take their parents' share equally among themselves. There has been some difference of opinion as to whether if all the children have predeceased their parent but have left issue, such grandchildren take as between themselves *per stirpes* as representatives of their parent or *per capita* as next of kin. Thus if A and B predecease their father but A leaves three children and B one, should the property be divided into fourths, or first into moieties and then one moiety subdivided into thirds among A's children and the other moiety be given undivided to B's child? It is now settled that the latter method of distribution is the correct one, and it is thought that this will also apply when only great-grandchildren are alive. (4) The next of kin must be ascertained according to the rules of consanguinity, which are the same in English as in the civil law. Degree is calculated from the intestate, through the common ancestor if any, to the kindred. Thus from son to father is one degree, to grandfather two degrees, to brother two degrees, to uncle three degrees, and so on. The statute ordains distribution to be made "to the next of kindred in equal degrees *pro suo cuique jure*, according to the laws in such cases and the rules and limitations hereafter set down." Equality in degree is therefore not in all cases accompanied by equality in rights of succession. Neglecting the cases of wife and children already noticed, the father excludes all other next of kin. So would a mother, in default of a father surviving, but an act of 1685 enacted that in such a case the brothers and sisters, and children of brothers and sisters, of the intestate should share equally with the mother. In the absence of brothers or sisters and their representatives, the mother in the case supposed would take the whole. Mothers-in-law and stepmothers are not within the rules of consanguinity. As between a brother and a grandfather who are both in the second degree, preference is given to the brother; but a grandfather, being in the second degree, will exclude an uncle, who is in the third. An uncle and a nephew, both being in the third degree, take together. Brothers or sisters of the half blood take equally with brothers and sisters of the whole blood. The rule which prohibits representation after brothers' and sisters' children would, in a case where the next of kin were uncles or nephews, wholly exclude the children of a deceased uncle or nephew. Also, as between the son of a brother and the grandson of a brother, the latter would not be admitted by representation. Where a brother and the children of a deceased brother are the next of kin, they will take *per stirpes*, *i.e.* the brother will take one half, and the children of the other brother will take the other half between them. When the next of kin are all children of the deceased brothers or sisters, they will take equally *per capita*. Subject to these modifications, the personal property will be divided equally among the next of kin of equal degree, *e.g.* great-grandfathers would share with uncles or aunts, as being in the third degree. Failing next of kin, under these rules, the estate goes to the crown as *ultimus haeres*, a result which is more likely to happen in the case of illegitimate persons than in any other.

Personal or movable property takes its legal character from the domicile of the owner, and the distribution of an intestate's goods is therefore regulated by the law of the country in which the intestate was domiciled. A domiciled Scotsman, for example, dies intestate in England, leaving personal property in England; the administrator appointed by the court of probate will be bound to distribute the property according to the Scots rules of succession.

> In the law of Scotland the free movable estate of the intestate is divided amongst the nearest of kin, the full blood excluding the half blood, and neither mother nor maternal relations being originally admitted. The heir of the heritable (*i.e.* real) property if one of the next of kin must collate with the next of kin if he wishes to share in the movables. Proximity of kin is reckoned in the same order as in the case of inheritance. The Intestate Movable Succession Act 1855 among other changes allows the issue of a predeceasing next of kin to come in the place of their parent in succession to an intestate, gives the father of an intestate dying without issue one-half of the movable property in preference to brothers and sisters, and to the mother if the father be dead a similar preference to the extent of one-third, and admits brothers and sisters uterine in the

absence of brothers and sisters german or consanguinean.

In the United States the English Statute of Distribution has been taken as the basis of the law for the distribution of personal property in intestacy, and its principles have been applied to real property also. “In a majority of the states the descent of real and personal property is to the same persons and in the same proportions, and the regulation is the same in substance as the English Statute of Distribution. In Georgia the real and personal property of the intestate is considered as altogether of the same nature and upon the same footing.” There are many states, however, in which the distribution differs materially from the English statute. In Illinois the distribution is the same as descent of real property. In Alabama the whole goes to the widow if there are no children (*Phillips* v. *Lawing*, 1907, 43 Southern Rep. 494). In many states the husband’s share is in all cases like the widow’s, as in Texas, New York and Washington. In Pennsylvania he takes an equal share with the children.

The statutes of each state of the American union must be consulted, as no general rules can be laid down. As to the right to the intestate’s interest in community property in the states where the law of “community”—of “acquets and gains”—prevails, see INHERITANCE.

INTESTINAL OBSTRUCTION (*Ilius*), in surgery, a condition in which the onward passage of the faeces is prevented. It is often associated with phenomena due to strangulation of the gut, leading to gangrene, and with systemic poisoning due to the absorption of toxins, resulting from the decomposition of the retained faeces. Intestinal obstruction may be conveniently divided into acute and chronic.

Acute Intestinal Obstruction forms one of the most urgent of surgical emergencies. The following are its chief causes: (1) strangulation by bands or adhesions or through apertures; (2) volvulus; (3) the impaction of foreign bodies; (4) acute intussusception; (5) strangulation over a band or acute kinking of the gut; (6) the termination supervening on chronic obstruction; (7) congenital malformations of the intestines.

Strangulation by Bands or Adhesions or through Apertures.—These terms are applied to obstruction by constricting bands within the abdomen. These may be the result of the stretching of old inflammatory adhesions, the result of former peritonitis. These bands are commonly situated between different parts of the mesentery or between the mesentery and another organ such as the appendix. Two methods of producing strangulation exist; in the first the bowel passes under an arch or loop formed by some short constricting band and cannot return, or if the band is long it may form a noose in which the bowel is strangled (fig. 1); in the second the remains of a foetal structure (Meckel’s diverticulum) becoming adherent to some other organ may ensnare the intestine in the loop. A coil of intestine may also slip into a hole in the mesentery or omentum or find its way into a pouch of peritoneum, forming what is known as an internal hernia. The onset of symptoms is sudden and abrupt. The patient is seized with acute abdominal pain associated with collapse. The pain is usually referred to the region of the umbilicus; this localization, however, is no guide to the situation of the lesion. Vomiting is early and persistent, generally assuming a faecal character between the second and the ninth day. There is no obvious tumour; constipation is present, the abdominal walls are flaccid at first, but if no relief is obtained become tender when peritonitis ensues. This form of obstruction is most frequent in young people, and there is usually a history of previous peritonitis. In cases not treated by operation the average duration is five to seven days, and death takes place from exhaustion or from toxaemia following peritonitis.

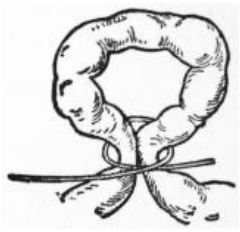

FIG. 1.—Diagram to show how Strangulation by a Band may take place.

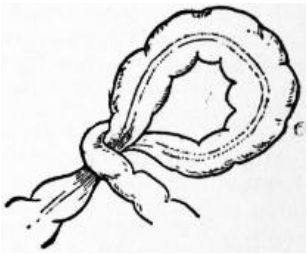

FIG. 2.—Diagram to show how Volvulus may take place.

Volvulus means a torsion or twisting of the gut. There are two chief varieties: (1) in which the bowel is twisted upon its mesenteric axis (fig. 2); (2) in which it is wound round another coil of intestine. The sigmoid flexure is the situation in which volvulus most commonly takes place, but it may occur in the caecum and small intestine. When once present, plastic peritonitis fixes the coil in position and the blood supply becomes obstructed. Volvulus is generally preceded by a history of chronic constipation. The acute symptoms start abruptly and are similar to those of internal strangulation, but the pain at first is more intermittent in type. There is usually early tenderness over the spot and constipation is absolute. Much distress is occasioned by abdominal

distension from flatus, which develops with remarkable rapidity. The swelling is localized at first. Spontaneous natural cure is unknown, and without surgical interference death is inevitable.

Impacted Foreign Bodies.—Gall-stones may cause obstruction when they are of large size. These gall-stones when lodged in the intestine may there be enlarged by subsequent accretion. Leichenstern describes such a stone with a circumference of 5 in., and Sir F. Treves removed from the intestine of an old lady a calculus, the large size of which was due to layers of magnesia, the patient having taken carbonate of magnesia daily for many years. Gall-stones may give rise to intermittent sub-acute attacks of incomplete obstruction and finally give rise to an acute attack accompanied by severe pain and vomiting, which is constant and early becomes faecal. The abdomen is soft and flaccid and the affected coil is rarely to be felt. The symptoms vary with the situation of the obstruction and are generally more urgent the nearer to the duodenum. Foreign bodies that have been swallowed by accident or otherwise may give rise to obstruction, though extraordinary objects, as knives, coins, pipes, flints, &c. swallowed by jugglers, are known to have passed by rectum without injury. In cases where the foreign body lodges in the intestine the caecum and duodenum are favourite situations for obstruction. In the museum of the Royal College of Surgeons is a specimen in which the duodenum is blocked by a mass of pins weighing nearly a pound. Foreign bodies may remain weeks or months in situ before giving rise to serious symptoms, the progress of the larger substances being marked by temporary obstruction. In a case quoted by Duchaussoy the obstructing mass consisted of over 700 cherry stones. The diagnosis of obstruction by foreign bodies has been much simplified since the introduction of the X-rays. Enteroliths may themselves cause obstruction. They may consist of masses of indigestible vegetable material matted together with faeces and mucous. In Scotland they are frequently found to consist of husks of coarse oatmeal (aenoliths). In thin persons large enteroliths and foreign bodies may be palpable. The symptoms are those similar to obstruction by a large gall-stone.

Acute Intussusception forms about 30% of all cases of intestinal obstruction, and is the most common variety found in children. More than 50% of the cases are found during the first ten years of life, and half that amount in babies under one year; the large preponderance is in males. By intussusception is meant an invagination or protrusion of a part of the intestine in the lumen of the intestine immediately below it; the lower part of the intestine may be said to have swallowed that immediately above it. The mesentery attached to the upper portion is necessarily dragged in with it. The condition may be seen by referring to the diagram (fig. 3). The invaginated portion is termed the *intussusceptum*, and the lower portion which it enters is known as the *intussuscipiens*. It is to the constriction of the vessels in the entering mesentery and later to their possible complete obstruction that are due the late serious phenomena of intussusception, *e.g.* gangrene or rupture of the gut. Peritonitis also ensues, and by the formation of adhesions between the serous coats of the entering and returning parts leads to irreducibility of the intussusception. A cure occasionally ensues from spontaneous reduction of the invagination, or again permanent stenosis of the intestine may result from the adhesion of the opposed surfaces, or the occurrence of gangrene may lead to perforation of the intestine with acute septic peritonitis. Occasionally when there is no perforation adherence takes place between the segments, and the gangrenous portion sloughs off and is discharged by the rectum. The cause of intussusception is said to be violent peristaltic action, however produced. Polypoid tumours or masses of worms, or masses of irritating ingesta, are said to lead to its occurrence. X. Dolore and R. Leriche contend that the primary factor is congenital mobility of the caecum. They state that in 48% of foeti the caecum is mobile in half, fixation gradually going on; while in 8.5% of adults it retains its mobility. They thus endeavour to account for the fact that in 300 collected cases 204 occurred in children less than one year old. Intussusception is met with in four chief situations: (*a*) the ileo-caecal, which is said to be the most frequent, constituting 44% of all cases (Treves); (*b*) the enteric variety, involving the small intestine; (*c*) the colic form; (*d*) the ileo-colic, the ileum being invaginated through the ileo-caecal valve. Intussusception may be acute or chronic, sometimes lasting intermittently for years. The acute form is the most common. In young children an attack occurs with severe pain, at first paroxysmal but later continuous; vomiting is less early and less continuous than in strangulation by bands, and diarrhoea tenesmus, much straining and the passage of blood mucus from the anus are common. Collapse soon supervenes. Early in the case the abdomen is but little distended, and in about half the cases a distinct tumour can be felt. In some cases the invaginated gut may be felt protruding through the sphincter. Chronic intussusception occurs more frequently in adults than in children; the symptoms may resemble chronic enteritis and be so masked that the nature of the illness remains undiagnosed until an acute attack supervenes, or the patient succumbs to the diarrhoea, vomiting and haemorrhage.

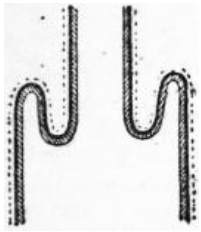

FIG. 3.—Diagram to show how an Intussusception takes place.

Congenital Malformations of the Intestines.—Cases have been recorded in which the small intestine ended in a blind pouch. Imperforate anus is a fairly frequent occurrence in young infants, but attention is usually called to the condition. Partial strictures of the intestine, if the stricture be not too narrow, may pass unnoticed for years, and final complete obstruction may result from a blockage of the stricture by some foreign substance such as a plug of hard faecal

matter or a fruit stone.

Treatment of Acute Intestinal Obstruction.—Early diagnosis and early laparotomy are essential, and it is important to operate before the patient is poisoned by the absorption of toxins from the bowel. To administer purgatives is worse than useless. Of massage and abdominal taxis Sir F. Treves says: “These are to be condemned, as they may rupture the already moribund bowel and make effective a threatened perforation. These measures are for the most part feeble excuses for avoiding or delaying the operation.” The operation may be undertaken in one or two stages, and includes the opening and evacuation of the distended intestines and the search for and reduction or removal of the obstruction.

Chronic Intestinal Obstruction.—The causes of chronic obstruction are very numerous, and may be divided into the following groups: (1) intra-intestinal conditions, *i.e.* the impaction of foreign bodies and impaction of faeces; (2) affections of the intestinal wall such as stricture, new growths in the intestine, particularly those of a malignant type, adhesions or matting together of the intestines from peritonitis or kinking of the gut from disease of the mesenteric glands; (3) chronic intussusception; (4) compression of the bowel by a tumour or bands developing outside the intestine. Of these the commonest are malignant growths and faecal impaction.

The general symptoms of chronic obstruction are more or less alike. The patient is attacked with gradually increasing constipation, which may alternate with diarrhoea which is generally set up by the irritation of the retained faeces. In obstruction due to malignant growths the character of the motions is changed, they become scybalous, pipe-like or flattened. The abdomen becomes distended, and at intervals severe symptoms may supervene, consisting of pain and vomiting with complete constipation owing to some temporary complete obstruction. The attacks usually pass off, and relief may be obtained naturally or by the administration of a purgative, but they have a tendency to recur and in malignant disease to increase to complete obstruction. Finally a seizure may persist and take on all the characters of an acute attack, and death may supervene from exhaustion, perforation or peritonitis, unless immediately treated. When it arises from simple stricture no tumour is to be felt, but in malignant disease the tumour may be frequently palpated, unless during an acute attack when the abdomen is much distended with gas.

Faecal Impaction is not uncommon in adult females who have suffered from chronic constipation. The common seat of the blockage is in the colon, chiefly in the sigmoid flexure and in the rectum, but it may occur in the caecum. The accumulation may form a doughy tumour which in parts may be nodular and intensely hard. The causes are due to the state of the contents of the bowel itself, to congenital or acquired weakness and diminished expulsive power of the bowel, or to painful affections of the anus, fissures, piles and painful bladder affections. The acute symptoms are always preceded by a prolonged period of malaise; the breath is offensive and the tongue foul, and the temperature may be raised from the absorption of toxins. Faecal impaction requires the regular and repeated administration of large enemata, given through a long tube, together with the administration of calomel and belladonna. Large impacted masses in the rectum may be broken up and removed by a scoop.

Strictures of the Intestinal Wall.—Simple strictures are infrequent, and are dealt with by the operation of lateral anastomosis. They follow dysenteric or tuberculous ulceration or the passage of gall-stones. Stricture due to carcinoma of the intestinal wall occurs usually in the old or middle-aged, and the symptoms come on insidiously. As soon as the condition is diagnosed an attempt should be made to remove the tumour if freely movable, or if this is not possible to afford relief by short-circuiting the intestine or by colotomy.

Chronic Intussusception has been frequently mistaken in the diagnosis for rectal polypus, cancer, tuberculous peritonitis, &c. (Treves). If diagnosed it may be reduced by inflation with air, but frequently too many adhesions are present for this to be possible, and laparotomy with excision of the mass should be undertaken; the results are said to be very encouraging.

Compression of the bowel due to a tumour or bands external to the bowel may occasionally give rise to obstruction. An exploratory operation should be undertaken for the excision of the tumour, or the separation of adhesions and release of the bowel, or if the intestines are much matted together by peritonitis an intestinal anastomosis may give relief. Obstruction due to paralysis of the muscular coat of the intestine has been described (adynamic obstruction), but its existence is a subject of dispute.

(H. L. H.)

INTESTINE (Lat. *intestinus*, internal, usually in neuter plural *intestina*, from *intus*, within), in anatomy, the lower part of the alimentary canal; in man and mammals divided into the smaller

intestine, from the pylorus to the iliocaecal valve, and the larger, reaching from the caecum and colon to the end of the rectum. The word is frequently applied to the whole of the alimentary canal in invertebrates. (See Alimentary Canal.)

INTOXICATION (Lat. *toxicare*, *intoxicare*, to smear with poison, *toxicum*, an adaptation of Gr. τοξικόν, *sc.* φάρμακον, a poison smeared on arrows; τόξον, bow), poisoning, or the action of poisons, whether of drugs, bacterial products, or other toxic substances, and hence the condition resulting from such poisoning, particularly the disorder of the nervous system produced by excessive drinking of alcohol (see Inebriety and Drunkenness).

INTRA, a town of Piedmont, Italy, in the province of Novara, on the W. shore of Lake Maggiore, 685 ft. above sea-level, 12 m. N. of Arona by steamer. Pop. (1901) 6924. It is situated between two torrents, which afford water-power for cotton and silk mills, hat factories, foundries, &c.; these chiefly belong to Swiss proprietors, who have fine villas with beautiful gardens. The church is a large edifice of 1708-1751.

INTRADOS (a French term, Lat. *intra*, within, Fr. *dos*, back), in architecture, the under-curved surface or soffit of an arch (*q.v.*).

INTRANSIGENT (adopted from the Fr. *intransigeant*, taken, through the Spanish *intransigente*, from the Lat. *in*, not, and *transigere*, to come to an understanding), one whose attitude is that of an irreconcilable. The term is used chiefly of politicians of an advanced type; those in complete antagonism to the existing form of government; but is especially applied on the continent of Europe to members of legislatures holding extreme Radical views. In this sense the word was first used in the political troubles which arose in Spain in the years 1873-1874. Intransigentism implies an attitude of uncompromising disagreement with political opponents. The word is also used non-politically, in the sense of intractability and intolerance.

INTRINSIC (through Fr. *intrinsique*, from Lat. *intrinsecus*, inwardly; *inter*, within, *secus*, following, from root of *sequi*, to follow), an adjective originally applied to something internal or inside another, but now ordinarily used to express a quality inherent in or inseparable from a person, thing or abstract conception. In anatomy the term is, however, still used of a muscle which has both its origin and insertion in the organ in which it is found.

INTROSPECTION (from Lat. *introspicere*, to look within), in psychology, the process of examining the operations of one’s own mind with a view to discovering the laws which govern psychic processes. The introspective method has been adopted by psychologists from the earliest

times, more especially by Hobbes, Locke, Berkeley, Hume, and English psychologists of the earlier school. It possesses the advantage that the individual has fuller knowledge of his own mind than that of any other person, and is able therefore to observe its action more accurately under systematic tests. On the other hand it has the obvious weakness that in the total content of the psychic state under examination there must be taken into account the consciousness that the test is in progress. This consciousness necessarily arouses the attention, and may divert it to such an extent that the test as such has little value. Such psychological problems as those connected with the emotions and their physical concomitants are especially defective in the introspective method; the fact that one is looking forward to a shock prepared in advance constitutes at once an abnormal psychic state, just as a nervous person's heart will beat faster when awaiting a doctor's diagnosis. The purely introspective method has of course always been supplemented by the comparison of similar psychic states in other persons, and in modern psycho-physiology it is of comparatively minor importance.

See PSYCHOLOGY, ATTENTION, &c.; a clear statement will be found in G. F. Stout's *Manual of Psychology* (1898), i. 14.

INTUITION (from Lat. *intuēri*, to look at), in philosophy, a term applied to immediate or direct apprehension. The truth of a theorem in geometry is demonstrated by a more or less elaborate series of arguments. This is not the case, according to the intuitionalist school of philosophy, with the apprehension of universal principles, which present themselves as necessarily true in their own right, without any sort of proof. The fact that things which are equal to the same things are equal to one another is apprehended directly or immediately without demonstration. Similarly in ethics the intuitional school holds that the principles of right and wrong are immediately apprehended without reference to any other criterion and without any appeal to experience. Ethical intuitionalism sometimes goes even farther, and holds that the conscience when faced with any particular action at once assigns to it a definite moral value. Such a view presupposes that the moral quality of an action has, as it were, concrete reality which the special faculty of conscience immediately recognizes, much in the same way as a barometer records atmospheric pressure. The intuitionalist view is attacked mainly on the ground that it is false to the facts of experience, and it is maintained that many of the so-called immediate a priori judgments are in point of fact the result of forgotten processes of reasoning, and therefore a posteriori. Minor grounds of attack are found in the difficulty of discovering in certain primitive peoples any intuitive conception of right and wrong, and in the great differences which exist between moral systems in different countries and ages.

INULIN $(C_6H_{10}O_5)_x$, in chemistry, a starch-like carbohydrate, known also as alantin, menyanthin, dahlin, synanthrin and sinistrin. It occurs in many plants of the large genus *Compositae*, to which the elicampane (Lat. *inula*) belongs; and forms a white tasteless powder, sparingly soluble in cold water, very soluble in hot water and insoluble in alcohol. It is not coloured blue by iodine; and it reduces ammoniacal silver and gold solutions, but not Fehling's solution. Heated with water or dilute acids, it is converted into laevulose.

INVAR, an alloy of nickel and steel, characterized by an extremely small coefficient of thermal expansion; it is specially useful in the construction of pendulums and of geodetic measuring apparatus, in fact, in all mechanical devices where it is an advantage to avoid temperature compensation. The name was chosen as expressing the invariability of its dimensions with heat. (See CLOCK; GEODESY.)

INVARIABLE PLANE, in celestial mechanics (see Astronomy), that plane on which the sum of the moments of momentum of all the bodies which make up a system is a maximum. It derives its celebrity from the demonstration by Laplace that to whatever mutual actions all the bodies of a system may be subjected, the position of this plane remains invariable.

A conception of it may be reached in the following way. Suppose that from the centre of gravity of the solar system (instead of which we may, if we choose, take the centre of the sun), lines or radii vectores be drawn to every body of the solar system. As the planet revolves around the centre, each radius vector describes a surface of which the area swept over in a unit of time measures the areal velocity of the planet. The constancy of this velocity in the case of the sun and a single planet is formulated in Kepler's second law. Next pass any plane through the centre of motion and project the area just defined upon that plane. We shall thus have a projected areal velocity, the product of which by the mass of the planet is the moment of momentum of the latter. Form this product for every body or mass of matter in the system, and the sum of the moments is then invariable whatever be the direction of the plane of projection. In the case of a single body revolving around the sun this plane is that of its orbit. When all the bodies of the system are taken into account, the invariable plane is a certain mean among the planes of all the orbits.

In the case of the solar system the moment of Jupiter is so preponderant that the position of the invariable plane does not deviate much from that of the orbit of Jupiter. The influence of Saturn comes next in determining it, that of all the other planets is much smaller. The latest computation of the position of this plane is by T. J. J. See, whose result for the position of the invariable plane is inclination to ecliptic 1° 35′ 7″.74, longitude of node on ecliptic 106° 8′ 46″.7 (Eq. 1850).

INVENTORY (post-class. Lat. *inventarium*, a list or repertory, from *invenire* to find), a detailed list, schedule or enumeration in writing, of goods and chattels, credits and debts, and sometimes also of lands and tenements.

(i) In law, perhaps its earliest, and certainly its most important use has been in connexion with the doctrine of "benefit of inventory," derived by many legal systems from the *beneficium inventarii* of Roman law, according to which an heir might enter on his ancestor's inheritance without being liable for the debts attaching to it or to the claims of legatees beyond the value—previously ascertained by "inventory"—of the estate. The benefit of inventory exists in Scots law, in France (*bénéfice d'inventaire*), in Italy, Mauritius (*Civil Code*, Art. 774), Quebec (*Civil Code*, Art. 660), St Lucia (*Civil Code*, Art. 585), Louisiana (*Civil Code*, Arts. 1025 et seq.), and under the Roman Dutch law in Ceylon. In South Africa benefit of inventory is superseded by local legislation.

(ii.) In many systems of law, the duty is imposed on executors and administrators of making an "inventory" of the estate of the testator or intestate, in order to secure the property to the persons entitled to it. In England this duty was created by statute in 1529. In modern practice an inventory is not made unless called for, but the court may order it *ex officio*, and will do so on the application of any really interested party. Similar provisions for an inventory of the estate of deceased persons are made in Scots law (Probate and Legacy Duties Act 1808 (s. 38), and Executors (Scotland) Act 1900 (s. 5), and in most of the British colonies. In Scotland, prior to the Finance Act 1894 (which imposed a tax, called "estate duty," on the principal value of all property, heritable or movable, passing on death), the stamp duty on movable property was termed "inventory duty."

In the United States, the duty of preparing an inventory is generally imposed on executors and administrators; see Kent, *Commentaries on American Law* (new ed., 1896), ii. 414, 415; and cf. Gen. Stats. of Connecticut, 1888, s. 578; New York Stats. s. 2714; New Jersey (Orphans Court, s. 58).

(iii.) An analogous duty of preparing an "inventory" is imposed in many countries on guardians and curators. In Scotland judicial factors are charged with a similar statutory duty (Act of Sederunt, Nov. 25th, 1857, under the Bankruptcy (Scotland) Act 1856) as regards the estate of insolvent debtors.

(iv.) In Scots law, the term "inventory" is also applied to a list of documents made up for any purpose, *e.g.* the *inventory of process* or the *inventory of documents*, in an action, and the *inventory of title-deeds* produced on a judicial sale of lands.

(v.) In England an "inventory" of the personal chattels comprised in the security is required to be annexed to a bill of sale (Bills of Sale Act 1882, s. 5). See also Executors and Administrators.

INVERARAY, a royal and municipal burgh, the county town of Argyllshire, Scotland. Pop. (1901) 1369. It lies on the southern shore of a bay, where the river Aray enters Loch Fyne, 40 m. directly N.W. of Glasgow, and 85 m. by water. The town consists of one street running east and west, and a row of houses facing the bay. Near the church stands an obelisk in memory of the Campbells who were hanged, untried, for their share in the Argyll expedition of 1685 in connexion with the duke of Monmouth's rebellion. The ancient market-cross, 8 ft. high, supposed to have been brought from Iona in 1472, is a beautiful specimen of the Scottish sculptured stones. The chief industry is the herring fishery, the herring of Loch Fyne being celebrated. The town originally stood on the north side of the bay, clustering round the ancient baronial hold, attributed to Sir Colin Campbell of Lochow, "the Singular," who flourished at the end of the 14th century, but it was removed to its present site in the middle of the 18th century. Inveraray was erected into a burgh of barony in 1472; and Charles I., while a prisoner in Carisbrooke Castle, raised it to a royal burgh in 1648. Much has been done for it by the ducal house of Argyll, whose seat, Inveraray Castle, is about 1 m. from the town. This handsome square structure, built between 1744 and 1761 from designs by Robert Adam, consists of two storeys, with a round overtopping tower at each corner. Some fine tapestry and valuable relics were destroyed by fire in 1877, but the damage to the castle was repaired in 1880. The earls and dukes of Argyll were great planters of trees—mainly larch, spruce, silver fir and New England pines—and their estates around Inveraray are consequently among the most luxuriantly wooded in the Highlands. Duniquoich, a finely timbered conical hill about 900 ft. high, adjoins the castle on the north and is a picturesque landmark.

