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Ichthyology to Independence

Articles in This Slice

ICHTHYOLOGY (from Gr. ἰχθύς, fish, and λόγος, doctrine or treatise), the branch of zoology which treats of the internal and external structure of fishes, their mode of life, and their distribution in space and time. According to the views now generally adopted, all those vertebrate animals are referred to the class of fishes which combine the following characteristics: they live in water, and by means of gills or branchiae breathe air dissolved in water; the heart consists of a single ventricle and single atrium; the limbs, if present, are modified into fins, supplemented by unpaired median fins; and the skin is either naked or covered with scales or with osseous plates or bucklers. With few exceptions fishes are oviparous. There are, however, not a few members of this class which show a modification of one or more of these characteristics, and which, nevertheless, cannot be separated from it. 243

I. History and Literature down to 1880

The commencement of the history of ichthyology coincides with that of zoology generally. Aristotle (384-322 B.C.) had a perfect knowledge of the general structure of fishes, which he clearly discriminates both from the aquatic animals with lungs and mammae, *i.e.* Cetaceans, and from the various groups of aquatic invertebrates. According to him: “the special characteristics of the true fishes consist in the branchiae and fins, the majority having four fins, but those of an elongate form, as the eels, having two only. Some, as the *Muraena*, lack the fins altogether. The rays swim with their whole body, which is spread out. The branchiae are sometimes furnished with an operculum, sometimes they are without one, as in the cartilaginous fishes.... No fish has hairs or feathers; most are covered with scales, but some have only a rough or a smooth skin. The tongue is hard, often toothed, and sometimes so much adherent that it seems to be wanting. The eyes have no lids, nor are any ears or nostrils visible, for what takes the place of nostrils is a blind cavity; nevertheless they have the senses of tasting, smelling and hearing. All have blood. All scaly fishes are oviparous, but the cartilaginous fishes (with the exception of the sea-devil, which Aristotle places along with them) are viviparous. All have a heart, liver and gall-bladder; but kidneys and urinary bladder are absent. They vary much in the structure of their intestines: for, whilst the mullet has a fleshy stomach like a bird, others have no stomachic dilatation. Pyloric caeca are close to the stomach, and vary in number; there are even some, like the majority of the cartilaginous fishes, which have none whatever. Two bodies are situated along the spine, which have the function of testicles; they open towards the vent, and are much enlarged in the spawning season. The scales become harder with age. Not being provided with lungs, fishes have no voice, but several can emit grunting sounds. They sleep like other animals. In most cases the females exceed the males in size; and in the rays and sharks the male is distinguished by an appendage on each side of the vent.”

Aristotle’s information on the habits of fishes, their migrations, mode and time of propagation, and economic uses is, so far as it has been tested, surprisingly correct. Unfortunately, we too often lack the means of recognizing the species of which he gives a description. His ideas of specific distinction were as vague as those of the fishermen whose nomenclature he adopted; it never occurred to him that vernacular names are subject to change, or may be entirely lost in course of time, and the difficulty of identifying his species is further increased by the circumstance that sometimes several popular names are applied by him to the same fish, or different stages of growth are designated by distinct names. The number of fishes known to Aristotle seems to have been about one hundred and fifteen, all of which are inhabitants of the Aegean Sea. 244

That one man should have laid so sure a basis for future progress in zoology is less surprising than that for about eighteen centuries a science which seemed to offer particular attractions to men gifted with power of observation was no further advanced. Yet such is the case. Aristotle’s successors remained satisfied to be his copiers or commentators, and to collect fabulous stories or vague notions. With few exceptions (such as Ausonius, who wrote a small poem, in which he describes from his own observations the fishes of the Moselle) authors abstained from original research; and it was not until about the middle of the 16th century that ichthyology made a new step in advance by the appearance of Belon, Rondelet and Salviani, who almost simultaneously published their great works, by which the idea of species was established.

Belon.

P. Belon travelled in the countries bordering on the eastern part of the Mediterranean in the years 1547-1550; he collected rich stores of positive knowledge, which he embodied in several works. The one most important for the progress of ichthyology is that entitled *De aquatilibus libri duo* (Paris, 1553). Belon knew about one hundred and ten fishes, of which he gives rude but generally recognizable figures. Although Belon rarely gives definitions of the terms used by him, it is not generally very difficult to ascertain the limits which he intended to assign to each division of aquatic animals. He very properly divides them into such as are provided with blood and those without it—two divisions corresponding in modern language to vertebrate and invertebrate aquatic animals. The former are classified by him according to size, the further sub-divisions being based on the structure of the skeleton, mode of propagation, number of limbs, form of the body and physical character of the habitat.

Salviani.

The work of the Roman ichthyologist H. Salviani (1514-1572), bears evidence of the high social position which the author held as physician to three popes. Its title is *Aquatilium animalium historia* (Rome, 1554-1557, fol.). It treats exclusively of the fishes of Italy. Ninety-two species are figured on seventy-six plates, which, as regards artistic execution, are masterpieces of that period, although those specific characteristics which nowadays constitute the value of a zoological drawing were overlooked by the author or artist. No attempt is made at a natural classification, but the allied forms are generally placed in close proximity. The descriptions are equal to those given by Belon, entering much into the details of the economy and uses of the several species, and were evidently composed with the view of collecting in a readable form all that might prove of interest to the class of society in which the author moved. Salviani’s work is of a high order. It could not fail to render ichthyology popular in the country to the fauna of which it was devoted, but it was not fitted to advance ichthyology as a science generally; in this respect Salviani is not to be compared with Rondelet or Belon.

G. Rondelet (1507-1557) had the great advantage over Belon of having received a medical education at Paris, and especially of having gone through a complete course of instruction in anatomy as a pupil of Guentherus of Andernach. This is conspicuous throughout his works—*Libri de piscibus marinis* (Lyons, 1554); and *Universae aquatilium historiae pars altera* (Lyons, 1555). Nevertheless they cannot be regarded as more than considerably enlarged editions of Belon's work. For, although he worked independently of the latter, the system adopted by him is characterized by the same absence of the true principles of classification. His work is almost entirely limited to European and chiefly to Mediterranean forms, and comprises no fewer than one hundred and ninety-seven marine and forty-seven fresh-water fishes. His descriptions are more complete and his figures much more accurate than those of Belon; and the specific account is preceded by introductory chapters, in which he treats in a general manner of the distinctions, the external and internal parts, and the economy of fishes. Like Belon, he had no conception of the various categories of classification—confounding throughout his work the terms "genus" and "species," but he had an intuitive notion of what his successors called a "species," and his principal object was to give as much information as possible regarding such species.

Rondelet.

For nearly a century the works of Belon and Rondelet continued to be the standard works on ichthyology; but the science did not remain stationary during that period. The attention of naturalists was now directed to the fauna of foreign countries, especially of the Spanish and Dutch possessions in the New World; and in Europe the establishment of anatomical schools and academies led to careful investigation of the internal anatomy of the most remarkable European forms. Limited as these efforts were as to their scope, they were sufficiently numerous to enlarge the views of naturalists, and to destroy that fatal dependence on preceding authorities which had kept in bonds even Rondelet and Belon. The most noteworthy of those engaged in these inquiries in tropical countries were W. Piso and G. Marcgrave, who accompanied as physicians the Dutch governor, Count Maurice of Nassau, to Brazil (1630-1644).

Of the men who left records of their anatomical researches, we may mention Borelli (1608-1679), who wrote a work *De motu animalium* (Rome, 1680, 4to), in which he explained the mechanism of swimming and the function of the air-bladder; M. Malpighi (1628-1694), who examined the optic nerve of the sword-fish; the celebrated J. Swammerdam (1637-1680), who described the intestines of numerous fishes; and J. Duverney (1648-1730), who investigated in detail the organs of respiration.

A new era in the history of ichthyology commences with Ray, Willughby and Artedi, who were the first to recognize the true principles by which the natural affinities of animals should be determined. Their labours stand in so intimate a connexion with each other that they represent but one great step in the progress of this science.

J. Ray (1628-1705) was the friend and guide of F. Willughby (1635-1672). They found that a thorough reform in the method of treating the vegetable and animal kingdoms had become necessary; that the only way of bringing order into the existing chaos was by arranging the various forms according to their structure. They therefore substituted facts for speculation, and one of the first results of this change, perhaps the most important, was that, having recognized "species" as such, they defined the term and fixed it as the starting-point of all sound zoological knowledge.

Ray and Willughby.

Although they had divided their work so that Ray attended to the plants principally, and Willughby to the animals, the *Historia piscium* (Oxf., 1686), which bears Willughby's name on the title-page and was edited by Ray, is their joint production. A great part of the observations contained in it were collected during the journeys they made together in Great Britain and in the various countries of Europe.

By the definition of fishes as animals with blood, breathing by gills, provided with a single ventricle of the heart, and either covered with scales or naked, the Cetaceans are excluded. The fishes proper are arranged primarily according to the cartilaginous or the osseous nature of the skeleton, and then subdivided according to the general form of the body, the presence or the absence of ventral fins, the soft or the spinous structure of the dorsal rays, the number of dorsal fins, &c. No fewer than four hundred and twenty species are thus arranged and described, of which about one hundred and eighty were known to the authors from personal examination—a comparatively small proportion, but descriptions and figures still formed in great measure the substitute for our modern collections and museums. With the increasing accumulation of forms, the want of a fixed nomenclature had become more and more felt.

Peter Artedi (1705-1734) would have been a great ichthyologist if Ray or Willughby had not preceded him. But he was fully conscious of the fact that both had prepared the way for him, and therefore he did not fail to reap every possible advantage from their labours. His work, edited by Linnaeus, is divided as follows:—

Artedi.

> (1) In the *Bibliotheca ichthyologica* Artedi gives a very complete list of all preceding authors who had written on fishes, with a critical analysis of their works. (2) The *Philosophia ichthyologica* is devoted to a description of the external and internal parts of fishes; Artedi fixes a precise terminology for all the various modifications of the organs, distinguishing between those characters which determine a genus and such as indicate a species or merely a variety; in fact he establishes the method and principles which subsequently have guided every systematic ichthyologist. (3) The *Genera piscium* contains well-defined diagnoses of forty-five genera, for which he has fixed an unchangeable nomenclature. (4) In the *Species piscium* descriptions of seventy-two species, examined by himself, are given—descriptions which even now are models of exactitude and method. (5) Finally, in the *Synonymia piscium* references to all previous authors are arranged for every species, very much in the manner which is adopted in the systematic works of the present day.

Artedi has been justly called the father of ichthyology. So admirable was his treatment of the subject, that even Linnaeus could only modify and add to it. Indeed, so far as ichthyology is concerned, Linnaeus has scarcely done anything beyond applying binominal terms to the species properly described and classified by Artedi. His classification of the genera appears in the

Linnaeus.

12th edition of the Systema thus:—

A. *Amphibia nantia.*—*Spiraculis compositis.*—Petromyzon, Raía, Squalus, Chimaera. *Spiraculis solitariis.*—Lophius, Acipenser, Cyclopterus, Balistes, Ostracion, Tetrodon, Diodon, Centriscus, Syngnathus, Pegasus.

B. *Pisces apodes.*—Muraena, Gymnotus, Trichiurus, Anarrhichas, Ammodytes, Ophidium, Stromateus, Xiphias.

C. *Pisces jugulares.*—Callionymus, Uranoscopus, Trachinus, Gadus, Blennius.

D. *Pisces thoracici.*—Cepola, Echeneis, Coryphaena, Gobius, Cottus, Scorpaena, Zeus, Pleuronectes, Chaetodon, Sparus, Labrus, Sciaena, Perca, Gasterosteus, Scomber, Mullus, Trigla.

E. *Pisces abdominales.*—Cobitis, Amia, Silurus, Teuthis, Loricaria, Salmo, Fistularia, Esox, Elops, Argentina, Atherina, Mugil, Mormyrus, Exocoetus, Polynemus, Clupea, Cyprinus.

Two contemporaries of Linnaeus, L. T. Gronow and J. T. Klein, attempted a systematic arrangement of fishes.

The works of Artedi and Linnaeus led to an activity of research, especially in Scandinavia, Holland, Germany and England, such as has never been equalled in the history of biological science. Whilst some of the pupils and followers of Linnaeus devoted themselves to the examination and study of the fauna of their native countries, others proceeded on voyages of discovery to foreign and distant lands. Of these latter the following may be especially mentioned: O. Fabricius worked out the fauna of Greenland; Peter Kalm collected in North America, F. Hasselquist in Egypt and Palestine, M. T. Brünnich in the Mediterranean, Osbeck in Java and China, K. P. Thunberg in Japan; Forskål examined and described the fishes of the Red Sea; G. W. Steller, P. S. Pallas, S. G. Gmelin, and A. J. Güldenstädt traversed nearly the whole of the Russian empire in Europe and Asia. Others attached themselves as naturalists to celebrated navigators, such as the two Forsters (father and son) and Solander, who accompanied Cook; P. Commerson, who travelled with Bougainville; and Pierre Sonnerat. Of those who studied the fishes of their native countries, the most celebrated were Pennant (Great Britain), O. F. Müller (Denmark), Duhamel du Monceau (France), C. von Meidinger (Austria), J. Cornide (Spain), and A. Parra (Cuba).

The mass of materials brought together was so great that, not long after the death of Linnaeus, the necessity made itself felt for collecting them in a compendious form. Several compilers undertook this task; they embodied the recent discoveries in new editions of the classical works of Artedi and Linnaeus, but, they only succeeded in burying those noble monuments under a chaotic mass of rubbish. For ichthyology it was fortunate that two men at least, Bloch and Lacepède, made it a subject of prolonged original research.

Bloch.

Mark Eliezer Bloch (1723-1799), a physician of Berlin, had reached the age of fifty-six when he began to write on ichthyological subjects. His work consists of two divisions:— (1) *Öconomische Naturgeschichte der Fische Deutschlands* (Berl., 1782-1784); (2) *Naturgeschichte der ausländischen Fische* (Berl., 1785-1795). The first division, which is devoted to a description of the fishes of Germany, is entirely original. His descriptions as well as figures were made from nature, and are, with few exceptions, still serviceable; indeed many continue to be the best existing in literature. Bloch was less fortunate, and is much less trustworthy, in his natural history of foreign fishes. For many of the species he had to trust to more or less incorrect drawings and descriptions by travellers; frequently, also, he was deceived as to the origin of specimens which he purchased. Hence his accounts contain numerous errors, which it would have been difficult to correct had not nearly the whole of the materials on which his work is based been preserved in the collections at Berlin.

After the completion of his great work Bloch prepared a general system of fishes, in which he arranged not only those previously described, but also those with which he had afterwards become acquainted. The work was ably edited and published after Bloch's death by a philologist, J. G. Schneider, under the title *M. E. Blochii Systema ichthyologiae iconibus cx. illustratum* (Berl., 1801). The number of species enumerated amounts to 1519. The system is based upon the number of the fins, the various orders being termed *Hendecapterygii*, *Decapterygii*, &c. An artificial method like this led to the most unnatural combinations and distinctions.

Bloch's *Naturgeschichte* remained for many years the standard work. But as regards originality of thought Bloch was far surpassed by his contemporary, B. G. E. de Lacepède, born at Agen, in France, in 1756, who became professor at the museum of natural history in Paris, where he died in 1825.

Lacepède.

Lacepède had to contend with great difficulties in the preparations of his *Histoire des poissons* (Paris, 1798-1803, 5 vols.), which was written during the most disturbed period of the French Revolution. A great part of it was composed whilst the author was separated from collections and books, and had to rely on his notes and manuscripts only. Even the works of Bloch and other contemporaneous authors remained unknown or inaccessible to him for a long time. His work, therefore, abounds in the kind of errors into which a compiler is liable to fall. Thus the influence of Lacepède on the progress of ichthyology was vastly less than that of his fellow-labourer; and the labour laid on his successors in correcting numerous errors probably outweighed the assistance which they derived from his work.

The work of the principal students of ichthyology in the period between Ray and Lacepède was chiefly systematizing and describing; but the internal organization of fishes also received attention from more than one great anatomist. Albrecht von Haller, Peter Camper and John Hunter examined the nervous system and the organs of sense; and Alexander Monro, *secundus*, published a classical work, *The Structure and Physiology of Fishes Explained and Compared with those of Man and other Animals* (Edin., 1785). The electric organs of fishes (*Torpedo* and *Gymnotus*) were examined by Réaumur, J. N. S. Allamand, E. Bancroft, John Walsh, and still more exactly by J. Hunter. The mystery of the propagation of the eel called forth a large number of essays, and even the artificial propagation of *Salmonidae* was known and practised by J. G. Gleditsch (1764).

Bloch and Lacepède's works were almost immediately succeeded by the labours of Cuvier, but his early publications were tentative, preliminary and fragmentary, so that some little time elapsed before the spirit infused into ichthyology by this great anatomist could exercise its influence on all the workers in this field.

The *Descriptions and Figures of Two Hundred Fishes collected at Vizagapatam on the Coast of Coromandel* (Lond., 1803, 2 vols.) by Patrick Russel, and *An Account of the Fishes found in the River Ganges and its Branches* (Edin., 1822, 2 vols.) by F. Hamilton (formerly Buchanan), were works distinguished by greater accuracy of the drawings (especially the latter) than was ever attained before. A *Natural History of British Fishes* was published by E. Donovan (Lond., 1802-1808); and the Mediterranean fauna formed the study of the lifetime of A. Risso, *Ichthyologie de Nice* (Paris, 1810); and *Histoire naturelle de l'Europe méridionale* (Paris, 1827). A slight beginning in the description of the fishes of the United States was made by Samuel Latham Mitchell (1764-1831), who published, besides various papers, a *Memoir on the Ichthyology of New York*, in 1815.

Cuvier.

G. Cuvier (1769-1832) devoted himself to the study of fishes with particular predilection. The investigation of their anatomy, and especially their skeleton, was continued until he had succeeded in completing so perfect a framework of the system of the whole class that his immediate successors required only to fill up those details for which their master had had no leisure. He ascertained the natural affinities of the infinite variety of forms, and accurately defined the divisions, orders, families and genera of the class, as they appear in the various editions of the *Règne Animal*. His industry equalled his genius; he formed connections with almost every accessible part of the globe; and for many years the museum of the Jardin des Plantes was the centre where all ichthyological treasures were deposited. Thus Cuvier brought together a collection which, as it contains all the materials on which his labours were based, must still be considered as the most important. Soon after the year 1820, Cuvier, assisted by one of his pupils, A. Valenciennes, commenced his great work on fishes, *Historie naturelle des Poissons*, of which the first volume appeared in 1828. After Cuvier's death in 1832 the work was left entirely in the hands of Valenciennes, whose energy and interest gradually slackened, rising to their former pitch in some parts only, as, for instance, in the treatise, on the herring. He left the work unfinished with the twenty-second volume (1848), which treats of the Salmonoids. Yet, incomplete as it is, it is indispensable to the student.

Valenciennes.

The system finally adopted by Cuvier is the following:—

A. POISSONS OSSEUX.

I. A Branchies en Peignes ou en Lames.

1. *A Mâchoire Supérieure Libre.*

a. Acanthoptérygiens.

Percoïdes.	Sparoïdes.	Branchies labyrinthiques.
Polynèmes.	Chétodonoïdes.	Lophioïdes.
Mulles.	Scombéroïdes.	Gobioïdes.
Joues cuirassées.	Muges.	Labroïdes.
Sciénoïdes.		

b. Malacoptérygiens.

Abdominaux.	*Subbrachiens.*	*Apodes.*
——	——	——
Cyprinoïdes	Gadoïdes.	Murénoïdes.
Siluroïdes.	Pleuronectes.	
Salmonoïdes.	Discoboles.	
Clupéoïdes.		
Lucioïdes.		

2. *A Mâchoire Supérieure Fixée.*

Selérodermes. Gymnodontes.

II. A Branchies en Forme de Houppes.

Lophobranches.

B. CARTILAGINEUX OU CHONDROPTÉRYGIENS.

Sturioniens. Plagiostomes. Cyclostomes.

We have only to compare this system with that of Linnaeus if we wish to measure the gigantic stride made by ichthyology during the intervening period of seventy years. The various characters employed for classification have been examined throughout the whole class, and their relative importance has been duly weighed and understood. The important category of "family" appears now in Cuvier's system fully established as intermediate between genus and order. Important changes in Cuvier's system have been made and proposed by his successors, but in the main it is still that of the present day.