INVERCARGILL, the chief town of Southland county, South Island, New Zealand, 139 m. by rail S.W. by W. from Dunedin. Pop. (1906) 7299. It lies on a deep estuary of the south coast named New River Harbour, which receives several streams famous for trout-fishing. It is the centre of the large grazing and farming district of Southland; and has a number of factories, including breweries, foundries, woollen mills and timber-works. The plan of the town is rectangular, with wide streets; and there is a fine open reserve. The harbour is deep and well sheltered, but the greater part of the trade passes through the neighbouring Bluff Harbour, on which is Campbelltown, 17 m. S. of Invercargill by rail. Bluff Harbour is the port of call and departure for steamers for Melbourne and Hobart. Exports are wool, preserved meat and timber. The district of Southland was surveyed in 1841, but was reported unfavourable, and settlement was delayed till 1857. Southland was a separate province between 1860 and 1870, but, failing financially as such, rejoined the parent province of Otago. Invercargill became a municipality in 1871, and there are five suburban municipalities. The town is the regular starting-point of a journey to the famous lakes Wakatipu and Te Anau, which are approached by rail.

INVERELL, a town of Gough county, New South Wales, Australia, on the Macintyre river, 341 m. N. of Sydney, with which it is connected by rail. Pop. (1901) 3293. It is the centre of a prosperous agricultural district producing, chiefly, wheat and maize; the vine is also largely grown and excellent wine is made. Silver, tin and diamond mines are worked near the town. Inverell became a municipality in 1872.

INVERKEITHING, a royal and police burgh of Fifeshire, Scotland. Pop. (1901) 1676. It is situated on an inner bay of the shore of the Firth of Forth, 3½ m. S.E. of Dunfermline and 13¼ m. N.W. of Edinburgh by the North British railway, via the Forth Bridge. The chief industries are

tanning, shipbuilding, milling, paper-making, rope-making and brick-making. With Stirling, Dunfermline, Culross and Queensferry, Inverkeithing returns one member to parliament (the Stirling district burghs). It received its charter from David I. St Peter's, the parish church, dates from the 12th century, but having been nearly destroyed by fire was rebuilt in 1826 in the Gothic style, the ancient tower, however, being preserved. Sir Samuel Greig, the father of the Russian navy and designer of the fortifications at Cronstadt, was born at Inverkeithing in 1735. About half-way towards Dunfermline the battle of Inverkeithing or Pitreavie took place on the 20th of July 1650, when Cromwell's forces defeated the Royalists. A mile and a half to the south lies North Queensferry (pop. 594), the first railway station on the north side of the Forth Bridge. A little to the west lies the bay of St Margaret's Hope, which in 1903 was acquired by the government as the site for the naval base of Rosyth, so named from the neighbouring ruined castle of Rosyth, once the residence of Queen Margaret, wife of Malcolm Canmore. On the west side of the Forth Bridge, in the fairway, lies the rocky islet of Bimar with a lighthouse, and immediately to the east is the island of Inchgarvie (Gaelic, "the rough island"), which once contained a castle used as a State prison, the ruins of which were removed to make way for one of the piers of the Forth Bridge.

INVERNESS, a royal, municipal and police burgh, seaport and county town of Inverness-shire, Scotland. Pop. (1891), 19,303; (1901) 21,238. It lies on both banks, though principally on the right, of the Ness; and is 118 m. N. of Perth by the Highland railway. Owing to its situation at the north-eastern extremity of Glen More, the beauty of its environment and its fine buildings, it is held to be the capital of the Highlands; and throughout the summer it is the headquarters of an immense tourist traffic. The present castle, designed by William Burn (1789-1870), dates from 1835, and is a picturesque structure effectively placed on a hill by the river's side; it contains the court and county offices. Of the churches, the High or Parish church has a square tower surmounted with a steeple, containing one of the bells which Cromwell removed from Fortrose cathedral. On the left bank of the river stands St Andrew's Episcopal Cathedral, in the Decorated Gothic, erected in 1866 from designs by Dr Alexander Ross. Among the schools are the High School, the collegiate school, the school of science and art, and the Royal Academy, incorporated by royal charter in 1792. Other public buildings are the museum, public library, observatory, the northern infirmary, the district asylum, an imposing structure at the base of Dunain Hill (940 ft.), the Northern Counties Blind Institute, the Highland Orphanage and the Town Hall, opened in 1882. In front of the last stands the Forbes Memorial Fountain, and near it is the old town cross of 1685, at the foot of which, protected since the great fire of 1411, is the lozenge-shaped stone called Clach-na-Cudain (Stone of the Tubs), from its having served as a resting-place for women carrying water from the river. The old gaol spire, slightly twisted by the earthquake of 1816, serves as a belfry for the town clock. Half a mile to the west of the Ness is the hill of Tomnahurich (Gaelic, "The Hill of the Fairies"), upon which is one of the most beautifully-situated cemeteries in Great Britain. The open spaces in the town include Victoria park, Maggot Green and the ground where the Northern Meeting—the most important athletic gathering in Scotland—is held at the end of September. Inverness is the great distributing centre for the Highlands. Its industries, however, are not extensive, and consist mainly of tweed (tartan) manufactures, brewing, distilling, tanning, soap and candle-making; there are also nurseries, iron-foundries, saw-mills, granite works, and the shops of the Highland Railway Company. There is some shipbuilding and a considerable trade with Aberdeen, Leith, London and the east coast generally, and by means of the Caledonian Canal with Glasgow, Liverpool and Ireland. The Caledonian Canal passes within 1 m. of the town on its western side. In Muirtown Basin are wharves for the loading and unloading of vessels, and at Clachnaharry the Canal enters Beauly Firth. There is little anchorage in the Ness, but at Kessock on the left bank of the river-mouth, where there are piers, a breakwater and a coastguard station, there are several acres of deep water. The river at Inverness is crossed by four bridges, two of them for pedestrians only, and a railway viaduct. The town, which is governed by a provost, bailies and council, unites with Forres, Fortrose and Nairn (Inverness Burghs) in sending one member to parliament.

Inverness was one of the chief strongholds of the Picts, and in 565 was visited by Columba with the intention of converting the Pictish king Brude, who is supposed to have resided in the vitrified fort on Craig Phadrick (550 ft.), 1½ m. W. of the town. The castle is said to have been built by Malcolm Canmore, after he had razed to the ground the castle in which Macbeth according to tradition murdered Duncan, and which stood on a hill ½ m. to the north-east. William the Lion (d. 1214) granted the town four charters, by one of which it was created a royal burgh. Of the Dominican abbey founded by Alexander III. in 1233 hardly a trace remains. On his way to the battle of Harlaw in 1411 Donald of the Isles burned the town, and sixteen years later

James I. held a parliament in the castle to which the northern chieftains were summoned, of whom three were executed for asserting an independent sovereignty. In 1562, during the progress undertaken to suppress Huntly's insurrection, Queen Mary was denied admittance into the castle by the governor, who belonged to the earl's faction, and whom she afterwards therefor caused to be hanged. The house in which she lived meanwhile stands in Bridge Street. Beyond the northern limits of the town Cromwell built a fort capable of accommodating 1000 men, but with the exception of a portion of the ramparts it was demolished at the Restoration. In 1715 the Jacobites occupied the royal fortress as barracks, and in 1746 they blew it up.

INVERNESS-SHIRE, a highland county of Scotland, bounded N. by Ross and Cromarty, and the Beauly and Moray Firths, N.E. by the shires of Nairn and Elgin, E. by Banff and Aberdeen shires, S.E. by Perthshire, S. by Argyllshire and W. by the Atlantic. It includes the Outer Hebrides south of the northern boundary of Harris, and several of the Inner Hebrides (see HEBRIDES) and is the largest shire in Scotland. It occupies an area of 2,695,037 acres, or 4211 sq. m., of which more than one-third belongs to the islands. The county comprises the districts of Moidart, Arisaig and Morar in the S.W., Knoydart in the W., Lochaber in the S., Badenoch in the S.E. and the Aird in the N. Excepting comparatively small and fertile tracts in the N. on both sides of the river Ness, in several of the glens and on the shores of some of the sea lochs, the county is wild and mountainous in the extreme and characterized by beautiful and in certain respects sublime scenery. There are more than fifty mountains exceeding 3000 ft. in height, among them Ben Nevis (4406), the highest mountain in the British Isles, the extraordinary assemblage of peaks forming the Monadhliadh mountains in the S.E., Ben Alder (3757) in the S., and the grand group of the Cairngorms on the confines of the shires of Aberdeen and Banff.

In the north-west the Beauly river (16 m. long) is formed by the confluence of the Farrar and the Glass. The Enrick (18 m.), rising in Loch-nan-Eun, takes a north-easterly direction for several miles, and then flowing due east falls into Loch Ness, just beyond Drumnadrochit, close to the ruined keep of Castle Urquhart. The Ness (7 m.), a fine stream for its length, emerges from Loch Dochfour and enters the sea to the north of Inverness. The Moriston (19 m.), flows out of Loch Clunie, and pursuing a course E. by N.E. falls into Loch Ness 4 m. south of Mealfourvounie (2284 ft.) on the western shore opposite Foyers. The Lochy (9 m.), issuing from the loch of that name, runs parallel with the Caledonian Canal and enters Loch Linnhe at Fort William. The Spean (18 m.), flowing westwards from Loch Laggan, joins the Lochy as it leaves Loch Lochy. The Nevis (12 m.), rising at the back of Ben Nevis, flows round the southern base of the mountain and then running north-westwards enters Loch Linnhe at Fort William. The Leven (12 m.), draining a series of small lochs to the north-west of Rannoch, flows westward to Loch Leven, forming during its course the boundary between the shires of Inverness and Argyll. The Dulnain (28 m.), rising in the Monadhliath Mountains, flows north-eastwards and enters the Spey near Grantown, falling in its course nearly 2000 ft. The Truim (15½ m.), rising close to the Perthshire frontier, flows N.N.E. into the Spey. Three great rivers spring in Inverness-shire, but finish their course in other counties. These are the Spey, which for the first 60 m. of its course belongs to the shire; the Findhorn (70 m.), rising in the Monadhliath Mountains a few miles N.W. of the source of the Dulnain; and the Nairn (38 m.), rising within a few miles of Loch Farraline. The two falls of Foyers—the upper of 40 ft., the lower of 165 ft.—are celebrated for their beauty, but their volume is affected, especially in drought, by the withdrawal of water for the works of the British Aluminium Company, which are driven by electric power derived from the river Foyers, the intake being situated above the falls. Other noted falls are Moral on the Enrick and Kilmorack on the Beauly.

The number of hill tarns and little lakes is very great, considerably more than 200 being named. Loch Ness, the most beautiful and best known of the larger lakes, is 22½ m. long, 1¾ m. broad at its widest point (Urquhart Bay), has a drainage area of 696 m., and, owing to its vast depth (751 ft.), uniformity of temperature, and continual movement of its waters, never freezes. It is the largest body of fresh water in Great Britain, and forms part of the scheme of the Caledonian Canal. A few miles S.W. is Loch Oich (4 m. long), also utilized for the purposes of the Canal, which reaches its summit level (105 ft.) in this lake. To the S.W. of it is Loch Lochy (9½ m.), which is also a portion of the Canal. Loch Arkaig (12 m.) lies in the country of the Camerons, Achnacarry House, the seat of Lochiel, the chief of the clan, being situated on the river Arkaig near the point where it issues from the lake. The old castle was burnt down by the duke of Cumberland, but a few ruins remain. After Culloden Prince Charles Edward found shelter in a cave in the "Black Mile," as the road between Lochs Arkaig and Lochy is called. Loch Quoich (6 m.) lies N. by W. of Loch Arkaig, and Loch Garry (4½ m.) a few miles to the N.E.; Loch Morar (11½ m. long by 1½ broad) is only about 600 yds. from the sea, to which it drains by the river

Morar, which falls over a rocky barrier, at the foot of which is a famous salmon pool. The loch is 1017 ft. deep and is thus the deepest lake in the United Kingdom. It contains several islands, on one of which Lord Lovat was captured in 1746. Loch Laggan (7 m.) and Loch Treig (5½ m.) in the south of the county are both finely situated in the midst of natural forests. The principal salt-water lochs on the Atlantic seaboard are Loch Hourn ("Hell's Lake," so named from the wild precipices rising sheer from the water), running inland for 14 m. from the Sound of Sleat and separating Glenelg from Knoydart; and Loch Nevis (14 m.), a few miles farther south.

The parallel roads of Glen Roy, a glen with a north-easterly to south-westerly trend, a few miles east of Loch Lochy, presented a problem that long exercised the minds of geologists. At heights of 1148 ft., 1067 ft. and 835 ft., there run uninterruptedly along each side of the glen terraces of a width varying from 3 to 30 ft. Local tradition ascribes them to the Ossianic heroes, and John Playfair (1748-1819) argued that they were aqueducts. The fact that they occur also in the neighbouring Glen Gloy and Glen Spean, however, disposes of an artificial origin. John MacCulloch (1773-1835) propounded the theory that they were lacustrine and not marine, and Agassiz followed him with the suggestion that the water had been held up by a barrier of glacier ice. This view is now generally accepted, and the roads may therefore be regarded as the gently sloping banks of lakes dammed up by glacier ice. Glen More-nan-Albin, or the Great Glen, is a vast "fault," or dislocation, 62 m. in length, through which Thomas Telford constructed (1804-1822) the Caledonian Canal connecting Loch Linnhe and the Moray Firth. Glen More is said to be liable to shocks of earthquake, and Loch Ness was violently agitated at the time of the great Lisbon earthquake (1755).

Among the glens renowned for beauty are Glen Urquhart and Glen Moriston to the west of Loch Ness, Glen Feshie in the east, and Glen Nevis at the southern base of Ben Nevis. Glen Garry, to the west of Loch Oich, gave its name to the well-known cap or "bonnet" worn both in the Highlands and Lowlands. In Glen Finnan, at the head of Loch Shiel, Prince Charles Edward raised his standard in 1745, an incident commemorated by a monument erected in 1815 by Alexander Macdonald of Glenaladale. The great straths or valleys are in the north and east, the chief among them being Strathfarrar, Strathglass and Strathnairn, and the heads of Strathearn and Strathspey.

Geology.—Almost the entire area of this county is occupied by the younger Highland schists and metamorphic rocks. East of Loch Ericht and the rivers Traim and Spey as far as Airemore and between there and Duthel there are quartzites and quartzose schists; on the remaining area the various kinds of schistose and gneissose rock have hardly been worked out in detail. Granite masses occur in numerous isolated patches; the largest is on the eastern boundary and includes the flanks of Cairn Gorm, Cairn Tout, Braeriach, Carn Ban and Meall Tisnail. Other smaller ones are found at Ben Nevis, where the lower part of the mountain is granite, the upper part porphyritic felsite; between Moy and Ben Buidhe Mhor; E. of Foyers, including Whitebridge, Aberchalder and Loch Farraline; at Ben Alder, W. of Loch Ericht and another between that loch and the river Pattack; at Banavie on the W. of the river Lochy; around the upper end of Loch Clunie and at several other places. The dioritic mass of Rannoch Moor just enters this county between Loch Ericht and Loch Ossian.

The Old Red Sandstone extends into this county from Nairn through Culloden Moor past Inverness and down Loch Ness to a point south of Foyers; it occurs also on the south-east side of Loch Oich, and around Beauly, where it forms the falls of Kilmorach. These rocks consist at the base of coarse breccias and conglomerates passing upwards into chocolate-coloured sandstone and flags, with the shaly series containing limestone nodules known as the fish bed from the abundance and importance of its fossil contents; it is well exposed in the Big Burn and near Loch Ashie. At a higher horizon come more purple flags and grits. The Great Glen which traverses the county is an old line of earth fracture along which displacements have been produced during more than one geological period. Roches moutonnées, glacial striations and moraines and other evidences of the great Ice age are abundant, besides the parallel roads of Glen Roy to which allusion has already been made. The lowest of these terraces is prolonged into Glen Spean. At numerous places on the coasts the remains of old marine terraces occur at 100 ft. and 25 ft. above the sea.

Of the small isles belonging to Inverness-shire those of Rum and Eigg are of the greatest interest. The northern part of Rum is made of Torridonian rocks, shales below and red sandstones above; altogether over 10,000 ft. are visible. These rocks have suffered thrusting and the shales are thus made in places to overlie the sandstones. A few patches of Torridonian occur in the south. Tertiary peridotites in laccolitic masses cover a large area in the south of the island and form the highest ground. These are penetrated by eucrites and gabbros, followed later by granites; and the whole has been subsequently crushed into a complex gneissose mass. Still later, dolerite sills and sheets and dikes of granophyre and quartz felsite followed in the same region. Eigg is mainly built of great basaltic lava flows with intrusions of doleritic rocks; these were succeeded by more acid intrusions, and again by a more basic series of dikes. Pitchstones occur among the later rocks. The Sgurr is capped by a thick intrusion of pitchstone. Jurassic rocks, including the Estuarine Lower Oolite sandstones, shales and limestones and Middle Oolite

Oxfordian rocks are found in the north of this island; there is also a small trace of Upper Cretaceous sandstone. Canna, Sanday and Muck are almost wholly basaltic; a small patch of Jurassic occurs on the south of the last-named island. (See also Skye.)

Forests and Fauna.—Deer forests occupy an enormous area, particularly in the west, in the centre, in the south and south-east and in Skye. From the number of trees found in peat bogs, the county must once have been thickly covered with wood. Strathspey is still celebrated for its forests, and the natural woods on Loch Arkaig, in Glen Garry, Glen Moriston, Strathglass and Strathfarrar, and at the head of Loch Sheil, are extensive. The forests consist chiefly of oak, Scotch fir, birch, ash, mountain-ash (rowan), holly, elm, hazel and Scots poplar, but there are also great plantations of larch, spruce, silver fir, beech and plane. Part of the ancient Caledonian forest extends for several miles near the Perthshire boundary. Red and roe deer, the Alpine and common hare, black game and ptarmigan, grouse and pheasant abound on the moors and woodlands. Foxes and wild cats occur, and otters are met with in the lakes and streams. There are also eagles, hawks and owls, while great flocks of waterfowl, particularly swans, resort to Loch Inch and other lakes in Badenoch. Many of the rivers and several of the lochs abound with salmon and trout, the salmon fisheries of the Beauly, Ness and Lochy yielding a substantial return.

Climate and Agriculture.—Rain is heavy and frequent in the mountains, but slighter towards the northern coast; the fall for the year varying from 73.17 in. at Fort William to 43.17 in. at Fort Augustus, and 26.53 in. at Inverness. The mean temperature for the year is 47.2° F., for January 38.5° and for August 58°. Although since 1852 the cultivated area has increased greatly, actually the percentage of land under crops is still small. The Aird and Beauly districts, some of the straths and several of the glens are fertile. Oats are the predominant crop, barley is grown (mostly for the distilleries), but the wheat acreage is trifling. Of green crops turnips do well in certain districts, artificial manures being extensively used. In those quarters where the soil is dry, potatoes are successfully raised. An immense number of the holdings are crofts averaging 5 acres or under. About 50% are between 5 acres and 50; but few are above 50. The operations of the Crofters' Commission (1886) have been beneficial in a variety of ways. Not only have rentals been reduced considerably and arrears cancelled, but the increased sense of security resulting from the granting of fair rentals, fixity of tenure and compensation for disturbance has induced tenants to reclaim waste land, to enlarge their holdings and to apply themselves more thriftily and with greater enterprise and intelligence to the development of their farms. On the large holdings the most modern methods of husbandry are followed, the farm buildings are excellent and the implements up-to-date. The hills furnish good pastures. The flocks of sheep are exceptionally heavy, the chief varieties on the uplands being Cheviots and black-faced and in some of the lower districts Leicesters and half-breeds. Of the cattle the principal breed is the Highland, the largest and best herds of which are in the Western Isles. Polled and shorthorns are also reared, and Ayrshires are kept for dairy purposes. Great numbers of the hardy Highland ponies are raised on the hill farms, and the breed of agricultural horses was improved by the introduction of Clydesdale stallions. Where pigs are reared they appear to be kept, especially amongst the crofters, for domestic consumption.

Industries.—Manufactures are few. Indeed, excepting the industries carried on in Inverness, they are almost entirely confined to distilling—at Fort William, Kingussie, Carbost, Muir of Ord and some other places—brewing, woollens (especially tartans, plaids and rough tweeds), milling and (at Kirktown near Inverness) artificial manures. The catering for the wants of thousands of sportsmen and tourists, however, provides employment for a large number of persons, and has led to the opening of hotels even in the remotest regions. The fisheries, on the other hand, are of great value, especially to the Hebrideans. The kelp industry has died out.

Communications.—Owing to its physical character communication by rail is somewhat restricted, but the Highland railway enters the shire from the south near Dalwhinnie and runs to Inverness via Aviemore and Daviot. Another portion of the same system also reaches the county town from Nairnshire. The Dingwall and Skye railway passes along the southern shore of Beauly Firth. In the south-west the West Highland railway (North British) enters the county 2 m. N.W. of Rannoch station and terminates at Mallaig, via Fort William and Banavie, sending off at Spean Bridge a branch to Fort Augustus. There is also communication by steamer with the piers of the Caledonian Canal and with the Western Isles, and a considerable amount of shipping reaches Beauly and Inverness by way of Moray Firth. Coaches supplement rail and steamer at various points.

Population and Government.—The population was 90,121 in 1891, and 90,104 in 1901, when 43,281 persons spoke Gaelic and English, and 11,722 Gaelic only. The only considerable towns are Inverness (pop. in 1901, 23,066) and Fort William (2087). The county returns one member to parliament, but the county town, along with Forres, Fortrose and Nairn, belongs to the Inverness district group of parliamentary burghs. Inverness forms a sheriffdom with Elgin and Nairn, and there are resident sheriffs-substitute at Inverness, Fort William, Portree and Lochmaddy. The county is under school-board jurisdiction, and there are voluntary schools

(mostly Roman Catholic) in several places. The secondary schools in Inverness and some in the county earn grants for higher education. The town council of Inverness subsidizes the burgh technical and art school. At Fort Augustus is a well-known collegiate institution for the education of the sons of well-to-do Roman Catholics.

History.—To the north of the boundary hills of the present counties of Argyll and Perth (beyond which the Romans attempted no occupation) the country was occupied by the Picts, the true Caledonians. The territory was afterwards called the province of Moray, and extended from the Spey and Loch Lochy to Caithness. These limits it retained until the 17th century, when Caithness (in 1617), Sutherland (in 1633) and Ross-shire (in 1661) were successively detached. Towards the end of the 6th century Columba undertook the conversion of the Picts, himself baptizing their king, Brude, at Inverness; but paganism died hard and tribal wars prevented progress. In the 11th century, after the death of Duncan, Scotland was divided between Macbeth and the Norwegian leader Thorfinn, who took for his share the land peopled by the northern Picts. Malcolm Canmore, avenging his father, defeated and slew Macbeth (1057), and at a later date reduced the country and annexed it to the kingdom of Scotland. In 1107, when the bishopric of Moray was founded, the influence of the Church was beginning to effect some improvement in manners. Nevertheless, a condition of insurrection supervened until the reign of David I., when colonists of noble birth were settled in various parts of the shire. After the battle of Largs (1263) the Norse yoke was thrown off. In 1303 Edward I.’s expedition to Scotland passed through the northern districts, his army laying siege to Urquhart and Beaufort castles. After the plantation the clan system gradually developed and attained in the shire its fullest power and splendour. The Frasers occupied the Aird and the district around Beauly; the Chisholms the Urquhart country; the Grants the Spey; the Camerons the land to the west and south of Loch Lochy (Locheil); the Chattan—comprising several septs such as the Macphersons, Mackintoshes, Farquharsons and Davidsons—Badenoch; the Macdonalds of the Isles Lochaber; the Clanranald Macdonalds Moidart, Knoydart, Morar, Arisaig and Glengarry; and the Macleods Skye. Unfortunately the proud and fiery chieftains were seldom quiet. The clans were constantly fighting each other, occasionally varying their warfare by rebellion against the sovereign. In many quarters the Protestant movement made no headway, the clansmen remaining steadfast to the older creed. At the era of the Covenant, Montrose conducted a vigorous campaign in the interests of the Royalists, gaining a brilliant victory at Inverlochy (1645), but the effects of his crusade were speedily neutralized by the equally masterly strategy of Cromwell. Next Episcopacy appeared to be securing a foothold, until Viscount Dundee fell at Killiecrankie, that battle being followed by a defeat of the Highlanders at Cromdale in 1690. The futile rising headed by Mar in 1715 led to a combined effort to hold the clans in check. Forts were constructed at Inverness, Kilchumin (Fort Augustus) and Kilmallie (Fort William); Wade’s famous roads—exhibiting at many points notable examples of engineering—enabled the king’s soldiers rapidly to scour the country, and general disarming was required. Prince Charles Edward’s attempt in 1745 had the effect of bringing most of the clans together for a while; but the clan system was broken up after his failure and escape. Heritable jurisdictions were abolished. Even the wearing of the Highland dress was proscribed. The effects of this policy were soon evident. Many of the chieftains became embarrassed, their estates were sold, and the glensfolk, impoverished but high-spirited, sought homes in Canada and the United States. As time passed and passion abated, the proposal was made to raise several Highland regiments for the British army. It was entertained with surprising favour, and among the regiments then enrolled were the 79th Cameron Highlanders. With the closing of the chapter of the Jacobite romance the shire gradually settled down to peaceful pursuits.

The county in parts is rich in antiquarian remains. Stone axes and other weapons or tools have been dug up in the peat, and prehistoric jewelry has also been found. Lake dwellings occur in Loch Lundy in Glengarry and on Loch Beauly, and stone circles are numerous, as at Inches, Clava, and in the valley of the Ness. Pictish towers or brochs are met with in Glenbeg (Glenelg), and duns (forts) in the Aird and to the west and south-west of Beauly and elsewhere. Among vitrified forts the principal are those on Craig Phadrick, Dundbhairdghall in Glen Nevis, Dun Fionn or Fingal’s fort on the Beauly, near Kilmorack, Achterawe in Glengarry and in Arisaig.

See J. Cameron Lees, *History of the County of Inverness* (Edinburgh, 1897); C. Fraser-Mackintosh, *Letters of Two Centuries* (Inverness, 1890); Alexander Mackenzie, *Histories of the Mackenzies*, Camerons, &c. (Inverness, 1874-1896); A. Stewart, *Nether Lochaber* (Edinburgh, 1883); Alexander Carmichael, “Grazing and Agrestic Customs of the Outer Hebrides” (*Crofters’ Commission Report*, 1884).

INVERSION (Lat. *invertere*, to turn about), in chemistry, the name given to the hydrolysis of

cane sugar into a mixture of glucose and fructose (invert sugar); it was chosen because the operation was attended by a change from dextro-rotation of polarized light to a laevo-rotation. In mathematics, inversion is a geometrical method, discovered jointly by Stubbs and Ingram of Dublin, and employed subsequently with conspicuous success by Lord Kelvin in his electrical researches. The notion may be explained thus: If R be a circle of centre O and radius *r*, and P, Q be two points on a radius such that OP·OQ = r^2, then P, Q are said to be inverse points for a circle of radius *r*, and O is the centre of inversion. If one point, say P, traces a curve, the corresponding locus of Q is said to be the inverse of the path of P. The fundamental propositions are: (1) the inverse of a circle is a line or a circle according as the centre of inversion is on or off the circumference; (2) the angle at the intersection of two circles or of a line and a circle is unaltered by inversion. The method obviously affords a ready means for converting theorems involving lines and circles into other propositions involving the same, but differently placed, figures; in mathematical physics it is of special value in solving geometrically electrostatical and optical problems.

INVERURIE, a royal, municipal and police burgh of Aberdeenshire, Scotland, situated at the confluence of the rivers Don and Ury, 16¼ m. N.W. of Aberdeen by rail, on the Great North of Scotland railway. Pop. (1901) 3624. Paper-making, milling, and the making of mineral waters are the chief manufactures, but the town is an important centre of the cattle trade with London, markets being held at frequent intervals. It also contains the workshops of the Great North of Scotland railway. Inverurie belongs to the Elgin district group of parliamentary burghs. At Harlaw, about 3 m. to the N.W., was fought in 1411 the great battle between Donald, lord of the Isles, and the royal forces under the earl of Mar. Not far from the scene of this conflict stands Balquhain Castle, a seat of the Leslies, now a mere shell, which was occupied by Queen Mary in September 1562 before the fight at Corrichie between her forces, led by the earl of Moray, and those of the earl of Huntly. The granite block from which she is said to have viewed the combat is still called the Queen’s Chair or the Maiden Stone. Near Bennachie (1619 ft.) are stone circles and monoliths supposed to be of Druidical origin. There is a branch line from Inverurie to Old Meldrum, 5¾ m. to the N.E. by rail, a market town with a charter dating from 1672, where brewing and distilling are carried on.

INVESTITURE (Late Lat. *investitura*), the formal installation into an office or estate, which constituted in the middle ages one of the acts that betokened the feudal relation between suzerain and vassal. The suzerain, after receiving the vassal’s homage and oath of fealty, invested him with his land or office by presenting some symbol, such as a clod, a banner, a branch, or some other object according to the custom of the fief. Otto of Freising says: “It is customary when a kingdom is delivered over to any one that a sword be given to represent it, and when a province is transferred a standard is given.” As feudal customs grew more stereotyped, the sword and sceptre, emblematic respectively of service and military command and of judicial prerogatives, became the usual emblems of investiture of laymen. The word investiture (from *vestire*, to put in possession) is later than the 9th century; the thing itself was an outcome of feudal society.

It is in connexion with the Church that investiture has its greatest historical interest. The Church quite naturally shared in feudal land-holding; in addition to the tithes she possessed immense estates which had been given her by the faithful from early times, and for the defence of which she resorted to secular means. The bishops and abbots, by confiding their domains to laymen on condition of assistance with the sword in case of need, became temporal lords and suzerains with vassals to fight for them, with courts of justice, and in short with all the rights and privileges exercised by lay lords. On the other hand there were bishop-dukes, bishop-counts, &c., themselves vassals of other lords, and especially of the king, from whom they received the investiture of their temporalities. Many of the faithful founded abbeys and churches on condition that the right of patronage, that is the choice of beneficiaries, should be reserved to them and their heirs. Thus in various ways ecclesiastical benefices were gradually transformed into fiefs, and lay suzerains claimed the same rights over ecclesiastics as over other vassals from whom they received homage, and whom they invested with lands. This ecclesiastical investiture by lay princes dates at least from the time of Charlemagne. It did not seem fitting at first to confer ecclesiastical investiture by such military and worldly emblems as the sword and sceptre, nor to

exact an oath of fealty. The emperor Henry I. invested bishops with a glove; Otto II. presented the pastoral staff; Conrad II., according to Wipo, went farther and required from the archbishop of Milan an oath of fealty. By the time of Henry III. investiture with ring and crozier had become the general practice: it probably had been customary in some places since Otto II.

Investiture of ecclesiastics by laymen had certain serious effects which were bound to bring on a conflict between the temporal and spiritual authorities. In the first place the lay authorities often rendered elections uncanonical by interfering in behalf of some favourite, thereby impairing the freedom of the electors. Again, benefices were kept vacant for long periods in order to ensure to the lord as long as possible the exercise of his regalian rights. And, finally, control by temporal princes of investiture, and indirectly of election, greatly increased simony. Otto II. is charged with having practised simony in this connexion, and under Conrad II. the abuse grew prevalent. At a synod at Reims in 1049, the bishops of Nevers and Coutances affirmed that they had bought their bishoprics, and the bishop of Nantes stated that his father had been a bishop and that on his decease he himself had purchased the see. At a synod at Toulouse in 1056, Berengar of Narbonne accused the bishop of having purchased his see for 100,000 *solidi*, and of having plundered his church and sold relics and crucifixes to Spanish Jews in order to secure another 100,000 *solidi* with which to buy for his brother the bishopric of Urgel. Innumerable similar cases appear in acts of synods and in chronicles during the 11th century. Ecclesiastical investiture was further complicated by the considerable practice of concubinage. There was always the tendency for clerics in such cases to invest their sons with the temporalities of the Church; and the synod convened by Benedict VIII. at Pavia in 1018 (or 1022 according to some authorities) was mainly concerned with the issue of decrees against clerics who lived with wives or concubines and bestowed Church goods on their children. In time the Church came to perceive how closely lay investiture was bound up with simony. The sixth decree of the Lateran synod of 1059 forbade any cleric to accept Church office from a layman. In the following year this decree was reaffirmed by synods held at Vienne and Toulouse under the presidency of a legate of Nicholas II. The main investiture struggle with the empire did not take place, however, until Hildebrand became Pope Gregory VII. To Gregory it was intolerable that a layman, whether emperor, king or baron, should invest a churchman with the emblems of spiritual office; ecclesiastical investiture should come only from ecclesiastics. To the emperor Henry IV. it was highly undesirable that the advantages and revenues accruing from lay investiture should be surrendered; it was reasonable that ecclesiastics should receive investiture of temporalities from their temporal protectors and suzerains.

Although the full text of the decrees of the famous Lenten synod of 1075 has not been preserved, it is known that Gregory on that occasion denounced the marriage of the clergy, excommunicated five of Henry IV.’s councillors on the ground that they had gained church offices through simony, and forbade the emperor and all laymen to grant investiture of bishopric or inferior dignity. The pope immediately summoned Henry to appear at Rome in order to justify his private misconduct, and Henry replied by causing the partisan synod of Worms (1076) to pronounce Gregory’s deposition. The pope excommunicated the emperor and stirred up civil war against him in Saxony with such success that he brought about Henry’s bitter humiliation at Canossa in the following year. The papal prohibition of lay investiture was renewed at synods in 1078 and 1080, and although Gregory’s death in exile (1085) prevented him from realizing his aim in the matter, his policy was steadfastly maintained by his successors. Victor III. condemned lay investiture at the synod of Benevento in 1087, and Urban II. at that of Melfi in 1089. At the celebrated council of Clermont (1095), at which the first crusade was preached, Urban strengthened the former prohibitions by declaring that no one might accept any spiritual office from a layman, or take an oath of fealty to any layman. Urban’s immediate successor, Paschal II., stirred up the rebellion of the emperor’s son, but soon found Henry V. even more persistent in the claim of investiture than Henry IV. had been. Several attempts at settlement failed. In February 1111 legates of Paschal II. met Henry V. at Sutri and declared that the pope was ready to surrender all the temporalities that had been bestowed on the clergy since the days of Charlemagne in return for freedom of election and the abolition of lay investiture. Henry, having agreed to the proposal, entered Rome to receive his crown. The bishops and clergy who were present at the coronation protested against this surrender, and a tumult arising, the ceremony had to be abandoned. The king then seized pope and curia and left the city. After two months of close confinement Paschal consented to an unqualified renunciation on his part of the right of investiture. In the following year, however, a Lateran council repudiated this compact as due to violence, and a synod held at Vienne with papal approval declared lay investiture to be heresy and placed Henry under the ban. The struggle was complicated throughout its course by political and other considerations; there were repeated rebellions of German nobles, constant strife between rival imperial and papal factions in the Lombard cities and at Rome, and creation of several anti-popes, of whom Guibert of Ravenna (Clement III.) and Gregory VIII. were the most important. Final settlement of the struggle was retarded, moreover, by the question of the succession to the lands of the great Countess Matilda, who had bequeathed all her property to the Holy See, Henry claiming the estates as suzerain of the fiefs and as heir of the allodial lands.

The efforts of Gelasius II. to settle the strife by a general council were rendered fruitless by his death (1119).

At length in 1122 the struggle was brought to an end by the concordat of Worms, the provisions of which were incorporated in the eighth and ninth canons of the general Lateran council of 1123. The settlement was a compromise. The emperor, on the one hand, preserved feudal suzerainty over ecclesiastical benefices; but, on the other, he ceased to confer ring and crozier, and thereby not only lost the right of refusing the elect on the grounds of unworthiness, but also was deprived of an efficacious means of maintaining vacancies in ecclesiastical offices. Few efforts were made to undo the compromise. King Lothair the Saxon demanded of Innocent II. the renewal of lay investiture as reward for driving the antipope Anacletus from Rome, but the opposition of St Bernard and the German prelates was so potent that the king dropped his demand, and Innocent in 1133 confirmed the concordat. In fact, the imperial control over the election of bishops in Germany came later to be much curtailed in practice, partly by the tacitly changed relations between the empire and its feudatories, partly by explicit concessions wrung at various times from individual emperors, such as Otto IV. in 1209 and Frederick II. in 1213; but the principles of the concordat of Worms continued theoretically to regulate the tenure of bishoprics and abbacies until the dissolution of the empire on 1806.

In France the course of the struggle was somewhat different. As in the empire, the king and the nobles, each within his own sphere of influence, claimed the right of investing with ring and crozier and of exacting homage and oaths of fealty. The struggle, however, was less bitter chiefly because France was not a united country, and it was eventually terminated without formal treaty. The king voluntarily abandoned lay investiture and the claim to homage during the pontificate of Paschal II., but continued to interfere with elections, to appropriate the revenues of vacant benefices, and to exact an oath of fealty before admitting the elect to the enjoyment of his temporalities. Most of the great feudal lords followed the king’s example, but their concessions varied considerably, and in the south of France some of the bishops were still doing homage for their sees until the closing years of the 13th century; but long before then the right of investing with ring and crozier had disappeared from every part of France.

England was the scene of an investiture contest in which the chief actors were Henry I. and Anselm. The archbishop, in obedience to the decrees of Gregory VII. and Urban II., not only refused to perform homage to the king (1100), but also refused to consecrate newly-chosen bishops who had received investiture from Henry. The dispute was bitter, but was carried on without any of the violence which characterized the conflict between papacy and empire; and it ended in a compromise which closely foreshadowed the provisions of the concordat of Worms and received the confirmation of Paschal II. in 1106. Freedom of election, somewhat similar in form to that which still exists, was formally conceded under Stephen, and confirmed by John in Magna Carta.

Many documents relating to the investiture struggle have been edited by E. Dümmler in *Monumenta Germaniae historica, Libelli de lite imperatorum et pontificum saeculis xi. et xii.* (3 vols., 1891-1897), See Ducange, *Glossarium*, *s.v.* “Investitura.”

On investiture in the empire consult C. Mirbt, *Die Publizistik im Zeitalter Gregors VII.* (Leipzig, 1894); E. Bernheim, *Das Wormser Konkordat* (Breslau, 1906); R. Boerger, *Die Belehnungen der deutschen geistlichen Fürsten* (Leipzig, 1901); K. E. Benz, *Die Stellung der Bischöfe von Meissen, Merseburg und Naumburg im Investiturstreite unter Heinrich IV. und Heinrich V.* (Dresden, 1899); W. Martens, *Gregor VII., sein Leben und Wirken* (2 vols., Leipzig, 1894); P. Fisher, *The Medieval Empire*, c. 10 (London, 1898). For France, see P. Imbart de la Tour, *Les Élections épiscopales dans l’église de France du XI^e^ au XII^e^ siècle* (Paris, 1891); A. Luchaire, *Histoire des institutions monarchiques de la France sous les premiers Capétiens 987-1180* (2nd ed., Paris, 1891); P. Viollet, *Histoire des institutions politiques et administratives de la France* (Paris, 1898); Ibach, *Der Kampf zwischen Papsttum und Königtum von Gregor VII. bis Calixto II.* (Frankfort, 1884). For England, see J. F. Böhmer, *Kirche und Staat in England und in der Normandie in XI. und XII. Jahrhundert* (Leipzig, 1899); E. A. Freeman, *The Reign of William II. Rufus and the Accession of Henry I.* (London, 1882); H. W. C. Davis, *England under the Normans and Angevins* (London, 1905).

INVOICE (originally a plural, *Invoyes* or *Invoys*, of *Invoy*, a variant of “envoy,” from the French *envoyer*, to send), a statement giving full particulars of goods sent or shipped by a trader to a customer, with the quantity, quality and prices, and the charges upon them. Consular invoices, *i.e.* invoices signed at the port of shipment by a consul of the country to which the goods are being consigned, are generally demanded by those countries which impose *ad valorem*

duties.

INVOLUTION (Lat. *involvere*, to roll up), a rolling up or complication. In arithmetic, involution is the operation of raising a quantity to any power; it is the converse of evolution, which is the operation of extracting any root of a quantity (see Arithmetic; Algebra). In geometry, an involution is a one-to-one correspondence between two ranges of points or between two pencils (see Geometry: *Projective*). The "involute" of a curve may be regarded as the locus of the extremity of a string when it is unwrapped from the curve (see Infinitesimal Calculus).

IO, in Greek mythology, daughter of Inachus, the river-god of Argos and its first king. As associated with the oldest worship of Hera she is called the daughter of Peiren, who made the first image of that goddess out of a pear-tree at Tiryns; and under the name of Callithyia Io was regarded as the first priestess of Hera. Zeus fell in love with her, and, to protect her from the wrath of Hera, changed her into a white heifer (Apollodorus ii. 1; Hyginus, *Fab.* 145; Ovid, *Metam.* i. 568-733); according to Aeschylus (*Supplices*, 299) the metamorphosis was the work of Hera herself. Hera, having persuaded Zeus to give her the heifer, set Argus Panoptes to watch her. Zeus thereupon sent Hermes, who lulled Argus to sleep and cut off his head with the sword with which Perseus afterwards slew the Gorgon. In another account Argus is killed by a stone thrown by Hermes. But the wrath of Hera still pursued Io. Maddened by a gadfly sent by the goddess she wandered all over the earth, swam the strait known on this account as the Bosporus (Ox-ford), and crossed the Ionian sea (traditionally called after her) until at last she reached Egypt, where she was restored to her original form and became the mother of Epaphus. Accounts of her wanderings (differing considerably in detail) are given in the *Supplices* and *Prometheus Vinctus* of Aeschylus. Various interpretations are given of the latter part of her story, which dates from the 7th century B.C., when intercourse was frequent between Greece and Egypt, and when much influence was exerted on Greek thought by Egyptian religion. According 724
to the rationalistic explanation of Herodotus (i. 1) Io was an Argive princess who was carried off to Egypt by the Phoenicians. Epaphus, the son of Io, the supposed founder of Memphis, was identified with Apis. He was said to have been carried off by order of Hera to Byblus in Syria, where he was found again by Io. On returning to Egypt, Io, afterwards identified with Isis, married Telegonus and founded the royal families of Egypt, Phoenicia, Argos and Thebes. The journey to Syria in search of Epaphus was invented to explain the fact that the Phoenician goddess Astarte, who was sometimes represented as horned, was confounded with Io.

Io herself is variously interpreted. She is usually understood to be the moon in the midst of the mighty heaven, studded with stars, represented by Argus. According to others, she is the annual rising of the Nile; the personification of the Ionian race; the mist; the earth. It seems probable that she was a duplicate of Hera (Io βούκερως is Hera βοῶπις), or a deity in primitive times worshipped under the symbol of a cow, whose worship was superseded by that of Hera; the recollection of this early identity would account for Io being regarded as the priestess of the goddess in later times. Amongst the Romans she was sometimes identified with Anna Perenna. The legend of Io spread beyond Argos, especially in Byzantium and Euboea, where it was associated with the town of Argura. It was a favourite subject among Greek painters, and many representations of it are preserved on vases and wall paintings; Io herself appears as a horned maiden or as the heifer watched by Argus.

See R. Engelmann, *De Ione* (1868), with notes containing references to authorities, and his article in Roscher's *Lexikon der Mythologie*; J. Overbeck, *De Ione, telluris, non lunae, Dea* (1872); P. W. Forchhammer, *Die Wanderungen der Inachostochter Io* (1881), with map and special reference to Aeschylus's account of Io's wanderings; F. Durrbach in Daremberg and Saglio's *Dictionnaire des antiquités*; G. Mellén, *De Ius fabula* (1901); Wernicke *s.v.* "Argos" in Pauly-Wissowa's *Realencyclopädie*, ii. pt. i. (1896); J. E. Harrison in *Classical Review* (1893, p. 76); Bacchylides xviii. (xix.), with Jebb's notes.

IODINE (symbol I, atomic weight 126.92), a chemical element, belonging to the halogen group. Its name is derived from Gr. ἰοειδής (violet-coloured), in allusion to the colour of its vapour. It was discovered in 1812 by B. Courtois when investigating the products obtained from the mother-liquors prepared by lixiviating kelp or burnt seaweed, and in 1815 L. J. Gay-Lussac showed that it was an element. Iodine does not occur in nature in the uncombined condition, but is found very widely but sparingly distributed in the form of iodides and iodates, chiefly of sodium and potassium. It is also found in small quantities in sea-water, in some seaweeds, and in various mineral and medicinal springs. Deep-sea weeds as a rule contain more iodine than those which are found in the shallow waters.

Iodine is obtained either from kelp (the ashes of burnt seaweed) or from the mother-liquors obtained in the purification of Chile saltpetre. In the former case the seaweed is burnt in large heaps, care being taken that too high a temperature is not reached, for if the ash be allowed to fuse much iodine is lost by volatilization. The product obtained after burning is known either as *kelp* or *varec*. Another method of obtaining kelp is to heat the seaweed in large retorts, whereby tarry and ammoniacal liquors pass over and a very porous residue of kelp remains. A later method consists in boiling the weed with sodium carbonate; the liquid is filtered and hydrochloric acid added to the filtrate, when *alginic acid* is precipitated; this is also filtered off, the filtrate neutralized by caustic soda, and the whole evaporated to dryness and carbonized, the residue obtained being known as *kelp substitute*. The kelp obtained by any of these methods is then lixiviated with water, which extracts the soluble salts, and the liquid is concentrated, when the less soluble salts, which are chiefly alkaline chlorides, sulphates and carbonates, crystallize out and are removed. Sulphuric acid is now added to the liquid, and any alkaline sulphides and sulphites present are decomposed, while iodides and bromides are converted into sulphates, and hydriodic and hydrobromic acids are liberated and remain dissolved in the solution. The liquid is run into the iodine still and gently warmed, manganese dioxide in small quantities being added from time to time, when the iodine distils over and is collected. In the second method it is found that the mother-liquors obtained from Chile saltpetre contain small quantities of sodium iodate $NaIO_3$; this liquor is mixed with the calculated quantity of sodium bisulphite in large vats, and iodine is precipitated:—

$$2NaIO_3 + 5NaHSO_3 = 3NaHSO_4 + 2Na_2SO_4 + H_2O + I_2.$$

The precipitate is washed and then distilled from iron retorts. Iodine may also be prepared by the decomposition of an iodide with chlorine, or by heating a mixture of an iodide and manganese dioxide with concentrated sulphuric acid. Commercial iodine may be purified by mixing it with a little potassium iodide and then subliming the mixture; in this way any traces of bromine or chlorine are removed. J. S. Stas recommends solution of the iodine in potassium iodide and subsequent precipitation by the addition of a large excess of water, the precipitate being washed, distilled in steam, and dried *in vacuo* over solid calcium nitrate, and then over solid caustic baryta.

Iodine is a greyish-black shining solid, possessing a metallic lustre and having somewhat the appearance of graphite. Its specific gravity is 4.948 (17°/4°). It melts at 114.2° C. and boils at 184.35° C. under atmospheric pressure (W. Ramsay and S. Young). The specific heat of solid iodine is 0.0541 (H. Kopp). Its latent heat of fusion is 11.7 calories, and its latent heat of vaporization is 23.95 calories (P. A. Favre and J. T. Silbermann). The specific heat of iodine vapour at constant pressure is 0.03489, and at constant volume 0.02697. It volatilizes slowly at ordinary temperatures, but rapidly on heating. Iodine vapour on heating passes from a violet colour to a deep indigo blue; this behaviour was investigated by V. Meyer (*Ber.*, 1880, 13, p. 394), who found that the change of colour was accompanied by a change of vapour density. Thus, the density of air being taken as unity, Victor Meyer found the following values for the density of iodine vapour at different temperatures:—

T° C.	253	450	506	842	1027	1570
Density	8.89	8.84	8.73	6.08	5.75	5.67

This shows that the iodine molecule becomes less complex in structure at higher temperatures.

Iodine possesses a characteristic penetrating smell, not so pungent, however, as that of chlorine or bromine. It is only very sparingly soluble in water, but dissolves readily in solutions of the alkaline iodides and in alcohol, ether, carbon bisulphide, chloroform, and many liquid hydrocarbons. Its solutions in the alkaline iodides and in alcohol and ether are brown in colour, whilst in chloroform and carbon bisulphide the solution is violet. It appears to combine with the solvent (P. Waentig, *Zeit. phys. Chem.*, 1909, p. 513). Its chemical properties closely resemble those of chlorine and bromine; its affinity for other elements, however, is as a rule less than that of either. It will only combine with hydrogen in the presence of a catalyst, but combines with many other elements directly; for example, phosphorus melts and then inflames, antimony burns

in the vapour, and mercury when heated with iodine combines with it rapidly. It is completely oxidized to iodic acid when boiled with fuming nitric acid. It is soluble in a solution of caustic potash, a dilute solution most probably containing the hypoiodite, which, however, changes slowly into iodate, the change taking place rapidly on warming. When alkali is added to aqueous iodine, followed immediately by either soda water or sodium bicarbonate, most of the original iodine is precipitated (R. L. Taylor, *Jour. Chem. Soc.*, 1897, 71, p. 725, and K. J. P. Orton, *ibid.* p. 830). Iodine can be readily detected by the characteristic blue coloration that it immediately gives with starch paste; the colour is destroyed on heating, but returns on cooling provided the heating has not been too prolonged. Iodine in the presence of water frequently acts as an oxidizing agent; thus arsenious acid and the arsenites, on the addition of iodine solution, are converted into arsenic acid and arsenates. A dilute solution of iodine prevents the decomposition of hydrogen peroxide by colloidal platinum (G. Bredig, *Zeit. phys. Chem.*, 1899, 31, p. 258; 1901, 37, p. 323).

Iodine finds application in organic chemistry, forming addition products with unsaturated compounds, the combination, however, being more slow than in the case of chlorine or bromine. It rarely substitutes directly, because the hydriodic acid produced reverses the reaction; this can be avoided by the presence of precipitated mercuric oxide or iodic acid, which react with the hydriodic acid as fast as it is formed, and consequently remove it from the reacting system. As a rule it is preferable to use iodine in the presence of a carrier, such as amorphous phosphorus or ferrous iodide or to use it with a solvent. It is found that most organic compounds containing the grouping $CH_3{\cdot}CO{\cdot}C—$ or $CH_3{\cdot}CH(OH){\cdot}C—$ in the presence of iodine and alkali give iodoform CHI_3.

Hydriodic acid, HI, is formed by the direct union of its components in the presence of a catalytic agent; for this purpose platinum black is used, and the hydrogen and iodine vapour are passed over the heated substance. On shaking up iodine with a solution of sulphuretted hydrogen in water, a solution of hydriodic acid is obtained, sulphur being at the same time precipitated. The acid cannot be prepared by the action of concentrated sulphuric acid on an iodide on account of secondary reactions taking place, which result in the formation of free iodine and sulphur dioxide. The usual method is to make a mixture of amorphous phosphorus and a large excess of iodine and then to allow water to drop slowly upon it; the reaction starts readily, and the gas obtained can be freed from any admixed iodine vapour by passing it through a tube containing some amorphous phosphorus. It is a colourless sharp-smelling gas which fumes strongly on exposure to air. It readily liquefies at 0° C. under a pressure of four atmospheres, the liquefied acid boiling at −34.14° C. (730.4 mm.); it can also be obtained as a solid melting at −50.8° C. It is readily soluble in water, one volume of water at 10° C. dissolving 425 volumes of the acid. The saturated aqueous solution is colourless and fumes strongly on exposure to air; after a time it darkens in colour owing to liberation of iodine. The gas is readily decomposed by heat into its constituent elements. It is a powerful reducing agent, and is frequently employed for this purpose in organic chemistry; thus hydroxy acids are readily reduced on heating with the concentrated acid, and nitro compounds are reduced to amino compounds, &c. It is preferable to use the acid in the presence of amorphous phosphorus, for the iodine liberated during the reduction is then utilized in forming more hydriodic acid, and consequently the original amount of acid goes much further. It forms addition compounds with unsaturated compounds.

It has all the characteristics of an acid, dissolving many metals with evolution of hydrogen and formation of salts, called *iodides*. The iodides can be prepared either by direct union of iodine with a metal, from hydriodic acid and a metal, oxide, hydroxide or carbonate, or by action of iodine on some metallic hydroxides or carbonates (such as those of potassium, sodium, barium, &c.; other products, however, are formed at the same time). The iodides as a class resemble the chlorides and bromides, but are less fusible and volatile. Silver iodide, mercurous iodide, and mercuric iodide are insoluble in water; lead iodide is sparingly soluble, whilst most of the other metallic iodides are soluble. Strong heating decomposes the majority of the iodides. Nitrous acid and chlorine readily decompose them with liberation of iodine; the same effect being produced when they are heated with concentrated sulphuric acid and manganese dioxide. The soluble iodides, on the addition of silver nitrate to their nitric acid solution, give a yellow precipitate of silver iodide, which is insoluble in ammonia solution. Hydriodic acid and the iodides may be estimated by conversion into silver iodide.

Iodine combines with chlorine to form *iodine monochloride*, ICl, which may be obtained by passing dry chlorine over dry iodine until the iodine is completely liquefied, or according to R. Bunsen by boiling iodine with *aqua regia* and extracting with ether. It exists in two different crystalline forms, the more stable or α form melting at 27.2° C., and the less stable or β form melting at 13.9° C. It is readily decomposed by water. The *trichloride*, ICl_3, results from the action of excess of chlorine on iodine, or from iodic acid and hydrochloric acid, or by heating iodine pentoxide with phosphorus pentachloride. It crystallizes in long yellow needles and decomposes readily on heating into the monochloride and chlorine. It is readily soluble in water, but excess of water decomposes it. (See W. Stortenbeker, *Zeit. phys. Chem.*, 1889, 3, p. 11.) Iodine monochloride in glacial acetic acid solution was used by A. Michael and T. H. Norton (*Ber.*, 1876, 9, p. 1752) for the preparation of paraiodo-acetanilide.

Iodine Pentoxide, I_2O_5, the best-known oxide, is obtained as a white crystalline solid by heating iodic acid to 170° C.; it is easily soluble in water, combining with the water to regenerate iodic acid; and when heated to 300° C. it breaks up into its constituent elements, (see M. Guichard, *Compt. rend.*, 1909, 148, p. 925.) Iodine dioxide, I_2O_4, obtained by Millon, and reinvestigated by M. M. P. Muir (*Jour. Chem. Soc.*, 1909, 95, p. 656), is a lemon-yellow solid obtained by acting on iodic acid with sulphuric acid, oxygen being evolved. By acting with ozone on a chloroform solution of iodine, F. Fichter and F. Rohner (*Ber.*, 1909, 42, p. 4093) obtained a yellowish white oxide, of the formula I_4O_9, which they regard as an iodate of tervalent iodine, Millon's oxide being considered a basic iodate.

Although *hypoiodous acid* is not known, it is extremely probable that on adding iodine or iodine monochloride to a dilute solution of a caustic alkali, hypoiodites are formed, the solution obtained having a characteristic smell of iodoform, and being of a pale yellow colour. It oxidizes arsenites, sulphites and thiosulphates immediately. The solution is readily decomposed on the addition of sodium or potassium bicarbonates, with liberation of iodine. The hypoiodite disappears gradually on standing, and rapidly on warming, being converted into iodate (see R. L. Taylor, *Jour. Chem. Soc.*, 1897, 71, p. 725, and K. J. P. Orton, *ibid.* p. 830). The peculiar nature of the action between iodine and chlorine in aqueous solution has led to the suggestion that the product is a base, *i.e.* iodine hydroxide. Tri-iodine hydroxide, $I_3{\cdot}OH$, is obtained by oxidizing potassium iodide with sulphuric acid and potassium permanganate (A. Skrabal and F. Buchter, *Chem. Zeit.*, 1909, 33, pp. 1184, 1193).