Cuvier had extended his researches beyond the living forms, into the field of palaeontology; he was the first to observe the close resemblance of the scales of the fossil *Palaeoniscus* to those of the living *Polypterus* and *Lepidosteus*, the prolongation and identity of structure of the upper caudal lobe in *Palaeoniscus* and the sturgeons, the presence of peculiar "fulcra" on the anterior margin of the dorsal fin in *Palaeoniscus* and *Lepidosteus*, and inferred from these facts that the fossil genus was allied either to the sturgeons or to *Lepidosteus*. But it did not occur to him that there was a close relationship between those recent fishes. *Lepidosteus* and, with it, the fossil genus remained in his system a member of the order of *Malacopterygii abdominales*.

Agassiz.

It was left to L. Agassiz (1807-1873) to point out the importance of the structure of the scales as a characteristic, and to open a path towards the knowledge of a whole new subclass of fishes, the *Ganoidei*. Impressed with the fact that the peculiar scales of *Polypterus* and *Lepidosteus* are common to all fossil osseous fishes down to the Chalk, he takes the structure of the scales generally as the base for an ichthyological system, and distinguishes four orders:—

1. *Placoids.*—Without scales proper, but with scales of enamel, sometimes large, sometimes small, and reduced to mere points (Rays, Sharks and Cyclostomi, with the fossil Hybodontes). 2. *Ganoids.*—With angular bony scales, covered with a thick stratum of enamel: to this order belong the fossil Lepidoides, Sauroides, Pycnodontes and Coelacanthi; the recent Polypterus, Lepidosteus, Sclerodermi, Gymnodontes, Lophobranches and Siluroides; also the Sturgeons. 3. *Ctenoids.*—With rough scales, which have their free margins denticulated: Chaetodontidae, Pleuronectidae, Percidae, Polyacanthi, Sciaenidae, Sparidae, Scorpaenidae, Aulostomi. 4. *Cycloids.*—With smooth scales, the hind margin of which lacks denticulation: Labridae, Mugilidae, Scombridae, Gadoidei, Gobiidae, Muraenidae, Lucioidei, Salmonidae, Clupeidae, Cyprinidae.

If Agassiz had had an opportunity of acquiring a more extensive and intimate knowledge of existing fishes before his energies were absorbed in the study of fossil remains, he would doubtless have recognized the artificial character of his classification. The distinctions between cycloid and ctenoid scales, between placoid and ganoid fishes, are vague, and can hardly be maintained. So far as the living and post-Cretacean forms are concerned, he abandoned the vantage-ground gained by Cuvier; and therefore his system could never supersede that of his predecessor, and finally shared the fate of every classification based on the modifications of one organ only. But Agassiz opened an immense new field of research by his study of the infinite variety of fossil forms. In his principal work, *Recherches sur les poissons fossiles*, Neuchâtel, 1833-1843, 4to, atlas in fol., he placed them before the world arranged in a methodical manner, with excellent descriptions and illustrations. His power of discernment and penetration in determining even the most fragmentary remains is astonishing; and, if his order of Ganoids is an assemblage of forms very different from what is now understood by that term, he was the first who recognized that such an order of fishes exists.

The discoverer of the *Ganoidei* was succeeded by their explorer Johannes Müller (1801-1858). In his classical memoir *Über den Bau und die Grenzen der Ganoiden* (Berl., 1846) he showed that the Ganoids differ from all the other osseous fishes, and agree with the Plagiostomes, in the structure of the heart. By this primary character, all heterogeneous elements, as Siluroids, *Osteoglossidae*, &c., were eliminated from the order as understood by Agassiz. On the other hand, he did not recognize the affinity of *Lepidosiren* to the Ganoids, but established for it a distinct subclass, *Dipnoi*, which he placed at the opposite end of the system. By his researches into the anatomy of the lampreys and *Amphioxus*, their typical distinctness from other cartilaginous fishes was proved; they became the types of two other subclasses, *Cyclostomi* and *Leptocardii*.

Müller proposed several other modifications of the Cuvierian system; and, although all cannot be maintained as the most natural arrangements, yet his researches have given us a much more complete knowledge of the organization of the Teleostean fishes, and later inquiries have shown that, on the whole, the combinations proposed by him require only some further modification and another definition to render them perfectly natural.

The discovery (in the year 1871) of a living representative of a genus hitherto believed to be long extinct, *Ceratodus*, threw a new light on the affinities of fishes. The writer of the present article, who had the good fortune to examine this fish, was enabled to show that, on the one hand, it was a form most closely allied to *Lepidosiren*, and, on the other, that it could not be separated from the Ganoid fishes, and therefore that *Lepidosiren* also was a Ganoid,—a relation already indicated by Huxley in a previous paper on “Devonian Fishes.” 247

Having followed the development of the ichthyological system down to this period, we now enumerate the most important contributions to ichthyology which appeared contemporaneously with or subsequently to the publication of the great work of Cuvier and Valenciennes. For the sake of convenience we may arrange these works under two heads.

I. Voyages, containing general accounts of Zoological Collections

A. *French.*—1. *Voyage autour du monde sur les corvettes de S. M. l’Uranie et la Physicienne, sous le commandement de M. Freycinet*, “Zoologie—Poissons,” par Quoy et Gaimard (Paris, 1824). 2. *Voyage de la Coquille*, “Zoologie,” par Lesson (Paris, 1826-1830). 3. *Voyage de l’Astrolabe, sous le commandement de M. J. Dumont d’Urville*, “Poissons,” par Quoy et Gaimard (Paris, 1834). 4. *Voyage au Pôle Sud par M. J. Dumont d’Urville*, “Poissons,” par Hombron et Jacquinot (Paris, 1853-1854).

B. *English.*—1. *Voyage of H.M.S. Sulphur*, “Fishes,” by J. Richardson (Lond., 1844-1845). 2. *Voyage of H.M.SS. Erebus and Terror*, “Fishes,” by J. Richardson (Lond., 1846). 3. *Voyage of H.M.S. Beagle*, “Fishes,” by L. Jenyns (Lond., 1842).

C. German.—1. *Reise der österreichischen Fregatte Novara*, “Fische,” von R. Kner (Vienna, 1865).

II. Faunae

A. *Great Britain.*—1. R. Parnell, *The Natural History of the Fishes of the Firth of Forth* (Edin., 1838). 2. W. Yarrell, *A History of British Fishes* (3rd ed., Lond., 1859). 3. J. Couch, *History of the Fishes of the British Islands* (Lond., 1862-1865).

B. *Denmark and Scandinavia.*—1. H. Kröyer, *Danmark’s Fiske* (Copenhagen, 1838-1853). 2. S. Nilsson, *Skandinavisk Fauna*, vol. iv. “Fiskarna” (Lund, 1855). 3. Fries och Ekström, *Skandinaviens Fiskar* (Stockh.,

1836).

C. *Russia.*—1. Nordmann, "Ichthyologie pontique," in Demidoff's *Voyage dans la Russie méridionale*, tome iii. (Paris, 1840).

D. *Germany.*—1. Heckel und Kner, *Die Süsswasserfische der österreichischen Monarchie* (Leipz., 1858). 2. C. T. E. Siebold, *Die Süsswasserfische von Mitteleuropa* (Leipz., 1863).

E. *Italy and Mediterranean.*—1. Bonaparte, *Iconografia della fauna italica*, tom iii., "Pesci" (Rome, 1832-1841). 2. Costa, *Fauna del regno di Napoli*, "Pesci" (Naples, about 1850).

F. *France.*—1. E. Blanchard, *Les Poissons des eaux douces de la France* (Paris, 1866).

G. *Spanish Peninsula.*—The fresh-water fish fauna of Spain and Portugal was almost unknown, until F. Steindachner paid some visits to those countries for the purpose of exploring the principal rivers. His discoveries are described in several papers in the *Sitzungsberichte der Akademie zu Wien*. B. du Bocage and F. de B. Capello made contributions to our knowledge of the marine fishes on the coast of Portugal (*Jorn. Scienc. Acad. Lisb.*).

H. *North America.*—1. J. Richardson, *Fauna Bareali-Americana*, part iii., "Fishes" (Lond., 1836). The species described in this work are nearly all from the British possessions in the north. 2. Dekay, *Zoology of New York*, part iv., "Fishes" (New York, 1842). 3. *Reports of the U.S. Comm. of Fish and Fisheries* (5 vols., Washington, 1873-1879) and *Reports* and special publications of the U.S. Bureau of Fisheries contain valuable information. Numerous descriptions of North American fresh-water fishes have been published in the reports of the various U.S. Government expeditions, and in North American scientific journals, by D. H. Storer, S. F. Baird, C. Girard, W. O. Ayres, E. D. Cope, D. S. Jordan, G. Brown Goode, &c.

I. *Japan.*—1. *Fauna Japonica*, "Poissons," par H. Schlegel, (Leiden, 1850).

J. *East Indies; Tropical parts of the Indian and Pacific Oceans.*—1. E. Rüppell, *Atlas zu der Reise im nördlichen Afrika* (Frankf., 1828). 2. E. Rüppell, *Neue Wirbelthiere*, "Fische" (Frankf., 1837). 3. R. L. Playfair and A. Günther, *The Fishes of Zanzibar* (Lond., 1876). 4. C. B. Klunzinger, *Synopsis der Fische des Rothen Meers* (Vienna, 1870-1871). 5. F. Day, *The Fishes of India* (Lond., 1865, 4to) contains an account of the fresh-water and marine species. 6. A. Günther, *Die Fische der Südsee* (Hamburg, 4to), from 1873 (in progress). 7. Unsurpassed in activity, as regards the exploration of the fish fauna of the East Indian archipelago, is P. Bleeker (1819-1878), a surgeon in the service of the Dutch East Indian Government, who, from the year 1840, for nearly thirty years, amassed immense collections of the fishes of the various islands, and described them in extremely numerous papers, published chiefly in the journals of the Batavian Society. Soon after his return to Europe (1860) Bleeker commenced to collect the final results of his labours in a grand work, illustrated by coloured plates, *Atlas ichthyologique des Indes Orientales Néerlandaises* (Amsterd., fol., 1862), the publication of which was interrupted by the author's death in 1878.

K. *Africa.*—1. A. Günther, "The Fishes of the Nile," in Petherick's *Travels in Central Africa* (Lond., 1869). 2. W. Peters, *Naturwissenschaftliche Reise nach Mossambique*, iv., "Flussfische" (Berl., 1868, 4to).

L. *West Indies and South America.*—1. L. Agassiz, *Selecta genera et species piscium, quae in itinere per Brasiliam, collegit J. B. de Spix* (Munich, 1829, fol.). 2. F. de Castelnau, *Animaux nouveaux ou rares, recueillis pendant l'expédition dans les parties centrales de l'Amérique du Sud*, "Poissons" (Paris, 1855). 3. L. Vaillant and F. Bocourt, *Mission scientifique au Mexique et dans l'Amérique centrale*, "Poissons" (Paris, 1874). 4. F. Poey, the celebrated naturalist of Havana, devoted many years of study to the fishes of Cuba. His papers and memoirs are published partly in two periodicals, issued by himself, under the title of *Memorias sobre la historia natural de la isla de Cuba* (from 1851), and *Repertorio fisico-natural de la isla de Cuba* (from 1865), partly in North American scientific journals. And, finally, F. Steindachner and A. Günther have published many contributions, accompanied by excellent figures, to our knowledge of the fishes of Central and South America.

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N. *Arctic Regions.*—1. C. Lütken, "A Revised Catalogue of the Fishes of Greenland," in *Manual of the Natural History, Geology and Physics of Greenland* (Lond., 1875, 8vo). 2. The fishes of Spitzbergen were examined by A. J. Malmgren (1865).

(A. C. G.)

II. History and Literature from 1880

In the systematic account which followed the above chapter in the 9th edition of the *Encyclopaedia Britannica*, the following classification, which is the same as that given in the author's *Introduction to the Study of Fishes* (London, 1880) was adopted by Albert Günther:—

Subclass I. : Palaeichthyes.
  Order I. : *Chondropterygii.*
    With two suborders : Plagiostomata and Holocephala.
  Order II. : *Ganoidei.*
    With eight suborders : Placodermi, Acanthodini, Dipnoi, Chondrostei, Polypteroidei, Pycnodontoidei, Lepidosteoidei, Amioidei.
Subclass II. : Teleostei.
  Order I. : *Acanthopterygii.*
    With the divisions Perciformes, Beryciformes, Kurtiformes, Polynemiformes, Sciaeniformes, Xiphiiformes, Trichiuriformes, Cotto-Scombriformes, Gobiiformes, Blenniformes, Mugiliformes, Gastrosteiformes, Centrisciformes, Gobiesociformes, Channiformes, Labyrinthibranchii, Lophotiformes, Taeniiformes and Notacanthiformes.
  Order II. : *Acanthopterygii Pharyngognathi.*
  Order III. : *Anacanthini.*
    With two divisions : Gadoidei and Pleuronectoidei.

Order IV. : *Physostomi.*
Order V. : *Lophobranchii.*
Order VI. : *Plectognathi.*
Subclass III. : Cyclostomata.
Subclass IV. : Leptogardii.

It was an artificial system, in which the most obvious relationships of the higher groups were lost sight of, and the results of the already fairly advanced study of the fossil forms to a great extent discarded. This system gave rise to much adverse criticism; as T. H. Huxley forcibly put it in a paper published soon after (1883), opposing the division of the main groups into Palaeichthyes and Teleostei: "Assuredly, if there is any such distinction to be drawn on the basis of our present knowledge among the higher fishes, it is between the Ganoids and the Plagiostomes, and not between the Ganoids and the Teleosteans"; at the same time expressing his conviction, "first, that there are no two large groups of animals for which the evidence of a direct genetic connexion is better than in the case of the Ganoids and the Teleosteans; and secondly, that the proposal to separate the Elasmobranchii (Chondropterygii of Günther), Ganoidei and Dipnoi of Müller into a group apart from, and equivalent to, the Teleostei appears to be inconsistent with the plainest relations of these fishes." This verdict has been endorsed by all subsequent workers at the classification of fishes.

Günther's classification would have been vastly improved had he made use of a contribution published as early as 1871, but not referred to by him. As not even a passing allusion is made to it in the previous chapter, we must retrace our steps to make good this striking omission. Edward Drinker Cope (1840-1897) was a worker of great originality and relentless energy, who, in the sixties of the last century, inspired by the doctrine of evolution, was one of the first to apply its principles to the classification of vertebrates. Equally versed in recent and fossil zoology, and endowed with a marvellous gift, or "instinct" for perceiving the relationship of animals, he has done a great deal for the advance of our knowledge of mammals, reptiles and fishes. Although often careless in the working out of details and occasionally a little too bold in his deductions, Cope occupies a high rank among the zoologists of the 19th century, and much of his work has stood the test of time.

The following was Cope's classification, 1871 (*Tr. Amer. Philos. Soc.* xiv. 449).

Subclass I. Holocephali.
" II. Selachii.
" III. Dipnoi.
" IV. Crossopterygia, with two orders: Haplistia and Cladistia.
" V. Actinopteri.

The latter is subdivided in the following manner:—

Tribe I. : Chondrostei.
Two orders : Selachostomi and Glaniostomi.
Tribe II. : Physostomi.
Twelve orders: Ginglymodi, Halecomorphi, Nematognathi, Scyphophori, Plectospondyli, Isospondyli, Haplomi, Glanencheli, Ichthyocephali, Holostomi, Enchelycephali, Colocephali.
Tribe III. : Physoclysti.
Ten orders : Opisthomi, Percesoces, Synentognathi, Hemibranchii, Lophobranchii, Pediculati, Heterosomata, Plectognathi, Percomorphi, Pharyngognathi.

Alongside with so much that is good in this classification, there are many suggestions which cannot be regarded as improvements on the views of previous workers. Attaching too great an importance to the mode of suspension of the mandible, Cope separated the Holocephali from the Selachii and the Dipnoi from the Crossopterygii, thus obscuring the general agreement which binds these groups to each other, whilst there is an evident want of proportion in the five subclasses. The exclusion from the class Pisces of the Leptocardii, or lancelets, as first advocated by E. Haeckel, was a step in the right direction, whilst that of the Cyclostomes does not seem called for to such an authority as R. H. Traquair, with whom the writer of this review entirely concurs.

The group of Crossopterygians, first separated as a family from the other Ganoids by Huxley, constituted a fortunate innovation, and so was its division into two minor groups, by which the existing forms (*Polypteroidei*) were separated as Cladistia. The divisions of the Actinopteri, which includes all Teleostomes other than the Dipneusti and Crossopterygii also showed, on the whole, a correct appreciation of their relationships, the Chondrostei being well separated from the other Ganoids with which they were generally associated. In the groupings of the minor divisions, which Cope termed orders, we had a decided improvement on the Cuvierian-Müllerian classification, the author having utilized many suggestions of his fellow countrymen Theodore Gill, who has done much towards a better understanding of their relationships. In the association of the Characinids with the Cyprinids (Plectospondyli) in the separation of the flat-fishes from the Ganoids, in the approximation of the Lophobranchs to the sticklebacks and of the Plectognaths to the Acanthopterygians, and in many other points, Cope was in advance of his time, and it is to be regretted that his contemporaries did not more readily take up many of his excellent suggestions for the improvement of their systems.

In the subsequent period of his very active scientific life, Cope made many alterations to his system, the latest scheme published by him being the following ("Synopsis of the families of Vertebrata," *Amer. Natur.*, 1889, p. 849):—

Class : **Agnatha.**
I. Subclass : Ostracodermi.

Orders : Arrhina, Diplorrhina.
II. Subclass : Marsipobranchii.
Orders : Hyperotreti, Hyperoarti.
Class : **Pisces.**
I. Subclass : Holocephali.
II. Subclass : Dipnoi.
III. Subclass : Elasmobranchii.
Orders : Ichthyotomi, Selachii.
IV. Subclass : Teleostomi.
(i.) Superorder : *Rhipidopterygia.*
Orders : Rhipidistia, Actinistia.
(ii.) Superorder : *Crossopterygia.*
Orders : Placodermi, Haplistia, Taxistia, Cladistia.
(iii.) Superorder : *Podopterygia* (Chondrostei).
(iv.) Superorder : *Actinopterygia.*
Orders : Physostomi, Physoclysti.

This classification is that followed, with many emendations, by A. S. Woodward in his epoch-making *Catalogue of Fossil Fishes* (4 vols., London, 1889-1901), and in his most useful *Outlines of Vertebrate Paleontology* (Cambridge, 1898), and was adopted by Günther in the 10th edition of the *Encyclopaedia Britannica*:—

Class : **Agnatha.**
I. Subclass : Cyclostomi.
With three orders : (*a*) *Hyperoartia* (Lampreys); (*b*) *Hyperotreti* (Myxinoids); (*c*) *Cycliae* (Palaeospondylus).
II. Subclass : Ostracodermi.
With four orders : (*a*) *Heterostraci* (Coelolepidae, Psammosteidae, Drepanaspidae, Pteraspidae); (*b*) *Osteostraci* (Cephalaspidae, Ateleaspidae, &c.); (*c*) Antiarchi (Asterolepidae, Pterichthys, Bothrolepis, &c.); (*d*) Anaspida (Birkeniidae).
Class : **Pisces.**
I. Subclass : Elasmobranchii.
With four orders : (*a*) *Pleuropterygii* (Cladoselache); (*b*) *Ichthyotomi* (Pleuracanthidae); (*c*) *Acanthodii* (Diplacanthidae, and Acanthodidae); (*d*) *Selachii* (divided from the structure of the vertebral centres into Asterospondyli and Tectospondyli).
II. Subclass : Holocephali.
With one order : *Chimaeroidei.*
III. Subclass : Dipnoi.
With two orders : (*a*) *Sirenoidei* (Lepidosiren, Ceratodus, Uronemidae, Ctenodontidae); (*b*) *Arthrodira* (Homosteus, Coccosteus, Dinichthys).
IV. Subclass : Teleostomi.
A. Order : *Crossopterygii.*
With four suborders: (1) *Haplistia* (Tarassius); (2) *Rhipidistia* (Holoptychidae, Rhizodontidae, Osteolepidae); (3) *Actinistia* (Coelacanthidae); (4) *Cladistia* (Polypterus).
B. Order : *Actinopterygii.*
With about twenty suborders: (1) *Chondrostei* (Palaeoniscidae, Platysomidae, Chondrosteidae, Sturgeons); (2) *Protospondyli* (Semionotidae, Macrosemiidae, Pycnodontidae, Eugnathidae, Amiidae, Pachycormidae); (3) *Aetheospondyli* (Aspidorhynchidae, Lepidosteidae); (4) *Isospondyli* (Pholidophoridae, Osteoglossidae, Clupeidae, Leptolepidae, &c.); (5) *Plectospondyli* (Cyprinidae, Characinidae); (6) *Nematognathi*; (7) *Apodes*; and the other Teleosteans.