Iodic Acid, HIO_3, can be prepared by dissolving iodine pentoxide in water; by boiling iodine with fuming nitric acid, $6I + 10HNO_3 = 6HIO_3 + 10NO + 2H_2O$; by decomposing barium iodate with the calculated quantity of sulphuric acid, previously diluted with water, or by suspending iodine in water and passing in chlorine, $I_2 + 5Cl_2 + 6H_2O = 2HIO_3 + 10HCl$. It is a white crystalline solid, easily soluble in water, the solution showing a strongly acid reaction with litmus; the colour, however, is ultimately discharged by the bleaching power of the compound. It is a most powerful oxidizing agent, phosphorus being readily oxidized to phosphoric acid, arsenic to arsenic acid, silicon at 250° C. to silica, and hydrochloric acid to chlorine and water. It is readily reduced, with separation of iodine, by sulphur dioxide, hydriodic acid or sulphuretted hydrogen, thus:—

$$HIO_3 + 5HI = 3H_2O + 3I_2;\ 2HIO_3 + 5SO_2 + 4H_2O = 5H_2SO_4 + I_2;$$
$$2HIO_3 + 5H_2S = I_2 + 5S + 6H_2O.$$

The salts, known as the *iodates*, can be prepared by the action of the acid on a base, or sometimes by the oxidation of iodine in the presence of a base. They are mostly insoluble or only very slightly soluble in water. The iodates of the alkali metals are, however, readily soluble in water (except potassium iodate). They are more easily reduced than the corresponding chlorates; an aqueous solution of hydriodic acid giving free iodine and a metallic oxide, whilst aqueous hydrochloric acid gives iodine trichloride, chlorine, water and a chloride. They are decomposed on heating, with liberation of oxygen, in some cases leaving a residue of iodide and in others a residue of oxide of the metal, with liberation of iodine as well as of oxygen.

Periodic Acid, $HIO_4{\cdot}2H_2O$, is only known in the hydrated form. It can be prepared by the action of iodine on perchloric acid, or by boiling normal silver periodate with water: $2AgIO_4 + 4H_2O = Ag_2H_3IO_6 + HIO_4{\cdot}2H_2O$. It is a colourless, crystalline, deliquescent solid which melts at 135° C., and at 140° C. is completely decomposed into iodine pentoxide, water and oxygen. The periodates are a very complex class of salts, and may be divided into four classes, namely, meta-periodates derived from the acid HIO_4; meso-periodates from $HIO_4{\cdot}H_2O$, para-periodates from $HIO_4{\cdot}2H_2O$ and the diperiodates from $2HIO_4{\cdot}H_2O$ (see C. Kimmins, *Jour. Chem. Soc.*, 1887, 51, p. 356).

Iodine has extensive applications in volumetric analysis, being used more especially for the determination of copper.

The atomic weight of iodine was determined by J. S. Stas, from the analysis of pure silver iodate, and by C. Marignac from the determinations of the ratios of silver to iodine, and of silver iodide to iodine; the mean value obtained for the atomic weight being 126.53. G. P. Baxter (*Jour. Amer. Chem. Soc.*, 1904, 26, p. 1577; 1905, 27, p. 876; 1909, 31, p. 201), using the method of Marignac, obtained the value 126.985 (O = 16). P. Köthner and E. Aeuer (*Ber.*, 1904, 37, p. 2536; *Ann.*, 1904, 337, p. 362), who converted pure ethyl iodide into hydriodic acid and subsequently into silver iodide, which they then analysed, obtained the value 126.026 (H = 1); a discussion of this and other values gave as a mean 126.97 (O = 16).

In *medicine* iodine is frequently applied externally as a counter-irritant, having powerful antiseptic properties. In the form of certain salts iodine is very widely used, for internal administration in medicine and in the treatment of many conditions usually classed as surgical, such as the bone manifestations of tertiary syphilis. The most commonly used salt is the iodide of potassium; the iodides of sodium and ammonium are almost as frequently employed, and those of calcium and strontium are in occasional use. The usual doses of these salts are from five to thirty grains or more. Their pharmacological action is as obscure as their effects in certain

diseased conditions are consistently brilliant and unexampled. Our ignorance of their mode of action is cloaked by the term *deobstruent*, which implies that they possess the power of driving out impurities from the blood and tissues. Most notably is this the case with the poisonous products of syphilis. In its tertiary stages—and also earlier—this disease yields in the most rapid and unmistakable fashion to iodides; so much so that the administration of these salts is at present the best means of determining whether, for instance, a cranial tumour be syphilitic or not. No surgeon would think of operating on such a case until iodides had been freely administered and, by failing to cure, had proved the disease to be non-syphilitic. Another instance of this deobstruent power—"alterative," it was formerly termed—is seen in the case of chronic lead poisoning. The essential part of the medicinal treatment of this condition is the administration of iodides, which are able to decompose the insoluble albuminates of lead which have become locked up in the tissues, rapidly causing their degeneration, and to cause the excretion of the poisonous metal by means of the intestine and the kidneys. The following is a list of the principal conditions in which iodides are recognized to be of definite value: metallic poisonings, as by lead and mercury, asthma, aneurism, arteriosclerosis, angina pectoris, gout, goitre, syphilis, haemophilia, Bright's disease (nephritis) and bronchitis.

Small quantities of the iodate (KIO_3) are a frequent impurity in iodide of potassium, and cause the congeries of symptoms known as *iodism*. These comprise dyspepsia, skin eruption and the manifestations which are usually identified with a "cold in the head." In many cases, as in syphilis, aneurism, lead poisoning, &c., the life of the patient depends on the free and continued use of the iodide, and this is best to be accomplished by securing an absolutely pure supply of the salt. Another often successful method of preventing the onset of symptoms of poisoning is to administer small doses of ammonium carbonate with the drug, thereby neutralizing the iodic acid which is liberated in the stomach.

IODOFORM, CHI_3, a valuable antiseptic discovered by G. S. Sérullas in 1822; in 1834 J. B. Dumas showed that it contained hydrogen. It is formed by the action of iodine and aqueous potash on ethyl alcohol, acetone, acetaldehyde and from most compounds containing the grouping $CH_3{\cdot}CO{\cdot}C-$. Its formation from alcohol may be represented thus: $C_2H_5OH + 4I_2 + 6KHO = CHI_3 + KHCO_2 + 5KI + 5H_2O$. It crystallizes in yellow hexagonal plates, melting at 119-120° C., and is readily soluble in alcohol and ether, but is insoluble in water. It has a characteristic odour and is volatile in steam. On reduction with hydriodic acid, it yields methylene iodide, CH_2I_2.

More recently, iodoform has been prepared by the electrolysis of a solution of potassium iodide in the presence of alcohol or acetone, the electrolytic cell being fitted with a diaphragm, in order to prevent the hydrogen which is formed at the same time from reducing the iodoform, or from combining with the iodine to form hydriodic acid. K. Elbs uses a solution of potassium iodide and sodium carbonate in water, which with the necessary alcohol is contained in a porous cell fitted with a lead anode, whilst the cathode compartment contains a solution of caustic soda and a nickel electrode. The electrolysis is carried out at a temperature of 70° C., and a current density of one ampère per square decimetre is used. At the end of three hours a yield of 70% of the theoretical quantity is obtained.

IOLA, a city and the county-seat of Allen county, Kansas, U.S.A., on the Neosho river, about 100 m. S. by W. of Kansas City. Pop. (1890) 1706; (1900) 5791, of whom 237 were foreign-born and 207 were negroes; (1905) 10,287; (1910) 9032. It is served by the Atchison, Topeka & Santa Fé, the Missouri Pacific and the Missouri, Kansas & Texas railways. It is pleasantly situated in a level valley where there is a great abundance of natural gas and some fine building stone. The city has large zinc smelters and zinc rolling-mills, a foundry, machine shops, and manufactories of cement, sulphuric acid and brick. The municipality owns and operates its waterworks, gas plant and electric-lighting plant. Iola was founded in 1859 by a company whose members were dissatisfied with the location of the county-seat at Humboldt. It became the county-seat in 1865, was chartered as a city of the third class in 1870 and became a city of the second class in 1898. The rapid growth of the city dates from the discovery of natural gas here, on Christmas Day 1893.

IOLITE, a mineral occasionally cut as a gem-stone, and named from the violet colour which it sometimes presents (ἴον, "violet"; λίθος, "stone"). It is generally called by petrographers cordierite, a name given by R. J. Haüy in honour of the French mineralogist, P. L. Cordier, who discovered its remarkable dichroism, and suggested for it the name dichroite, still sometimes used. The difference of colour which it shows in different directions is so marked as to be well seen without the dichroscope. The typical colours are deep blue, pale blue and yellowish grey. While the crystal as a whole shows these three colours, each face is dichroic.

Iolite is a hydrous magnesium and aluminium silicate, with ferrous iron partially replacing magnesium. It crystallizes in the orthorhombic system. In hardness and specific gravity it much resembles quartz. The transparent blue or violet variety used as a gem occurs as pebbles in the gravels of Ceylon, and bears in many cases a resemblance to sapphire. The paler kinds are often called water-sapphire (*saphir d'eau* of French jewellers) and the darker kinds lynx-sapphire; the shade of colour varying with the direction in which the stone is cut. From sapphire the iolite is readily distinguished by its stronger pleochroism, its lower density (about 2.6) and its inferior hardness (about 7).

Iolite occurs in granite and in true eruptive rocks, but is most characteristically developed as a product of contact metamorphism in gneiss and altered slates. A variety occurring at the contact of clay-slate and granite on the border of the provinces of Shimotsuké and Ködzuké in Japan has been called cerasite. It readily suffers chemical change, and gives rise to a number of alteration-products, of which pinite is a characteristic example.

Although iolite, or cordierite, is rather widely distributed as a constituent of certain rocks, fine crystals of the mineral are of very limited occurrence. One of the best-known localities is Bodenmais, in Bavaria, where it occurs with pyrrhotite in a granite matrix. It is found also in Norway, Sweden and Finland, in Saxony and in Switzerland. Large crystals are developed in veins of granite running through gneiss at Haddam, Connecticut; and it is known at many other localities in the United States.

(F. W. R.*)

ION, of Chios, Greek poet, lived in the age of Pericles. At an early age he went to Athens, where he made the acquaintance of Aeschylus. He was a great admirer of Cimon and an opponent of Pericles. He subsequently met Sophocles in his native island at the time of the Samian war. From Aristophanes (*Peace*, 830 ff.) it is concluded that he died before the production of that play (421). His first tragedy was produced between 452-449 B.C.; and he was third to Euripides and Iophon in the tragic contest of 429. In a subsequent year he gained both the tragic and dithyrambic prizes, and in honour of his victory gave a jar of Chian wine to every Athenian citizen (Athenaeus p. 3). He is further credited by the scholiast on Aristophanes (*loc. cit.*) with having composed comedies, dithyrambs, epigrams, paeans, hymns, scolia, encomia and elegies; and he is the reputed author of a philosophical treatise on the mystic number three. His historical or biographical works were five in number, and included an account of the antiquities of Chios and of ἐπιδημίαι, recollections of visitors to the island.

See C. Nieberding, *De Ionis Chii vita* (1836, containing the fragments); F. Allègre, *De Ione Chio* (1890), an exhaustive monograph; and Bentley, *Epistola ad Millium*.

IONA, or ICOLMKILL, an island of the Inner Hebrides, Argyllshire, Scotland, 6½ m. S. of Staffa and 1¼ m. W. of the Ross of Mull, from which it is separated by the shallow Sound of Iona. Pop. (1901) 213. It is about 3½ m. long and 1½ m. broad; its area being some 2200 acres, of which about one-third is under cultivation, oats, potatoes and barley being grown. In the rest of the island grassy hollows, yielding pasturage for a few hundred cattle and sheep and some horses, alternate with rocky elevations, which culminate on the northern coast in Duni (332 ft.), from the base of which a dazzling stretch of white shell sand, partly covered with grass, stretches to the sea. To the south-west the island is fringed with precipitous cliffs. Iona is composed entirely of ancient gneisses and schists of Lewisian age; these include bands of quartzite, slate, marble and serpentine. The strike of the rocks is S.W.-N.E. and they are tilted to very high angles. Fronting the Sound is the village of Iona, or Buile Mor, which has two churches and a school. The inhabitants depend partly on agriculture and partly on fishing.

The original form of the name Iona was Hy, Hii or I, the Irish for Island. By Adamnan in his *Life* of St Columba it is called *Ioua insula*, and the present name Iona is said to have originated in some transcriber mistaking the *u* in Ioua for *n*. It also received the name of Hii-colum-kill (Icolmkill), that is, "the island of Columba of the Cell," while by the Highlanders it has been known as Innis nan Druidhneah ("the island of the Druids"). This last name seems to imply that Iona was a sacred spot before St Columba landed there in 563 and laid the foundations of his monastery. After this date it quickly developed into the most famous centre of Celtic Christianity, the mother community of numerous monastic houses, whence missionaries were despatched for the conversion of Scotland and northern England, and to which for centuries students flocked from all parts of the north. After St Columba's death the soil of the island was esteemed peculiarly sanctified by the presence of his relics, which rested here until they were removed to Ireland early in the 9th century. Pilgrims came from far and near to die in the island, in order that they might lie in its holy ground; and from all parts of northern Europe the bodies of the illustrious dead were brought here for burial. The fame and wealth of the monastery, however, sometimes attracted less welcome visitors. Several times it was plundered and burnt and the monks massacred by the heathen Norse sea-rovers. Late in the 11th century the desecrated monastery was restored by the saintly Queen Margaret, wife of Malcolm Canmore, king of Scotland; and in 1203 a new monastery and a nunnery were founded by Benedictine monks who either expelled or absorbed the Celtic community. In 838 the Western Isles, then under the rule of the kings of Man, were erected into a bishopric of which Iona was the seat. When in 1098 Magnus III., "Barefoot," king of Norway, ousted the jarls of Orkney from the isles, he united the see of the Isles (Sudreyar, "the southern islands," Lat. *Sodorenses insulae*) with that of Man, and placed both under the jurisdiction of the archbishopric of Trondhjem. About 1507 the island again became the seat of the bishopric of the Isles; but with the victory of the Protestant party in Scotland its ancient religious glory was finally eclipsed, and in 1561 the monastic buildings were dismantled by order of the Convention of Estates. (For the political fortunes of Iona see Hebrides.)

The existing ancient remains include part of the cathedral church of St Mary, of the nunnery of St Mary, St Oran's chapel, and a number of tombs and crosses. The cathedral dates from the 13th century; a great portion of the walls with the tower, about 75 ft. high, are still standing. The choir and nave have been roofed, and the cathedral has in other respects been restored, the ruins having been conveyed in 1899 to a body of trustees by the eighth duke of Argyll. The remains of the conventual buildings still extant, to judge by the portion of a Norman arcade, are of earlier date than the cathedral. The small chapel of St Oran, or Odhrain, was built by Queen Margaret on the supposed site of Columba's cell, and its ruins are the oldest in Iona. Its round-arched western doorway has the characteristic Norman beak-head ornamentation. Of the nunnery only the chancel and nave of the Norman chapel remain, the last prioress, Anna (d. 1543), being buried within its walls. The cemetery, called in Gaelic *Reilig Oiran* ("the burial-place of kings"), is said to contain the remains of forty-eight Scottish, four Irish and eight Danish and Norwegian monarchs, and possesses a large number of monumental stones. At the time of the Reformation it is said to have had 360 crosses, of which most were thrown into the sea by order of the synod of Argyll. Many, however, still remain, the finest being Maclean's cross and St Martin's. Both are still almost perfect, and are richly carved with Runic inscriptions, emblematic devices and fanciful scroll work. Of Columba's monastery, which was built of wood about ¼ m. from the present ruins, nothing remains.

IONIA, in ancient geography, the name given to a portion of the W. coast of Asia Minor, adjoining the Aegean Sea and bounded on the E. by Lydia. It consisted of a narrow strip of land near the coast, which together with the adjacent islands was occupied by immigrant Greeks of the Ionic race, and thus distinguished from the interior district, inhabited by the Lydians. According to the universal Greek tradition, the cities of Ionia were founded by emigrants from the other side of the Aegean (see Ionians), and their settlement was connected with the legendary history of the Ionic race in Attica, by the statement that the colonists were led by Neleus and Androclus, sons of Codrus, the last king of Athens. In accordance with this view the "Ionic migration," as it was called by later chronologers, was dated by them one hundred and forty years after the Trojan war, or sixty years after the return of the Heraclidae into the Peloponnese. Without assigning any definite date, we may say that recent research has tended to support the popular Greek idea that Ionia received its main Greek element rather late—after the descent of the Dorians, and, therefore, after any part of the Aegean period. The only Aegean objects yet found (1910) in or near Ionia are some sherds of the very latest Minoan age at Miletus. It is not probable that all the Greek colonists were of the not numerous Ionian race. Herodotus tells us (i. 146) that they comprised settlers from many different tribes and cities of

Greece (a fact indicated also by the local traditions of the cities), and that they intermarried with the native races. A striking proof of this was the fact that so late as the time of the historian distinct dialects were spoken by the inhabitants of different cities within the limits of so restricted an area. E. Curtius supposed that the population of this part of Asia was aboriginally of Ionic race and that the settlers from Greece found the country in the possession of a kindred people. The last contention is probably true; but the kinship was certainly more distant than that between two branches of one Ionian stock.

The cities called Ionian in historical times were twelve in number,—an arrangement copied as it was supposed from the constitution of the Ionian cities in Greece which had originally occupied the territory in the north of the Peloponnese subsequently held by the Achaeans. These were (from south to north)—Miletus, Myus, Priene, Ephesus, Colophon, Lebedus, Teos, Erythrae, Clazomenae and Phocaea, together with Samos and Chios. Smyrna (*q.v.*), originally an Aeolic colony, was afterwards occupied by Ionians from Colophon, and became an Ionian city,—an event which had taken place before the time of Herodotus. But at what period it was admitted as a member of the league we have no information. The cities above enumerated unquestionably formed a kind of league, of which participation in the Pan-Ionic festival was the distinguishing characteristic. This festival took place on the north slope of Mt. Mycale in a shrine called the Panionium. But like the Amphictyonic league in Greece, the Ionic was rather of a sacred than a political character; every city enjoyed absolute autonomy, and, though common interests often united them for a common political object, they never formed a real confederacy like that of the Achaeans or Boeotians. The advice of Thales of Miletus to combine in a political union was rejected.

Ionia was of small extent, not exceeding 90 geographical miles in length from N. to S., with a breadth varying from 20 to 30 m., but to this must be added the peninsula of Mimas, together with the two large islands. So intricate is the coastline that the voyage along its shores was estimated at nearly four times the direct distance. A great part of this area was, moreover, occupied by mountains. Of these the most lofty and striking were Mimas and Corycus, in the peninsula which stands out to the west, facing the island of Chios; Sipylus, to the north of Smyrna; Corax, extending to the south-west from the Gulf of Smyrna, and descending to the sea between Lebedus and Teos; and the strongly marked range of Mycale, a continuation of Messogis in the interior, which forms the bold headland of Trogilium or Mycale, opposite Samos. None of these mountains attains a height of more than 4000 ft. The district comprised three 728
extremely fertile valleys formed by the outflow of three rivers, among the most considerable in Asia Minor: the Hermus in the north, flowing into the Gulf of Smyrna, though at some distance from the city of that name; the Caÿster, which flowed under the walls of Ephesus; and the Maeander, which in ancient times discharged its waters into the deep gulf that once bathed the walls of Miletus, but which has been gradually filled up by this river's deposits. With the advantage of a peculiarly fine climate, for which this part of Asia Minor has been famous in all ages, Ionia enjoyed the reputation in ancient times of being the most fertile of all the rich provinces of Asia Minor; and even in modern times, though very imperfectly cultivated, it produces abundance of fruit of all kinds, and the raisins and figs of Smyrna supply almost all the markets of Europe.

The colonies naturally became prosperous. Miletus especially was at an early period one of the most important commercial cities of Greece; and in its turn became the parent of numerous other colonies, which extended all around the shores of the Euxine and the Propontis from Abydus and Cyzicus to Trapezus and Panticapaeum. Phocaea was one of the first Greek cities whose mariners explored the shores of the western Mediterranean. Ephesus, though it did not send out any colonies of importance, from an early period became a flourishing city and attained to a position corresponding in some measure to that of Smyrna at the present day.

History.—The first event in the history of Ionia of which we have any trustworthy account is the inroad of the Cimmerii (see Scythia), who ravaged a great part of Asia Minor, including Lydia, and sacked Magnesia on the Maeander, but were foiled in their attack upon Ephesus. This event may be referred to the middle of the 7th century B.C. About 700 B.C. Gyges, first Mermnad king of Lydia, invaded the territories of Smyrna and Miletus, and is said to have taken Colophon as his son Ardys did Priene. But it was not till the reign of Croesus (560-545 B.C.) that the cities of Ionia successively fell under Lydian rule. The defeat of Croesus by Cyrus was followed by the conquest of all the Ionian cities. These became subject to the Persian monarchy with the other Greek cities of Asia. In this position they enjoyed a considerable amount of autonomy, but were for the most part subject to local despots, most of whom were creatures of the Persian king. It was at the instigation of one of these despots, Histiaeus (*q.v.*) of Miletus, that in about 500 B.C. the principal cities broke out into insurrection against Persia. They were at first assisted by the Athenians, with whose aid they penetrated into the interior and burnt Sardis, an event which ultimately led to the Persian invasion of Greece. But the fleet of the Ionians was defeated off the island of Lade, and the destruction of Miletus after a protracted siege was followed by the reconquest of all the Asiatic Greeks, insular as well as continental.

The victories of the Greeks during the great Persian war had the effect of enfranchizing their kinsmen on the other side of the Aegean; and the battle of Mycale (479 B.C.), in which the defeat of the Persians was in great measure owing to the Ionians, secured their emancipation. They henceforth became the dependent allies of Athens (see DELIAN LEAGUE), though still retaining their autonomy, which they preserved until the peace of Antalcidas in 387 B.C. once more placed them as well as the other Greek cities in Asia under the nominal dominion of Persia. They appear, however, to have retained a considerable amount of freedom until the invasion of Asia Minor by Alexander the Great. After the battle of the Granicus most of the Ionian cities submitted to the conqueror. Miletus, which alone held out, was reduced after a long siege (334 B.C.). From this time they passed under the dominion of the successive Macedonian rulers of Asia, but continued, with the exception of Miletus (*q.v.*), to enjoy great prosperity both under these Greek dynasties and after they became part of the Roman province of Asia.

Ionia has laid the world under its debt not only by giving birth to a long roll of distinguished men of letters and science (see IONIAN SCHOOL OF PHILOSOPHY), but by originating the distinct school of art which prepared the way for the brilliant artistic development of Athens in the 5th century. This school flourished in the 8th, 7th and 6th centuries, and is distinguished by the fineness of workmanship and minuteness of detail with which it treated subjects, inspired always to some extent by non-Greek models. Naturalism is progressively obvious in its treatment, *e.g.* of the human figure, but to the end it is still subservient to convention. It has been thought that the Ionian migration from Greece carried with it some part of a population which retained the artistic traditions of the "Mycenaean" civilization, and so caused the birth of the Ionic school; but whether this was so or not, it is certain that from the 8th century onwards we find the true spirit of Hellenic art, stimulated by commercial intercourse with eastern civilizations, working out its development chiefly in Ionia and its neighbouring isles. The great names of this school are Theodorus and Rhoecus of Samos; Bathycles of Magnesia on the Maeander; Glaucus, Melas, Micciades, Archermus, Bupalus and Athenis of Chios. Notable works of the school still extant are the famous archaic female statues found on the Athenian Acropolis in 1885-1887, the seated statues of Branchidae, the Nikē of Archermus found at Delos, and the objects in ivory and electrum found by D. G. Hogarth in the lower strata of the Artemision at Ephesus in 1904-1905 (see GREEK ART).

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(E. H. B.; D. G. H.)

IONIA, a city and the county-seat of Ionia county, Michigan, U.S.A., on the Grand river, about 34 m. E. of Grand Rapids. Pop. (1904) 5222; (1910) 5030. It is served by the Grand Trunk and the Père Marquette railways. The greater part of the city is built on the bottom-lands of the valley within an area 2 m. in length and 1 m. in width, but some of the finest residences stand on the hills, which form an irregular semicircle behind the city, and command extensive views of the valley. Much of the building material is a brown sandstone obtained from quarries only 3 m. distant; white clay, also, is found in the vicinity. The city is a trade centre for a rich farming district, has car-shops (of the Père Marquette railway) and iron foundries, and manufactures wagons, pottery, furniture and clothing. The waterworks are owned and operated by the municipality. Ionia was settled in 1833 by immigrants from German Flats, near Herkimer, New York. It was incorporated as a village in 1857, but the charter was allowed to lapse; it was again incorporated as a village in 1865, and was chartered as a city in 1873.

IONIAN ISLANDS, the collective name for the Greek islands of Corfu, Cephalonia, Zante, Santa Maura, Ithaca, Cythera (Cerigo) and Paxo, with their minor dependencies. These seven islands (for details of which see their separate headings) are often described also as the *Heptanesus* ("Seven Islands"), but they have no real geographical unity. The history of the name "Ionian" in this connexion is obscure, but it is probably due to ancient settlements of Ionian colonists on the coasts and islands. The political unity of the seven islands is of comparatively modern date; their independence as a separate state lasted only seven years (1800-1807). To a

certain extent they have passed under the same succession of influences; they have been subjected to the same invasions, and have received accessions to their populations from the same currents of migration or conquest. But even what may be considered as common experiences have affected the individual islands in different ways; in the matter of population, for instance, Corfu has undergone much more important modifications than Ithaca.

The Ionian islands consist almost entirely of Cretaceous and Tertiary beds, but in Corfu Jurassic deposits belonging to various horizons have also been found. The oldest beds which have yet been recognized are shales and hornstones with Liassic fossils. These are overlaid conformably by a thick series of platy limestones, known as the Vigläs limestone, which appears to represent the rest of the Jurassic system and also the lower part of the Cretaceous. Then follows a mass of dolomite and unbedded limestones containing *Hippurites* and evidently of Upper Cretaceous age. The Eocene beds are folded with the Cretaceous, and in many places the two formations have not yet been separately distinguished. Both occasionally assume the form of Flysch. Miocene beds are found in Corfu and Zante, and Pliocene deposits cover much of the low-lying ground.

History.—The beginning of Heptanesian history may be said to date from the 9th century. Leo the Philosopher (about A.D. 890) formed all or most of the islands into a distinct province under the title of the Thema of Cephallenia, and in this condition they belonged to the Eastern empire after Italy had been divided into various states, but this political or administrative unity could not last long in the case of islands exposed by their situation to opposite currents of conquest. Robert Guiscard, having captured Corfu (1081) and Cephalonia, might have become the founder of a Norman dynasty in the islands but for his early death at Cassopo. Amid the struggles between Greek emperors and Western crusaders during the 12th century, Corfu, Cephalonia, Zante, &c., emerge from time to time; but it was not till the Latin empire was established at Constantinople in 1204 that the Venetians, who were destined to give the Ionian Islands their place in history, obtained possession of Corfu. They were afterwards robbed of the island by Leon Vetrano, a famous Genoese corsair; but he was soon defeated and put to death, and the senate, to secure their position, granted fiefs in Corfu to ten noble families in order that they might colonize it (1206). The conquest of Cephalonia and Zante followed, and we find five counts of the family of Tocco holding Cephalonia, and probably Zante as well as Santa Maura, as tributary to the republic. But the footing thus gained by the Venetians was not maintained, and through the closing part of the 13th and most of the 14th century the islands were a prey by turns to corsairs and to Greek and Neapolitan claimants. In 1386, however, the people of Corfu made voluntary submission to the Venetian republic which had now risen to be the first maritime power in the Mediterranean. In 1485 Zante was purchased from the Turks in a very depopulated condition; and in 1499 Cephalonia was captured from the same masters; but Santa Maura, though frequently occupied for a time, was not finally attached to Venice till 1684, and Cerigo was not taken till 1717.

Venetian and French rule.

The Venetians, who exacted heavy contributions from the islands, won the adherence of the principal native families by the bestowal of titles and appointments; the Roman Catholic Church was established, and the Italian and Greek races were largely assimilated by intermarriage; Greek ceased to be spoken except by the lower classes, which remained faithful to the Orthodox communion. On the fall of the Venetian republic in 1797 the treaty of Campo Formio, which gave Venice to Austria, annexed the Ionian Islands to France; but a Russo-Turkish force drove out the French at the close of 1798; and in the spring of 1799 Corfu capitulated. By treaty with the Porte in 1800, the emperor Paul erected the “Septinsular Republic,” but anarchy and confusion followed till a secret article in the treaty of Tilsit, in 1807, declared the Islands an integral part of the French empire. They were incorporated with the province of Illyria, and in this condition they remained till the decline of the French power. The British forces, under General Oswald, took Zante, Cephalonia and Cerigo in 1809, and Santa Maura in 1810; Colonel (afterwards Sir Richard) Church (*q.v.*), reduced Paxo in 1814; and after the abdication of Napoleon, Corfu, which had been well defended by General Donzelot, was, by order of Louis XVIII., surrendered to Sir James Campbell. By the treaty of Paris (9th November 1815) the contracting powers—Great Britain, Russia, Austria and Prussia—agreed to place the “United States of the Ionian Islands” under the exclusive protection of Great Britain, and to give Austria the right of equal commercial advantage with the protecting country, a plan strongly approved by Count Capo d’Istria, the famous Corfiot noble who afterwards became president of the new republic of Greece.

British Protectorate.

The terms of the treaty of Paris were not only of indefinite import but were susceptible of contradictory interpretations. And instead of interpreting the other articles in harmony with the first, which declared the islands one “sole free and independent state,” the protecting Power availed itself of every ambiguity to extend its authority. The first lord high commissioner, Sir Thomas Maitland, who as governor of Malta had acquired the sobriquet of “King Tom,” was not the man to foster the constitutional liberty of an infant state. The treaty required, with questionable wisdom, that a constitution should be established, and this was accordingly done; but its practical value was

trifling. The constitution, voted by a constituent assembly in 1817 and applied in the following year, placed the administration in the hands of a senate of six members and a legislative assembly of forty members; but the real authority was vested in the high commissioner, who was able directly to prevent anything, and indirectly to effect almost anything. Sir Thomas Maitland was not slow to exercise the control thus permitted him, though on the whole he did so for the benefit of the islands. The construction of roads, the abolition of direct taxes and of the system of farming the church lands, the securing of impartial administration of justice, and the establishment of educational institutions are among the services ascribed to his efforts. These, however, made less impression on the Heptanesians than his despotic character and the measures which he took to prevent them giving assistance in the Greek war of independence in 1821. He was succeeded in 1823 by General Sir Frederick Adam, who in the main carried out the same policy. Under his government the new fortifications of Corfu and some of the most important public works which still do honour to the English protectorate were undertaken. Lord Nugent, who became high commissioner in 1832, was followed by Sir Howard Douglas (1835-1841), who ruled with a firm, too often with a high hand; and he was met by continual intrigues, the principal exponent of the opposition being the famous Andreas Mustoxidi (d. 1861). A complete change of policy was inaugurated by Mr Mackenzie (1841-1843), and his successor Lord Seaton (1843-1849) was induced by the European disturbances of 1848 to initiate a number of important reforms. But the party which wished for union with Greece was rapidly growing in vigour and voice. Serious insurrections of the peasantry, especially in Cephalonia, had to be put down by military force, and the parliament passed a resolution in favour of immediate union with Greece. The hopes of the unionists were roused by the appointment of W. E. Gladstone as high commissioner extraordinary to investigate the condition of the islands. From his known sympathy with Greek independence, it was their expectation that he would support their pretensions. But after a tour through the principal islands Gladstone came to the conclusion that the abolition of the protectorate was not the wish of the mass of the people. For a few days in 1859 he held office as lord high commissioner, and in that capacity he proposed for the consideration of the assembly a series of reforms. These reforms were, however, declared inadmissible by the assembly; and Sir Henry Storks, who succeeded Gladstone in February 1859, began his rule by a prorogation. The contest continued between the assembly and the protectorate. The British government was slow to realize the true position of affairs: as late as May 1861 Gladstone spoke of the cession of the islands as “a crime against the safety of Europe,” and Sir Henry Storks continued to report of tranquillity and contentment. The assembly of 1862 accused the high commissioner of violation of the constitution and of the treaty of Paris, and complained that England remained in ignorance of what took place in the islands.

Cession to Greece.

On the abdication of King Otho of Greece in 1862 the Greek people by universal suffrage voted Prince Alfred of England to the throne, and when he declined to accept the crown England was asked to name a successor. The candidate proposed was Prince William George of Glücksburg, brother of the princess of Wales; and the British government declared to the provisional government of Greece that his selection would be followed by the long-refused cession of the Ionian Islands. After the prince’s election by the national assembly in 1863 the high commissioner laid before the Ionian parliament the conditions on which the cession would be carried out. The rejection of one of those conditions—the demolition of the fortifications of Corfu—led to a new prorogation; but none the less (on March 29, 1864) the plenipotentiaries of the five great powers signed the treaty by which the protectorate was brought to a close. The neutrality which they attributed to the whole of the islands was (January 1864) confined to Corfu and Paxo. On May 31st of that year Sir Henry Storks left Corfu with the English troops and men-of-war. King George made his entry into Corfu on the 6th of June.

Since their annexation to Greece the history of the Ionian islands has been uneventful; owing to various causes their prosperity has somewhat declined. Corfu (Corcyra) with Paxo; Cephalonia; Santa Maura (Levkas) with Thiaki (Ithaca) and Zante (Zacynthos) each form separate nomarchies or departments; Cerigo (Cýthera) forms part of the nomarchy of Laconia. The islands retain the exemption from direct taxation which they enjoyed under the British protectorate; in lieu of this there is an *ad valorem* tax of 20½% on exported oil and a tax of 6% on wine exported to Greek ports; these commodities are further liable to an export duty of 1½% which is levied on all agricultural produce and articles of local manufacture for the maintenance and construction of roads. The excellent roads, which date from the British administration, are kept in fair repair.

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(J. D. B.)

IONIANS, the name given by the Greeks to one of the principal divisions of the Hellenic peoples. In historic times it was applied to the inhabitants of (1) Attica, where some believed the Ionians to have originated; (2) parts of Euboea; (3) the Cycladic islands, except Melos and Thera; (4) a section of the west coast of Asia Minor, from the gulf of Smyrna to that of Iasus (see Ionia); (5) colonies from any of the foregoing, notably in Thrace, Propontis and Pontus in the west, and in Egypt (Naucratis, Daphnae); some authorities have found traces of an ancient Ionian population in (6) north-eastern Peloponnese. The meaning and derivation of the name are not known. It occurs in two forms, Ἰάϝονες and Ἴωνες (compare Χάονες and Χῶνες in Epirus)—not counting the name Ἰόνιος applied to the open sea west of Greece. In the traditional genealogy of the Hellenes, Ion, the ancestor of the Ionians, is brother of Achaeus and son of Xuthus (who held Peloponnese after the dispersal of the children of Hellen). But this genealogy, though it is attributed to Hesiod, is apparently post-Homeric; and it is clear that the Ionian name had independent and varied uses and meanings in very early times. In Homer the word Ἰάϝονες occurs as a name of inhabitants of Attica, with the epithet ἑλκεχίτωνες (*Il.* xiii. 685 = "trail-vest"), describing some point of costume, and later regarded as imputing effeminacy. The Homeric *Hymn to Apollo of Delos* (7th century) describes an Ionian population in the Cyclades with a loose religious league about the Delian sanctuary.

The same word Ἰάϝων (*Javan*) appears in Hebrew literature of the 8th and 7th centuries, to denote one group of the "Japhetic" peoples of Asia Minor, Cyprus and perhaps Rhodes: "by these were the isles of the nations divided, in their lands, every one after his tongue, after their families, in their nations," a comprehensive expression for the island-strewn regions farther west (Gen. x. 10). In Ezek. xxvii. 13, 19, *Javan* trades with Tyre in slaves, bronze-work, iron and drugs. Later allusions show that on Semitic lips *Javan* meant western traders in general. In Persian *Yauna* was the generic term for Greeks.[1]

The earliest explicit Greek account of the Ionians is given in the 5th century by Herodotus (i. 45, 56, 143-145, v. 66, vii. 94, viii. 44-46). The "children of Ion" originated in north-eastern Peloponnese; and traces of them remained in Troezen and Cynuria. Expelled by the Achaeans (who seem to have entered Peloponnese about four generations before the Dorian Invasion) they invaded and dominated Attica; and about the time of the Dorian Invasion took the lead under the Attic branch of the Neleids of Pylus (Hdt. i. 147, v. 65) in the colonization of the Cyclades and of Asiatic Ionia, which in Homer is still "Carian." Many of the colonists, however, were not Ionians, but refugees from other parts of Greece, between Euboea and Argolis (Hdt. i. 146); others looked on Attica as their first home, though the true Ionians were intruders there. The Pan-Ionian sanctuary of Poseidon on the Asiatic promontory of Mycale was regarded as perpetuating a cult from Peloponnesian Achaea, and the league of twelve cities which maintained it, as imitated from an Achaean dodecapolis, and as claiming (absurdly, according to Herodotus i. 143) purer descent than other Ionians.

In Herodotus's account of the first Greek intercourse with Egypt (about 664 B C.) he describes "Ionian and Carian" adventurers and mercenaries in the Delta. Later the commoner antithesis is between Ionian and Dorian, first (probably) in the colonial regions of Asia Minor, and later more universally.

In the 5th century the name "Ionian" was already falling into discredit. Causes of this were (1) the peace-loving luxury (born of commercial wealth and contact with Oriental life) of the great Ionian cities of Asia; (2) the tameness with which they submitted first to Lydia and to Persia, then to Athenian pretensions, then to Sparta, and finally to Persia again; (3) the decadence and downfall of Athens, which still counted as Ionian and had claimed (since Solon's time) seniority among "Ionian" states. In the later 4th century the name survives only (*a*) as a geographical expression for part of the coast of Asia Minor, (*b*) in European Greece as the name of that section of the Northern Amphictyony in which Athens and its colonies were reckoned.

The traditional history of Asiatic Ionia is generally accepted, and in its broad outlines is probably well founded. Common to all groups of Ionians in the Aegean is a dialect of Greek

which has η for α (in Attic only partially) and (in Asiatic Ionian especially) κ for π in certain words. Herodotus states that there were four distinct dialects in Asiatic Ionia itself (i. 142) and the dialect of Attica differed widely from all other forms of Ionic. Earlier phases of Ionic forms are dominant in the language of Homer. Most Ionian states exhibit also traces of the fourfold tribal divisions named after the "children of Ion"; but additional tribes occur locally. (Hdt. v. 66, 69.) All reputed colonies from Attica (except Ephesus and Colophon) kept also the feast of Apaturia; and many worshipped Apollo Patrous as the reputed father of Ion. The few observations hitherto made on the sites of Ionian cities indicate continuity of settlement and culture as far back as the latest phases of the Mycenaean (Late Minoan III.) Age and not farther, supporting thus far the traditional foundation dates.

The theory of E. Curtius (1856-1890) that the Ionians originated in Asia Minor and spread thence through the Cyclades to Euboea and Attica deserts ancient tradition on linguistic and ethnological grounds of doubtful value. Ad. Holm supports it (*Gesch. Gr.*, Berlin, 1886, i. 86), but A. von Gutschmid (*Beitr. z. Gesch. d. alten Orients*, Leipzig, 1856, 124 ff.) and E. Meyer (*Philologus* NF. 2, 1889, p. 268 ff.; NF. 3, 1890, p. 479 ff.) follow Herodotus with qualifications. J. B. Bury (*Eng. Hist. Rev.* xv. 228), though he regards the Ionian peoples as of European origin, thinks that they may have got their name from some part of the Asiatic coast. Ionian culture and art, though little known in their earlier phases, derive their inspiration on the one side from those of the old Aegean (Minoan) civilization, on the other from the Oriental (mainly Assyrian) models which penetrated to the coast through the Hittite civilization of Asia Minor. Egyptian influence is almost absent until the time of Psammetichus, but then becomes predominant for a while. Local and regional peculiarities, however, disappear almost wholly in the 5th and 4th centuries, under the overpowering influence of Athens. 731

AUTHORITIES.—Besides the sections on *Ionians* in the general histories of Greece and the references given in G. Busolt, *Griechische Geschichte*, i. (2nd ed., Gotha, 1893), pp. 262, 277 ff., see E. Curtius, *Die Ionier vor der ionischen Wanderung* (Berlin, 1855), and papers in *Gott. Gel. Anz.* (1856), p. 1152 f. and (1859), p. 2021 f.; *Jahrb. f. kl. Philol.* 83 (1860), p. 449 f.; *Hermes* 25 (1890), p. 141 f.; A. von Gutschmid, *Beiträge z. Gesch. d. alten Orients* (Leipzig, 1856), p. 124 ff.; E. Meyer, *Philologus* 47 (NF. 2, 1889), p. 268 ff. and 49 (NF. 3, 1890), p. 479 ff.; V. Boehlau, *Aus ionischen und äolischen Necropolen* (Cassel, 1897); H. W. Smyth, *The Ionic Dialect* (1889). P. Cauer, "De dialecto attica vetustiore quaestiones epigraphicae," in G. Curtius, *Studien z. gr. u. lat. Gramm.* 8 (1875), p. 223, 399; Karsten, *De titulorum Ionicorum dialecto* (Halle, 1882); F. Bechtel, *Die Inschriften des ion. Dialekts* (Göttingen, 1877). For the political history of the Ionian Greeks see GREECE: *History*, and IONIA; for the special history and characteristics of individual Ionian cities, the respective names.

(J. L. M.)

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1 *Yunān* is still a popular synonym for *Oroum*, a Greek, among the Arabs; in India *Yavana* was long the generic name for all foreigners from the north and west, a use dating probably from Alexander's day and the Graeco-Bactrian monarchs.

IONIAN SCHOOL OF PHILOSOPHY. Under this name are included a number of philosophers of the 6th and 5th centuries B.C. Mainly Ionians by birth, they are united by a local tie and represent all that was best in the early Ionian intellect. It is a most interesting fact in the history of Greek thought that its birth took place not in Greece but in the colonies on the Eastern shores of the Aegean Sea. But not only geographically do these philosophers form a school; they are one in method and aim. They all sought to explain the material universe as given in sensible perception; their explanation was in terms of matter, movement, force. In this they differed from the Eleatics and the Pythagoreans who thought in the abstract, and explained knowledge and existence in metaphysical terminology. In tracing the development of their ideas, two periods may be distinguished. The earliest thinkers down to Heraclitus endeavoured to find a material substance of which all things consist; Heraclitus, by his principle of universal flux, took a new line and explained everything in terms of force, movement, dynamic energy. The former asked the question, "What is the substratum of the things we see?"; the latter, "How did the sensible world become what it is; of what nature was the motive force?"

The first name in the list of the Ionian philosophers—and, indeed, in the history of European thought—is that of Thales (*q.v.*). He first, so far as we know, sought to go behind the infinite multiplicity of phenomena in the hope of finding an infinite unity from which all difference has been evolved. This unity he decided is Water (πάντα ὕδωρ ἐστίν). It is impossible to discover precisely what he conceived to be the relation of this unity to the plurality of phenomena. Later writers from whom we derive our knowledge of Thales attributed to him ideas which seem to have been conceived by subsequent thinkers. Thus the suggestion preserved by Stobaeus that he

conceived water to be endowed with mind is discredited by the specific statement of Aristotle that the earlier physicists (*physiologi*) did not distinguish the material from the moving cause, and that before Anaxagoras no one postulated creative intelligence. Again in the *De anima* (i. 5) Aristotle quotes the statement that Thales attributed to water a divine intelligence, and criticizes it as an inference from later speculations. It is probably safest to credit Thales with the bare mechanical conception of a universal material cause, leaving pantheistic ideas to a later period of thought.

The successors of Thales were Anaximander and Anaximenes, who also sought for a primal substance of things. Anaximander postulated a corporeal substance intermediate between air and fire on the one hand, and between earth and water on the other hand. This substance he called "the Infinite" (τὸ ἄπειρον). Unlike Thales, he was struck by the infinite variety in things; he felt that all differences are finite, that they have emerged from primal unity (first called ἄρχη by him) into which they must ultimately return, that the Infinite One has been, is, and always will be, the same, indeterminate but immutable. Change, growth and decay he explained on the principle of mechanical compensation (διδόναι γὰρ αὐτὰ τίσιν καὶ δίκην τῆς ἀδικίας).

Anaximenes, pupil of Anaximander, seems to have rebelled against the extreme materialism of his master. Perceiving that air is necessary to life, that the universe is surrounded by air, he was convinced that out of air all things have resulted. The process by which things grow is twofold, condensation (πύκνωσις) and rarefaction (ἀραίωσις), or, in other words, *heat* and *cold*. From the former process result cloud, water and stone; from the latter, fire and aether. This theory is closely allied to that of Thales, but it is superior in that it specifies the processes of change. Further, it is difficult not to accept Cicero's statement that Anaximenes made air a conscious deity; we are, at all events, justified in regarding Anaximenes as a link (perhaps an unconscious link) between crude Hylozoism (*q.v.*) and definitely metaphysical theories of existence.

We have seen that Thales recognized change, but attempted no explanation; that Anaximander spoke of change in two directions; that Anaximenes called these two directions by specific names. From this last, the transition to the doctrine of Heraclitus is easy. He felt that change is the essential fact of experience and pointed out that any merely physical explanation of plurality is inherently impossible. The Many is of Sense; Unity is of Thought. Being is intelligible only in terms of Becoming. That which is, is what it is in virtue of its perpetually changing relations (πάντα ῥεῖ καὶ οὐδὲν μένει). By this recognition of the necessary correlation of Being and Not-being, Heraclitus is in a very real sense the father of metaphysical and scientific speculation, and in him the Ionian school of philosophy reached its highest point. Yet there is reason to doubt the view of Hegel and Lassalle that Heraclitus recognized the fundamental distinction of subject and object and the relations of mind and matter. Like the early Ionians he postulated a primary substance, fire, out of which all things have emerged and into which all must return. This elemental fire is in itself a divine rational process, the harmony of which constitutes the law of the universe. Human knowledge consists in the comprehension of this all-pervading harmony as embodied in the manifold of perception; the senses are "bad witnesses" in that they report multiplicity as fixed and existent in itself rather than in its relation to the One. This theory gives birth to a sort of ethical by-product whose dominant note is Harmony, the subordination of the individual to the universal reason; moral failure is proportionate to the degree in which the individual declines to recognize his personal transience in relation to the eternal Unity. From the same principle there follows the doctrine of Immortality. The individual, like the phenomena of sense, comes out of the infinite and again is merged; hence on the one hand he is never a separate entity at all, while on the other hand he exists in the infinite and must continue to exist. Moreover, the soul approaches most nearly to perfection when it is least differentiated from elemental fire; it follows that "while we live our souls are dead within us, but when we die our souls are restored to life." This doctrine is at once the assertion and the denial of the self, and furnishes a striking parallel between European thought in its earliest stages and the fundamental principles of Buddhism. Knowledge of the self is one with knowledge of the Universal Logos (Reason); such knowledge is the basis not only of conduct but of existence itself in its only real sense.

Thus far the Ionian philosophers had held the field of thought. Each succeeding thinker had more or less assumed the methods of Thales, and had approached the problem of existence from the empirical side. About the time of Heraclitus, however, there sprang up a totally new philosophical spirit. Parmenides and Zeno (see Eleatic School) enunciated the principle that "Nothing is born of nothing." Hence the problem becomes a dialectical a priori speculation wherein the laws of thought transcend the sense-given data of experience. It was therefore left for the later Ionians to frame an eclectic system, a synthesis of Being and Not-being, a correlation of universal mobility and absolute permanence. This examination of diametrically opposed tendencies resulted in several different theories. It will be sufficient here to deal with Anaxagoras, Diogenes of Apollonia, Archelaus and Hippo, leaving Empedocles, Leucippus and Democritus to special articles (*q.v.*). The latter three do not belong strictly to the Ionian School.

Anaxagoras (*q.v.*) elaborated a quasi-dualistic theory according to which all things have existed from the beginning. Originally they existed in infinitesimal fragments, infinite in number and devoid of arrangement. Amongst these fragments were the seeds of all things which have since emerged by the process of aggregation and segregation, wherein homogeneous fragments came

together. These processes are the work of Nous (νοῦς) which governs and arranges. But this Nous, or Mind, is not incorporeal; it is the thinnest of all things; its action on the particle is conceived materially. It originated a rotatory movement, which arising in one point gradually extended till the whole was in motion, which motion continues and will continue infinitely. By this motion things are gradually constructed not entirely of homogeneous particles (the homoeomerê, ὁμοιομερῆ) but in each thing with a majority of a certain kind of particle. It is this aggregation which we describe variously as birth, death, maturity, decay, and of which the senses give inaccurate reports. His vague dualism works a very distinct advance upon the crude hylozoism of the early Ionians (see Atom), and the criticisms of Plato and Aristotle show how highly his work was esteemed. The great danger is that we should credit him with more than he actually thought. His *Nous* was not a spiritual force; it was no omnipotent deity; it is not a pantheistic world-soul. But by isolating Reason from all other growths, by representing it as the motor-energy of the Cosmos, in popularizing a term which suggested personality and will, Anaxagoras gave an impetus to ideas which were the basis of Aristotelian philosophy in Greece and in Europe at large.

In Diogenes of Apollonia we find a return to Anaximenes. Diogenes (*q.v.*) began by insisting on the necessity of there being only one principle of things, herein contradicting the pluralism of Heraclitus. This principle is that of the universal homogeneity of nature; all things are at bottom the same, or interaction would be impossible (πάντα τὰ ἔοντα ἀπὸ τοῦ αὐτοῦ ἑτεροιοῦσθαι καὶ τὸ αὐτὸ εἶναι). This universal substance is Air. But Diogenes went much farther than Anaximenes by attributing to air not only infinity and eternity but also intelligence. This Intelligence alone would have produced the orderly arrangement which we observe in Nature, and is the basis of human thought by the physical process of inhalation.

Another pupil of Anaxagoras was Archelaus of Miletus (*q.v.*). His work was mainly the combination of previous views, except that he is said to have introduced an ethical side into the Ionian philosophy. “Justice and injustice,” he said, “are not natural but legal.” He endeavoured to overcome the dualism of Anaxagoras, and in so doing approached more nearly to the older Ionians.

The last of the Ionians whom we need mention is Hippo (*q.v.*), who, like Archelaus, is intellectually amongst the earlier members of the school. He thought that the source of all things was moisture (τὸ ὑγρόν), and is by Aristotle coupled with Thales (*Metaphysics*, A 3).

Bibliography.—Ritter and Preller, ch. i.; Zeller’s *History of Greek Philosophy*; J. Burnet, *Early Greek Philosophy* (1892); Fairbanks, *The First Philosophers of Greece* (1898); Grote, *History of Greece*, ch. viii.; Windelband, *History of Ancient Philosophy* (1899); Benn, *The Greek Philosophers* (1883) and *The Philosophy of Greece* (1898); Th. Gomperz, *Greek Thinkers* (Eng. trans. vol. i., L. Magnus, 1901).

IOPHON, Greek tragic poet, son of Sophocles. He gained the second prize in 428 B.C., Euripides being first, and Ion third. He must have been living in 405, the date of the production of the *Frogs* of Aristophanes, in which he is spoken of as the only good Athenian tragic poet, although it is hinted that he owed much to his father’s assistance. He wrote 50 plays, of which only a few fragments remain. It is said that Iophon accused his father before the court of the phratores of being incapable of managing his affairs, to which Sophocles replied by reading the famous chorus of the *Oedipus at Colonus* (688 ff.), with the result that he was triumphantly acquitted.

See Aristophanes, *Frogs*, 73, 78, with scholia; Cicero, *De senectute*, vii. 22; Plutarch, *Moralia*, 785 B; A. Nauck, *Tragicorum Graecorum fragmenta* (1889); O. Wolff, *De Iophonte poëta* (Leipzig, 1884).

I.O.U. (“I owe you”), a written acknowledgment of a debt. It usually runs thus:

To——. I.O.U. ——pounds.
(Signed)——. Date——.

An I.O.U., if worded as above, or even if the words “for value received” are added, does not acquire a stamp, as it contains no terms of agreement. If any such words as “to be paid on such

a day" are added, it requires a stamp. An I.O.U. should be addressed to the creditor by name, though its validity is not impaired by such omission. Being a distinct admission of a sum due, it is prima facie evidence of an account stated, but where it is the only item of evidence of account it may be rebutted by showing there was no debt and no demand which could be enforced by virtue of it. An I.O.U. is not negotiable.

IOVILAE, or JOVILAE, a latinized form of *iůvilas*, the name given by the Oscan-speaking Campanians in the 5th, 4th and 3rd centuries B.C. to an interesting class of monuments, not yet fully understood. They all bear crests or heraldic emblems proper to some family or group of families, and inscriptions directing the annual performance of certain ceremonies on fixed days. While some of them are dedicated to Jupiter (in a special capacity, which our present knowledge of Oscan is insufficient to determine), others were certainly found attached to graves.

See the articles OSCA LINGUA, CAPUA, CUMAE and MESSAPII. The text of all those yet discovered (at Capua and Cumae), with particulars of similar usages elsewhere in Italy and other historical and archaeological detail, is given by R. S. Conway in *The Italic Dialects* (Cambridge, 1897, pp. 101 ff.). A briefer but valuable discussion of the chief characteristics of the group will be found in R. von Planta's *Oskisch-umbrische Grammatik*, ii. 631 ff., and a summary description in C. D. Buck's *Osco-Umbrian Grammar*, 247.

(R. S. C.)

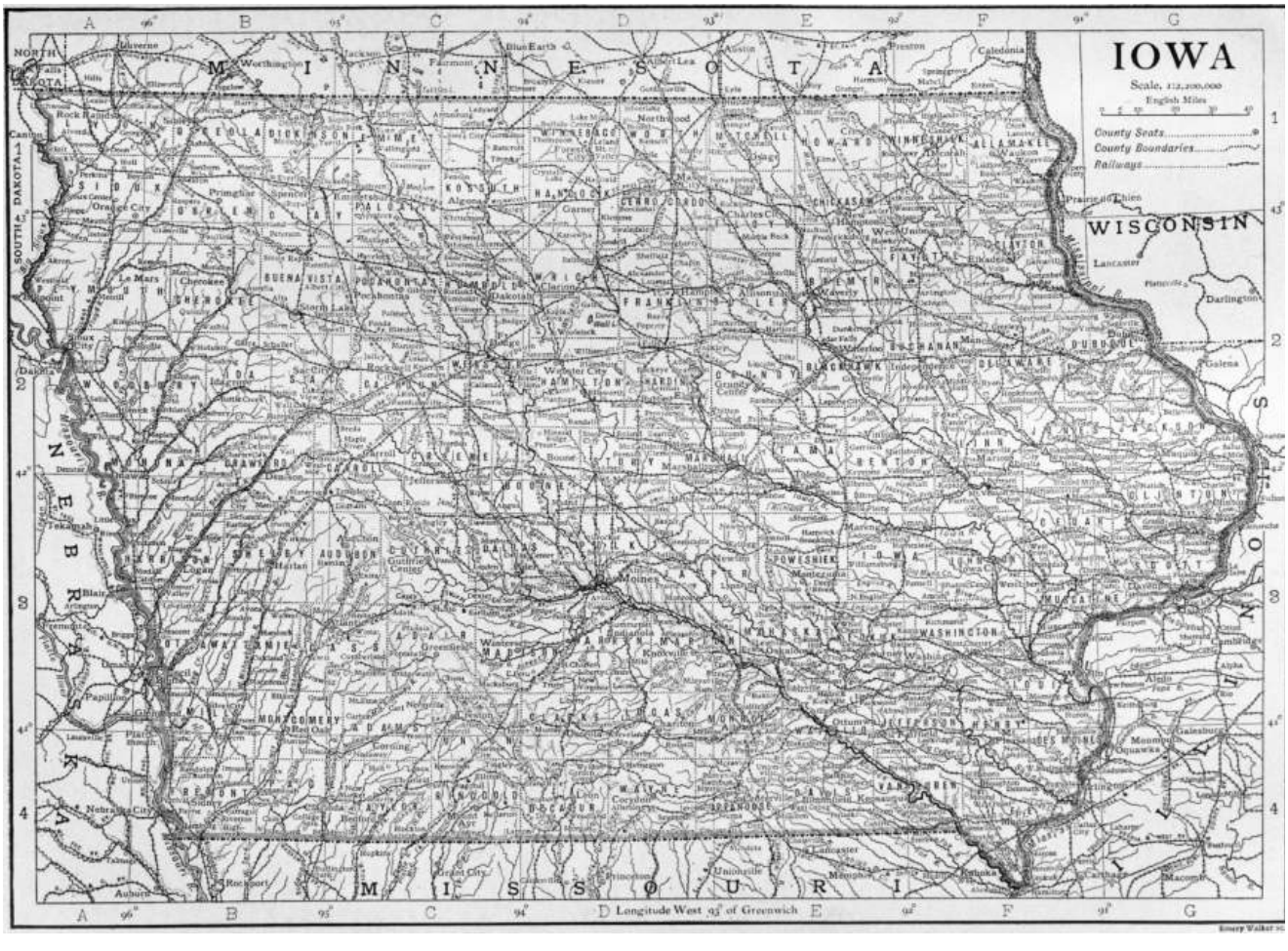
IOWA, a north central state of the United States, situated between latitudes 40° 36′ and 43° 30′ N. and between longitudes 89° 5′ and 96° 31′ W. It is bounded N. by Minnesota, E. by the Mississippi river, which separates it from Wisconsin and Illinois, S. by Missouri, and W. by the Missouri and Big Sioux rivers, which separate it from Nebraska and South Dakota. Its total area is 56,147 sq. m., of which 561 sq. m. are water surface.