There are, however, grave objections to this system, which cannot be said to reflect the present state of our knowledge. In his masterly paper on the evolution of the Dipneusti, L. Dollo has conclusively shown that the importance of the autostyly on which the definition of the Holocephali from the Elasmobranchii or Selachii and of the Dipneusti from the Teleostomi rested, had been exaggerated, and that therefore the position assigned to these two groups in Günther's classification of 1880 still commended itself. Recent work on *Palaeospondylus*, on the Ostracoderms, and on the Arthrodira, throws great doubt on the propriety of the positions given to them in the above classification, and the rank assigned to the main divisions of the Teleostomi do not commend themselves to the writer of the present article, who would divide the fishes into three subclasses:—

I. Cyclostomi
II. Selachii
III. Teleostomi,

the characters and contents of which will be found in separate articles; in the present state of uncertainty as to their position, *Palaeospondylus* and the *Ostracodermi* are best placed *hors cadre* and will be dealt with under these names.

The three subclasses here adopted correspond exactly with those proposed in Theo. Gill's classification of the recent fishes ("Families and Subfamilies of Fishes," *Mem. Nat. Ac. Sci.* vi. 1893), except that they are regarded by that authority as classes.

The period dealt with in this chapter, ushered in by the publication of Günther's *Introduction to the Study of Fishes*, has been one of extraordinary activity in every branch of ichthyology, recent and fossil. A glance at the *Zoological Record*, published by the Zoological Society of London, will show the ever-increasing number of monographs, morphological papers and systematic contributions, which appear year after year. The number of new genera and species which are being proposed is amazing, but it is difficult to tell how many of them will simply go to swell the already overburdened synonymy. Perhaps a reasonable estimate of the living species known at the present day would assess their number at about 13,000.

It is much to be regretted that there is not a single general modern systematic work on fishes. The most important treatises, the 7th volume of the *Cambridge Natural History*, by T. W. Bridge and G. A. Boulenger, and D. S. Jordan's *Guide to the Study of Fishes*, only profess to give definitions of the families with enumerations of the principal genera. Günther's *Catalogue of the Fishes in the British Museum* therefore remains the only general descriptive treatise, but its last volume dates from 1870, and the work is practically obsolete. A second edition of it was begun in 1894, but only one volume, by Boulenger, has appeared, and the subject is so vast that it seems doubtful now whether any one will ever have the time and energy to repeat Günther's achievement. The fish fauna of the different parts of the world will have to be dealt with separately, and it is in this direction that descriptive ichthyology is most likely to progress.

North America, the fishes of which were imperfectly known in 1880, now possesses a *Descriptive Catalogue* in 4 stout volumes, by D. S. Jordan and B. W. Evermann, replacing the synopsis brought out in 1882 by D. S. Jordan and C. H. Gilbert. A similar treatise should embrace all the fresh-water species of Africa, the fishes of the two principal river systems, the Nile and the Congo, having recently been worked out by G. A. Boulenger. Japanese ichthyology has been taken in hand by D. S. Jordan and his pupils.

The fishes of the deep sea have been the subject of extensive monographs by L. Vaillant (*Travailleur* and *Talisman*), A. Günther (*Challenger*), A. Alcock (*Investigator*), R. Collett (*Hirondelle*), S. Garman (*Albatross*) and a general résumé up to 1895 was provided in G. B. Goode's and T. H. Bean's *Oceanic Ichthyology*. More than 600 true bathybial fishes are known from depths of 1000 fathoms and more, and a great deal of evidence has been accumulated to show the general transition of the surface fauna into the bathybial.

A recent departure has been the exploration of the Antarctic fauna. Three general reports, on the results of the *Southern Cross*, the *Belgica* and the Swedish *South Polar* expeditions, had already been published in 1907, and others on the *Scotia* and *Discovery* were in preparation. No very striking new types of fishes have been discovered, but the results obtained are sufficient to entirely disprove the theory of bipolarity which some naturalists had advocated. Much has been done towards ascertaining the life-histories of the fishes of economic importance, both in Europe and in North America, and our knowledge of the larval and post-larval forms has made great progress.

Wonderful activity has been displayed in the field of palaeontology, and the careful working out of the morphology of the archaic types has led to a better understanding of the general lines of evolution; but it is to be regretted that very little light on the relationships of the living groups of Teleosteans has been thrown by the discoveries of palaeontologists.

Among the most remarkable additions made in recent years, the work of R. H. Traquair on the problematic fishes *Palaeospondylus*, *Thelodus*, *Drepanaspis*, *Lanarkia*, *Ateleaspis*, *Birkenia* and *Lanasius*, ranks foremost; next to it must be placed the researches of A. S. Woodward and Bashford Dean on the primitive shark *Cladoselache*, and of the same authors, J. S. Newberry, C. R. Eastman, E. W. Claypole and L. Hussakof, on the Arthrodira, a group the affinities of which have been much discussed.

AUTHORITIES.—The following selection from the extremely extensive ichthyological literature which has appeared during the period 1880-1906 will supplement the bibliographical notice appended to section I. I. **The General Subject**: A. Günther, *Introduction to the Study of Fishes* (Edinburgh, 1880); B. Dean, *Fishes Living and Fossil* (New York, 1895); T. W. Bridge and G. A. Boulenger, "Fishes," *Cambridge Natural History*, vii. (1904); D. S. Jordan, *Guide to the Study of Fishes* (2 vols., New York, 1905). II. **Palaeontological**: A. Fritsch, *Fauna der Gaskohle und der Kalksteine der Permformation Böhmens* (vols, i.-iii., Prague, 1879-1894); K. A. von Zittel, *Handbuch der Paläontologie*, vol. iii. (Munich, 1887); A. Smith Woodward, *Catalogue of Fossil Fishes in the British Museum*, vols. i.-iii. (London, 1889-1895); A. Smith Woodward, *Outlines of Vertebrate Palaeontology for Students of Zoology* (Cambridge, 1898); J. S. Newberry, "The Palaeozoic Fishes of North America," *Mon. U.S. Geol. Surv.* vol. xvi. (1889); J. V. Rohon, "Die obersilurischen Fische von Ösel, Thyestidae und Trematapidae," *Mém. Ac. Imp. Sc. St-Pétersb.* xxxviii. (1892); O. Jaekel, *Die Selachier von Bolca, ein Beitrag zur Morphogenie der Wirbeltiere* (Berlin, 1894); B. Dean, "Contributions to the Morphology of Cladoselache," *Journ. Morphol.* ix. (1894); R. H. Traquair, "The Asterolepidae," *Mon. Palaeont. Soc.* (1894-1904, in progress); "Report on Fossil Fishes collected by the Geological Survey of Scotland in the Silurian Rocks of the South of Scotland," *Trans. Roy. Soc. Edin.* xxxix. (1899); L. Dollo, "Sur la phylogénie des Dipneustes," *Bull. Soc. Belge Géol.* vol. ix. (1895); E. W. Claypole, "The Ancestry of the Upper Devonian Placoderms of Ohio," *Amer. Geol.* xvii. (1896); B. Dean, "Palaeontlogical Notes," *Mem. N.Y. Ac.* ii. (1901); A. Stewart and S. W. Williston, "Cretaceous Fishes of Kansas," *Univ. Geol. Surv. Kansas*, vi. (Topeka, 1901); A. S. Woodward, "Fossil Fishes of the English Chalk," *Palaeontogr. Soc.* (1902-1903, etc.); R. H. Traquair, "The Lower Devonian Fishes of Gemünden.," *Roy. Soc. Edin. Trans.* 40 (1903); W. J. and I. B. J. Sollas, "Account of the Devonian Fish Palaeospondylus," *Phil. Trans.* 196 (1903); C. T. Regan, "Phylogeny of the Teleostomi," *Ann. & Mag. N.H.* (7) 13 (1904); C. R. Eastman, "Fishes of Monte Bolca," *Bull. Mus. C.Z.* 46 (1904); "Structure and Relations of Mylostoma," *Op. cit.* 2 (1906); O. Abel, "Fossile Flugfische," *Jahrb. Geol. Reichsanst.* 56 (Wien, 1906); L. Hussakof. "Studies on the Arthrodira," *Mem. Amer. Mus. N.H.* ix. (1906). III. **Faunistic** (recent fishes): (A) EUROPE: E. Bade, *Die mitteleuropäischen Süsswasserfische* (2 vols., Berlin, 1901-1902). GREAT BRITAIN: F. Day, *The Fishes of Great Britain and Ireland* (2 vols., London, 1880-1884); J. T. Cunningham, *The Natural History of the Marketable Marine Fishes of the British Islands* (London, 1896); W. C. M'Intosh and A. T. Masterman, *The Life-Histories of the British Marine Food-Fishes* (London, 1897); Sir H. Maxwell, *British Fresh-water Fish* (London, 1904); F. G. Aflalo, *British Salt-water Fish* (London, 1904). Numerous important researches into the development, life-conditions and distributions, carried out at the Biological Laboratories at Plymouth and St Andrews and during the survey of the fishing grounds of Ireland, have been published by W. L. Calderwood, J. T. Cunningham, E. W. L. Holt, W. C. M'Intosh, J. W. Fulton, W. Garstang and Prince in the *Journ. Mar. Biolog. Assoc.*, *The Reports of the Fishery Board of Scotland*, *Scient. Trans. R. Dublin Soc.* and other periodicals. (B) DENMARK AND SCANDINAVIA: W. Lilljeborg, *Sveriges och Norges Fiskar* (3 vols., Upsala, 1881-1891); F. A. Smith, *A History of Scandinavian Fishes by B. Fries, C. U. Ekström and C. Sundevall, with Plates by W. von Wright* (second edition, revised and completed by F. A. S., Stockholm, 1892); A. Stuxberg, *Sveriges och Norges Fiskar* (Göteborg, 1895); C. G. J. Petersen, *Report of the Danish Biological Station* (Copenhagen, 1802-1900) (annual reports containing much information on fishes of and fishing in the Danish seas). (C) FINLAND: G.

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(G. A. B.)

III. DEFINITION OF THE CLASS *PISCES*. ITS PRINCIPAL DIVISIONS

Fishes, constituting the class *Pisces*, may be defined as Craniate Vertebrata, or Chordata, in which the anterior portion of the central nervous system is expanded into a brain surrounded by an unsegmented portion of the axial skeleton; which are provided with a heart, breathing through gills; and in which the limbs, if present, are in the form of fins, as opposed to the pentadactyle, structure common to the other Vertebrata. With the exception of a few forms in which lungs are present in addition to the gills, thus enabling the animal to breathe atmospheric air for more or less considerable periods (Dipneusti), all fishes are aquatic throughout their existence.

In addition to the paired limbs, median fins are usually present, consisting of dermal rays borne by endoskeletal supports, which in the more primitive forms are strikingly similar in structure to the paired

fins that are assumed to have arisen from the breaking up of a lateral fold similar to the vertical folds out of which the dorsal, anal and caudal fins have been evolved. The body is naked, or scaly, or covered with bony shields or hard spines.

Leaving aside the Ostracophori, which are dealt with in a separate article, the fishes may be divided into three subclasses—

I. Cyclostomi or Marsipobranchii, with the skull imperfectly developed, without jaws, with a single nasal aperture, without paired fins, and with an unpaired fin without dermal rays. Lampreys and hag-fishes.

II. Selachii or Chondropterygii, with the skull well developed but without membrane bones, with paired nasal apertures, with median and paired fins, the ventrals bearing prehensile organs (claspers) in the males. Sharks, skates and chimaeras.

III. Teleostomi, with the skull well developed and with membrane bones, with paired nasal apertures, primarily with median and paired fins, including all other fishes.

(G. A. B.)

IV. Anatomy[1]

The special importance of a study of the anatomy of fishes lies in the fact that fishes are on the whole undoubtedly the most archaic of existing craniates, and it is therefore to them especially that we must look for evidence as to the evolutionary history of morphological features occurring in the higher groups of vertebrates.

In making a general survey of the morphology of fishes it is essential to take into consideration the structure of the young developing individual (embryology) as well as that of the adult (comparative anatomy in the narrow sense). Palaeontology is practically dumb excepting as regards external form and skeletal features, and even of these our knowledge must for long be in a hopelessly imperfect state. While it is of the utmost importance to pay due attention to embryological data it is equally important to consider them critically and in conjunction with broad morphological considerations. Taken by themselves they are apt to be extremely misleading.

External Features.—The external features of a typical fish are intimately associated with its mode of life. Its shape is more or less that of a spindle; its surface is covered with a highly glandular epidermis, which is constantly producing lubricating mucus through the agency of which skin-friction is reduced to an extraordinary degree; and finally it possesses a set of remarkable propelling organs or fins.

> The exact shape varies greatly from the typical spindle shape with variations in the mode of life; *e.g.* bottom-living fishes may be much flattened from above downwards as in the rays, or from side to side in the Pleuronectids such as flounder, plaice or sole, or the shape may be much elongated as in the eels.

Head, Trunk and Tail.—In the body of the fish we may recognize the three main sub-divisions of the body —head, trunk and tail—as in the higher vertebrates, but there is no definite narrowing of the anterior region to form a neck such as occurs in the higher groups, though a suspicion of such a narrowing occurs in the young *Lepidosiren*.

The tail, or postanal region, is probably a secondary development—a prolongation of the hinder end of the body for motor purposes. This is indicated by the fact that it frequently develops late in ontogeny. 251

> The vertebrate, in correlation perhaps with its extreme cephalization, develops from before backwards (except the alimentary canal, which develops more *en bloc*), there remaining at the hind end for a prolonged period a mass of undifferentiated embryonic tissue from the anterior side of which the definitive tissues are constantly being developed. After development has reached the level of the anus it still continues backwards and the tail region is formed, showing a continuation of the same tissues as in front, notochord, nerve cord, gut, myotomes. Of these the (postanal) gut soon undergoes atrophy.

Fins.—The fins are extensions of the body surface which serve for propulsion. To give the necessary rigidity they are provided with special skeletal elements, while to give mobility they are provided with special muscles. These muscles, like the other voluntary muscles of the body, are derived from the primitive myotomes and are therefore segmental in origin. The fins are divisible into two main categories—the median or unpaired fins and the paired fins.

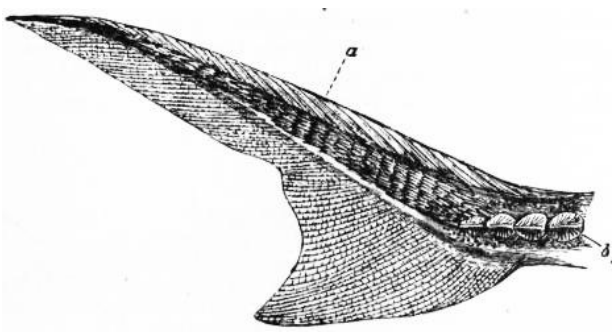

Fig. 1.—Heterocercal Tail of *Acipenser*. *a*, Modified median scales (“fulcra”); *b*, bony plates.

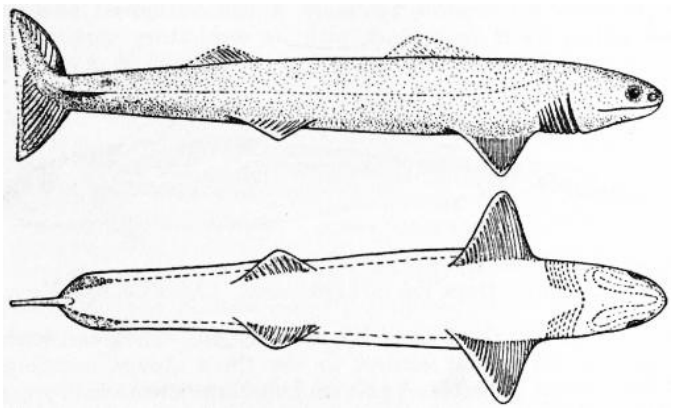

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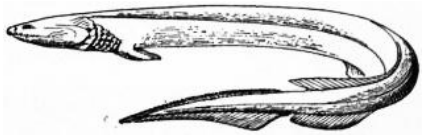
FIG. 2.—*Cladoselache.* (After Dean.)



From "*Challenger*" *Reports Zool.*, published by H.M. Stationery Office.

FIG. 3.—*Chlamydoselachus*. (After Günther.)

The median fins are to be regarded as the more primitive. The fundamental structure of the vertebrate, with its median skeletal axis and its great muscular mass divided into segments along each side of the body, indicates that its primitive method of movement was by waves of lateral flexure, as seen in an Amphioxus, a cyclostome or an eel. The system of median fins consists in the first instance of a continuous fin-fold extending round the posterior end of the body—as persists even in the adult in the existing Dipneusti. A continuous median fin-fold occurs also in various Teleosts (many deep-sea Teleosts, eels, &c.), though the highly specialized features in other respects make it probable that we have here to do with a secondary return to a condition like the primitive one. In the process of segmentation of the originally continuous fin-fold we notice first of all a separation of and an increase in size of that portion of the fin which from its position at the tip of the tail region is in the most advantageous position for producing movements of the body. There is thus formed the *caudal* fin. In this region there is a greatly increased size of the fin-fold—both dorsally and ventrally. There is further developed a highly characteristic asymmetry. In the original symmetrical or *protocercal* (= *diphycercal*) type of tail (as seen in a cyclostome, a Dipnoan and in most fish embryos) the skeletal axis of the body runs straight out to its tip—the tail fold being equally developed above and below the axis. In the highly developed caudal fin of the majority of fishes, however, the fin-fold is developed to a much greater extent on the ventral side, and correlated with this the skeletal axis is turned upwards as in the *heterocercal* tail of sharks and sturgeons. The highest stage in this evolution of the caudal fin is seen in the Teleostean fishes, where the ventral tail-fold becomes developed to such an extent as to produce a secondarily symmetrical appearance (*homocercal* tail, fig. 4).

> The sharks have been referred to as possessing heterocercal tails, but, though this is true of the majority, within the limits of the group all three types of tail-fin occur, from the protocercal tail of the fossil Pleuracanthids and the living *Chlamydoselachus* to the highly developed, practically homocercal tail of the ancient *Cladoselache*(fig. 2).

The praecaudal portion of the fin-fold on the dorsal side of the body becomes broken into numerous finlets in living Crossopterygians, while in other fishes it disappears throughout part of its length, leaving only one, two or three enlarged portions—the *dorsal* fins (fig. 4, *d.f.*). Similarly the praecaudal part of the fin-fold ventrally becomes reduced to a single *anal* fin (*a.f.*), occasionally continued backwards by a series of finlets (*Scombridae*). In the sucker-fishes (*Remora*, *Eckeneis*) the anterior dorsal fin is metamorphosed into a sucker by which the creature attaches itself to larger fishes, turtles, &c.

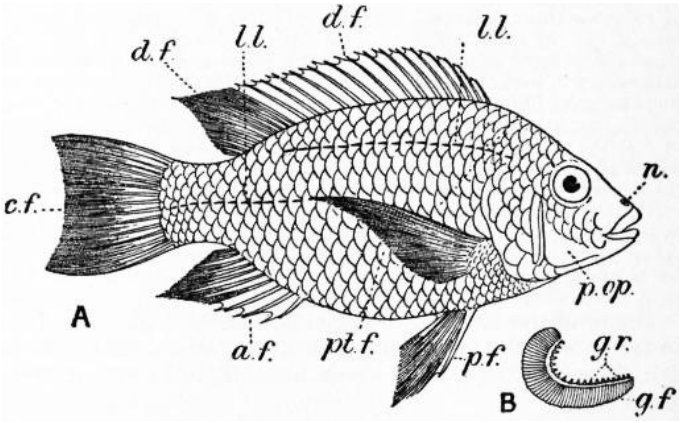


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FIG. 4.—*Tilapia dolloi*, a teleostean fish, to illustrate external features. (After Boulenger.)

A, Side view.
B, First branchial arch.
a.f, Anal fin.
c.f, Caudal fin.
g.r, Gill rakers.
l.l, Lateral line organs.
n, Nasal opening.
p.f, Pelvic fin.

d.f, Dorsal fin.
g.f, Gill lamellae.
p.op, Preoperculum.
pt.f, Pectoral fin.

The paired fins—though more recent developments than the median—are yet of very great morphological interest, as in them we are compelled to recognize the homologues of the paired limbs of the higher vertebrates. We accordingly distinguish the two pairs of fins as pectoral or anterior and pelvic (= "ventral") or posterior. There are two main types of paired fin—the *archipterygial* type, a paddle-like structure supported by a jointed axis which bears lateral rays and exists in an unmodified form in *Neoceratodus* alone amongst living fishes, and the *actinopterygial* type, supported by fine raylike structures as seen in the fins of any ordinary fish. The relatively less efficiency of the archipterygium and its predominance amongst the more ancient forms of fishes point to its being the more archaic of these two types.

In the less highly specialized groups of fishes the pectoral fins are close behind the head, the pelvic fins in the region of the cloacal opening. In the more specialized forms the pelvic fins frequently show a more or less extensive shifting towards the head, so that their position is described as thoracic (fig. 4) or jugular (*Gadus*—cod, haddock, &c., fig. 5).

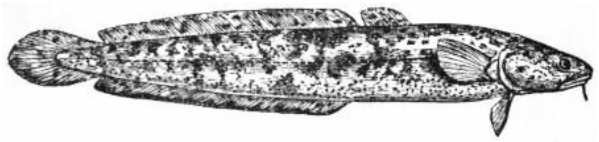


Fig. 5.—Burbot (*Lota vulgaris*), with jugular ventral fins.

The median fin, especially in its caudal section, is the main propelling organ: the paired fins in the majority of fishes serve for balancing. In the Dipneusti the paired fins are used for clambering about amidst vegetation, much in the same fashion as the limbs of Urodeles. In *Ceratodus* they also function as paddles. In various Teleosts the pectoral fins have acquired secondarily a leg-like function, being used for creeping or skipping over the mud (*Periophthalmus*; cf. also Trigloids, Scorpaenids and Pediculati). In the "flying" fishes the pectoral fins are greatly enlarged and are used as aeroplanes, their quivering movements frequently giving a (probably erroneous) impression of voluntary flapping movements. In the gobies and lumpsuckers (*Cyclopteridae*) the pelvic fins are fused to form an adhesive sucker; in the *Gobiesocidae* they take part in the formation of a somewhat similar sucker.

The evolutionary history of the paired limbs forms a fascinating chapter in vertebrate morphology. As regards their origin two hypotheses have attracted special attention: (1) that enunciated by Gegenbaur, according to which the limb is a modified gill septum, and (2) that supported by James K. Thacher, F. M. Balfour, St George Mivart and others, that the paired fins are persisting and modified portions of a once continuous fin-fold on each side of the body. The majority of morphologists are now inclined to accept the second of these views. Each has been supported by plausible arguments, for which reference must be made to the literature of the subject.[2] Both views rest upon the assumed occurrence of stages for the existence of which there is no direct evidence, viz. in the case of (1) transitional stages between gill septum and limb, and in the case of (2) a continuous lateral fin-fold. (There is no evidence that the lateral row of spines in the acanthodian *Climatius* has any other than a defensive significance.) In the opinion of the writer of this article, such assumptions are without justification, now that our knowledge of Dipnoan and Crossopterygian and Urodele embryology points towards the former possession by the primitive vertebrate of a series of projecting, voluntarily movable, and hence potentially motor structure on each side of the body. It must be emphasized that these—the true external gills—are the *only* organs known actually to exist in vertebrates which might readily be transformed into limbs. When insuperable objections are adduced to this having actually taken place in the course of evolution, it will be time enough to fall back upon purely hypothetical ancestral structures on which to base the evolutionary history of the limbs.

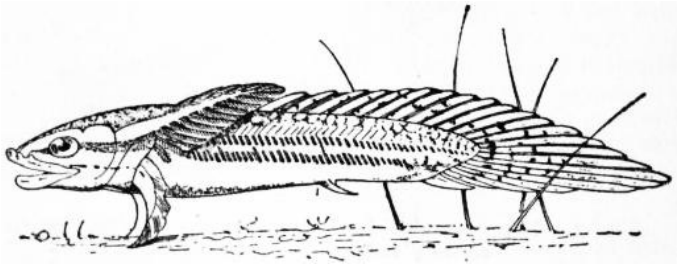
The ectoderm covering the general surface is highly glandular. In the case of the Dipneusti, flask-shaped multicellular glands like those of Amphibians occur in addition to the scattered gland cells.

A characteristic feature of glandular activity is the production of a slight electrical disturbance. In the case of *Malopterurus* this elsewhere subsidiary function of the skin has become so exaggerated as to lead to the conversion of the skin of each side of the body into a powerful electrical organ.[3] Each of these consists of some two million small chambers, each containing an electric disk and all deriving their nerve supply from the branches of a single enormous axis cylinder. This takes its origin from a gigantic ganglion cell situated latero-dorsally in the spinal cord between the levels of the first and second spinal nerves.

Cement Organs.—The larvae of certain Teleostomes and Dipnoans possess special glandular organs in the head region for the secretion of a sticky cement by which the young fish is able to attach itself to water-plants or other objects. As a rule these are ectodermal in origin; *e.g.* in *Lepidosiren* and *Protopterus*[4] the crescentic cement organ lying ventrally behind the mouth consists of a glandular thickening of the deep layer of the ectoderm. In young ganoid fishes preoral cement organs occur. In Crossopterygians there is one cup-shaped structure on each side immediately in front of the mouth. Here the glandular epithelium is endodermal, developed[5] as an outgrowth from the wall of the alimentary canal, closely resembling a gill pouch. In *Amia*[6] the same appears to be the case. In a few Teleosts similar organs occur, *e.g. Sarcodaces*, *Hyperopisus*,[7] where so far as is known they are ectodermal.

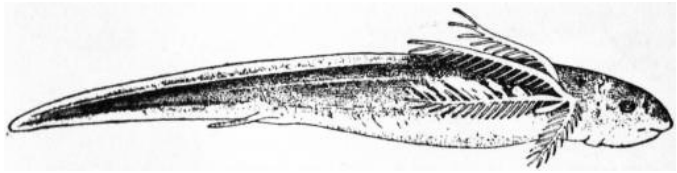
Photogenic Organs.—The slimy secretion produced by the epidermal glands of fishes contains in some cases substances which apparently readily undergo a slow process of oxidation, giving out light of low wave-length in the process and so giving rise to a phosphorescent appearance. In many deep-sea fishes this property of producing light-emitting secretion has undergone great development, leading to the existence of definite photogenic organs. These vary much in character, and much remains to be done in working out their minute structure. Good examples are seen in the Teleostean family *Scopelidae*, where they form

brightly shining eye-like spots scattered about the surface of the body, especially towards the ventral side.



From *Trans. Zool. Soc. of London.*

FIG. 6.—Larva of Polypterus. (After Budgett.)



From *Phil. Transactions, Royal Society of London.*

FIG. 7.—Thirty Days' Larval Lepidosiren. (After Graham Kerr.)

External Gills.—In young Crossopterygians and in the young *Protopterus* and *Lepidosiren* true external gills occur of the same morphological nature as those of Urodele amphibians. In Crossopterygians a single one is present on each side on the hyoid arch; in the two Dipnoans mentioned four are present on each side —on visceral arches III., IV., V. and VI. (It may be recalled that in Urodeles they occur on arches III., IV. and V., with vestiges[8] on arches I. and II.). Each external gill develops as a projection of ectoderm with mesodermal core near the upper end of its visceral arch; the main aortic arch is prolonged into it as a loop. When fully developed it is pinnate, and is provided with voluntary muscles by which it can be moved freely to renew the water in contact with its respiratory surface. In the case of *Polypterus* a short rod of cartilage projects from the hyoid arch into the base of the external gill. Their occurrence with identical main features in the three groups mentioned indicates that the external gills are important and archaic organs of the vertebrata. Their non-occurrence in at least some of the groups where they are absent is to be explained by the presence of a large vascular yolk sac, which necessarily fulfils in a very efficient way the respiratory function.

Alimentary Canal.—The alimentary canal forms a tube traversing the body from mouth to cloacal opening. Corresponding with structural and functional differences it is for descriptive purposes divided into the following regions—(1) Buccal cavity or mouth cavity, (2) Pharynx, (3) Oesophagus or gullet, (4) Stomach, (5) Intestine, and (6) Cloaca. The buccal cavity or mouth cavity is morphologically a stomodaeum, *i.e.* it represents an inpushing of the external surface. Its opening to the exterior is wide and gaping in the embryo in certain groups (Selachians and Crossopterygians), and even in the adult among the Cyclostomata, but in the adult Gnathostome it can be voluntarily opened and shut in correlation with the presence of a hinged jaw apparatus. The mouth opening is less or more ventral in position in Cyclostomes and Selachians, while in Dipnoans and Teleostomes it is usually terminal.

In certain cases (*e.g. Lepidosiren*)[9] the buccal cavity arises by secondary excavation without any actual pushing in of ectoderm.

It is highly characteristic of the vertebrata that the pharynx—the portion of the alimentary canal immediately behind the buccal cavity —communicates with the exterior by a series of paired clefts associated with the function of respiration and known as the visceral clefts. It is especially characteristic of fishes that a number of these clefts remain open as functional breathing organs in the adult.

The visceral clefts arise as hollow pouches (or at first solid projections) of the endoderm. Each pouch fuses with the ectoderm at its outer end and then becomes perforated so as to form a free communication between pharynx and exterior.

The mesenchymatous packing tissue between consecutive clefts forms the visceral arches, and local condensation within each gives rise to important skeletal elements—to which the name visceral arches is often restricted. From the particular skeletal structures which develop in the visceral arches bounding it the anterior cleft is known as the hyomandibular cleft, the next one as hyobranchial. In common usage the hyomandibular cleft is called the spiracle, and the series of clefts behind it the branchial clefts.

The typical functional gill cleft forms a vertical slit, having on each

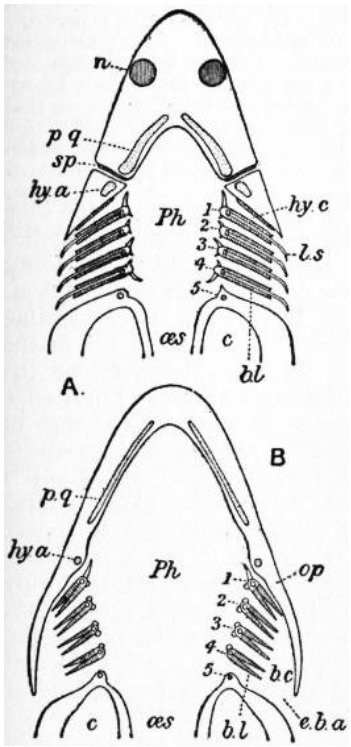


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FIG. 8.—Diagrams to illustrate the relations of branchial clefts and pharynx in an Elasmobranch (A) and a Teleost (B); 1, 2, &c., Branchial septa.

b.c, Opercular cavity.
b.l, Respiratory lamellae.

side a gill septum which separates it from its neighbours in the series. The lining of the gill cleft possesses over a less or greater extent of its area a richly developed network of capillary blood-vessels, through the thin covering of which the respiratory exchange takes place between the blood and the water which washes through the gill cleft. The area of respiratory surface tends to become increased by the development of outgrowths. Frequently these take the form of regular plate-like structures known as gill lamellae. In the Selachians these lamellae are strap-like structures (*Elasmobranch*) attached along nearly their whole length to the gill septum as shown in fig. 8, A. In the Holocephali and in the sturgeon the outer portions of the gill septa have disappeared and this leads to the condition seen in the higher Teleostomes (fig. 8, B), where the whole of the septum has disappeared except its thick inner edge containing the skeletal arch. It follows that in these higher Teleostomes—including the ordinary Teleosts—the gill lamellae are attached only at their extreme inner end.

c, Coelom.
e.b.a, Opercular opening.
hy.a, Hyoid arch.
hy.c, Hyobranchial cleft.
l.s, Valvular outer edge of gill septum.
n, Nasal aperture.
oes, Oesophagus.
op, Operculum.
p.q, Palato quadrate cartilage.
Ph, Pharynx.
sp, Spiracle.

In the young of Selachians and certain Teleosts (*e.g. Gymnarchus* and *Heterotis*)[10] the gill lamellae are prolonged as filaments which project freely to the exterior. These must not be confused with true external gills.

The partial atrophy of the gill septa in the Teleostomes produces an important change in their appearance. Whereas in the Selachian a series of separate gill clefts is seen in external view each covered by a soft valvular backgrowth of its anterior lip, in the Teleostean fish, on the other hand, a single large opening is seen on each side (opercular opening) covered over by the enormously enlarged valvular flap belonging to the anterior lip of the hyobranchial cleft. This flap, an outgrowth of the hyoid arch, is known as the operculum.

In the Teleostomi there are usually five functional clefts, but these are the survivors of a formerly greater number. Evidence of reduction is seen at both ends of the series. In front of the first functional cleft (the hyobranchial) there is laid down in the embryo the rudiment of a spiracular cleft. In the less highly organized fishes this survives in many cases as an open cleft.

In many sharks and in sturgeons the spiracle forms a conspicuous opening just behind the eye. In rays and skates, which are modified in correlation with their ground feeding habit, the spiracle is a large opening which during the great widening out of the body during development comes to be situated on the dorsal side, while the branchial clefts come to be ventral in position. In existing Crossopterygians the spiracle is a slit-like opening on the dorsal side of the head which can be opened or closed at will. In Dipneusti, as in the higher Teleostomes, the spiracle is found as an embryonic rudiment, but in this case it gives rise in the adult to a remarkable sense organ of problematical function.[11]

Traces of what appear to be pre-spiracular clefts exist in the embryos of various forms. Perhaps the most remarkable of these is to be found in the larval Crossopterygian,[12] and apparently also in *Amia*[13] at least, amongst the other ganoids, where a pair of entodermal pouches become cut off from the main entoderm and, establishing an opening to the exterior, give rise to the lining of the cement organs of the larva. Posteriorily there is evidence that the extension backwards of the series of gill clefts was much greater in the primitive fishes. In the surviving sharks (*Chlamydoselachus* and *Notidanus cinereus*), there still exist in the adult respectively six and seven branchial clefts, while in embryonic Selachians there are frequently to be seen pouch-like outgrowths of entoderm apparently representing rudimentary gill pouches but which never develop. Further evidence of the progressive reduction in the series of clefts is seen in the reduction of their functional activity at the two ends of the series. The spiracle, even where persisting in the adult, has lost its gill lamellae either entirely or excepting a few vestigial lamellae forming a “pseudobranch” on its anterior wall (Selachians, sturgeons). A similar reduction affects the lamellae on the anterior wall of the hyobranchial cleft (except in Selachians) and on the posterior wall of the last branchial cleft.

A pseudobranch is frequently present in Teleostomes on the anterior wall of the hyobranchial cleft, *i.e.* on the inner or posterior face of the operculum. It is believed by some morphologists to belong really to the cleft in front.[14]

Phylogeny.—The phylogeny of the gill clefts or pouches is uncertain. The only organs of vertebrates comparable with them morphologically are the enterocoelic pouches of the entoderm which give rise to the mesoderm. It is possible that the respiratory significance of the wall of the gill cleft has been secondarily acquired. This is indicated by the fact that they appear in some cases to be lined by an ingrowth of ectoderm. This suggests that there may have been a spreading inwards of respiratory surface from the external gills. It is conceivable that before their walls became directly respiratory the gill clefts served for the pumping of fresh water over the external gills at the bases of which they lie.

Lung.—As in the higher vertebrates, there develops in all the main groups of gnathostomatous fishes, except the Selachians, an outgrowth of the pharyngeal wall intimately associated with gaseous interchange. In the Crossopterygians and Dipnoans this pharyngeal outgrowth agrees exactly in its mid-ventral origin and in its blood-supply with the lungs of the higher vertebrates, and there can be no question about its being morphologically the same structure as it is also in function.

In the Crossopterygian the ventrally placed slit-like glottis leads into a common chamber produced anteriorly into two horns and continued backwards into two “lungs.” These are smooth, thin-walled, saccular structures, the right one small, the left very large and extending to the hind end of the splanchnocoele. In the Dipnoans the lung has taken a dorsal position close under the vertebral column and above the

splanchnocoele. Its walls are sacculated, almost spongy in *Lepidosiren* and *Protopterus*, so as to give increase to the respiratory surface. In *Nexeratodus* (fig. 9) an indication of division into two halves is seen in the presence of two prominent longitudinal ridges, one dorsal and one ventral. In *Lepidosiren* and *Protopterus* the organ is completely divided except at its anterior end into a right and a left lung. The anterior portion of the lung or lungs is connected with the median ventral glottis by a short wide vestibule which lies on the right side of the oesophagus.

In the Teleostei the representative of the lung, here termed the swimbladder, has for its predominant function a hydrostatic one; it acts as a float. It arises as a diverticulum of the gut-wall which may retain a tubular connexion with the gut (*physostomatous* condition) or may in the adult completely lose such connexion (*physoclistic*). It shows two conspicuous differences from the lung of other forms: (1) it arises in the young fish as a dorsal instead of as a ventral diverticulum, and (2) it derives its blood-supply not from the sixth aortic arch but from branches of the dorsal aorta.

These differences are held by many to be sufficient to invalidate the homologizing of the swimbladder with the lung. The following facts, however, appear to do away with the force of such a contention. (1) In the Dipneusti (*e.g. Neoceratodus*) the lung apparatus has acquired a dorsal position, but its connexion with the mid-ventral glottis is asymmetrical, passing round the right side of the gut. Were the predominant function of the lung in such a form to become hydrostatic we might expect the course of evolution to lead to a shifting of the glottis dorsalwards so as to bring it nearer to the definitive situation of the lung. (2) In *Erythrinus* and other Characinids the glottis is not mid-ventral but decidedly lateral in position, suggesting either a retention of, or a return to, ancestral stages in the dorsalward migration of the glottis. (3) The blood-supply of the Teleostean swimbladder is from branches of the dorsal aorta, which may be distributed over a long anteroposterior extent of that vessel. Embryology, however, shows that the swimbladder arises as a localized diverticulum. It follows that the blood-supply from a long stretch of the aorta can hardly be primitive. We should rather expect the primitive blood-supply to be from the main arteries of the pharyngeal wall, *i.e.* from the hinder aortic arch as is the case with the lungs of other forms. Now in *Amia* at least we actually find such a blood-supply, there being here a pulmonary artery corresponding with that in lung-possessing forms. Taking these points into consideration there seems no valid reason for doubting that in lung and swimbladder we are dealing with the same morphological structure.

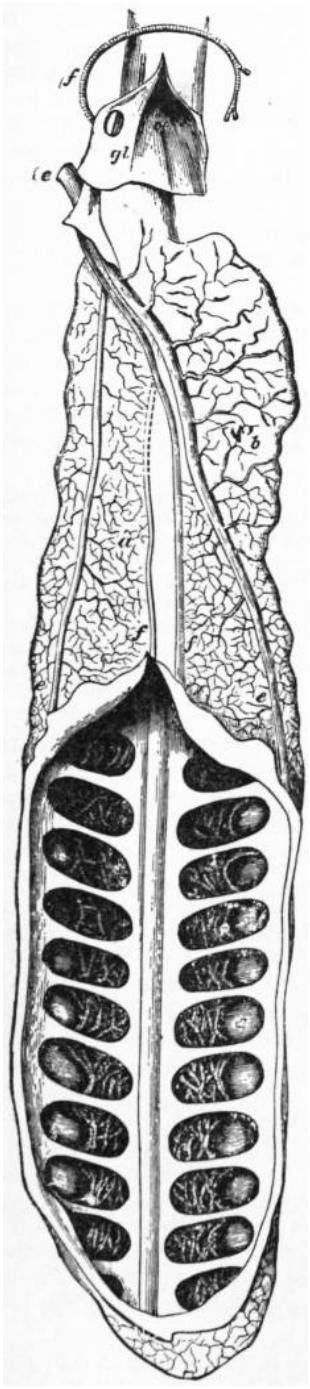


FIG. 9.—Lung of *Neoceratodus*, opened in its lower half to show its cellular pouches. *a*, Right half; *b*, Left half; *c*, Cellular pouches; *e*, Pulmonary vein; *f*, Arterial blood-vessel; *oe*, Oesophagus, opened to show glottis (*gl.*)

Function.—In the Crossopterygians and Dipnoans the lung is used for respiration, while at the same time fulfilling a hydrostatic function. Amongst the Actinopterygians a few forms still use it for respiration, but its main function is that of a float. In connexion with this function there exists an interesting compensatory mechanism whereby the amount of gas in the swimbladder may be diminished (by absorption), or, on the other hand, increased, so as to counteract alterations in specific gravity produced, *e.g.* by change of pressure with change of depth. This mechanism is specially developed in physoclistic forms, where there occur certain glandular patches ("red glands") in the lining epithelium of the swimbladder richly stuffed with capillary blood-vessels and serving apparently to secrete gas into the swimbladder. That the gas in the swimbladder is produced by some vital process, such as secretion, is already indicated by its composition, as it may contain nearly 90% of oxygen in deep-sea forms or a similar proportion of nitrogen in fishes from deep lakes, *i.e.* its composition is quite different from what it would be were it accumulated within the swimbladder by mere ordinary diffusion processes. Further, the formation of gas is shown by experiment to be controlled by branches of the vagus and sympathetic nerves in an exactly similar fashion to the secretion of saliva in a salivary gland. (See below for relations of swimbladder to ear).