Physical Features.—Topographically, Iowa lies wholly in the Prairie Plains Region, part of it having been overrun by the Great Ice Sheet of the Glacial epoch. For the most part the surface is that of a prairie tableland, moderately rolling, and with a general but scarcely perceptible slope, which in the eastern two-thirds is from N.W. to S.E., and in the western third from N.E. to S.W. Elevations above the sea range from between 1200 to 1675 ft. in the N.W. to 500 ft. and less in the S.E., the highest point being in the vicinity of Spirit lake in Dickinson county, the lowest at Keokuk. In the southern half of the state the height of the crests of the divides is very uniform. The northern half is more broken and irregular; elevations, usually rounded, mingle with depressions some of which are occupied by small shallow lakes or ponds, the characteristic physical features of this region being due to glaciation. But the most marked departures from the prairie surface are in the N.E. and S.W. In the N.E. the whole of Allamakee and parts of Winneshick, Fayette, Clayton, Delaware, Dubuque and Jackson counties form the only driftless area of the state; in that section cliffs frequently rise almost vertically from the banks of a river to a height of from 300 to 400 ft., and from the summit of the cliff to the crest of the divide, a few miles distant, there is another ascent of 300 ft. or more terminating occasionally in knob-topped hills crowned in many instances with small cedar. Moreover, the largest streams have numerous tributaries, and nearly all alike flow circuitously between steep if not vertical cliffs or in deep craggy ravines overlooked by distant hills, among which the wagon road has wound its way with difficulty. In the W., S. from the mouth of the Big Sioux river, extends a line of mound-like bluffs usually free from rocks, but rising abruptly from the flood plain of the Missouri to a height varying from 100 to 300 ft. A broad water-parting extending from Spirit lake, on the northern border, nearly S. to within 60 m. of the southern border, and thence S.E. to Wayne county in the south central part of Iowa, divides the state into two drainage systems. That to the E., comprising about two-thirds of the whole area, is drained by tributaries of the Mississippi, of which the Des Moines, the Skunk, the Iowa with its tributary the Cedar, and the Wapsipinicon are the largest, streams of long courses and easy fall over beds frequently pebbly in the N. but muddy in the S., and through valleys broad at their sources, well drained, and gently sloping in the middle of their courses, but becoming narrower and deeper towards their mouths; that to the W. is drained by tributaries of the Missouri, mostly short streams taking their rise from numerous rivulets, flowing quite rapidly over muddy beds through much of their courses, and in the bluff belt along the Missouri having steep but grassy banks 200 ft. in height or more. (For geological details, see UNITED STATES, section *Geology, ad fin.*)

Flora and Fauna.—The predominant feature of the flora is the grasses of the prairie. The

former forests of the state were of two general classes: on the bottom lands along the rivers grew cottonwood, willow, honey-locust, coffee trees, black ash, and elm; on the less heavily wooded uplands were oaks (white, red, yellow and bur), hickory (bitternut and pignut), white and green ash, butternut, ironwood and hackberry. The growth was heavier, however, in the E. than in the W., but, it has been estimated, covered in all about one-fifth of the area of the state at the time of its first settlement by the whites. In the N.E., also, small cedar and pine are found. But everywhere now most of the merchantable timber has been cut; in 1900 it was estimated that there were altogether about 7000, sq. m. of woodland in the state. The bison and elk long ago disappeared; black bear and deer were long found in unsettled parts of the state. Ducks, geese and other water birds are common, especially during their migrations.

Climate.—The climate is one of great extremes of heat and cold, with a dry winter and a usually wet summer, the prevailing wind of winter being N.W. while in summer it not infrequently blows from the S.W. Both the midwinter isotherm of Montreal and the mid-summer one of Washington, D.C., pass through the state. The mean annual temperature is 47.5° F.; the average range of extremes per year during the decade ending with 1900 was 136° F., while the greatest extremes recorded are from −43° F. in 1888 to 113° F. in 1901, a difference of 156° F. From 1893 to 1898 the average mean annual temperature at Cresco in Howard county, near the N.E. corner of the state, was 44.3° F., while at Keokuk in the S.E. corner it was 52.2° F., and as the isotherms cross the state, especially in the N., their tendency is to move S.W. The rainfall is also very unequal in distribution throughout the year, as also between the same periods of different years, and as between the different parts of the state. For while the mean annual precipitation is 31.42 in., 22.48 in., or 71% of this, fall during the six months from the 1st of April to the 1st of October, or 10% in winter, 23% in autumn, 28% in spring and 39% in summer, June and July being the two wettest months. At the same time extremes during the four most critical crop months, from the 1st of May to the 1st of September, have ranged from 6.75 in. in 1894 to 27.8 in. in 1902. Within any one year the precipitation is in general usually less in the western part of the state than in the eastern, the mean difference for all the years of record up to the close of 1903 being 2.5 in.; the western part also is marked by having a still larger per cent of its rain in spring and summer than has the eastern. The unequal distribution throughout the state is in much larger measure due to local showers. Injury to crops from drought and hot winds has occurred about two or three times in a decade, but liability to injury of the crops from excessive rainfall and hailstorms is greater than that from a deficiency of moisture. Three notable tornadoes have swept portions of the state: the Comanche in June 1860, the Grinnell in June 1882 and the Pomeroy in July 1893; but the greatest area traversed by any of these was less than one-twentieth of 1% of the total area of the state, and this kind of storm has been less destructive to human life, animals and buildings than the lightning which accompanies summer showers.



(Click to enlarge.)

Soil, Agriculture.—Its depth, together with its porous nature, makes the fertile soil of Iowa capable of withstanding the extremes of wet and dry remarkably well, and it is perhaps true that, taken as a whole, no other state in the Union has a superior soil for agriculture. Certainly no other has so many acres of improved land, or so large a proportion—from 85 to 90%—of its land subject to cultivation. The soil is of four kinds: till or drift, alluvial, loess or bluff and geest. The dark drift, composed chiefly of clay, sand, gravel, boulders and lime, is both the soil and subsoil of the greater part (about 66%) of the state, being especially predominant in the N. and N.W. The alluvial soil, composed of what has been washed from other soils, together with decayed vegetable matter, covers about 6% of the surface of the state and is found in the river bottoms, of greatest extent in that of the Missouri; it varies much in fertility. The loess soil, chiefly a mixture of porous clay and carbonate of lime, forms the bluffs bordering the bottom lands of the Missouri and is common in the N.E. Its fertility is not inferior to that of the better drift. Geest is found particularly in the north-eastern part of the state; it covers less than 1% of the area of the state.

The superior qualities of the soil, together with the usually warm and moist months of spring and summer, make Iowa one of the foremost states of the Union in agriculture and stock-raising, especially in the production of Indian corn, oats, hay and eggs, and in the raising of hogs, horses, dairy cows and poultry. In comparison with its other industries it stands also pre-eminently as an agricultural state; for of its 789,404 labourers in 1900, 371,604, or 47%, were engaged in agriculture, 129,006 being engaged in trade and transportation, and 124,803 in manufactures and mechanical pursuits. In 1899 the total value of the agricultural products, $365,411,528, was greater than that of any other state. Of the farms 65.1% were cultivated by owners in 1900, a decrease from 76.2% in 1880; and 19.5% were cultivated by cash tenants, an increase from 4.5% in 1880. After 1880 the percentage of farms operated by share tenants slowly but steadily decreased, falling from 19.4% in 1880 to 15.4% in 1900. Between 1880 and 1900 the average number of acres to a farm slightly increased—from 133.5 acres in 1880 to 151.2 acres in 1900—instead of decreasing as in the older states of the Union; though the increase was not nearly so marked as in such states as Nevada, Montana, Wyoming and Texas. Iowa about equals Illinois in the production of both Indian corn and oats, nearly 10,000,000 acres or about one-third of its improved area usually being planted with Indian corn, with a yield varying from 227,908,850 bushels in 1901 (according to state reports) to 373,275,000 (the largest in the United States, with a crop value second only to that of Illinois) in 1906. According to the Department of Agriculture in 1907 the acreage was 9,160,000 and the yield 270,220,000 bushels (considerably less than the Illinois crop); the yield of oats was 168,364,170 bushels (Twelfth U.S. Census) in 1899, 124,738,337 bushels (U.S. Department of Agriculture) in 1902, and in 1907 the acreage and crop (greater than those of any other state) were 4,500,000 acres and 108,900,000 bushels, valued at $41,382,000—a valuation second only to that of Illinois. In total acreage of cereals (16,920,095 in 1899) it ranked first (Twelfth Census of the United States), and in product of cereals was exceeded by Illinois only; in acreage of hay and forage (4,649,378 in 1899) as well as in the annual supply of milk (535,872,240 gallons in 1899) it was exceeded by New York only. In 1905, according to railway reports, 91,051,551 lb of butter were carried to points outside the state. It ranked far ahead of any other state in 1908 in the number of its hogs (8,413,000, being 15% of the whole number in the United States), Illinois, the second in rank, having only about half as many. It ranked first in 1900 in the number of horses (1,392,573); in the number of poultry (about 20,000,000); in the annual egg product (99,621,290 dozen in 1899); in the total acreage of all crops (22,170,000); in the total value of agricultural products; and in the total value of live stock ($271,844,034). In 1899 it ranked fourth in the production of barley (18,059,050 bushels) and in 1907 sixth (14,178,000 bushels). The wheat crop has varied from 12,531,304 bushels in 1903, 13,683,003 bushels in 1905, 7,653,000 bushels in 1907 (according to the U.S. Department of Agriculture), to 22,769,440 bushels (Twelfth Census) in 1899. Potatoes, apples and small fruits are grown successfully. For the most part the several crops are quite evenly distributed throughout the state; but nearly all the winter wheat is grown in the S. and N.W., spring wheat most largely in the N.W., barley mostly in the N., flax-seed and prairie hay in the N.E.

Minerals.—The first mines to be worked in Iowa were those for lead and zinc at Dubuque and to the northward. These are little mined at present, only 110 tons of lead ore and 516 tons of zinc ore being taken from the mines in 1908. Of more promise is the gypsum deposit extending over an area of about 50 sq. m. in the vicinity of Fort Dodge (Webster county), from which was taken in 1908 a product valued at $565,645, having increased to that figure from $45,819 in 1898. Limestones and sandstone are also profitably quarried, the value of the product in 1908 being $530,945 for limestone and $2337 for sandstone. The principal mineral of Iowa, however, is bituminous coal; it ranked in 1908 eighth among the coal-producing states of the Union, its product being valued at $11,706,402. The beds lie in the southern half of the state, extending under about two-fifths of its surface.

Trade and Commerce.—The manufactures of Iowa are chiefly such as have to do with the products of the farm. Meat packing is the most important, the product of this industry amounting

in 1900 to $25,695,044, and in 1905 to $30,074,070, an increase of 17% in this period; in 1900 the state was seventh, in 1905 sixth, among the states in the value of this industry, producing in each year 3.3% of the total. Next in importance is the manufacture of dairy products, the value of which in 1900 was $15,846,077 (an increase of 50.3% in ten years) and in 1905 was $15,028,326; at both censuses the state ranked third in the value of cheese, butter, and condensed milk and of food preparations, which were valued at $6,934,724 in 1905. Flour and grist-mill products ranked third both in 1900 and 1905, the value of the product for the later year being $12,099,493, an increase of 9.9% over the value for the earlier. Among the lesser manufactures are lumber and timber products (value in 1905, $5,610,772), most of the raw material being floated down on rafts from Wisconsin and Minnesota. The largest centres of industry are Sioux City, Davenport, Dubuque, Des Moines, Burlington and Council Bluffs. In 1905 the gross value of the manufactured product (of establishments on the factory system) was $160,572,313, as against $132,870,865 in 1900, an increase of 20.8%; whereas, even including the products of smaller establishments not technically factories, the value of the product in 1850 was only $3,551,783, and in 1880 was only $71,045,926.

The means of transportation is afforded chiefly by the steam railways, of which the state had 9,907.44 m. in January 1909. Scarcely a farm is more than 6 or 8 m. from a railway station; and only three other states have a greater railway mileage. The great period of railway building in Iowa was during the twenty-five years immediately following the close of the Civil War, the railway mileage being only 655 m. in 1860. The several roads are under the management of twenty-seven companies, but about 75% of the business is done by the Chicago Burlington & Quincy, the Chicago & North-Western, the Chicago Milwaukee & St Paul and the Chicago Rock Island & Pacific. Electric interurban railways are increasing in importance for freight and passenger service. In 1908 about 225 m. of such railways were in operation. Transportation facilities by water are afforded by the Mississippi river. The former difficulties with the Des Moines Rapids of the Mississippi (which are passable for rafts and light boats at high water) have been overcome by a canal from Keokuk to Montrose constructed by the National Government. Other federal improvements undertaken are a harbour at Muscatine, a harbour of refuge below Davenport and channel improvements at Clinton.

Population.—The population of Iowa in 1850 was 192,214; in 1860, 674,913; in 1880, 1,624,615; in 1890, 1,911,896; in 1900, 2,231,853. The state census of 1905 showed a total population of 2,210,050, and the Federal census of 1910, of 2,224,771. Of the population in 1905, 1,264,443 (57.2%) were native whites of native parentage, 648,532 (29.3%) were native whites of foreign parentage, 289,296 (12.8%) were foreign-born and 14,832 (0.7%) were coloured, including 346 Indians. The Indians, a remnant of the Sauk and Foxes, are most unprogressive, and are settled on a reservation in Tama county in the east-central section of the state.

In 1906 it was estimated that there were 788,667 communicants of all religious denominations; of these 207,607 were Roman Catholics; 164,329 Methodists; 117,668 Lutherans; 60,081 Presbyterians; 55,948 Disciples of Christ; 44,096 Baptists; 37,061 Congregationalists; 11,681 members of the German Evangelical Synod; and 8990 Protestant Episcopalians.

The rural element of the population is large, though it is not increasing as rapidly as the urban; and no other state in the Union is so uniformly settled. There were in 1905 seven cities with a population of 25,000 or more; twenty with 8000 or more; and thirty-seven with 4000 or more. Between 1890 and 1900 the urban population increased 38.3%, while the rural increased 14.6%. The chief cities are Des Moines (pop. in 1905, 75,626), Dubuque (41,941), Davenport (39,797), Sioux City (40,952), Cedar Rapids (28,759), Council Bluffs (25,231) and Burlington (25,318).

Government.—There is comparatively little in the political institutions of Iowa dissimilar to those of other states of the Union; they show in recent years a tendency toward greater centralization—in boards, however, rather than in individual officers. The constitution now in force was adopted in 1857, the constitution of 1846 having been superseded chiefly on account of its prohibition of banking corporations. The present one admits of amendment by a vote of a majority of the members of both houses of the legislature, followed by a majority vote of the electors in the state voting on the amendment; and by this process it was amended in 1868, 1880, 1884 and 1904. The present constitution also provides that the question, “Shall there be a convention to revise the constitution and amend the same?” shall be submitted to the people once every ten years (beginning with 1870), but the affirmative vote taken in accordance with this provision has hitherto been small. The suffrage now belongs to all male citizens of the United States at least twenty-one years of age who shall have resided in the state for six months, and in some one county sixty days preceding an election, except idiots and persons insane or convicted of some infamous crime. The franchise was conferred on negroes by an amendment adopted in 1868. Prior to 1904 elections were annual, but by an amendment of that year they became biennial.

The central executive and administrative authority is vested in a governor, a lieutenant-governor, an executive council, several boards and a few other officers. The governor and the lieutenant-governor was elected for a term of two years, and the qualifications for both offices require that the incumbents shall be at least thirty years of age and shall have been for two years immediately before their election residents of the state. Under the Territorial government when first organized the governor was given an extensive appointing power, as well as the right of an absolute veto on all legislation, but this speedily resulted in such friction between him and the legislature that Congress was petitioned for his removal, with the outcome that the office has since been much restricted in its appointing power, and the veto has been subjected to the ordinary United States limit, *i.e.* it may be overridden by a two-thirds vote of both houses of the legislature. Members of boards of regents or trustees of state institutions are for the most part elected by the General Assembly; railway commissioners are elected by the state electors; while in the case of the few appointments left for the governor, the recommendation or approval of the executive council, a branch of the legislature, or of some board, is usually required. He, however, is himself a member of the executive council as well as of some important boards or commissions, and it is in such capacity that he often has the greatest opportunity to exert power and influence. His salary is $5000 per annum (with $600 for house rent and $800 as a member of the executive council). The executive council, composed of the governor, secretary of state, auditor of state and treasurer of state, all elected by the people for a term of two years, has extensive powers. It supervises and audits the accounts of state departments, directs the taking of the census, transfers cities from one class to another in accordance with census returns, constitutes the board for canvassing election returns, classifies railways, assesses railway and other companies, constitutes the state board of equalization for adjusting property valuations between the several counties for taxing purposes, supervises the incorporation of building and loan associations, appoints the board of examiners of mine inspectors and has many other powers. Among other state boards the more important are the board of railroad commissioners, the board of control of state institutions, the board of health, and the board of educational examiners.

The state legislature, or General Assembly, composed of a senate and a house of representatives, sits biennially at Des Moines. Senators are elected for a term of four years, one from each of fifty senatorial districts, the term of one-half expiring every two years. Senators must be at least twenty-five years of age and residents of the state for one year at the time of election. Representatives are elected for a term of two years, one from each of the ninety-nine counties, with an additional one from each of the counties (not exceeding nine) having the largest population; the ratio of representation and the apportionment of the additional representatives from the larger counties is fixed by the General Assembly. The qualifications for representatives differ from those for electors only in that they must have been residents of the state for one year at the time of election, the disqualification of negroes for sitting in both senate and house having been removed by an amendment adopted in 1880. No bill can pass either house without the assent of a majority of all the members elected to that house; the governor is allowed three days (Sunday excepted) in which to veto a bill.

The state judiciary consists of a supreme court of six judges and a district court of fifty-three judges, from one to four in each of twenty districts. The supreme court has three sessions a year, while each district-court judge is directed to hold at least one session a year in each county of his district, and no two district-court judges may sit together on the same case. The supreme court has appellate jurisdiction in chancery cases only, but may correct errors at law in other cases. The district court has general, original and exclusive jurisdiction in all matters civil, criminal and probate not expressly conferred on an inferior court, and may hear appeals from inferior courts, boards or officers.

For purposes of administration and local government the state is divided into ninety-nine counties, each of which is itself divided into townships that are usually 6 m. square. The township may be divided into school districts and highway districts, but in these matters option has resulted in irregularity. Each county has its own administrative boards and officers; and there are two justices of the peace and two constables for every township. The board of supervisors, consisting of not more than seven members, elected for a term of three years, has the care of county property and the management of county business, including highways and bridges; it fixes the rate of county taxes within prescribed limits, and levies the taxes for state and county purposes. The officers of the township are three trustees, a clerk and an assessor. The trustees are elected for a term of three years, the clerk and assessor for two years. All taxable property of the state, that of corporations for the most part excepted, is assessed by the township assessor.

The municipal corporations are civil divisions quite independent of the county and township system. They are divided into cities of the first class, cities of the second class and towns, besides a few cities with special charters. Cities of the first class are those having a population of 15,000 or over; cities of the second class are those having a population of 2000 but less than 15,000; all other municipal corporations, except cities with special charters, are known as

incorporated towns. In all these cities and towns a mayor, council and various officers are elected, and also a police judge in cities of the first class where there is no superior court. By a law of 1907 cities with a population of 25,000 or more may adopt a commission form of government, with a mayor and four councilmen elected at large on a non-partisan ticket.

Under the laws of Iowa a wife enjoys property rights equal to those of her husband. The expenses of the family, including the education of the children, are chargeable alike upon the property of either or both. Otherwise, the wife may control her property as if single, and neither is liable for what are clearly the debts of the other. In case of the death of either, one-third of the property of the deceased becomes that of the survivor. A homestead cannot be conveyed or encumbered without the consent of both husband and wife, if held by a married man; and a homestead, to the value of $500, is exempt from liability for debts postdating the purchase, unless for improvements on the property. A petition for a divorce may be presented after a residence within the state of one year immediately preceding, and a decree may be granted against the defendant if judged guilty of adultery, desertion for two years without reasonable cause, habitual drunkenness, such inhuman treatment as to endanger the life of the plaintiff, or if convicted of felony after marriage. In 1882 an amendment to the constitution was passed prohibiting the manufacture and the sale of intoxicating liquors within the state. In April 1883 the Supreme Court pronounced this amendment invalid on the ground of irregularity in recording it, whereupon the legislature provided for a like prohibition in an ordinary statute. But attempts to execute this were so unsuccessful that it has been succeeded by a law imposing what is known as the “mulct tax,” which requires the payment of $600 in quarterly instalments for a licence to sell such liquors and places a lien for the whole amount on the real property in use for the business. One-half the proceeds goes to the county and one-half to the municipality or township in which the liquor is sold. The exceptional dependence of Iowa on eastern markets has given more than ordinary prominence to railway legislation, and the conflict of interests between the railways and the shippers has agitated the state for forty years, various attempts being made to regulate freight rates by legal enactment. In 1888 an elective commission was established with power to fix maximum rates, which has met with general commendation throughout the country.

The charitable, penal and reformatory institutions of the state are all under a “Board of Control of State Institutions,” composed of three electors appointed by the governor and approved by two-thirds of the senators, careful provision being made also to prevent the board from becoming subject to either political party. The institutions under its charge include a Soldiers’ Orphans’ Home at Davenport; a Soldiers’ Home at Marshalltown; a College for the Blind at Vinton; a School for the Deaf at Council Bluffs; an Institution for Feeble-minded Children at Glenwood; an Industrial School for Boys at Eldora; an Industrial School for Girls at Mitchellville; and, at Oakdale, a Sanatorium for the Treatment of Tuberculosis. The Board of Control of State Institutions has supervisory and inquisitorial powers over all county and private institutions in the state in which insane are kept, and over homes for friendless children maintained by societies or institutions. In 1907 the General Assembly passed a law under which the indeterminate sentence was established in the state, and the governor appoints a Board of Parole of three members, of whom one must be an attorney and not more than two are to belong to the same political party.

Education.—The percentage of illiterates (*i.e.* both those unable to read and write and those unable to write) ten years of age and over, according to the census returns of 1900, was only 2.3; of all the other states of the Union, Nebraska alone made such a good return. But teachers were poorly paid, and fourteen schools have been closed at a time within a single county from want of teachers. However, there are laws requiring that each school be taught at least six months in a year, and that children between the ages of seven and fourteen attend for at least twelve consecutive weeks, and for a total of sixteen weeks in every year. In 1905-1906 male teachers received on an average $63.97 per month, women teachers, $43.41. Although the electors of each school district have ample powers reserved to them, in actual practice matters are attended to chiefly by an elected board of directors. The county administration is in the hands of a board of education and a superintendent. The school tax was derived in 1905-1906 from interest on the state’s permanent school fund—amounting to 2.3% of the total tax, and distributed in proportion to the population of school age; from a 1 to 3 mill county tax, amounting to 5.2% of the whole; and from local or district taxation, 92.5% of the entire tax. A law of the state provides for the establishment of a county high school whenever a majority of the electors of a county desire it, but in 1902 only one county (Guthrie county) had such a school. The number of public high schools in towns and cities, however, increased from 256 in 1893 to 345 in 1903. The state established a university at Iowa City in 1847, a State Agricultural College and Model Farm in 1858 (opened at Ames in 1869 as the Iowa State College of Agriculture and the Mechanic Arts), an Agricultural Experiment Station in 1887, an Engineering Experiment Station in 1904, and a normal school at Cedar Falls in 1876.

At the head of the whole system is the state superintendent of public instruction, assisted by a board of educational examiners. In 1901 the total receipts for school purposes were $6,001,187; and the total disbursements $5,813,541; in 1906 the receipts were $7,126,162.12 and the disbursements $6,950,580.27. The pupils enumerated in 1906 were 707,843. Educational

institutions not supported by the state include: Iowa Wesleyan University (Methodist, opened in 1842) at Mt. Pleasant; Iowa College (Congregational, 1848) at Grinnell; Central University of Iowa (Baptist, 1853) at Pella; Cornell College (Methodist, 1857) at Mt. Vernon; Western College (United Brethren, 1856) at Toledo; Upper Iowa University (Methodist Episcopal, 1857) at Fayette; Leander Clark College (United Brethren, 1857) at Toledo; Lenox College (Presbyterian, 1859) at Hopkinton; Luther College (Norwegian Evangelical Lutheran, 1861) at Decorah; Des Moines College (Baptist, 1865) at Des Moines; Tabor College (Congregational, 1866) at Tabor; Simpson College (Methodist, 1867) at Indianola; Wartburg Kollege (Lutheran, 1868) at Clinton; Amity College (Non-sectarian, 1872) at College Springs; German College (Methodist Episcopal, 1873) at Mt. Pleasant; Penn College (Friends, 1873) at Oskaloosa; St Joseph's College (Roman Catholic, 1873) at Dubuque; Parsons College (Presbyterian, 1875) at Fairfield; Coe College (Presbyterian, 1881) at Cedar Rapids; Drake University (Disciples of Christ, 1881) at Des Moines; Palmer College (Disciples of Christ, 1889) at Legrand; Buena Vista College (Presbyterian, 1891) at Storm Lake; Charles City College (Methodist Episcopal, 1891) at Charles City; Morningside College (Methodist Episcopal, 1894) at Sioux City; Graceland College (Reorganized Church of Latter Day Saints, 1895) at Lamoni.

Finance.—The taxing system of Iowa embraces a general property tax, corporation taxes (imposed on the franchises or on either the capital stock or the stock in the hands of shareholders), taxes on certain businesses and a collateral inheritance tax. Several important attempts have been made to effect a segregation as between state and local taxes, but for the most part without success. For the year ending June 30th, 1908, the receipts of the state from all sources were $3,663,154.67, and the total expenditure was $3,891,842.81. The full value of all property, according to assessment of 1904, is $2,567,330,328. The state has no bonded debt, and the constitution forbids it to incur debts exceeding in the aggregate a quarter of a million dollars, except for warlike purposes or for some single work to which the people give their consent by vote; the constitution also forbids any county or municipal corporation from incurring an indebtedness exceeding 5% of the value of its taxable property. When first admitted into the Union, Iowa had a strongly pronounced antipathy to banks. This was largely overcome by the year 1857, and yet the constitution of that date prohibits any legislation of primary importance relating to banks without referring the matter to a direct vote of the people. The number of banks and the amount of banking business has, nevertheless, rapidly increased.