Of the important non-respiratory derivatives of the pharyngeal wall (thyroid, thymus, postbranchial bodies, &c.), only the thyroid calls for special mention, as important clues to its evolutionary history are afforded by the lampreys. In the larval lamprey the thyroid develops as a longitudinal groove on the pharyngeal floor. From the anterior end of this groove there pass a pair of peripharyngeal ciliated tracts to the dorsal side of the pharynx where they pass backwards to the hind end of the pharynx. Morphologically the whole apparatus corresponds closely with the endostyle and peripharyngeal and dorsal ciliated tracts of the pharynx of *Amphioxus*. The correspondence extends to function, as the open thyroid groove secretes a sticky mucus which passes into the pharyngeal cavity for the entanglement of food particles exactly as in *Amphioxus*. Later on the thyroid groove becomes shut off from the pharynx; its secretion now accumulates in the lumina of its interior and it functions as a ductless gland as in the Gnathostomata. The only conceivable explanation of this developmental history of the thyroid in the lamprey is that it is a repetition of phylogenetic history.

Behind the pharynx comes the main portion of the alimentary canal concerned with the digestion and absorption of the food. This forms a tube varying greatly in length, more elongated and coiled in the higher Teleostomes, shorter and straighter in the Selachians, Dipnoans and lower Teleostomes. The oesophagus or

gullet, usually forming a short, wide tube, leads into the glandular, more or less dilated stomach. This is frequently in the form of a letter **J**, the longer limb being continuous with the gullet, the shorter with the intestine. The curve of the **J** may be as in *Polypterus* and the perch produced backwards into a large pocket. The intestine is usually marked off from the stomach by a ring-like sphincter muscle forming the pyloric valve. In the lower gnathostomatous fishes (Selachians, Crossopterygians, Dipnoans, sturgeons) the intestine possesses the highly characteristic spiral valve, a shelf-like projection into its lumen which pursues a spiral course, and along the turns of which the food passes during the course of digestion. From its universal occurrence in the groups mentioned we conclude that it is a structure of a very archaic type, once characteristic of ancestral Gnathostomata; a hint as to its morphological significance is given by its method of development.[15] In an early stage of development the intestinal rudiment is coiled into a spiral and it is by the fusion together of the turns that the spiral valve arises. The only feasible explanation of this peculiar method of development seems to lie in the assumption that the ancestral gnathostome possessed an elongated, coiled intestine which subsequently became shortened with a fusion of its coils. In the higher fishes the spiral valve has disappeared—being still found, however, in a reduced condition in *Amia* and *Lepidosteus*, and possibly as a faint vestige in one or two Teleosts (certain *Clupeidae*[16] and *Salmonidae*[17]). In the majority of the Teleosts the absence of spiral valves is coupled with a secondary elongation of the intestinal region, which in extreme cases (*Loricariidae*) may be accompanied by a secondary spiral coiling.

The terminal part of the alimentary canal—the cloaca—is characterized by the fact that into it open the two kidney ducts. In Teleostomes the cloaca is commonly flattened out, so that the kidney ducts and the alimentary canal come to open independently on the outer surface.

The lining of the alimentary canal is throughout the greater part of its extent richly glandular. And at certain points local enlargements of the secretory surface take place so as to form glandular diverticula. The most ancient of these as indicated by its occurrence even in *Amphioxus* appears to be the *liver*, which, originally—as we may assume—mainly a digestive gland, has in the existing Craniates developed important excretory and glycogen-storing functions. Arising in the embryo as a simple caecum, the liver becomes in the adult a compact gland of very large size, usually bi-lobed in shape and lying in the front portion of the splanchnocoele. The stalk of the liver rudiment becomes drawn out into a tubular bile duct, which may become subdivided into branches, and as a rule develops on its course a pocket-like expansion, the gall-bladder. This may hang freely in the splanchnocoele or may be, as in many Selachians, imbedded in the liver substance.

The pancreas also arises by localized bulging outwards of the intestinal lining—there being commonly three distinct rudiments in the embryo. In the Selachians the whitish compact pancreas of the adult opens into the intestine some little distance behind the opening of the bile duct, but in the Teleostomes it becomes involved in the liver outgrowth and mixed with its tissue, being frequently recognizable only by the study of microscopic sections. In the Dipnoans the pancreatic rudiment remains imbedded in the wall of the intestine: its duct is united with that of the liver.

Pyloric Caeca.—In the Teleostomi one or more glandular diverticula commonly occur at the commencement of the intestine and are known as the pyloric caeca. There may be a single caecum (crossopterygians, *Ammodytes* amongst Teleosts) or there may be nearly two hundred (mackerel). In the sturgeons the numerous caeca form a compact gland. In several families of Teleosts, on the other hand, there is no trace of these pyloric caeca.

In Selachians a small glandular diverticulum known as the *rectal gland* opens into the terminal part of the intestine on its dorsal side.

Coelomic Organs.—The development of the mesoderm in the restricted sense (mesothelium) as seen in the fishes (lamprey, *Lepidosiren*, *Protopterus*, *Polypterus*) appears to indicate beyond doubt that the mesoderm segments of vertebrates are really enterocoelic pouches in which the development of the lumen is delayed. Either the inner, or both inner and outer (*e.g. Lepidosiren*) walls of the mesoderm segment pass through a myoepithelial condition and give rise eventually to the great muscle segments (myomeres, or myotomes) which lie in series on each side of the trunk. In the fishes these remain distinct throughout life. The fins, both median and paired, obtain their musculature by the ingrowth into them of muscle buds from the adjoining myotomes.

Electrical Organs.[18]—It is characteristic of muscle that at the moment of contraction it produces a slight electrical disturbance. In certain fishes definite tracts of the musculature show a reduction of their previously predominant function of contraction and an increase of their previously subsidiary function of producing electrical disturbance; so that the latter function is now predominant.

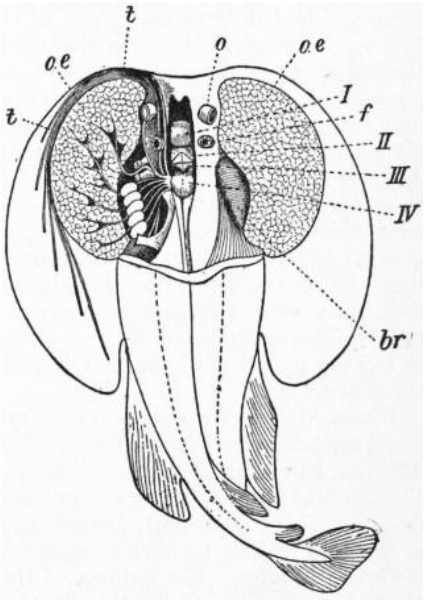
In the skates (*Raia*) the electrical organ is a fusiform structure derived from the lateral musculature of the tail; in *Gymnotus*—the electric eel—and in *Mormyrus* it forms an enormous structure occupying the place of the ventral halves of the myotomes along nearly the whole length of the body; in *Torpedo* it forms a large, somewhat kidney-shaped structure as viewed from above lying on each side of the head and derived from the musculature of the anterior visceral arches. In *Torpedo* the nerve-supply is derived from cranial nerves VII. IX. and the anterior branchial branches of X.

The electric organ is composed of prismatic columns each built up of a row of compartments. Each compartment contains a lamellated electric disc representing the

shortened-up and otherwise metamorphosed muscle fibre. On one face (ventral in *Torpedo*, anterior in *Raia*) of the electric disc is a gigantic end-plate supplied by a beautiful, dichotomously branched, terminal nervous arborization.

The development of the mesoderm of the head region is too obscure for treatment here.[19] The ventral portion of the trunk mesoderm gives rise to the splanchnocoel or general coelom. Except in the Myxinoids the anterior part of the splanchnocoel becomes separated off as a pericardiac cavity, though in adult Selachians the separation becomes incomplete, the two cavities being in communication by a pericardio-peritoneal canal.

Nephridial System.—-The kidney system in fishes consists of segmentally arranged tubes leading from the coelom into a longitudinal duct which opens within the hinder end of the enteron—the whole forming what is known as the *archinephros* (Lankester) or *holonephros* (Price). Like the other segmented organs of the vertebrate the archinephros develops from before backwards. The sequence is, however, not regular. A small number of tubules at the head end of the series become specially enlarged and are able to meet the excretory needs during larval existence (*Pronephros*): the immediately succeeding tubules remain undeveloped, and then come the tubules of the rest of the series which form the functional kidney of the adult (*Mesonephros*).



From Gegenbaur, *Untersuchungen zur vergleich. Anat. der Wirbeltiere*, by permission of Wilhelm Engelmann.

FIG. 10.—View of *Torpedo* from the dorsal side: the electric organs are exposed.

I, Fore-brain.
II, Mesencephalon.
III, Cerebellum.
IV, Electric lobe.
br, Common muscular sheath covering branchial clefts (on the left side this has been removed so as to expose the series of branchial sacs).
f, Spiracle.
o.e, Electric organ, on the left side the nerve-supply is shown.
o, Eye.
t, Sensory tubes of lateral line system.

The kidney tubules subserve the excretory function in two different ways. The wall of the tubule, bathed in blood from the posterior cardinal vein, serves to extract nitrogenous products of excretion from the blood and pass them into the lumen of the tubule. The open ciliated funnel or nephrostome at the coelomic end of the tubule serves for the passage outwards of coelomic fluid to flush the cavity of the tubule. The secretory activity of the coelomic lining is specially concentrated in certain limited areas in the neighbourhood of the nephrostomes, each such area ensheathing a rounded mass depending into the coelom and formed of a blood-vessel coiled into a kind of skein—a glomerulus. In the case of the pronephros the glomeruli are as a rule fused together into a single glomus. In the mesonephros they remain separate and in this case the portion of coelom surrounding the glomerulus tends to be nipped off from the general coelom—to form a Malpighian body. The separation may be incomplete—the Malpighian coelom remaining in connexion with the general coelom by a narrow peritoneal canal. The splanchnocoelic end of this is usually ciliated and is termed a peritoneal funnel: it is frequently confused with the nephrostome.

Mesonephros.—The kidney of the adult fish is usually a compact gland extending over a considerable distance in an anteroposterior direction and lying immediately dorsal to the coelomic cavity.

Peritoneal funnels are present in the adult of certain Selachians (*e.g. Acanthias*, *Squatina*), though apparently in at least some of these forms they no longer communicate with the Malpighian bodies or tubules. The kidneys of the two sides become fused together posteriorly in *Protopterus* and in some Teleosts. The mesonephric ducts undergo fusion posteriorly in many cases to form a median urinary or urinogenital sinus. In the Selachians this median sinus is prolonged forwards into a pair of horn-like continuations—the sperm sacs. In Dipnoans the sinus becomes greatly dilated and forms a large, rounded, dorsally placed cloacal caecum. In Actinopterygians a urinary bladder of similar morphological import is commonly present.

Gonads.—The portion of coelomic lining which gives rise to the reproductive cells retains its primitive relations most nearly in the female, where, as a rule, the genital cells are still shed into the splanchnocoele. Only in Teleostomes (*Lepidosteus* and most Teleosts) the modification occurs that the ovary is shut off from the splanchnocoele as a closed cavity continuous with its duct.

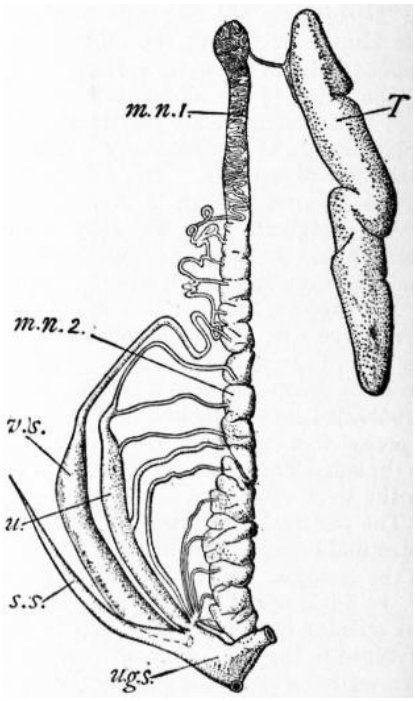
In a few Teleosts (*Salmonidae*, *Muraenidae*, *Cobitis*) the ovary is not a closed sac, its eggs being shed into the coelom as in other groups.

The appearance of the ovary naturally varies greatly with the character of the eggs.

The portion of coelomic lining which gives rise to the male genital cells (testis) is in nearly, if not quite, all cases, shut off from the splanchnocoele. The testes are commonly elongated in form. In Dipneusti[20] (*Lepidosiren* and *Protopterus*) the hinder portion of the elongated testis has lost its sperm-producing function, though the spermatozoa produced in the anterior portion have to traverse it in order to reach the kidney. In *Polypterus*[21] the testis is continued backwards as a “testis ridge,” which appears to correspond with the posterior vesicular region of the testis in *Lepidosiren* and *Protopterus*. Here also the spermatozoa pass back through the cavities of the testis ridge to reach the kidney duct. In the young Teleost[22] the rudiment of the duct forms a backward continuation of the testis containing a network of cavities and opening as a rule posteriorly into the kidney duct. It is difficult to avoid the conclusion that the testis duct of the Teleost is for the most part the equivalent morphologically of the posterior vesicular region of the testis of *Polypterus* and the Dipneusti.

Relations of Renal and Reproductive Organs. (1) *Female.*—In the Selachians and Dipnoans the oviduct is of the type (Müllerian duct) present in the higher vertebrates and apparently representing a split-off portion of the archinephric duct. At its anterior end is a wide funnel-like coelomic opening. Its walls are glandular and secrete accessory coverings for the eggs. In the great majority of Teleosts and in *Lepidosteus* the oviduct possesses no coelomic funnel, its walls being in structural continuity with the wall of the ovary. In most of the more primitive Teleostomes (Crossopterygians, sturgeons, *Amia*) the oviduct has at its front end an open coelomic funnel, and it is difficult to find adequate reason for refusing to regard such oviducts as true Müllerian ducts. On this interpretation the condition characteristic of Teleosts would be due to the lips of the oviduct becoming fused with the ovarian wall, and the duct itself would be a Müllerian duct as elsewhere.

A departure from the normal arrangement is found in those Teleosts which shed their eggs into the splanchnocoele, *e.g.* amongst *Salmonidae*, the smelt (*Osmerus*) and capelin (*Mallotus*) possess a pair of oviducts resembling Müllerian ducts while the salmon possesses merely a pair of genital pores opening together behind the anus. It seems most probable that the latter condition has been derived from the former by reduction of the Müllerian ducts, though it has been argued that the converse process has taken place. The genital pores mentioned must not be confused with the *abdominal pores*, which in many adult fishes, particularly in those without open peritoneal funnels, lead from coelom directly to the exterior in the region of the cloacal opening. These appear to be recent developments, and to have nothing to do morphologically with the genitourinary system.[23]



From *Arch. zool, expérimentale*, by permission of Schleicher Frères.

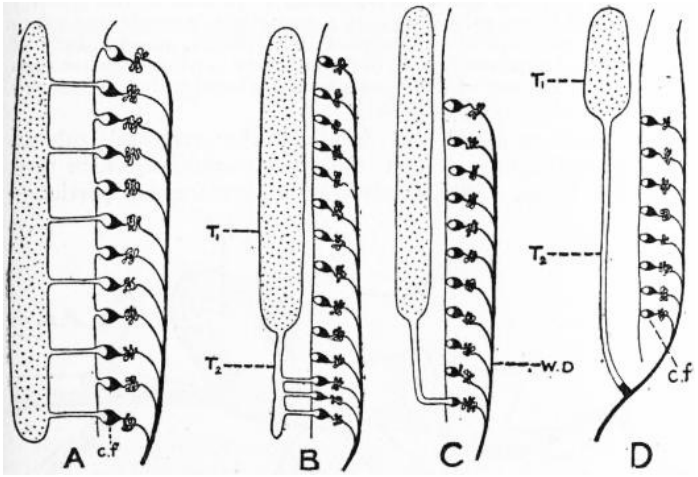
FIG. 11.—Urino-Genital Organs of the right side in a male *Scyllium*. (After Borcea.)

m.n. 1, Anterior (genital) portion of mesonephros with its coiled duct.
m.n. 2, Posterior (renal) portion of mesonephros.
s.s, Sperm sac.
T, Testis.
u, "Ureter" formed by fusion of collecting tubes of renal portion of mesonephros.
u.g.s, Urino-genital sinus;
v.s, Vesicula seminalis.

(2) *Male.*—It seems that primitively the male reproductive elements like the female were shed into the coelom and passed thence through the nephridial tubules. In correlation probably with the greatly reduced size of these elements they are commonly no longer shed into the splanchnocoele, but are conveyed from the testis through covered-in canals to the Malpighian bodies or kidney tubules. The system of covered-in canals forms the testicular network, the individual canals being termed vasa efferentia. In all probability the series of vasa efferentia was originally spread over the whole length of the elongated testis (cf. *Lepidosteus*), but in existing fishes the series is as a rule restricted to a comparatively short anteroposterior extent. In Selachians the vasa efferentia are restricted to the anterior end of testis and kidney, and are connected by a longitudinal canal ending blindly in front and behind. The number of vasa efferentia varies and in the rays (*Raia*, *Torpedo*) may be reduced to a single one opening directly into the front end of the mesonephric duct. The anterior portion of the mesonephros is much reduced in size in correlation with the fact that it has lost its renal function. The hinder part, which is the functional kidney, is considerably enlarged. The primary tubules of this region of the kidney have undergone a modification of high morphological interest. Their distal portions have become much elongated, they are more or less fused, and their openings into the mesonephric duct have undergone backward migration until they open together either into the mesonephric duct at its posterior end or into the urinogenital sinus independently of the mesonephric duct. The mesonephric duct is now connected only with the anterior part of the kidney, and serves merely as a vas deferens or sperm duct. In correlation with this it is somewhat enlarged, especially in its posterior portion, to form a vesicula seminalis.

The morphological interest of these features lies in the fact that they represent a stage in evolution which carried a little farther would lead to a complete separation of the definitive kidney (*metanephros*) from the purely genital anterior section of the mesonephros (*epididymis*), as occurs so characteristically in the Amniota.

Dipneusti.—In *Lepidosiren*[24] a small number (about half a dozen) of vasa efferentia occur towards the hind end of the vesicular part of the testis and open into Malpighian bodies. In *Protopterus* the vasa efferentia are reduced to a single one on each side at the extreme hind end of the testis.



Graham Kerr, *Proc. Zool. Soc. London.*

FIG. 12.—Diagram illustrating Connexion between Kidney and Testis in Various Groups of Fishes.

A, Distributed condition of *vasa efferentia* (*Acipenser*, *Lepidosteus*).
B, *Vasa efferentia* reduced to a few at the hind end (*Lepidosiren*).
C, Reduction of vasa efferentia to a single one posteriorly (*Protopterus*).
D, Direct communication between testis and kidney duct (*Polypterus*, Teleosts).
c.f, Nephrostome leading from Malpighian coelom into kidney tubule.
T_1, Functional region of testis.
T_2, Vesicular region of testis.
WD, Mesonephric duct.

Teleostomi.—In the actinopterygian Ganoids a well-developed testicular network is present; *e.g.* in *Lepidosteus*[25] numerous vasa efferentia arise from the testis along nearly its whole length and pass to a longitudinal canal lying on the surface of the kidney, from which in turn transverse canals lead to the Malpighian bodies. (In the case of *Amia* they open into the tubules or even directly into the mesonephric duct.) In the Teleosts and in *Polypterus* there is no obvious connexion between testis and kidney, the wall of the testis being continuous with that of its duct, much as is the case with the ovary and its duct in the female. In all probability this peculiar condition is to be explained[26] by the reduction of the testicular network to a single vas efferens (much as in *Protopterus* or as in *Raia* and various anurous Amphibians at the front end of the series) which has come to open directly into the mesonephric duct (cf. fig. 12).

Organs of the Mesenchyme.—In vertebrates as in all other Metazoa, except the very lowest, there are numerous cell elements which no longer form part of the regularly arranged epithelial layers, but which take part in the formation of the packing tissue of the body. Much of this forms the various kinds of connective tissue which fill up many of the spaces between the various epithelial layers; other and very important parts of the general mesenchyme become specialized in two definite directions and give rise to two special systems of organs. One of these is characterized by the fact that the intercellular substance or matrix assumes a more or less rigid character—it may be infiltrated with salts of lime—giving rise to the supporting tissues of the skeletal system. The other is characterized by the intercellular matrix becoming fluid, and by the cell elements losing their connexion with one another and forming the characteristic fluid tissue, the blood, which with its well-marked containing walls forms the blood vascular system.

Skeletal System.—The skeletal system may be considered under three headings—(1) the chordal skeleton, (2) the cartilaginous skeleton and (3) the osseous skeleton.

1. *Chordal Skeleton.*—The most ancient element of the skeleton appears to be the *notochord*—a cylindrical rod composed of highly vacuolated cells lying ventral to the central nervous system and dorsal to the gut. Except in *Amphioxus*—where the condition may probably be secondary, due to degenerative shortening of the central nervous system—the notochord extends from a point just behind the infundibulum of the brain (see below) to nearly the tip of the tail. In ontogeny the notochord is a derivative of the dorsal wall of the archenteron. The outer layer of cells, which are commonly less vacuolated and form a “chordal epithelium,” soon secretes a thin cuticle which ensheaths the notochord and is known as the primary sheath. Within this there is formed later a secondary sheath, like the primary, cuticular in nature. This secondary sheath attains a considerable thickness and plays an important part in strengthening the notochord. The notochord with its sheaths is in existing fishes essentially the skeleton of early life (embryonic or larval). In the adult it may, in the more primitive forms (Cyclostomata, Dipneusti), persist as an important part of the skeleton, but as a rule it merely forms the foundation on which the cartilaginous or bony vertebral column is laid down.

2. *Cartilaginous or Chondral Skeleton.*—(A) Vertebral column.[27] In the embryonic connective tissue or mesenchyme lying just outside the primary sheath of the notochord there are developed a dorsal and a ventral series of paired nodules of cartilage known as *arcualia* (fig. 13, *d.a*, *v.a*). The dorsal arcualia are commonly prolonged upwards by supradorsal cartilages which complete the *neural arches* and serve to protect the spinal cord. The ventral arcualia become, in the tail region only, also incorporated in complete arches—the *haemal arches*. In correlation with the flattening of the body of the fish from side to side the arches are commonly prolonged into elongated neural or haemal spines.

The relations of the arcualia to the segmentation of the body, as shown by myotomes and spinal nerves, is somewhat obscure. The mesenchyme in which they arise is segmental in origin (sclerotom), which suggests

that they too may have been primitively segmental, but in existing fishes there are commonly two sets of arcualia to each body segment.

In gnathostomatous fishes the arcualia play a most important part in that cartilaginous tissue derived from them comes into special relationships with the notochord and gives rise to the vertebral column which functionally replaces this notochord in most of the fishes. This replacement occurs according to two different methods, giving rise to the different types of vertebral column known as chordacentrous and arcicentrous.

(*a*) Chordacentrous type. An incipient stage in the evolution of a chordacentrous vertebral column occurs in the Dipneusti, where cartilage cells from the arcualia become amoeboid and migrate into the substance of the secondary sheath, boring their way through the primary sheath (fig. 13, C). They wander throughout the whole extent of the secondary sheath, colonizing it as it were, and settle down as typical stationary cartilage cells. The secondary sheath is thus converted into a cylinder of cartilage. In Selachians exactly the same thing takes place, but in recent forms development goes a step further, as the cartilage cylinder becomes broken into a series of segments, known as vertebral centra. The wall of each segment becomes much thickened in the middle so that the notochord becomes constricted within each centrum and the space occupied by it is shaped like the cavity of a dice-box. When free from notochord and surrounding tissues such a cartilaginous centrum presents a deep conical cavity at each end (*amphicoelous*).

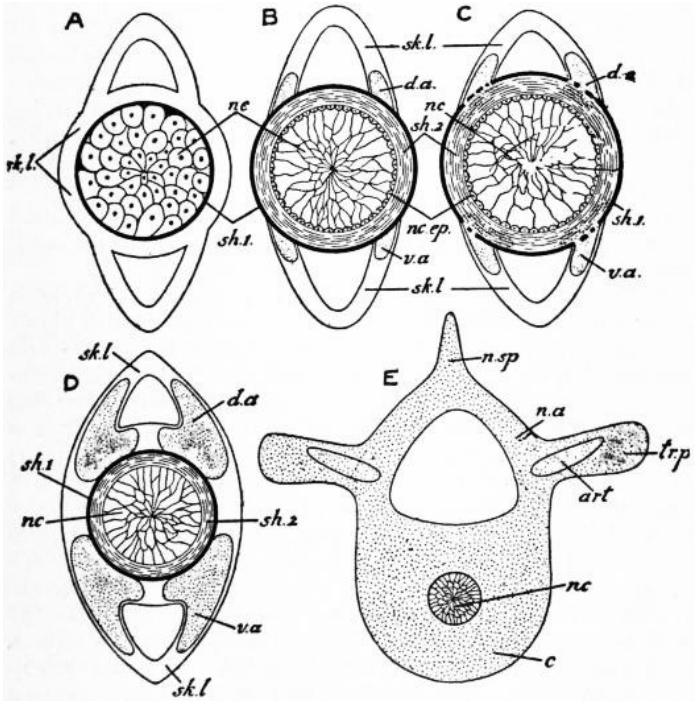


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FIG. 13.—Diagrammatic transverse sections to illustrate the morphology of the vertebral column.

A, Primitive conditions as seen in any young embryo.
B, Condition as it occurs in Cyclostomata, sturgeons, embryos of bony Actinopterygians.
C, Condition found in Selachians and Dipnoans.
D and E, Illustrating the developmental process in bony Actinopterygians and higher vertebrates.

c, Centrum.
d.a, Dorsal arcualia.
n.a, Neural arch.
nc, Notochord.
nc.ep, Chordal epithelium.
n.sp, Neural spine.
sh.1, Primary sheath.
sh.2, Secondary sheath.
sk.l, Connective tissue.
tr.p, Transverse process.
v.a, Ventral arcualia.

A secondary modification of the centrum consists in the calcification of certain zones of the cartilaginous matrix. The precise arrangement of these calcified zones varies in different families and affords characters which are of taxonomic importance in palaeontology where only skeletal structures are available (see SELACHIANS).

(*b*) Arcicentrous type. Already in the Selachians the vertebral column is to a certain extent strengthened by the broadening of the basis of the arcualia so as partially to surround the centra. In the Teleostomes, with the exceptions of those ganoids mentioned, the expanded bases of the arcualia undergo complete fusion to form cartilaginous centra which, unlike the chordacentrous centra, lie outside the primary sheath (figs. 13, D and E). In these forms no invasion of the secondary sheath by cartilage cells takes place. The composition of the groups of arcualia which give rise to the individual centrum is different in different groups. The end result is an amphicoelous or biconcave centrum in general appearance much like that of the Selachian.

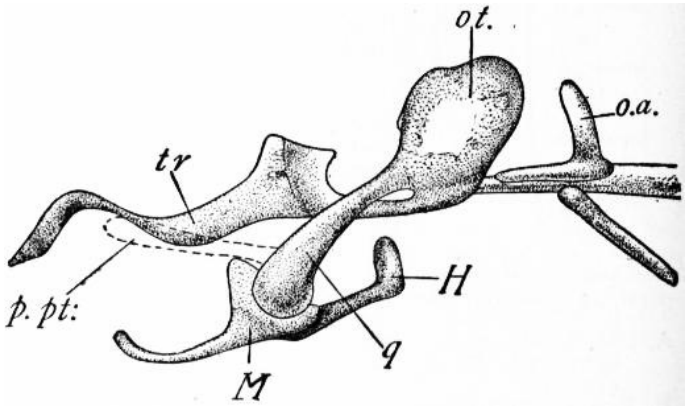
In *Lepidosteus* the spaces between adjacent centra become filled by a secondary development of

intervertebral cartilage which then splits in such a way that the definitive vertebrae are *opisthocoelous*, *i.e.* concave behind, convex in front.

Ribs.—In the Crossopterygians a double set of "ribs" is present on each side of the vertebral column, a ventral set lying immediately outside the splanchnocoelic lining and apparently serially homologous with the haemal arches of the caudal region, and a second set passing outwards in the thickness of the body wall at a more dorsal level. In the Teleostomes and Dipnoans only the first type is present; in the Selachians only the second. It would appear that it is the latter which is homologous with the ribs of vertebrates above fishes.

Median Fin Skeleton.—the foundation of the skeleton of the median fins consists of a series of rod-like elements, the radialia, each of which frequently is segmented into three portions. In a few cases the radialia correspond segmentally with the neural and haemal arches (living Dipnoans, *Pleuracanthus* tail region) and this suggests that they represent morphologically prolongations of the neural and haemal spines. That this is so is rendered probable by the fact that we must regard the evolution of the system of median fins as commencing with a simple flattening of the posterior part of the body. It is only natural to suppose that the edges of the flattened region would be at first supported merely by prolongations of the already existing spinous processes. In the Cyclostomes (where they are branched) and in the Selachians, the radialia form the main supports of the fin, though already in the latter they are reinforced by a new set of fin rays apparently related morphologically to the osseous or placoid skeleton (see below).

The series of radialia tends to undergo the same process of local concentration which characterizes the fin-fold as a whole. In its extreme form this leads to complete fusion of the basal portions of a number of radialia (dorsal fins of *Holoptychius* and various Selachians, and anal fin of *Pleuracanthus*). In view of the identity in function it is not surprising that a remarkable resemblance exists between the mechanical arrangements (of skeleton, muscles, &c.), of the paired and unpaired fins. The resemblance to paired fins becomes very striking in some of the cases where the basal fusion mentioned above takes place (*Pleuracanthus*).



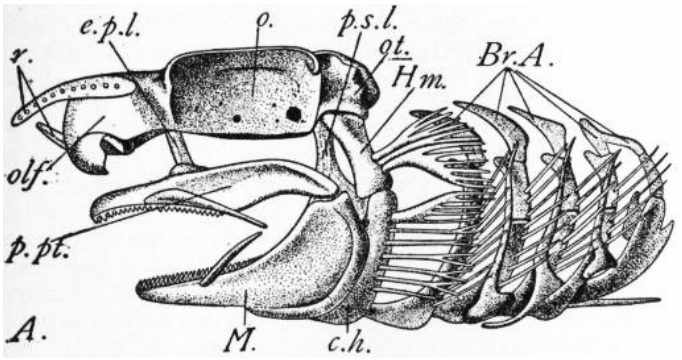
Trans. Roy. Soc. Edinburgh.

FIG. 14.—Chondrocranium of a young Lepidosiren, showing the suspension of the lower jaw by the upper portion of the mandibular arch. (After Agar.)

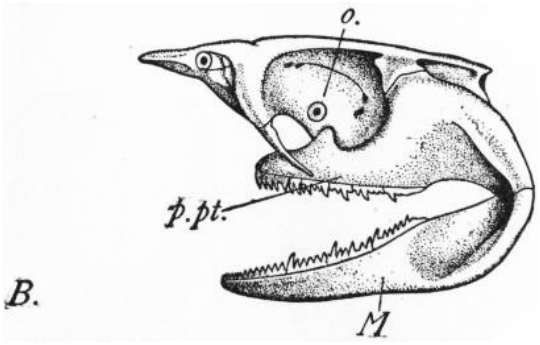
H, Hyoid arch.
M, Mandibular arch.
o.a, Occipital arch.
ot, Auditory capsule.
q, Quadrate = upper end of mandibular arch.
tr, Trabecula.

The palatopterygoid bar (*p.pt*) is represented by a faint vestige which disappears before the stage figured.

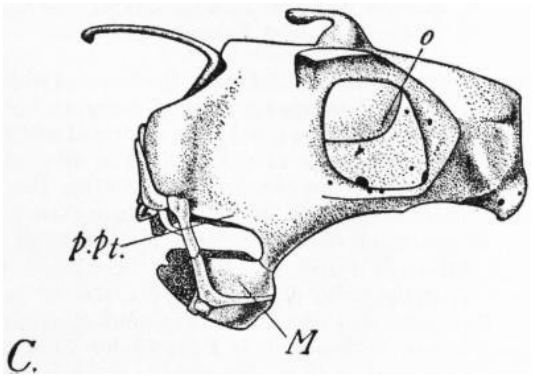
(B) *Chondrocranium*[28].—In front of the vertebral column lies the cartilaginous trough, the chondrocranium, which protects the brain. This consists of a praechordal portion—developed out of a pair of lateral cartilaginous rods—the *trabeculae cranii*—and a parachordal portion lying on either side of the anterior end of the notochord. This arises in development from a cartilaginous rod (parachordal cartilage) lying on each side of the notochord and possibly representing a fused row of dorsal arcualia. The originally separate parachordals and trabeculae become connected to form a trough-like, primitive cranium, complete or nearly so laterally and ventrally but open dorsally. With the primitive cranium there are also connected cartilaginous capsules developed round the olfactory and auditory organs. There also become fused with the hinder end of the cranium a varying number of originally distinct neural arches.



After W. K. Parker, *Trans. Zool. Soc. London.*



After Gegenbaur, *Untersuchungen zur verg. Anat. der Wirbeltiere*, by permission of Wilhelm Engelmann.



After Hubrecht, Brown's *Tierreich*, by permission of Gustav Fischer.

FIG. 15.—Chondrocranium, &c. of *Scyllium* (A), *Notidanus cinereus* (B) and *Chimaera* (C).

Br.A, Branchial arches.
c.h, Ceratohyal.
e.p.l, Ethmopalatine ligament.
Hm, Hyomandibular.
M, Meckel's cartilage.
o, Orbit.
olf, Olfactory capsule.
ot, Auditory capsule.
p.pt, Palato-pterygoid bar.
p.s.l, Prespiracular ligament.
r, Rostrum.

(C) *Visceral Arches.*—The skeleton of the visceral arches consists essentially of a series of half-hoops of cartilage, each divided in the adult into a number of segments and connected with its fellow by a median ventral cartilage. The skeleton of arches I. and II. (mandibular and hyoidean) undergoes modifications of special interest (figs. 14 and 15). The lower portion of the mandibular arch becomes greatly thickened to support the lower or hinder edge of the mouth. It forms the primitive lower jaw or "Meckel's cartilage." Dorsal to this an outgrowth arises from the anterior face of the arch which supports the upper or anterior margin of the mouth: it is the primitive upper jaw or palato-pterygoquadrate cartilage. The portion of the arch dorsal to the palato-pterygo-quadrate outgrowth may form the suspensorial apparatus of the lower jaw, being fused with the cranium at its upper end. This relatively primitive con-arrangement (*protostylic*, as it may be termed) occurs in Dipneusti among fishes (cf. fig. 14). More usually this dorsal part of the mandibular arch becomes reduced, its place being occupied by a ligament (pre-spiracular) uniting the jaw apparatus to the chondrocranium, the upper jaw being also attached to the chondrocranium by the ethmopalatine ligament situated more anteriorly. The main attachment, however, of the jaws to the chondrocranium in such a case, as holds for the majority of fishes, is through the enlarged dorsal segment of the hyoid arch (hyomandibular) which articulates at its dorsal end with the chondrocranium, while its ventral end is attached to the hinge region of the jaw by stout ligamentous bands. A skull in which the jaws are suspended in this

manner is termed a hyostylic skull (*e.g. Scyllium* in fig. 15).

In *Notidanus* (fig. 15, B) there is a large direct articulation of the upper jaw to the chondrocranium in addition to the indirect one through the hyomandibular: such a skull is amphistylic. In *Heterodontus* the upper jaw is firmly bound to the cranium throughout its length, while in Holocephali (fig. 15, C) complete fusion has taken place, so that the lower jaw appears to articulate directly with the cranium ("auto stylic" condition). In Dipneusti[29] (*Lepidosiren* and *Protopterus*) the cartilaginous upper jaw never develops (except in its hinder quadrate portion) beyond the condition of a faint rudiment, owing doubtless to its being replaced functionally by precociously developed bone.

(D) *Appendicular Skeleton.*—The skeleton of the free part of the limb is attached to the limb girdle which lies embedded in the musculature of the body. Each limb girdle is probably to be looked upon as consisting, like the skeleton of the visceral arches, of a pair of lateral half-hoops of cartilage. While in *Pleuracanthus* the lateral halves are distinct (and segmented like the branchial arches), in living Selachians generally the two halves are completely fused ventrally with one another. The part of the girdle lying dorsal to the articulation of the limb is termed scapular in the case of the pectoral limb, iliac in the case of the pelvic, while the ventral portions are known respectively as coracoid and ischio-pubic.

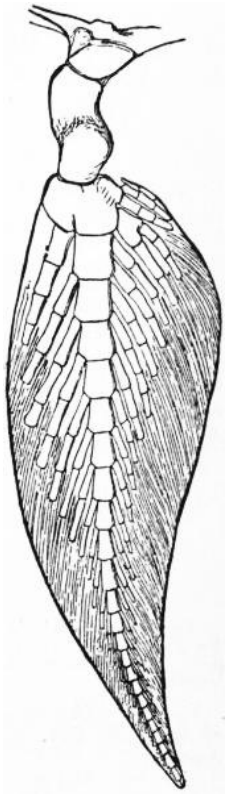


FIG. 16.—Fore-limb of *Ceratodus*.

In most Teleostomes the primitive pelvic girdle does not develop; in the Dipneusti it is represented by a median unpaired cartilage.

The skeleton of the free limb is probably seen in its most archaic form amongst existing fishes in the biserial archipterygium of *Ceratodus* (fig. 16). This is indicated by the relative predominance of this type of fin amongst the geologically more ancient fishes. The biserial archipterygium consists of a segmented axial rod, bearing a praeaxial and a postaxial series of jointed rays.

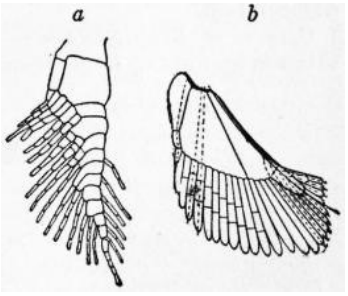
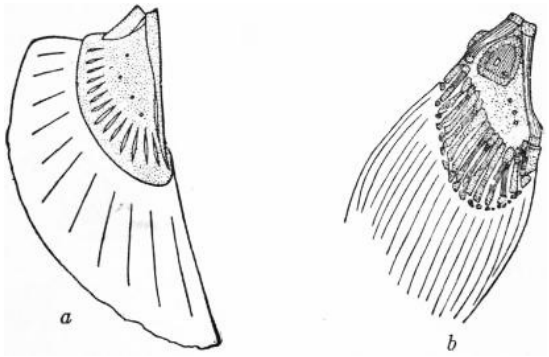


FIG. 17.—*a*, Skeleton of pectoral limb of *Pleuracanthus*. (From Gegenbauer, after Frisch.) *b*, Skeleton of pectoral limb of *Acanthias*. (After Gegenbauer.)

In *Protopterus* and *Lepidosiren* the limbs are reduced and the lateral rays have less (*Protopterus*) or more (*Lepidosiren*) completely disappeared.



From Budgett, *Trans. Zool. Soc. London*, xvi, part vii. From Wiedersheim's *Verg. Anat. der Wirbeltiere*, by permission of Gustav Fischer.

FIG. 18.—Skeleton of Pectoral Limb of *Polypterus*. *a*, 30 mm. larva. *b*, Adult.

In such an archaic Selachian as *Pleuracanthus* the fin is clearly of the biserial archipterygial type, but the lateral rays are reduced (pectoral) or absent (pelvic) (fig. 17, *a*) on one side of the axis. In a typical adult Selachian the pectoral fin skeleton has little apparent resemblance to the biserial archipterygium—the numerous outwardly directed rays springing from a series of large basal cartilages (*pro-*, *meso-* and *metapterygium*). The condition in the young (*e.g.* fig. 17, *b*, *Acanthias*) hints strongly, however, at the possibility of the fin skeleton being really a modified biserial archipterygium, and that the basal cartilages represent the greatly enlarged axis which has become fixed back along the side of the body. In Crossopterygians (*Polypterus*) the highly peculiar fin skeleton (fig. 18) while still in the embryonic cartilaginous stage is clearly referable to a similar condition. In the Actinopterygians—with the increased development of dermal fin rays—there comes about reduction of the primitive limb skeleton. The axis becomes particularly reduced, and the fin comes to be attached directly to the pectoral girdle by a number of basal pieces (Teleosts) probably representing vestigial rays (cf. fig. 19).