History.—Iowa, as a part of the whole Mississippi Valley, was taken into the formal possession of France in 1682; in 1762 as a part of the western half of that valley it was ceded to Spain; in 1800 it was retroceded to France; in 1803 was ceded to the United States; from 1804 to 1805, as a part of the District of Louisiana, it was under the government of Indiana Territory; from 1805 to 1812 it was a part of Louisiana Territory; from 1812 to 1821 a part of Missouri Territory; from 1821 to 1834 a part of the unorganized territory of the United States; from 1834 to 1836 a part of Michigan Territory; from 1836 to 1838 a part of Wisconsin Territory. In 1838 Wisconsin Territory was divided, the western portion being named Iowa, and out of this the state with its present bounds was carved in 1846.

The name Iowa (meaning "sleepy ones") was taken from a tribe of Siouan Indians (probably of Winnebago stock), which for some time had dwelt in that part of the country and were still there when the first white men came—the Frenchmen, Marquette and Joliet, in 1673 and Hennepin in 1680. Early in the next century the Sauk and Foxes, vanquished by the French in Michigan, retreated westward, and in their turn largely supplanted the Iowas. Thither also came Julien Dubuque, a French Canadian, to trade with the new occupants. He discovered lead mines on and near the site of the city which now bears his name, in 1788 obtained an Indian grant or lease of about 21 sq. m., established there a settlement of miners and continued his mining operations, together with a trade in furs, until his death in 1810. The Indians refused permission to others to work the mines, and when intruders attempted to do so without it United States troops protected the red man's rights, especially from 1830 to 1832. But Black Hawk's war policy soon resulted in letting the white man in; for the war which he instigated was concluded in 1832 by a cession to the United States of nearly 9000 sq. m., embracing much of what is now the district of the Iowa lead and zinc mines. Without further waiting, though still in the face of the Act of Congress of 1807 prohibiting such settlements, the frontiersmen rushed in to mine and to farm, and government was established through voluntary associations. Such proceedings of these associations as related to claims to land were later recognized by the United States authorities, while such as related to the establishment of schools were tolerated for a time by the state government. Iowa, having separated from Wisconsin in 1838 on account of lack of courts for judicial relief, the question of applying for admission into the Union as a state was voted on as early as 1840, the Territory in that year having a population of 43,112; but the measure was defeated then, as it was again in 1842, by those who most wished to avoid an increase of taxes. In 1844, however, the vote was otherwise, a convention was called, a constitution framed and application for admission made. The question of boundaries, to which the question of slavery gave rise, then became the cause of delay, but the Territory became a state in 1846.

During the period in which the question of admission was under consideration, the Whigs opposed the measure, while the Democrats carried it through and remained in power until 1854;

but ever since 1857 the state has been preponderantly Republican in all national campaigns; and with but two exceptions, in 1889 and 1891, when liquor and railroad legislation were the leading issues, has elected a Republican state administration. Nevertheless there has always been a strong sentiment in the state urging that corporations be held more in check, and its industries are not such as to receive a large benefit directly from tariff legislation. As a consequence there has been a tendency towards the formation of two opposing elements within the dominant party; the more radical seeking the promotion of what since 1902 has been known as the "Iowa Idea," which in substance is to further the expansion of the trade of the United States with the rest of the world through the more extended application of tariff reciprocity, and at the same time to revise the tariff so as to prevent it from "affording a shelter to monopoly."

GOVERNORS OF IOWA

	Territorial.	
Robert Lucas	Democrat	1838-1841
John Chambers	Whig	1841-1845
James Clark	Democrat	1845-1846
	State.	
Ansel Briggs	Democrat	1846-1850
Stephen Hempstead	"	1850-1854
James Wilson Grimes	Whig and Free-Soil Democrat	1854-1858
Ralph P. Lowe	Republican	1858-1860
Samuel Jordan Kirkwood	"	1860-1864
William Milo Stone	"	1864-1868
Samuel Merrill	"	1868-1872
Cyrus Clay Carpenter	"	1872-1876
Samuel Jordan Kirkwood	"	1876-1877
Joshua Giddings Newbold[1]	"	1877-1878
John Henry Gear	"	1878-1882
Buren Robinson Sherman	"	1882-1886
William Larrabee	"	1886-1890
Horace Boies	Democrat	1890-1894
Frank Darr Jackson	Republican	1894-1896
Francis Marion Drake	"	1896-1898
Leslie Mortier Shaw	"	1898-1902
Albert Baird Cummins	"	1902-1909
B. F. Carroll	"	1909-

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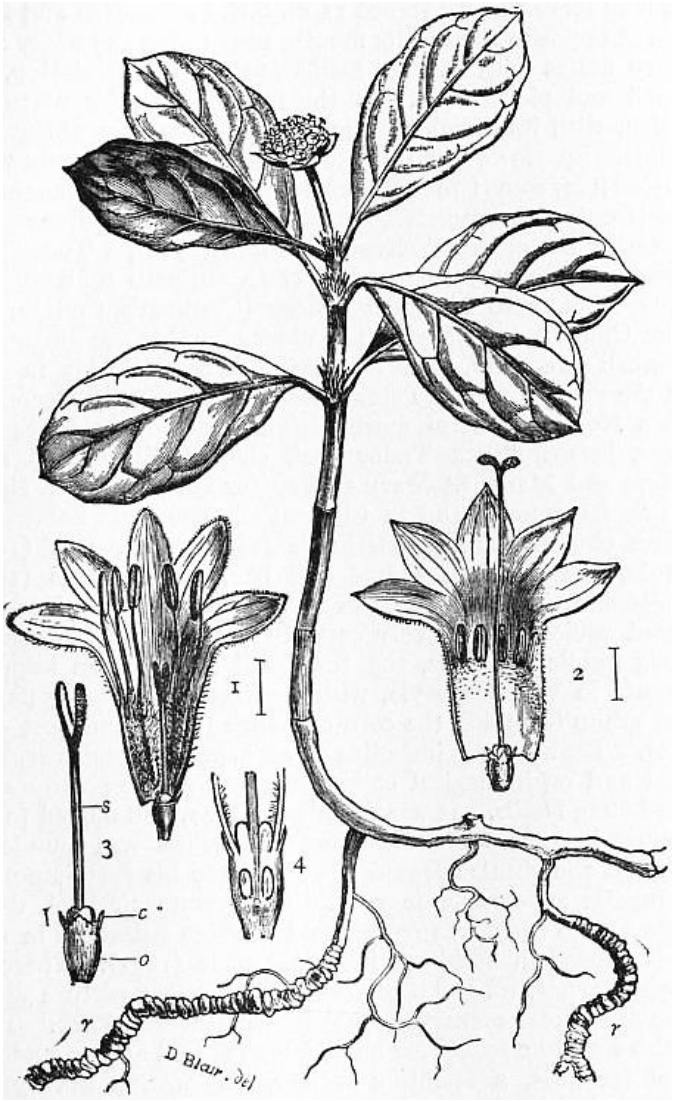
1 As lieutenant-governor, Newbold serves for the unexpired portion of the term to which Kirkwood was elected; Kirkwood resigned on the 1st of February 1877, having been chosen United States senator.

IOWA CITY, a city and the county-seat of Johnson county, Iowa, U.S.A., on Iowa river, about 120 m. E. of Des Moines. Pop. (1890) 7016; (1900) 7987, of whom 1355 were foreign born; (1905) 8497; (1910) 10,091. It is served by two branches of the Chicago, Rock Island & Pacific railroad, and by the Iowa City & Cedar Rapids Interurban railway (electric), of which it is a terminus. The ground on which the city is built forms an amphitheatre surrounded for the most

part by hills and bluffs. Iowa City is the seat of the state university of Iowa, of Iowa City Academy, of the library of the State Historical Society and of the state Sanatorium for the Treatment of Tuberculosis. The university, organized in 1847, and occupying the old State Capitol grounds, is an integral part of the public school system of the state, and is under the control of a board of regents, consisting of the governor, the superintendent of public instruction and eleven members, elected—one from each congressional district—by the General Assembly. The university's preparatory department was opened in 1855 and continued until 1879; the first collegiate session was in 1856-1857, but during 1858-1860 the collegiate department was closed. The institution embraces a college of liberal arts (1860), with a school of political and social science (1900)—which offers courses in commerce, administration, modern history and practical philanthropy—and a school of education, first opened in 1907, to train secondary and college teachers and school principals and superintendents; a college of law (1868); a college of medicine (1870), including a training school for nurses (1897); a college of homoeopathic medicine (1877), including a nurses' training school (1894); a college of dentistry (1882); a college of pharmacy (1885); a graduate college; a college of applied science (1903), with courses in civil, electrical, mechanical, mining, municipal and sanitary engineering and courses in chemistry; a summer school for teachers and librarians and a university extension department. Affiliated with the university is a school of music. The university's income is derived from the proceeds of invested funds and lands originally given by the United States, from permanent appropriations by the state and from the proceeds of a one-fifth mill tax to be used for buildings alone. In 1907-1908 the institution had 28 buildings (including the old State Capitol, built in 1840), a teaching and administrative force of nearly 200 members and 2315 students, of whom 1082 were in the college of liberal arts; the university library had about 65,000 volumes (25,000 were destroyed by fire in 1897), and the university law library, 14,000 volumes; and the total income of the university was about $611,000. In 1908 the library of the State Historical Society of Iowa, housed in the Hall of the Liberal Arts of the university, numbered about 40,000 volumes. Iowa City has a considerable variety of small manufacturing establishments. In 1839 Iowa City was selected as the site for the seat of government of the newly created Territory of Iowa. The legislature met for the first time in 1841 and continued to hold its sessions here until 1857, when Des Moines, on account of its more central position, was made the capital.

IPECACUANHA.[1] The root used in medicine under this name is obtained from *Psychotria* (or *Uragoga*) *Ipecacuanha*, a small shrubby plant of the natural order Rubiaceae. It is a native of Brazil, growing in clumps or patches in moist shady forests from 8° to 22° S., and is also found in New Granada and probably in Bolivia. The drug of commerce is procured chiefly from the region lying between the towns of Cuyaba, Villa Bella, Villa Maria and Diamantina in the province of Matto Grosso, and near the German colony of Philadelphia, north of Rio Janeiro. Ipecacuanha, although in common use in Brazil, was not employed in Europe previous to 1672. In France within a few years after that date it formed the chief ingredient in a remedy for dysentery, the secret of the composition of which was purchased by the French Government for 1000 louis d'or, and made public in 1688. The botanical source of ipecacuanha was not accurately known until 1800. The root appears to be possessed of very great vitality, for in 1869 M'Nab, of the Botanical Gardens of Edinburgh, discovered that so small a portion as $\frac{1}{16}$ of an inch of the annulated root, placed in suitable soil, would throw out a leaf-bud and develop into a fresh plant, while Lindsay, a gardener in the same establishment, proved that even the leaf-stalk is capable of producing roots and buds; hence there is but little probability of the plant being destroyed in its native habitat. The great value of the drug in dysentery, and its rapid increase in price from an average of 2s. 9½d. per ℔ in 1850 to about 8s. 9d. per ℔ in 1870, led to attempts to acclimatize the plant in India, which, however, have not hitherto proved to be a commercial success, owing to the difficulty of finding suitable spots for its cultivation, and to its slowness of growth. Like other dimorphic plants, ipecacuanha ripens seeds best when cross-fertilized, and presents various forms. Two of these were described by the late Professor F. M. Balfour of Edinburgh, one distinguished by having a woody stem, firm elliptic or oval leaves, with wavy margins and few hairs, and the other by an herbaceous stem, and leaves less coriaceous in texture, more hairy and not wavy at the margins. This diversity of form is most apparent in young plants, and tends to disappear with age.



Ipecacuanha Plant (about ⅓ nat. size). 1, 2, Flowers cut open, showing short-styled (1) and long-styled (2) forms; 3, Flower after removal of corolla, showing the inferior ovary (*o*), the small toothed calyx (*c*), and the style (*s*) with its forked stigma; 4, Ovary cut lengthwise showing the two chambers with the basally attached ovules; r, annulated root.

Ipecacuanha root occurs in pieces about 2 or 3 lines in thickness, of a greyish-brown or reddish-brown tint externally, having a ringed or annulated surface (see *r* in fig.), and exhibiting a white or greyish interior and a hard wiry centre. It has a faint rather musty odour, and a bitterish taste. It is usually mixed with more or less of the slender subterranean stem, which has a very thin bark, and is thus easily distinguished from the root. The activity of the drug resides chiefly in the cortical portion, and hence the presence of the stem diminishes its value. The variety imported from Colombia and known as Cartagena ipecacuanha differs only in its larger size and in being less conspicuously annulated. Ipecacuanha owes its properties to the presence of rather more than 1% of the alkaloid emetine, which, with the exception of traces, occurs only in the cortical portion of the root. It is a white amorphous substance, with the formula $C_{20}H_{30}NO_5$. It has a bitter taste, no odour, and turns yellow when exposed to air and light. There are also present a volatile oil, starch, gum, and a glucoside, which is a modification of tannin and is known as ipecacuanhic acid. The dose of the powdered root is ¼ to 2 grains when an expectorant action is desired, and from 15 to 30 grains when it is given as an emetic, which is one of its most valuable functions. The Pharmacopoeias contain a very large number of preparations of this substance, most of which are standardized. A preparation from which the emetine has been removed, and known as “de-emetized ipecacuanha,” is also in use for cases of dysentery.

When applied to the skin, ipecacuanha powder acts as a powerful irritant, even to the extent of causing pustulation. When inhaled it causes violent sneezing and a mild inflammation of the nasal mucous membrane, resembling a common cold in the head. It has feeble antiseptic properties. Small doses of ipecacuanha act as a stimulant to the secretions of the mouth, stomach, intestine and liver. The drug, therefore, increases appetite and aids digestion. Toxic doses cause gastro-enteritis, cardiac failure, dilatation of the blood-vessels, severe bronchitis and pulmonary inflammation closely resembling that seen in ordinary lobar pneumonia. In this respect and in its action on the skin, the drug resembles tartar emetic. Ipecacuanha is very frequently used as an expectorant in cases in which the bronchial secretion is deficient. Its

diaphoretic properties are employed in the *pulvis ipecacuanhae compositus* or Dover's powder, which contains one part of ipecacuanha powder and one part of opium in ten.

Other plants to which the name of ipecacuanha has been popularly applied are American ipecacuanha (*Gillenia stipulacea*), wild ipecacuanha (*Euphorbia Ipecacuanha*), bastard ipecacuanha (*Asclepias curassavica*), Guiana ipecacuanha (*Boerhavia decumbens*), Venezuela ipecacuanha (*Sarcostemma glaucum*), and ipecacuanha des Allemands (*Vincetoxicum officinale*). All these possess emetic properties to a greater or less degree.

The term *poaya* is applied in Brazil to emetic roots of several genera belonging to the natural orders Rubiaceae, Violaceae and Polygalaceae, and hence several different roots have from time to time been sent over to England as ipecacuanha; but none of them possesses the ringed or annulated appearance of the true drug. Of these the roots of *Ionidium Ipecacuanha*, *Richardsonia scabra* and *Psychotria emetica* are those which have most frequently been exported from Brazil or Colombia.

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1 The name is the Portuguese form of the native word *i-pe-kaa-guéne*, which is said to mean "road-side sick-making plant" (Skeat, *Etym. Dict.* 1898).

IPEK (Slav. *Petch*, Lat. *Pescium*), a town of Albania, European Turkey, in the vilayet of Kossovo and sanjak of Novibazar, 73 m. E.N.E. of Scutari, near the eastern base of the Mokra Planina, the Montenegrin frontier, and the headwaters of the Ibar and White Drin. Pop. (1905), about 15,000, principally Albanians and Serbs. A small stream bearing, like several others in the Balkan peninsula, the name of Bistritza (the bright or clear), flows through the town. On one of the neighbouring heights is situated the monastery of Ipek, founded by Archbishop Arsenius in the 13th century, and famous as the seat until 1690 of the patriarchs of the Servian church. The buildings are surrounded by thick walls, and comprise a large central church (Our Lady's), and two side chapels (the Martyrs' and St Demetrius'), each surmounted by a leaden cupola. The church dates from the 16th and 17th centuries. Among its numerous objects of interest are the white marble tombs of Arsenius and other chiefs of the Servian church, and the white marble throne on which the patriarchs were crowned. Ipek has been incorrectly identified by some writers with Doclea or Dioclea (Duklé in Montenegro), the birthplace of Diocletian, and the capital of a small principality which was overthrown by the Bulgarians in the 11th century.

See Barth, *Reise durch das Innere der europäischen Turkei* (Berlin, 1864); A. P. Irby and G. M. M. Mackenzie, *Travels in the Slavonic Provinces of Turkey* (1877); M. E. Durham, *Through the Lands of the Serb* (London, 1904).

IPHICRATES, Athenian general, son of a shoemaker, flourished in the earlier half of the 4th century B.C. He owes his fame as much to the improvements which he made in the accoutrements of the peltasts or light-armed mercenaries (so called from their small round shield, πέλτη) as to his military successes. Increasing the length of their javelins and swords, substituting linen corselets for their heavy coats-of-mail, and introducing the use of a kind of light leggings, called after him "iphicratides," he increased greatly the rapidity of their movements (Diod. Sic. xv. 44). He also paid special attention to discipline, drill and manœuvres. With his peltasts Iphicrates seriously injured the allies of the Lacedaemonians in the Corinthian War, and in 392 (or 390) dealt the Spartans a heavy blow by almost annihilating a *mora* (battalion of about 600 men) of their famous hoplites (Diod. Sic. xiv. 91; Plutarch, *Agesilaus*, 22). Following up his success, he took city after city for the Athenians; but in consequence of a quarrel with the Argives he was transferred from Corinth to the Hellespont, where he was equally successful. After the peace of Antalcidas (387) he assisted Seuthes, king of the Thracian Odrysae, to recover his kingdom, and fought against Cotys, with whom, however, he subsequently concluded an alliance. About 378 he was sent with a force of mercenaries to assist the Persians to reconquer Egypt; but a dispute with Pharnabazus led to the failure of the expedition (Diod. Sic. xv. 29-43). On his return to Athens he commanded an expedition in 373 for the relief of Corcyra, which was besieged by the Lacedaemonians (Xenophon, *Hellenica*, vi. 2). On the peace of 371, Iphicrates returned to Thrace, and somewhat tarnished his fame by siding with his father-in-law Cotys in a war against Athens for the possession of the entire Chersonese. The Athenians, however, soon pardoned him and gave him a joint command in the Social War.

He and two of his colleagues were impeached by Chares, the fourth commander, because they had refused to give battle during a violent storm. Iphicrates was acquitted but sentenced to pay a heavy fine. He afterwards remained at Athens (according to some he retired to Thrace) till his death (about 353).

There is a short sketch of his life by Cornelius Nepos; see also C. Rehdantz, *Vitae Iphicratis, Chabriae et Timothei* (1854); Bauer, *Griech. Kriegsaltert*. in Müller's *Handbuch*, 4, § 49; and histories of Greece, *e.g.* Holm, Eng. trans., vol. iii.

IPHIGENEIA, or IPHIANASSA, in Greek legend, daughter of Agamemnon and Clytaem(n)estra. Agamemnon had offended Artemis, who prevented the Greek fleet from sailing for Troy, and, according to the soothsayer Calchas, could be appeased only by the sacrifice of Agamemnon's daughter. According to some accounts the sacrifice was completed, according to others Artemis carried away the maiden to be her priestess in the Tauric Chersonese [*Crimea*] and substituted for her a hind. In this new country it was her duty to sacrifice to the goddess all strangers; and as her brother Orestes came to search for her and to carry off to Attica the image of the goddess, she was about to sacrifice him, when a happy recognition took place. These legends show how closely the heroine is associated with the cult of Artemis, and with the human sacrifices which accompanied it in older times before the Hellenic spirit had modified the barbarism of this borrowed religion. Orestes and Iphigeneia fled, taking with them the image; at Delphi they met Electra, the sister of Orestes, who having heard that her brother had been sacrificed by the Tauric priestess, was about to tear out the eyes of Iphigeneia. The brother and sister returned to Mycenae; Iphigeneia deposited the image in the deme of Brauron in Attica, where she remained as priestess of Artemis Brauronia. Attica being one of the chief seats of the worship of Artemis, this explains why Iphigeneia is sometimes called a daughter of Theseus and Helen, and thereby connected with the national hero. The grave of Iphigeneia was shown at Brauron and Megara. According to other versions of the legend, when saved from sacrifice Iphigeneia was transported to the island of Leuke, where she was wedded to Achilles under the name of Orsilochia (Antoninus Liberalis 27); or she was transformed by Artemis into the goddess Hecate (Pausanias i. 43. 1). According to the Spartans, the image of Artemis was transported by Orestes and Iphigeneia to Laconia, where the goddess was worshipped as Artemis Orthia, the human sacrifices originally offered to her being abolished by Lycurgus and replaced by the flogging of youths (*diamastigosis*, Pausan. iii. 16). At Hermione, Artemis was worshipped under the name of Iphigeneia, thus showing the heroine in the last resort to be a form of that goddess (Pausanias ii. 35. 1). Originally, Iphigeneia, the "mighty born," is probably merely an epithet of Artemis, in which the notion of a priestess of the goddess had its origin. Iphigeneia is a favourite subject in Greek literature. She is the heroine of two plays of Euripides, and of many other tragedies which have been lost (see also Pindar, *Pythia* xi. 23; Ovid, *Metam.* xii. 27). In ancient vase paintings she is frequently met with; and the picture by Timanthes representing Agamemnon hiding his face at her sacrifice was one of the famous works of antiquity (Pliny, *Nat. Hist.* xxxv. 10).

See M. Jacobson, *De fabulis ad Iphigeniam pertinentibus* (1888); R. Förster, *Iphigenie* (1898); H. W. Stoll in Roscher's *Lexikon der Mythologie*; and P. Decharme in Daremberg and Saglio's *Dictionnaire des antiquités*.

IPSWICH, a town of Stanley county, Queensland, Australia, on the river Bremer, 23½ m. by rail W. by S. of Brisbane. Pop. (1901), 8637. It is the centre of a rich and populous agricultural mining and manufacturing district. Coal is worked on the banks of the river with but little labour, as it crops out on the surface. There are a woollen factory, several saw-mills, and foundries and large railway workshops at North Ipswich. The first settlement was made here in 1829; the town was incorporated in 1860.

IPSWICH, a municipal, county and parliamentary borough and county town of Suffolk, England, 69 m. N.E. by E. from London by the Great Eastern railway. Pop. (1901), 66,630. It stands on a gentle ascent above the left bank of the river Gipping, which here widens into the tidal estuary of the Orwell. This land-locked inlet extends 11 m. S.E. to Harwich and Felixstowe at opposite sides of its mouth, near which the wider Stour estuary unites with it. Its banks are gently undulating, well wooded and picturesque. In the lower and older portion of Ipswich, with its irregular streets, are some few antiquarian remains. Sparrowe's house (1567), named from a family which occupied it for some two centuries, is well preserved and has ornate gabled fronts to two streets. Archdeacon's Place (1471) is another still earlier example. Wolsey's Gateway (1528), a Tudor brick building, is the only remnant of the Cardinal's foundation to supply scholars to his great college (Cardinal's College, now Christ Church) at Oxford. The older churches are all towered flint-work structures, wholly or mainly Perpendicular in style, with the exception of St Peter's, which is principally Decorated, with a Norman font of marble. They include St Margaret's with a beautiful oak Tudor roof, elaborately painted *temp.* William and Mary; St Mary-at-Key (or Quay), with a similar roof; St Lawrence; and St Clement's. The most noteworthy modern churches are St Michael's (1880), All Saints' (1892), St John the Baptist's (1899) and St Bartholomew's (1901). The Roman Catholic church of St Pancras (1863), a late First Pointed edifice, has a richly carved reredos and a lofty flèche. Among public buildings, the town hall (1868) is an imposing structure in Venetian style, with clock tower; forming part of a fine group including the corn exchange (1881) and post office (1880). The museum, including an art gallery, contains archaeological and ornithological collections, and a noteworthy series of Red Crag fossils. It was founded in 1847, and moved to new buildings in 1881. The East Suffolk hospital was founded in 1836. In the theatre David Garrick made his first important and regular appearance in 1741. The grammar school, dating at latest from 1477, was refounded by Queen Elizabeth in 1565, and is housed in buildings in Tudor style (1851). There are borough science, art and technical schools, with a picture gallery in the fine Tudor mansion (1549) in Christchurch Park. There are also a middle school for boys, a high school and an endowed school for girls, a scientific society, corporation library and small medical library. Of two beautiful arboretums the upper is public; part of Christchurch Park adjacent to this is owned by the corporation; there are also recreation grounds and a race-course. Industries include large engineering and agricultural implement works, railway plant works, the making of artificial manures, boots and shoes, clothing, bricks and tobacco and malting. The port has a dock of nearly 30 acres, accommodating vessels drawing 19 ft. and a large extent of quayage. Imports are principally grain, timber and coal; exports agricultural machinery, railway plant, artificial manures, oil cake, &c. Ipswich is a suffragan bishopric in the diocese of Norwich. The parliamentary borough returns two members. The corporation consists of a mayor, 10 aldermen and 30 councillors. Area, 8112 acres.

A Roman villa has been discovered here. But the Saxon settlement at the head of the Orwell was doubtless the first of any importance. In 991 the town (*Gipeswic*, *Gipeswich*) was sacked by vikings. It owes its subsequent prosperity to its situation on a harbour admirably suited for trade with the Continent. The townsmen had acquired the privileges of burgesses by 1086 when Roger Bigot kept the borough in the king's hands. In 1200 King John granted the burgesses their first charter, confirming their town to them to be held at fee-farm, exempting them from tolls and similar customs, and granting them a gild-merchant. These liberties were extended in 1256; Edward I. and Edward III. both resumed the borough for short periods, but the charter of 1200 was confirmed by almost every subsequent sovereign. The burgesses were definitely incorporated in 1464 and re-incorporated in 1665 under a charter which remained in force previous to its modification by the Municipal Act of 1835, except during a short period in the reign of Charles II. From 1295 onwards the town has sent two representatives to parliament. The cattle market, held on Tuesdays, and the provision market on Saturdays are the prescriptive right of the corporation. A September fair, still held in 1792, was in the hands of the corporation in the 17th century. Large ironworks were established late in the 18th century. The wool and cloth trade which flourished here in the 14th and 15th centuries was superseded by the manufacture of sailcloth, now represented by the sacking industry.

See *Victoria County History*: Suffolk; J. Wodderspoon, *Memorials of the Ancient Town of Ipswich* (ed. 1850).

IPSWICH, a township of Essex county, Massachusetts, U.S.A., on both sides of the Ipswich river, about 27 m. N.N.E. of Boston. Pop. 1910 (Federal census), 5777. It is served by the Boston & Maine railroad. The surface is diversified by drumlins, vales, meadows, sand-dunes and tidal marshes. Ipswich has several manufacturing industries, including hosiery. The public library was

the gift of Augustine Heard. Among the residences are several built in the 17th and 18th centuries. The oldest of these, the John Whipple House, is the home of the Ipswich Historical Society (1890), which has gathered here a collection of antiques and issues publications of antiquarian interest. In the Ipswich Female Seminary, which no longer exists, Mary Lyon taught from 1828 to 1834 and here planned Mount Holyoke Seminary; Professor J. P. Cowles and his wife conducted a famous school for girls in the building for many years. Facing the South Common were the homes of Rev. Nathaniel Ward (1578-1652), principal author of the Massachusetts "Body of Liberties" (1641), the first code of laws in New England, and author of *The Simple Cobler of Aggawam in America, Willing to help mend his Native Country, lamentably tattered, both in the upper-Leather and the Sole* (1647), published under the pseudonym, "Theodore de la Guard," one of the most curious and interesting books of the colonial period; of Richard Saltonstall (1610-1694), who wrote against the life tenure of magistrates, and although himself an Assistant espoused the more liberal principles of the Deputies; and of Ezekiel Cheever (1614-1708), a famous schoolmaster, who had charge of the grammar school in 1650-1660. In the vicinity was the house of the Rev. William Hubbard (1621-1704), author of a *Narrative of the Troubles with the Indians in New England* (Boston, 1677) and a general *History of New England*, published by the Massachusetts Historical Society in 1815.