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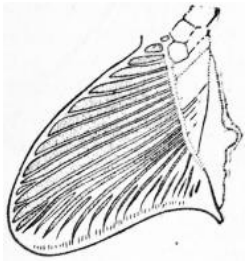
FIG. 19.—Skeleton of Pectoral Fin of *Amia*.

Views on the general morphology of the fin skeleton are strongly affected by the view held as to the mode of evolution of the fins. By upholders of the lateral fold hypothesis the type of fin skeleton described for *Cladoselache*[30] is regarded as particularly primitive. It is, however, by no means clear that the obscure basal structures figured (Fig. 20) in this fin do not really represent the pressed back axis as in *Pleuracanthus*.

The pelvic fin skeleton, while built obviously on the same plan as the pectoral, is liable to much

modification and frequently degeneration.



From Bashford Dean, Mem. *N.Y. Acad. of Science.*
FIG. 20.—Skeleton of Pectoral Fin of *Cladoselache*.

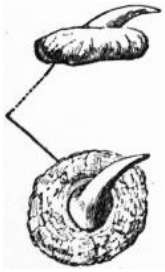


FIG. 21.—Placoid elements of a male Thorn-back, *Raia clavata*.

Osseous or Bony Skeleton.—The most ancient type of bony skeleton appears to be represented in the *placoid* elements such as are seen in the skin of the Selachian (fig. 21). Each placoid element consists of a spine with a broadly expanded base embedded in the dermis. The base is composed of bone: the spine of the somewhat modified bone known as dentine. Ensheathing the tip of the spine is a layer of extremely hard enamel formed by the inner surface of the ectoderm which originally covered it. Such typical placoid scales are well seen on any ordinary skate. In the groups of fishes above the Selachians, the coating of placoid elements shows various modifications. The spines disappear, though they may be present for a time in early development. The bony basal plates tend to undergo fusion—in certain cases they form a continuous bony cuirass (various Siluroids, trunk-fishes) formed of large plates jointed together at their edges. More usually the plates are small and regular in size. In Crossopterygians and *Lepidosteus* and in many extinct forms the scales are of the ganoid type, being rhomboidal and having their outer layer composed of hard glistening ganoine. In other Teleostomes the scales are as a rule thin, rounded and overlapping—the so-called cycloid type (fig. 22, A); where the posterior edge shows toothlike projections the scale is termed ctenoid (fig. 22, B). In various Teleosts the scales are vestigial (eel); in others (as in most electric fishes) they have completely disappeared.

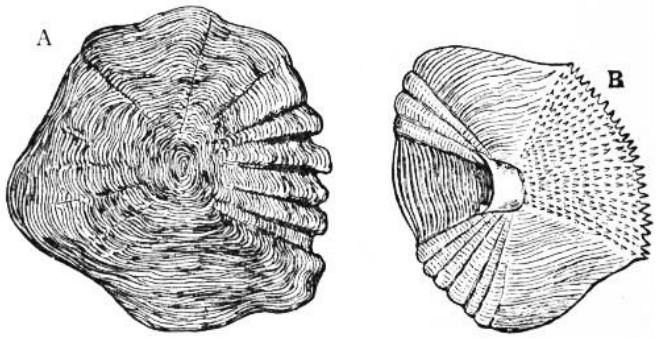


FIG. 22.—A, Cycloid Scale of *Scopelus resplendens* (magn.). B, Ctenoid Scale of *Lethrinus* (magn.).

Teeth.—Certain of the placoid elements belonging to that part of the skin which gives rise to the lining of the stomodaeum have their spines enlarged or otherwise modified to form teeth. In the majority of fishes these remain simple, conical structures: in some of the larger sharks (*Carcharodon*) they become flattened into trenchant blades with serrated edges: in certain rays (*Myliobatis*) they form a pavement of flattened plates suited for crushing molluscan shells. In the young *Neoceratodus*[31] there are numerous small conical teeth, the bases of which become connected by a kind of spongework of bony trabeculae. As development goes on a large basal mass is formed which becomes the functional tooth plate of the adult, the original separate denticles disappearing completely. In the other two surviving Dipnoans, similar large teeth exist, though here there is no longer trace in ontogeny of their formation by the basal fusion of originally separate denticles. In the Selachians the bony skeleton is restricted to the placoid elements. In the Teleostomes and the Dipnoans the original cartilaginous skeleton becomes to a great extent unsheathed or replaced by bony tissue. It seems highly probable that the more deeply seated osseous elements occurring in these as in the higher groups arose in the course of evolution by the spreading inwards of bony trabeculae from the bases of the placoid elements. Such a method has been demonstrated as occurring in individual development in the case of certain of the more superficially placed bones.[32]

> The placoid element with its cap of enamel secreted by the ectoderm is probably originally derived from a local thickening of the basement membrane which with the external cuticle may be looked on as the most ancient skeletal structure in the Metazoa. The basal plate appears to have been a later development than the spine; in the palaeozoic *Coelolepidae*[33] the basal plate is apparently not yet developed.

Only a brief summary can be given here of the leading features in the osteology of fishes. Care must be taken not to assume that bony elements bearing the same name in fishes and in other groups, or even in the various sub-divisions of the fishes, are necessarily strictly homologous. In all probability bony elements occupying similar positions and described by the same anatomical name have been evolved independently from the ancestral covering of placoid elements.

Teleostei.—It will be convenient to take as the basis of our description the bony skeleton of such a Teleostean fish as the salmon. In the vertebral column all the cartilaginous elements are replaced by bone. The haemal spines of the turned-up tip of the tail are flattened (hypural bones) and serve to support the

caudal fin rays.

In *Argyropelecus* and in one or two deep-sea forms the vertebral column remains cartilaginous.

Apart from the ossification of the radialia which takes place in the adults of bony fishes there exist special supporting structures in the fins (paired as well as median) of all the gnathostomatous fishes and apparently in nature independent of the cartilaginous skeleton. These are known as dermal fin-rays.[34] Morphologically they are probably to be looked on (like placoid elements) as local exaggerations of the basement membrane.

In their detailed characters two main types of dermal fin-ray may be recognized. The first of these are horny unjointed rays and occur in the fins of Selachians and at the edge of the fins of Teleostomes (well seen in the small posterior dorsal or "adipose" fin, particularly in Siluroids). The second type of dermal fin-ray is originally arranged in pairs and forms the main supports of the fin in the adult Teleost (fig. 23). The members of each pair are in close contact except proximally where they separate and embrace the tip of one of the radialia. The fin-rays of this second type are frequently branched and jointed: in other cases they form unbranched rigid spines.

In the angler or fishing-frog (*Lophius*) the anterior rays of the dorsal fin become greatly elongated to form small fishing-rods, from which depend bait-like lures for the attraction of its prey.

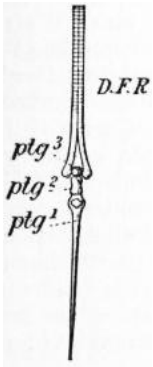


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FIG. 23.—One of the radialia of the salmon, consisting of three segments, *ptg*[1], *ptg*[2], *ptg*[3], and supporting a dermal fin ray. *D.F.R.*

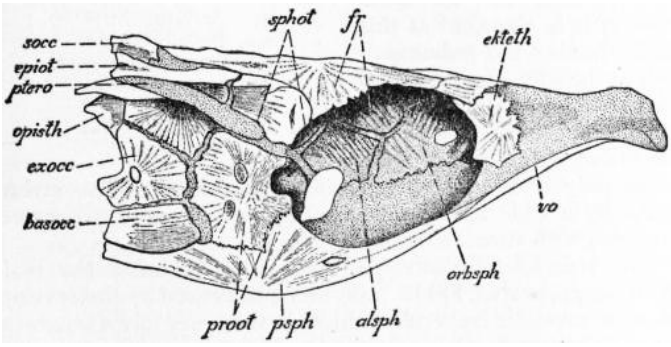

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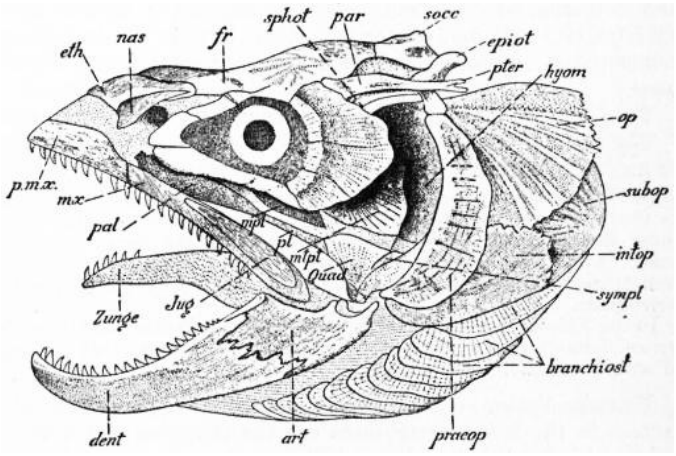
FIG. 24.—Chondrocranium of Salmon, seen from the right side.

alsph, Alisphenoid.
basocc, Basioccipital.
ekteth, Lateral ethmoid.
epiot, Epiotic.
exocc, Exoccipital.
fr, Frontal.
opisth, Opisthotic.
orbsph, Orbitosphenoid.
proot, Prootic.
psph, Parasphenoid.
ptero, Pterotic.
socc, Supra occipital.
sphot, Sphenotic.
vo, Vomer.

In the skull of the adult salmon it is seen that certain parts of the chondrocranium (fig. 24) have been replaced by bone ("cartilage bones") while other more superficially placed bones ("membrane bones") cover its surface (fig. 25). Of cartilage bones four are developed round the foramen magnum—the basioccipital, supraoccipital and two exoccipitals. In front of the basioccipital is the basisphenoid with an alisphenoid on each side. The region (presphenoidal) immediately in front of the basisphenoid is unossified, but on each side of it an orbitosphenoid is developed, the two orbitosphenoids being closely approximated in the mesial plane and to a certain extent fused, forming the upper part of the interorbital septum. In the anterior or ethmoidal portion of the cranium the only cartilage bones are a pair of lateral ethmoids lying at the anterior boundary of the orbit. A series of five distinct elements are ossified in the wall of the auditory or otic capsule, the prootic and opisthotic more ventrally, and the sphenotic, pterotic and epiotic more dorsally. The roof of the cranium is covered in by the following dermal bones—parietals (on each side of the supraoccipital), frontals, dermal ethmoid and small nasals, one over each olfactory organ. The floor of the cranium on its oral aspect is ensheathed by the large parasphenoid and the smaller vomer in front of and overlapping it. The cartilaginous lower jaw is ossified posteriorly to form the articular (fig. 25) with a small membrane bone, the angular, ventral to it, but the main part of the jaw is replaced functionally by a large membrane bone which ensheaths it—the dentary—evolved in all probability by the spreading outwards of bony tissue from the bases of the placoid elements (teeth) which it bears. The original upper jaw (palatopterygoid bar) is replaced by a chain of bones—palatine in front, then pterygoid and mesopterygoid, and posteriorly metapterygoid and quadrate, the latter giving articulation to the articular bone of the lower jaw. These representatives of the palatopterygoid bar no longer form the functional upper jaw. This function is performed by membrane bones which have appeared external to the palatopterygoid bar—the premaxilla and maxilla—which carry teeth—and the small scale-like jugal behind them. The quadrate is suspended from the skull as in the Selachians (hyostylic skull) by the upper portion of the hyoid arch—here represented by two bones—the hyomandibular and symplectic. The ventral portion of the hyoid arch is also represented by a chain of bones (stylohyal, epihyal, ceratohyal, hypohyal and the ventral unpaired basihyal), as is also each of the five branchial arches behind it. In addition to the bony elements belonging to the hyoid arch proper a series of membrane bones support the opercular flap. Ventrally there project backwards from the ceratohyal

a series of ten overlapping branchiostegal rays, while more dorsally are the broader interopercular, subopercular and opercular.



From Wiedersheim, *Verg. Anat. der Wirbeltiere*, by permission of Gustav Fischer.

FIG. 25.—Complete Skull of Salmon from left side.

art, Articular.
branchiost, Branchiostegal.
dent, Dentary.
epiot, Epiotic.
eth, Dermal ethmoid.
fr, Frontal.
hyom, Hyomandibular.
intop, Interopercular.
Jug, Jugal.
mpt, Mesopterygoid.
mtpt, Metapterygoid.
mx, Maxilla.
nas, Nasal.
op, Opercular.
pal, Palatine.
par, Parietal.
pmx, Premaxilla.
preop, Preopercular.
pt, Pterygoid.
pter, Pterotic.
Quad, Quadrate.
socc, Supraoccipital.
sphot, Sphenotic.
subop, Subopercular.
sympl, Symplectic.
Zunge, Tongue.

In addition to the bones already enumerated there is present a ring of circumorbital bones, a preopercular, behind and external to the hyomandibular and quadrate, and squamosal, external to the hinder end of the auditory capsule.

In the salmon, pike, and various other Teleosts, extensive regions of the chondrocranium persist in the adult, while in others (*e.g.* the cod) the replacement by bone is practically complete. Bony elements may be developed in addition to those noticed in the salmon.

In the sturgeon the chondrocranium is ensheathed by numerous membrane bones, but cartilage bones are absent. In the Crossopterygians[35] the chondrocranium persists to a great extent in the adult, but portions of it are replaced by cartilage bones—the most interesting being a large sphenethmoid like that of the frog. Numerous membrane bones cover the chondrocranium externally. In the Dipneusti[36] the chondrocranium is strengthened in the adult by numerous bones. One of the most characteristic is the great palatopterygoid bone which develops very early by the spreading of ossification backwards from the tooth bases, and whose early development probably accounts for the non-development of the palatopterygoid cartilage.

Appendicular Skeleton.—The primitive pectoral girdle, which in the Dipneusti is strengthened by a sheath of bone, becomes in the Teleostomes reduced in size (small scapula and coracoid bones) and replaced functionally by a secondary shoulder girdle formed of superficially placed membrane bones (supraclavicular and cleithrum or "clavicle," with, in addition in certain cases, an infraclavicular and one or two postclavicular elements), and connected at its dorsal end with the skull by a post-temporal bone.

The pelvic girdle is in Teleostomes completely absent as a rule.

The skeleton of the free limb undergoes ossification to a less or greater extent in the Teleostomes.

In *Polypterus* the pectoral fin (fig. 18, B) shows three ossifications in the basal part of the fin—pro-, meso- and metapterygium. Of these the metapterygium probably represents the ossified skeletal axis: while the propterygium and also the numerous diverging radials probably represent the lateral rays of one side of the archipterygium.

In the *Teleostomes* the place of the pelvic girdle is taken functionally by an element apparently formed by the fusion of the basal portions of several radials.

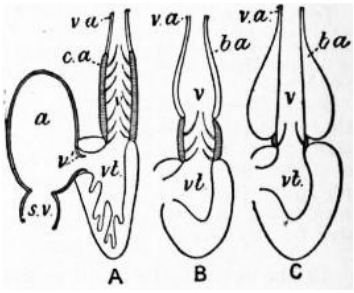
Vascular System.—The main components of the blood vascular system in the lower vertebrates are the following: (1) a single or double dorsal aorta lying between the enteron and notochord; (2) a ventral vessel lying beneath the enteron; and (3) a series of paired hoop-like aortic arches connecting dorsal and ventral vessels round the sides of the pharynx. The blood-stream passes forwards towards the head in the ventral vessel, dorsalwards through the aortic arches, and tailwards in the dorsal aorta.

The dorsal aorta is single throughout the greater part of its extent, but for a greater or less extent at its anterior end (*circulus cephalicus*) it consists of two paired aortic roots. It is impossible to say whether the paired or the unpaired condition is the more primitive, general morphological conditions being in favour of

the latter, while embryological evidence rather supports the former. The dorsal aorta, which receives its highly oxygenated blood from the aortic arches, is the main artery for the distribution of this oxygenated blood. Anteriorly the aortic roots are continued forwards as the dorsal carotid arteries to supply the head region. A series of paired, segmentally-arranged arteries pass from the dorsal aorta to supply the muscular body wall, and the branches which supply the pectoral and pelvic fins (subclavian or brachial artery, and iliac artery) are probably specially enlarged members of this series of segmental vessels. Besides these paired vessels a varying number of unpaired branches pass from dorsal aorta to the wall of the alimentary canal with its glandular diverticula (coeliac, mesenteric, rectal).

The ventral vessel undergoes complicated changes and is represented in the adults of existing fishes by a series of important structures. Its post-anal portion comes with the atrophy of the post-anal gut to lie close under the caudal portion of the dorsal aorta and is known as the caudal vein. This assumes a secondary connexion with, and drains its blood into, the posterior cardinal veins (see below). In the region between cloaca and liver the ventral vessel becomes much branched or even reticular and—serving serving to convey the food-laden blood from the wall of the enteron to the capillary network of the liver—is known as the hepatic portal vein. The short section in front of the liver is known as the hepatic vein and this conveys the blood, which has been treated by the liver, into a section of the ventral vessel, which has become highly muscular and is rhythmically contractile. This enlarged muscular portion, in which the contractility—probably once common to the main vessels throughout their extent—has become concentrated, serves as a pump and is known as the heart. Finally the precardiac section of the ventral vessel—the ventral aorta—conveys the blood from heart to aortic arches.

In addition to the vessels mentioned a large paired vein is developed in close relation to the renal organ which it serves to drain. This is the posterior cardinal. An anterior prolongation (anterior cardinal) serves to drain the blood from the head region. From the point of junction of anterior and posterior cardinal a large transverse vessel leads to the heart (*ductus Cuvieri*).



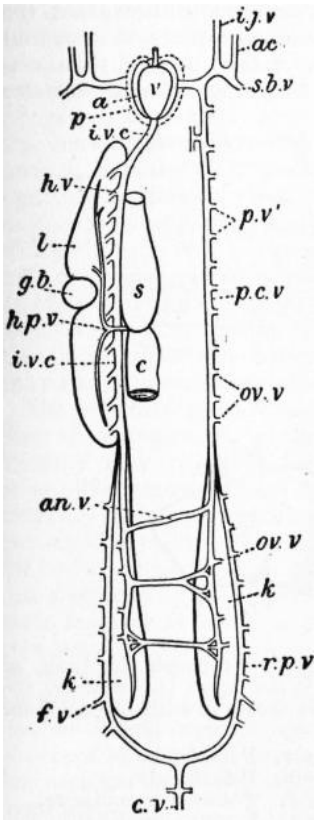
From Boas, *Lehrbuch der Zoologie*, by permission of Gustav Fischer.

FIG. 26.—Diagram to illustrate the condition of the Conus in an Elasmobranch (A), *Amia* (B) and a typical Teleost (C).

a, Atrium.
b.a, Bulbus aortae.
c.a, Conus arteriosus.
s.v, Sinus venosus.
v,v', Valves.
v.a, Ventral aorta.
vt, Ventricle.

Heart.—Originally a simple tube curved into a somewhat S-shape, the heart, by enlargements, constrictions and fusions of its parts, becomes converted into the complex, compact heart of the adult. In this we recognize the following portions—(1) *Sinus venosus*, (2) *Atrium*, (3) *Ventricle*. A fourth chamber, the *conus arteriosus*, the enlarged and contractile hinder end of the ventral aorta, is also physiologically a part of the heart. The sinus venosus receives the blood from the great veins (ductus Cuvieri and hepatic veins). It—like the atrium which it enters by an opening guarded by two lateral valves—has thin though contractile walls. The atrium is as a rule single, but in the Dipnoans, in correlation with the importance of their pulmonary breathing, it is incompletely divided into a right and a left auricle. In Neoceratodus the incomplete division is effected by the presence of a longitudinal shelf projecting into the atrial cavity from its posterior wall. The opening of the sinus venosus is to the right of this shell, that of the pulmonary vein to the left. In *Prototerus* and *Lepidosiren* a nearly complete septum is formed by the fusion of trabeculae, there being only a minute opening in it posteriorly. The atrium opens by a wide opening guarded by two or more flap valves provided with chordae tendineae into the ventricle.