The town was founded under the name of Aggawam in 1633 by John Winthrop, jun., and twelve others, with a view to preventing the French from occupying the N. part of Massachusetts, and in the next year it was incorporated under its present name. In wealth and influence during the early colonial period it was little inferior to Boston, whose policies it not infrequently opposed. When Governor Andros and his Council in 1687 issued an order for levying a tax, a special town meeting of Ipswich promptly voted "that the s'd act doth infringe their Liberty as Free borne English subjects of His Majestie by interfearing with ye statutory Laws of the Land, By which it is enacted that no taxes shall be levied on ye Subjects without consent of an assembly chosen by ye Freeholders for assessing the same," and refused to assess the tax. For this offence six leaders, headed by the Rev. John Wise, minister of the Chebacco Parish (now Essex), were prosecuted, found guilty, imprisoned for three weeks to await sentence and then disqualified for office; they were also fined from £15 to £50 each, and were required to give security for their good behaviour. In Ipswich were originally included the present townships of Hamilton (1793) and Essex (1819).

See T. F. Waters, *Ipswich in the Massachusetts Bay Colony 1633-1700* (Ipswich, 1905), and the publications of the Ipswich Historical Society.

IQUIQUE, a city and port of Chile, capital of the province of Tarapacá, 820 m. N. of Valparaiso, in 20° 12′ 15″ S., 70° 11′ 15″ W. Pop. (1895), 33,031; (1900, est.), 42,440. The coast here runs due N. and S. and the city is built on a narrow level plain between the sea and bluffs, the latter rising steeply 2000 ft. to the level of the great desert plain of Tarapacá, celebrated for its rich deposits of nitrate of soda. Facing the city is the low barren island of Serrano, or Iquique, which is connected with the mainland by a stone causeway 1500 ft. long, and shelters the anchorage from southerly storms. A mole extending from the N.E. end of the island affords some further protection. The city is laid out in the rectangular plan, with broad streets and large squares. Water is brought by pipes from Pica, 50 m. distant. Iquique is a city of much commercial importance and is provided with banks, substantial business houses, newspapers, clubs, schools, railways, tramways, electric lights, telephone lines, and steamship and cable communication with the outside world. It exports iodine and immense quantities of nitrate of soda obtained from the desert region of the province. A large number of vessels are engaged in the nitrate trade, and Iquique ranks as one of the two leading ports of Chile in the aggregate value of its foreign commerce. It is connected by rail with the inland town of Tarapacá and various mining centres, and through them with the ports of Pisagua on the N., and Patillos on the S. Iquique was an insignificant Peruvian fishing settlement until 1830 when the export of nitrate began. In 1868 the town was nearly destroyed by an earthquake, in 1875 by fire, and again in 1877 by earthquakes, a fire and a tidal wave. It was occupied by the Chileans in 1879 in the war between Chile and Peru, and was ceded to Chile by the treaty of the 20th of October 1883.

IQUITOS, a tribe of South American Indians. It is divided into many branches, some on the river Tigre, others on the Nanay. Missionary efforts have failed and they remain savages, worshipping figures carved in the shape of birds and beasts. They brew the Indian fermented liquor *chicha* better than any of the neighbouring tribes, flavouring it with the shoots of some plant which has the effect of an opiate.

IQUITOS, a city and river port of Peru, and capital of the great inland department of Loreto, on the left bank of the upper Amazon near the mouth of the Rio Nanay, 87 m. below the mouth of the Ucayali and 930 m. from Puerto Bermudez. The geographical position of Iquitos is 3° 44′ S., 73° W. Pop. of the city (1906, est.), 6000; of the district (1906, est.), 12,000. Iquitos stands about 348 ft. above sea-level, on the low wooded banks of the river opposite some islands of the same name, and has a warm but healthful climate (mean annual temperature, about 78° F.). The city consists of two *pueblos*, the larger of which is occupied by Indians and half-breeds, the descendants of the Iquitos tribe from whom the city takes its name. The opening of the Amazon to navigation, and the subsequent arrival of foreign ocean-going vessels at Iquitos, added immensely to the importance of the city, and made it the commercial entrepôt of eastern Peru. In 1908 three lines of ocean-going steamers were making regular voyages up the Amazon to Iquitos (about 2500 m.). The city has a large import and export trade for an immense region watered by the Marañon, Huallaga, Ucayali and other large Amazonian rivers navigated from Iquitos by lines of small boats. Iquitos was put in wireless telegraphic communication with Puerto Bermudez on the 8th of July 1908, whence a land line runs across the Andes to Lima. Besides machine shops and shipbuilding facilities, the important industries are the weaving of hats and hammocks, and the preparation of salt fish; and there is a considerable export of rubber and straw hats. Tobacco is produced in the vicinity and sent to other parts of the Montaña region. Iquitos dates officially from 1863, when it had a population of 431, though there had been a white settlement there for more than half a century.

IRAK, a province of Persia, situated W. of Kum and Kashan and E. of Burujird, and paying a yearly revenue of about £16,000. The province has many flourishing villages which produce much grain, but its greatest income is derived from the carpets made in many of its villages and mostly exported to Europe, the value of which is estimated at about £100,000 per annum. An important British firm is established at Sultanabad, the capital of the province, solely for this trade. Sultanabad is situated 77 m. S.W. of Kum in 34° 6′ N. and 49° 42′ E. at an elevation of 5925 ft. It has a population of about 8000 and post and telegraph offices. It was founded in 1808 and made a recruiting centre for some battalions of infantry which were to form part of the reorganized Persian army as recommended by the chief of the French mission, General Gardane. In consequence of its recent foundation it is still occasionally spoken of as Shahr-i-no, the “new city.”

IRAK-ARABI (’Iraq-Arabi, “Arab Irak”), the name employed since the Arab conquest to designate that portion of the valley of the Tigris and Euphrates known in older literature as Babylonia. Irak is approximately the region below the Median Wall, from Opis on the Tigris, at the mouth of Shatt-el-Adhem, to the neighbourhood of Ramadieh (Ramadiya) on the Euphrates; that is, from nearly latitude 34° to the Persian Gulf, and from the Syrian desert to the Persian mountains. It consists of two unequal portions, an extensive dry steppe with a healthy desert climate, and an unhealthy region of swamps. There is a good deal more agriculture along the Euphrates than along the Tigris, but swamps are at the same time much more extensive along the former. The borders of both streams wherever there is habitation are lined with date-palms. This is especially true of the lower part of Irak in the Basra vilayet, where the date-palm forms dense groves bordering the banks for a distance of many days’ journey. A luxuriant vegetation of water plants is to be found in the swamps, which are the haunt of numerous wild beasts—pigs, lions, different kinds of aquatic animals and birds. These swamps are inhabited by a wild race of

men, dark of hue, with many negroes among them, who cultivate rice and weave straw mats. Their chiefs, with their wives and a very few retainers or members of their immediate families, live in mud castles; the tribesmen live in rude huts of reeds and mats about these castles. In the main these swamp-dwellers, who designate themselves *Ma'-dan*, keep pretty free both of the Turkish government and of the semi-Bedouins of Irak. Some of them are very lawless, especially the inhabitants of the region below the Shatt-el-Haī, between the two rivers. Here the Turkish government exercises no authority, and the tribesmen of the swamps play pirate on the merchandise passing up and down the Euphrates above Korna, where for some 80 m. the river has been allowed to form an immense swamp. Some of the Bedouin tribes also engage in marauding expeditions and terrorize certain portions of the country. Especially troublesome are the edh-Dhafir, westward of the Euphrates, opposite the mouth of the Shatt-el-Haī, and the Beni Lam (7500 tents strong) who occupy the country east of the Tigris to the south of Bagdad. Still more difficult of control is the great tribe of Shammar, who descend every year from the north, pitching their tents in the Jezireh (*i.e.* the region between the two rivers) southward of Bagdad, and terrifying the whole country during their stay. The Turkish government is, however, gradually extending its authority over all Irak partly by force, partly by treachery. The Affech nation, Ma'-dan Arabs, occupying the swamps behind Diwanieh between the Tigris and Euphrates, and the great Montefich tribes, Bedouins who claimed the whole country southward of the Affech to the Shatt-el-Haī and beyond, have since 1880 been deprived gradually of their power and a considerable part of their independence. In 1903 the Turkish government transferred the capital of the sanjak of Hillah to Diwanieh opposite the Affech swamps, and there is now a line of towns, centres of Turkish power and Turkish force, extending southward from Ana to Nasrieh, at the mouth of the Shatt-el-Haī canal, while similar stations are being established or strengthened along the Tigris. Some important steps have also been taken by the Turkish government to control the Euphrates floods, and to drain the swamps in some sections of the country, especially westward of the Euphrates. A dam was built at the mouth of the Hindieh canal to prevent the waters of the Euphrates from losing themselves as heretofore in the swamps westward, and to assure a continual supply of water in the main bed of the Euphrates. It is, however, frequently carried away. The ancient Assyrium Stagnum, or Bahr Nejef near the town of that name, with other swamps formed by the overflow of the Hindieh, have been drained and turned into rice plantations. At the same time large sections of Irak have been converted into imperial domain, to the diminution of the revenues of the country but to the increase of the prosperity of the population which inhabits that domain. Something, though not very much, has thus been done to restore the land to its ancient fertility.

Ethnographically Irak is subject to a double influence. On the one hand the connexion with Nejd, the centre plateau of Arabia, continues uninterrupted, even the 'Agel Bedouins from central Arabia having a quarter of their own in Bagdad. Many of these Arabs come to Irak merely for a temporary residence, returning later to their homes with the earnings acquired in that comparatively rich country; but a considerable number remain permanently. Even stronger than the influence of Arabia is that of Persia. In general the inhabitants of Irak are Shi'ites not Sunnites, and their religious connexion and allegiance is therefore toward Persia, not Turkey. Persian customs are in fashion, Persian coinage is used equally with the Turkish, and in some parts, more especially in Bagdad, there is an important Persian quarter, while Kerbela and Meshed 'Ali to the west of the Euphrates are really Persian enclaves in Turkish territory. No traces remain of that rich intellectual development which was produced in the time of the caliphs through the reciprocal action of Persian and Arabic elements. Still, the quick-wittedness of the inhabitants of Irak makes a decided impression on the traveller passing through Asiatic Turkey. Throughout Irak also Indian influence is visible in not a few particulars. In the hot summer months, for instance, when the natives live in those underground apartments called *serdab*, the Indian punkah is used in the houses of the rich. There are also small Indian colonies at most of the large towns and a considerable trade with India is carried on, especially in horses.

The trade of Irak is even now not unimportant. The principal exports from Basra are dates, various grains, millet seed, rice and wool, while the imports consist chiefly of Manchester goods, lumber, petroleum, coal and household necessities. Besides this there is a considerable land commerce by caravan, of which Bagdad is the centre. The total value of the exports of Irak according to the official figures of the Turkish government amounts to nearly £2,000,000, while the imports of every kind reach the value of about £1,800,000. If the ancient system of irrigation were restored and the land restored to cultivation, the country could support five hundred times as many inhabitants as it usually contains. Steamboats navigate the Tigris only as far as Bagdad, and that with great difficulty. In general, communication by water is carried on by means of the most primitive craft. Goods are transported in the so-called *turradas*, moderately big high-built vessels, which also venture out into the Persian Gulf as far as Kuwet. Passengers are conveyed, especially on the Euphrates, in the *meshhuf*, a very long narrow boat, mostly pushed along the river bank with poles or towed by ropes. The Mesopotamian *kelleks*, rafts laid on goat-skin bladders, come down the Tigris as far as Bagdad. At Bagdad round boats made of plaited reeds pitched with asphalt, the so-called *kufas* (*qufas*), are used. At Basra the *bellems* are in use, boats

of large size, having the appearance of being hollowed out of tree trunks and partly in fact so constructed. There are no roads, and the extensive swamps and periodic inundations which lay large sections under water render land traffic by caravan somewhat uncertain.

Irak in general is an alluvial plain, formed by the deposits of the rivers Tigris and Euphrates, with a few scattered reaches of sand appearing here and there. The mass of solid matter which the rivers deposit is very considerable. The maximum proportion for the Euphrates in the month of January is $\frac{1}{80}$ and at other times $\frac{1}{200}$; for the Tigris the maximum is $\frac{1}{100}$. In general, the northern plains of the interior have a slight but well-defined southerly inclination, with local depressions. The territory undulates in the central districts, and then sinks away into mere marshes and lakes. The clay, of a deep blue colour, abounds with marine shells, and shows a strong efflorescence of natron and sea-salt. When the soil is parched the appearance of the mirage (*serab*) is very common. As extensive inundations in spring are caused by both the rivers, especially the Tigris, great changes must have taken place in this part of the country in the course of thousands of years. It has been asserted that in former times the alluvial area at the mouth of the river increased 1 m. in the space of thirty years; and from this it has been assumed that about the 6th century B.C. the Persian Gulf must have stretched from 45 to 55 m. farther inland than at present. The actual rate of increase at the present time is about 72 ft. per annum. While we may be unable to determine accurately the former physical configuration of southern Babylonia, it is at least certain that in Babylonian times the Euphrates and Tigris reached the sea as independent rivers, and Ritter estimates that in the time of Alexander the Great the embouchures were still separated by a good day's journey. Although they cannot now be traced, great alterations have probably taken place also in the upper portions of the rivers as well as in the country near their mouths. The names of a large number of canals occur in the old Babylonian inscriptions, as in the works of the Arabian geographers, but while some of these have been traced it has not been possible hitherto to identify the greater number of them with actually existing canals or remains of canals. To the west of the Euphrates, on the edge of the Syrian desert from Hit downward to the neighbourhood of Basra and beyond, ran the Sa'ade, now for the most part dry, a very ancient canal, extended or enlarged at different periods. Lower down near Mussaib, the Hindieh canal, at least equal in volume to the present main stream, branches off and after traversing and irrigating an extensive territory rejoins the river at Samawa. Between the Euphrates and the Tigris, there was a large number of great canals, especially in the region northward of Babylon between that city and the northern edge of the alluvial plain, of which the most famous were the 'Isa, the Sarsar, the Malk ("Royal"), the canal of Kutha, the Sura and the Arakhat (Shatt-en-Nil). Of these only one at present carries water, namely, the Nahr 'Isa, which, leaving the Euphrates at Sakhlawieh (Sakh lawiya), terminates in extensive marshes near Bagdad; but this is now no longer navigable. Southward of Babylon the Daghara canal, which leaves the Euphrates a little below Hillah and empties into the Affech marshes, and the Shatt-el-Kehr, which, leaving that stream a little above Diwanieh, makes a great curve through the interior of the Jezireh, finally losing itself in the Hosainieh (Hosainiya) marshes near the mouth of the Shatt-el-Haï, are the only navigable or partly navigable canals of the Euphrates in the Jezireh. The Tigris canals are not so numerous as those of the Euphrates and were not so famous in history, but eastward of that river the great Nahrawan channel still exists in part, while the Tigris is connected with the Euphrates by a navigable stream, the Shatt-el-Haï, which leaves the former river at Kut-el-'Amara and enters the Euphrates at Nasrieh. Everywhere the country is intersected with ancient canals, some still deep dry beds, other so silted up that their course is represented only by parallel lines of hillocks. Some of these, of great antiquity, like the Shatt-en-Nil, which can be traced through its whole course from Babylon, through or past Nippur, Udnun (Bismya) Gishban (Gis-ukh), Erech and Larsa, to the Hosainieh marshes, were equally as important as the Euphrates itself; and indeed it may be said that in ancient times that stream after reaching the alluvial plain was divided into a large number of channels, partly natural partly artificial, no single one of which, but all together, constituted the Euphrates. By the restoration of these old canals, traces of which are met with at every step, the country might be again raised to that condition of high civilization which it enjoyed not only in antiquity but even as late as the time of the caliphs. The classical writers are unanimous in their admiration of Babylonia, and it is certain that nowhere else in the ancient world was the application of canals to the exigencies of agriculture worked out so successfully as here. The most luxuriant vegetation was diffused over the whole country and three crops were obtainable in the year. In the matter of civilization indeed no country of the ancient world surpassed. Babylonia. How densely peopled this country once was may be gathered from the fact that about 794 B.C., 89 fortified towns and 820 smaller places in the Chaldaean region were captured during one military expedition. And even in the times of the caliphs there stood on the royal canal and its branches, north of Babylon, 360 villages, contributing in gold 225,000 dirhems to the state treasury besides the tax in kind. To-day the whole region from the swamps about Basra northward is dotted with ruin mounds, and at places the plain itself is strewn for miles with fragments of glass and pottery, evidence of earlier occupation, while, as stated, lines of canals of all possible sizes, from the great triple canals with four rows of parallel hillocks, down to the small canals for purposes of irrigation, intersect the country in every direction.

There seem to have been almost from the outset two centres which strove with one another for political supremacy in this region, the south and the north. In the north in the Babylonian time

lay Kish, Akkad, Kutha (Tell-Ibrahim), Sippara (Abu Habba), Babylon and Borsippa (Birs-Nimrud). In the south were Eridu and Ur (Mughair)—originally on the shores of the Persian Gulf, now 125 m. inland—Erech (Warka), Larsa (Senkereh), Lagash (Tello) and Gishban (Yokha). Nearly in the centre lay Nippur and Udnun (Bismya). Besides these there were numerous other cities, some of considerable importance, which are known to us at present only by name; and there are in Irak hundreds of ruin mounds, some of them of considerable size, covering ancient Babylonian cities, the greater part of which are still unexplored and unidentified. During the period of Greek domination a Greek city, Seleucia (*q.v.*), which afterwards attained great prosperity, was founded by Seleucus I. in an extremely favourable situation on the right bank of the Tigris. Greek cities were founded also in the south, at the head of the Persian Gulf, and some of the ancient Babylonian cities of the interior like Lagash, Erech and Nippur, were rebuilt on the old sites. After the conquest of Babylonia by the Parthians (130 B.C.) Ctesiphon (*q.v.*) was built on the east bank of the Tigris opposite Seleucia, and became the winter residence of the Persian kings. Later this double city became the imperial capital of the Sassanids, and under the name Madain still continued to flourish after the Arabic conquest, to be finally superseded by the neighbouring Bagdad. That region was called in the time of the Sassanids, Suristan, a translation of the Aramaean designation Beth-Aramaya, "country of the Syrians," for the land was mainly occupied by Aramaeans. By a notable substitution the Arabs afterwards gave the name Nabat, *i.e.* Nabataeans, to these Aramaean tenantry, who it may be added were already found in these parts at the time of the Babylonian empire. Indeed, some small portion of this old Syrian population of Irak still remains distinguished by a special religion (see MANDAEANS), chiefly on the shores of the lower Euphrates in the neighbourhood of Suk-esh-Sheiukh. Another important city of the Sassanian period was Perisabora, known in the Arabian period as Anbar, the centre also of Babylonian Judaism after the destruction of Pombeditha in A.D. 588, situated on the east bank of the Euphrates in about the same latitude as Bagdad. During the Sassanian period flourished in the south-east the Arabic kingdom of Hira (*q.v.*). There was also for a time a Jewish kingdom in Babylonia, and Nehardea and Pombeditha are mentioned as centres of Jewish religions and national life during this period.

After the Arabian conquest in the 7th century A.D., Irak entered for a time on a new period of prosperity. Several important new cities were founded, among them Kufa, Basra, Wasit on the Shatt-el-Haï, and Bagdad on the site of an old Babylonian city of the same name, which later became under the Abbasid caliphs not only the capital of Irak but for a time the metropolis of the world (see CALIPHATE). With the decay of the Abbasid power the system of irrigation began to fall into disrepair, the ancient sites were gradually deserted, and the country finally returned to a condition of semi-barbarism alternating between inundation and drought, which is its present state.

See Ritter, *Die Erdkunde von Asien*, 2nd ed., vol. vii., 10th and 11th parts (Berlin, 1843, 1844); W. F. Ainsworth, *Researches in Assyria* (London, 1838); F. R. Chesney, *Expedition for the Survey of the Rivers Euphrates and Tigris* (2 vols., London, 1850); W. K. Loftus, *Chaldaea and Susiana* (1857); F. Delitzsch, *Wo lag das Paradies?* (Leipzig, 1881); W. F. Ainsworth, *The Euphrates Expedition* (1888); J. P. Peters, *Nippur* (1897); E. Sachau, *Am Euphrat und Tigris* (1900); F. Delitzsch, *Im Lande des einstigen Paradieses* (1903). Maps: Chesney (1850); Selby, Bewsher and Collingwood (1871); Kiepert, *Ruinenfelder* (1883).

(A. SO.; J. P. PE.)

IRAK-I-AJAMI (*i.e.* Persian Irak), the name (now obsolete) of the important Persian province which the Arab geographers called Jebel (the mountainous region). It used to be the country bounded N. by Azerbaijan and Gílán, E. by Samnan and the central Persian desert, S. by Kerman, Fars and Arabistan, W. by Kermanshah and Kurdistan. Its length, N.W.-S.E., was about 600 m. from the Kaflán Kuh on the Kizil Uzain, the frontier of Azerbaijan, to the frontier of Kerman beyond Yezd, and its width, N.E.-S.W., about 300 m.

IRAN, the great plateau between the plain of the Tigris in the west and the valley of the Indus in the east, the Caspian Sea and the Turanian desert in the north, and the Persian Gulf and the Indian Ocean in the south, surrounded on all sides by high mountain ranges with a great salt desert in the centre. The modern name Iran, in middle-Persian Eran (a form preferred by many German authors) is derived from the ancient *Aryāna*, "the country of the Aryans," *i.e.* that part of

the Aryans which we call Iranians. Eratosthenes limited the name of Ariana to the south-eastern part of Iran, and excluded Persia, Media and Bactria, and therein he is followed by Strabo (ii. 78, 130, xv. 720 ff.; Pomp. Mela i. 3; Pliny, *Nat. Hist.* vi. 113, 116, xii. 33); Pliny (*Nat. Hist.* vi. 93) confounds it with Arīa, Areia, Pers. Haraiva, *i.e.* the district of Herat; but Strabo himself says (xv. 724) that some extended the name to the Persians, Medes, Bactrians and Sogdians, as they all spoke the same language with small dialectic variations (cf. 727 and i. 66, xi. 523).

For the ethnography and history of Iran see PERSIA.

(ED. M.)

IRBIT, a town of Russia, in the government of Perm, 110 m. N.E. of Ekaterinburg, and on the Irbit river. Pop. (1860) 3408, (1897) 20,064. It is famous for a great fair, held since 1643, which lasts from the 1st of February to the 1st of March (O.S.), and at which are sold (to an average annual value of over £4,000,000) cottons, woollens, flax and hemp, silks, leather, metals, metallic and other manufactured goods, furs, hides, felt, raw wool and tea.

IRELAND, JOHN (1761-1842), English divine and dean of Westminster, was born at Ashburton, Devonshire, on the 8th of September 1761, his father being a butcher in that town. For a short time he worked in a shoemaker's shop. Subsequently he proceeded to Oxford, and in due course took holy orders. Through the interest of the earl of Liverpool he was in 1802 appointed a prebendary of Westminster Abbey, in 1815 he was promoted to the deanery of Westminster, and from 1816 to 1835 he was also rector of Islip, Oxfordshire. In 1825 he gave £4000 for the foundation at Oxford of four "Ireland" scholarships of the value of £30 a year each, "for the promotion of classical learning and taste." He also gave £500 to Westminster school for the establishment of prizes for Latin hexameters. He died at Westminster on the 2nd of September 1842, and was buried in the abbey.

IRELAND, JOHN (1838-), American Roman Catholic prelate, was born at Burnchurch, County Kilkenny, Ireland, on the 11th of September 1838. In 1849 he was taken to the United States by his parents, who settled at St Paul, Minnesota Territory. After being educated in France for the priesthood, he returned to the United States in 1861; he was ordained at St Paul and in the following year he accompanied the 5th Minnesota Volunteer Infantry south as chaplain. Subsequently he became rector of the cathedral at St Paul, and in 1870-1871 represented Bishop Thomas Langdon Grace (1814-1897) at the Vatican council at Rome. In 1875 he was appointed bishop of Nebraska, but at the urgent request of Bishop Grace the appointment was changed so that he might remain at St Paul as bishop-coadjutor with the right of succession; at the same time he was made titular bishop of Maronea. In 1884 he succeeded to the bishopric, and in 1888 he became the first archbishop of the see. His liberal views gave him a wide influence and reputation both within and without the church, and he came to be looked upon as a leader of the "American" as distinguished from the "Roman" party in the clergy. His views were, however, opposed by several leading Catholics; and several of his administrative acts, notably his plan for the partial taking over of control of the parochial schools by the local authorities (known from the town in which it was first attempted, "the Faribault plan"), were strenuously attacked. He was prominently identified with the planting of Catholic communities or colonies in the North-West, with the establishment of the Catholic University at Washington, and with the Catholic total abstinence movement. The degree of LL.D. was conferred on him by Yale University in 1901. He published *The Church and Modern Society* (1896).

IRELAND, WILLIAM HENRY (1777-1835), forger of Shakespearian manuscripts, was born in London in 1777. His father, Samuel Ireland, was an engraver and author, and dealer in rare books and curios. In 1794 young Ireland, with his father, visited Stratford, where he met John Jordan, a local poet who had published a deal of gossipy matter about Shakespeare and had even forged the will of the poet's father. Seeing his own father's credulous interest, Ireland conceived the idea of doing a little forgery on his own account. He copied, in ink which had all the signs of age, Shakespeare's style and handwriting, and produced leases, contracts with actors, notes, receipts, a profession of faith, and even a love letter to Anne Hathaway with an enclosed lock of hair, to the delight of his unsuspecting father, and the deception of many scholars who attested their belief in the genuineness of his finds. These he accounted for by inventing an ancestor "William Henrye Irelaunde," to whom they had been bequeathed by Shakespeare in gratitude for rescue from drowning. At last the discovery of a whole new play named *Vortigern* was announced. Sheridan purchased it for Drury Lane Theatre, and an overflowing house assembled on the 2nd of April 1796 to sit in judgment upon it. But away from the glamour of crabbed handwriting and yellow paper, the feeble dialogue and crude conceptions of the tragedy could not stand the test, and its one representation was greeted with shouts of laughter. Its fate prevented the composition of a series of historical plays, of which *Henry II.* had already been produced by this audacious forger. Samuel Ireland the elder had published in 1795 the *Miscellaneous Papers and Legal Instruments under the Hand and Seal of William Shakespeare; including the Tragedy of King Lear and a small fragment of Hamlet* (dated 1796). He had the fullest belief in their authenticity, but the hostile criticism of Malone and others, and the unsatisfactory account of the source of the papers, made him demand a full disclosure from his son. Harassed by the success of his own deceit, which had carried him far beyond his first intention, Ireland at last confessed his fraud, and published (1796) an *Authentic Account of the Shakespearian MSS.*, and in 1805, a more elaborate *Confession*, entirely exculpating his father and making a full admission. The elder Ireland felt the disgrace very bitterly, and it probably hastened his death, which occurred in July 1800. After the exposure Ireland was forced to abandon both his home and his profession. He wrote several novels of no value, gradually sank into penury, and died on the 17th of April 1835.

The more interesting publications on the Ireland forgeries are: *Inquiry into the authenticity of certain Papers, &c., attributed to Shakespeare*, by Edmond Malone (1796); the elder Ireland's *Vindication of his Conduct* (1796); *An Apology for the Believers in the Shakespeare Papers* (1797), and a *Supplemental Apology* (1799), both by George Chalmers; and pamphlets by Boaden, Waldron, Wyatt, Webb and Oulton. *Vortigern* was republished in 1832. The elder Ireland's correspondence with regard to the forgeries is preserved in the British Museum, with numerous specimens of his son's talent. Ireland's career supplied the subject-matter of James Payn's novel *The Talk of the Town* (1885).

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