The ventricle, in correspondence with it being the main pumping apparatus, has its walls much thickened by the development of muscular trabeculae which, in the lower forms separated by wide spaces in which most of the blood is contained, become in the Teleostomes so enlarged as to give the wall a compact character, the spaces being reduced to small scattered openings on its inner surface. In the Dipnoans the ventricle, like the atrium, is incompletely divided into a right and left ventricle. In *Ceratodus* this is effected by an extension of the interauricular shelf into the ventricle. In *Lepidosiren* the separation of the two ventricles is complete but for a small perforation anteriorly, the heart in this respect showing a closer approximation to the condition in the higher vertebrates than is found in any Amphibians or in any reptiles except the Crocodilia. The conus arteriosus is of interest from the valvular arrangements in its interior to prevent regurgitation of blood from ventral aorta into ventricle. In their simplest condition, as seen *e.g.* in an embryonic Selachian, these arrangements consist of three, four or more prominent longitudinal ridges projecting into the lumen of the conus, and serving to obliterate the lumen when jammed together by the systole of the conus. As development goes on each of these ridges becomes segmented into a row of pocket valves with their openings directed anteriorly so that regurgitation causes them to open out and occlude the lumen by their free edges



After Newton Parker, from *Trans. of the Royal Irish Academy*, vol. xxx.

FIG. 27.—Venous System of *Protopterus*, as seen from ventral side.

a, Atrium.
ac, Anterior cardinal.
an.v, Anastomotic vein.
c, Intestine.
c.v, Caudal vein.
f.v, Femoral vein.
g.b, Gall-bladder.
h.v, Hepatic vein.
i.j.v, Inferior jugular vein.
i.v.c, Posterior vena cava.
k, Kidney.
l, Liver.
ov.v, Ovarian veins.
p, Pericardium.
p.c.v, Left posterior cardinal.
p.v', Parietal veins.
r.p.v, Renal portal.
s, Stomach.
s.b.v, Subclavian.

meeting. Amongst the Teleostomes the lower ganoids show a similar development of longitudinal rows of valves in the conus. In *Amia* (fig. 26, B), however, the conus is shortened and the number of valves in each longitudinal row is much reduced. This leads to the condition found in the Teleosts (fig. 26, O), where practically all trace of the conus has disappeared, a single circle of valves representing a last survivor of each row (save in a few exceptional cases, *e.g. Albula*, *Tarpen*, *Osteoglossum*, where two valves of each row are present).

In Front of the conus vestige of the Teleost there is present a thick walled *bulbus aortae* differing from the conus in not being rhythmically contractile, its walls being on the contrary richly provided with elastic tissue.

The Dipnoans[37] show an important advance on the conus as in atrium and ventricle. The conus has a characteristic spiral twist. Within it in *Neoceratodus* are a number of longitudinal rows of pocket valves. One of these rows is marked out by the very large size of its valves and by the fact that they are not distinct from one another but even in the adult form a continuous, spirally-running, longitudinal fold. This ridge projecting into the lumen of the conus divides it incompletely into two channels, the one beginning (*i.e.* at its hinder end) on the *left* side and ending in front *ventrally*, the other beginning on the *right* and ending *dorsally*. In *Protopterus* a similar condition occurs, only in the front end of the conus a second spiral fold is present opposite the first and, meeting this, completes the division of the conus cavity into two separate parts. The rows of pocket valves which do not enter into the formation of the spiral folds are here greatly reduced.

These arrangements in the conus of the Dipnoans are of the highest morphological interest, pointing in an unmistakable way towards the condition found in the higher lung-breathing vertebrates. Of the two cavities into which the conus is partially divided in the Dipneusti the one which begins posteriorly on the right receives the (venous) blood from the right side of the heart, and ending up anteriorly dorsal to the other cavity communicates only with aortic arches V. and VI. In the higher vertebrates this cavity has become completely split off to form the root of the pulmonary arteries, and a result of aortic arch V. receiving its blood along with the functionally much more important VI. (the pulmonary arch) from this special part of the conus has been the almost complete disappearance of this arch (V.) in all the higher vertebrates.

Arterial System.—There are normally six aortic arches laid down corresponding with the visceral arches, the first (mandibular) and second (hyoidean) undergoing atrophy to a less or greater extent in post-embryonic life. Where an external gill is present the aortic arch loops out into this, a kind of short-circuiting of the blood-stream taking place as the external gill atrophies. As the walls of the clefts assume their respiratory function the aortic arch becomes broken into a network of capillaries in its respiratory portion, and there is now distinguished a ventral afferent and a dorsal efferent portion of each arch. Complicated developmental changes, into which it is unnecessary to enter,[38] may lead to each efferent vessel draining the two sides of a single cleft instead of the adjacent walls of two clefts as it does primitively. In the Crossopterygians and Dipnoans as in the higher vertebrates the sixth aortic arch gives off the pulmonary artery to the lung. Among the Actinopterygians this, probably primitive, blood-supply to the lung (swimbladder) persists only in *Amia*.

Venous System.—The most interesting variations from the general plan outlined have to do with the arrangements of the posterior cardinals. In the Selachians these are in their anterior portion wide and sinuslike, while in the region of the kidney they become broken into a sinusoidal network supplied by the postrenal portion now known as the renal portal vein. In the Teleostomes the chief noteworthy feature is the tendency to asymmetry, the right posterior cardinal being frequently considerably larger than the left

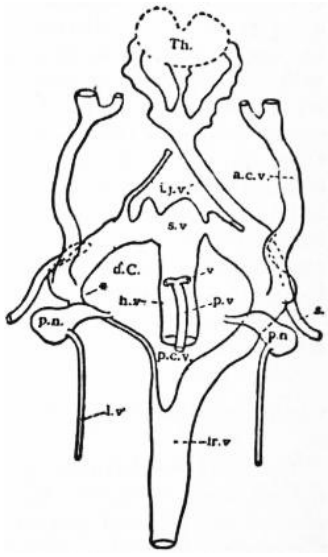


FIG. 28.—Venous System of Polypterus 30 mm. larva (dorsal view).

a.c.v, Anterior cardinal vein.
*d.*C, Ductus Cuvieri
.
h.v, Hepatic vein.

and connected with it by transverse anastomotic vessels, the result being that most of the blood from the two kidneys passes forwards by the right posterior cardinal. The Dipnoans (fig. 27) show a similar asymmetry, but here the anterior end of the right posterior cardinal disappears, being replaced functionally by a new vessel which conveys the blood from the right posterior cardinal direct to the sinus venosus instead of to the outer end of the ductus Cuvieri. This new vessel is the posterior vena cava which thus in the series of vertebrates appears for the first time in the Dipneusti.

i.j.v, Inferior jugular vein.
ir.v, Inter-renal vein.
l.v, Lateral cutaneous vein.
p.c.v, Posterior cardinal vein.
p.n, Pronephros.
p.v, Pulmonary vein.
s, Subclavian vein.
s.v, Sinus venosus.
th, Thyroid.
v, Vein from pharyngeal wall.
* Anterior portion of left posterior cardinal vein.

Pulmonary Veins.—In *Polypterus* (fig. 28) the blood is drained from the lungs by a pulmonary vein on each side which unites in front with its fellow and opens into the great hepatic vein behind the heart. In the Dipnoans the conjoined pulmonary veins open directly into the left section of the atrium as in higher forms. In the Actinopterygians with their specialized air-bladder the blood passes to the heart via posterior cardinals, or hepatic portal, or —a probably more primitive condition—directly into the left ductus Cuvieri (*Amia*).

Lymphatics.—More or less irregular lymphatic spaces occur in the fishes as elsewhere and, as in the Amphibia, localized muscular developments are present forming lymph hearts.

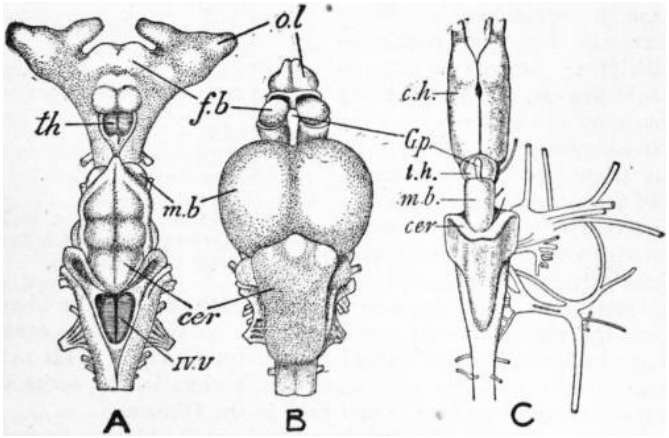
Central Nervous System.—The neural tube shows in very early stages an anterior dilated portion which forms the rudiment of the brain in contradistinction to the hinder, narrower part which forms the spinal cord. This enlargement of the brain is correlated with the increasing predominance of the nerve centres at the anterior end of the body which tend to assume more and more complete control over those lying behind.

Spinal Cord.—A remarkable peculiarity occurs in the sun fishes (*Molidae*), where the body is greatly shortened and where the spinal cord undergoes a corresponding abbreviation so as to be actually shorter than the brain.

Brain.—It is customary to divide the brain into three main regions, fore-, mid-, and hind-brain, as in the most familiar vertebrates there is frequently seen in the embryo a division of the primitive brain dilatation into three vesicles lying one behind the other. A consideration of the development of the brain in the various main groups of vertebrates shows that these divisions are not of equal importance. In those archaic groups where the egg is not encumbered by the presence of a large mass of yolk it is usual for the brain to show in its early stages a division into two main regions which we may term the primitive fore-brain or cerebrum and the primitive hind-brain or rhombencephalon. Only later does the hinder part of the primitive fore-brain become marked off as mid-brain. In the fully developed brain it is customary to recognize the series of regions indicated below, though the boundaries between these regions are not mathematical lines or surfaces any more than are any other biological boundaries:—

Rhombencephalon (Hind-brain)	Myelencephalon (Medulla oblongata). Metencephalon (Cerebellum).
Cerebrum (Primitive Fore-brain)	Mesencephalon (Mid-brain). Thalamencephalon (Diencephalon). [Hemispheres (Telencephalon).]

The myelencephalon or medulla oblongata calls for no special remark, except that in the case of *Torpedo* there is a special upward bulging of its floor on each side of the middle line forming the electric lobe and containing the nucleus of origin of the nerves to the electric organ.



A and B from Wiedersheim, by permission of Gustav Fischer.

FIG. 29.—Brain of *Scyllium* (A), *Salmo* (B) and *Lepidosiren* (C). The three figures are not drawn to the same scale.

cer, Cerebellum.
c.h, Cerebral hemisphere.
th, Thalamencephalon.
f.b, Primitive fore-brain (in B the line points to the thickened wall of the fore-brain, the so-called "basal ganglia").
G.p, Pineal body.
m.b, Roof of mid-brain, optic lobes, *tectum opticum*.
o.l, Olfactory lobe.
IV.*v*, Fourth ventricle.

The cerebellum occurs in its simplest form in lampreys and Dipnoans (fig. 29, C), where it forms a simple band-like thickening of the anterior end of the roof of the hind-brain. In Selachians it is very large and bulges upwards, forming a conspicuous organ in a dorsal view of the brain (fig. 29, A). In Teleosts (fig. 29, B) the cerebellum is also large. It projects back as a great tongue-like structure over the roof of the fourth ventricle, while in front it dips downwards and projects under the roof of the mid-brain forming a highly characteristic *valvula cerebelli*. A *valvula cerebelli* occurs also in ganoids, while in the Crossopterygians a similar extension of the cerebellum projects backwards into the IV. ventricle or cavity of the hind-brain (fig. 30).

The mesencephalon is a conspicuous structure in the fishes from its greatly developed roof (*tectum opticum*) which receives the end pencils of the optic nerve. Normally it projects upwards as a pair of large optic lobes, but in the Dipnoans (fig. 29, C) the lateral thickening is not sufficiently great to cause obvious lateral swellings in external view.

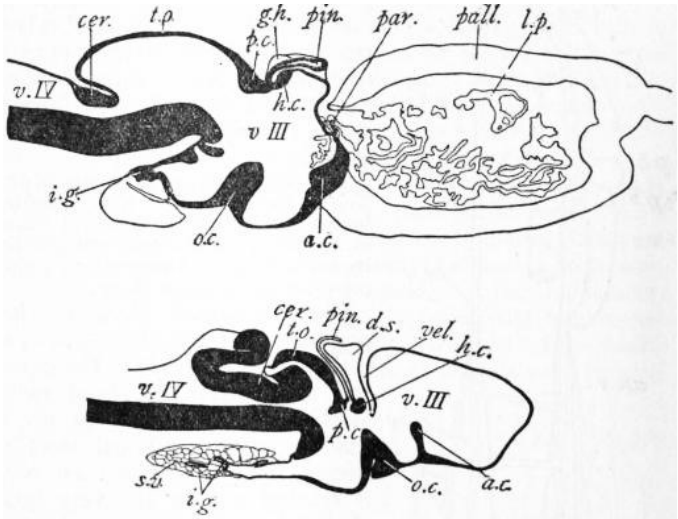


FIG. 30.—Median Longitudinal Section through the brain of *Lepidosiren* and *Polypterus*. In the upper figure (*Lepidosiren*) the habenular ganglion and hemisphere are shown in outline though not actually present in a median section.

a.c, Anterior commissure.
cer, Cerebellum.
d.s, Dorsal sac.
g.h, Habenular ganglion.
h.c, Habenular commissure.
i.g, Infundibular gland.
l.p, Lateral plexus.
o.c, Optic chiasma.
pall, Pallium.
par, Paraphysis.
pin, Pineal body.
p.c, Posterior commissure.
s.v, Saccus vasculosus.
t.o, Tectum opticum.
*v.*III, Third ventricle.
*v.*IV, Fourth ventricle.
vel, Velum transversum.

The thalamencephalon is one of the most interesting parts of the brain from its remarkable uniformity throughout the Vertebrata. Even in *Amphioxus* the appearance of a sagittal section strongly suggests vestiges of a once present thalamencephalon.[39] The roof—like that of the myelencephalon—remains to a great extent membranous, forming with the closely applied *pia mater* a vascular roof to the III. ventricle. Frequently a transverse fold of the roof dips down into the III. ventricle forming the *velum transversum* (fig. 30).

The side walls of the thalamencephalon are greatly thickened forming the *thalamus* (epithalamus and hypothalamus), while a ganglionic thickening of the roof posteriorly on each side forms the *ganglia habenulae* which receive olfactory fibres from the base of the hemisphere. The habenular ganglia are unusually large in the lampreys and are here strongly asymmetrical, the right being the larger.

The floor of the thalamencephalon projects downwards and backwards as the infundibulum. The side walls of this are thickened to form characteristic *lobi inferiores*, while the blind end develops glandular outgrowths (infundibular gland, fig. 30) overlaid by a rich development of blood sinuses and forming with them the *saccus vasculosus*. The optic chiasma, where present, is involved in the floor of the thalamencephalon and forms a large, upwardly-projecting ridge. Farther forwards on the floor or anterior wall is the anterior commissure (see below).

Passing forwards from the mid-brain (cf. fig. 30) a series of interesting structures are found connected with the roof of the primitive fore-brain, viz.—posterior commissure (intercalary region), pineal organ, habenular commissure with anterior parietal organ, dorsal sac (= pineal cushion), *velum transversum*, paraphysis. The posterior commissure is situated in the boundary between thalamencephalon and mid-brain. It is formed of fibres connecting up the right and left sides of the tectum opticum (?). The habenular or superior commissure situated farther forwards connects the two ganglia habenulae. In the immediate neighbourhood of these ganglia there project upwards two diverticula of the brain-roof known as the pineal organ and the parapineal (or anterior parietal) organ. The special interest of these organs[40] lies in the fact that in certain vertebrates one (parapineal in *Sphenodon* and in lizards) or both (*Petromyzon*) exhibit histological features which show that they must be looked on as visual organs or eyes. In gnathostomatous

fishes they do not show any definite eye-like structure, but in certain cases (*Polyodon*, *Callichthys*, &c.) the bony plates of the skull-roof are discontinuous over the pineal organ forming a definite parietal foramen such as exists in lizards where the eye-like structure is distinct. It is also usual to find in the epithelial wall of the pineal organ columnar cells which show club-shaped ends projecting into the lumen (exactly as in the young visual cells of the retina[41]) and are prolonged into a root-like process at the other end. Definite nerve fibres pass down from these parietal organs to the brain. It is stated that the fibres from the pineal organ pass into the posterior commissure, those of the parapineal organ into the habenular commissure.

The facts mentioned render it difficult to avoid the conclusion that these organs either have been sensory or are sensory. Possibly they represent the degenerate and altered vestiges of eye-like organs present in archaic vertebrates, or it may be that they represent the remains of organs not eye-like in function but which for some other reason lay close under the surface of the body. It would seem natural that a diverticulum of brain-tissue exposed to the influence of light-rays should exhibit the same reaction as is shown frequently elsewhere in the animal kingdom and tend to assume secondarily the characters of a visual organ. The presence of the rod-like features in the epithelial cells is perhaps in favour of the latter view. In evolution we should expect these to appear before the camera-like structure of a highly developed eye, while in the process of degeneration we should expect these fine histological characters to go first.

Selachians.—No parapineal organ is present. The pineal body (except in *Torpedo* where it is absent) is in the form of a long slender tube ending in front in a dilated bulb lying near the front end of the brain in close contact with, or enclosed in, a definite foramen in the cranial roof.

Holocephali and Crossopterygii.—Here also the pineal body is long and tubular: at its origin it passes dorsalwards or slightly backwards behind the large dorsal sac.

Actinopterygian Ganoids resemble Selachians on the whole. In *Amia* a parapineal organ is present, and it is said to lie towards the left side and to be connected by a thick nerve with the *left* habenular ganglion (cf. *Petromyzon*, article Cyclostomata). This is adduced to support the view that the pineal and parapineal bodies represent originally paired structures.

Teleostei.—A parapineal rudiment appears in the embryo of some forms, but in the adult only the pineal organ is known to exist. This is usually short and club-shaped, its terminal part with much folded wall and glandular in character. In a few cases a parietal foramen occurs (*Callichthys*, *Loricaria*, &c.).

Dipneusti.—The pineal organ is short and simple. No parapineal organ is developed.

The dorsal sac is formed by that part of the roof of the thalamencephalon lying between the habenular commissure and the region of the velum. In some cases a longitudinal groove is present in which the pineal organ lies (Dipneusti). In the Crossopterygians the dorsal sac is particularly large and was formerly mistaken for the pineal organ.

The *velum transversum* is a transverse, inwardly-projecting fold of the roof of the primitive fore-brain in front of the dorsal sac. To those morphologists who regard the hemisphere region or telencephalon as a primitively unpaired structure the velum is an important landmark indicating the posterior limit of the telencephalon. Those who hold the view taken in this article that the hemispheres are to be regarded as paired outpushings of the side wall of the primitive fore-brain attribute less morphological importance to the velum. Physiologically the velum is frequently important from the plexus of blood-vessels which passes with it into the III. ventricle.

In *Petromyzon* and *Chimaera* the velum is not developed. In Dipnoans there are present in its place *paired* transverse folds which are probably merely extensions backwards of the lateral plexuses.

The Paraphysis is a projection from the roof of the primitive fore-brain near its anterior end. It is well seen in Dipnoans[42] (*Lepidosiren* and *Protopterus*) where in the larva (exactly as in the urodele larva) it forms a blindly ending tube sloping upwards and forwards between the two hemispheres. In the adult it becomes mixed with the two lateral plexuses and is liable to be confused with them. In the other groups—except the Teleosts where it is small (*Anguilla*) or absent (most Teleosts)—the paraphysis is by no means such a definite structure, but generally there is present a more or less branched and divided diverticulum of the brain wall, frequently glandular, which is homologized with the paraphysis. The morphological significance of the paraphysis is uncertain. It may represent the remains of an ancient sense organ, or it may simply represent the last connexion between the brain and the external ectoderm from which it was derived.

An important derivative of the primitive fore-brain is seen in the pair of cerebral hemispheres which in the higher vertebrates become of such relatively gigantic dimensions. The hemispheres appear to be primitively associated with the special sense of smell, and they are prolonged anteriorly into a pair of olfactory lobes which come into close relation with the olfactory organ. From a consideration of their adult relations and of their development—particularly in those groups where there is no disturbing factor in the shape of a large yolk sac—it seems probable that the hemispheres are primitively paired outpushings of the lateral wall of the primitive fore-brain[43]—in order to give increased space for the increased mass of nervous matter associated with the olfactory sense. They are most highly developed in the Dipneusti amongst fishes. They are there (cf. fig. 29, C) of relatively enormous size with thick nervous floor (corpus striatum) and side walls and roof (pallium) surrounding a central cavity (lateral ventricle) which opens into the third ventricle. At the posterior end of the hemisphere a small area of its wall remains thin and membranous, and this becomes pushed into the lateral ventricle by an ingrowth of blood-vessel to form the huge lateral plexus (= *plexus hemisphaerium*). In this great size of the hemispheres[44] and also in the presence of a rudimentary cortex in the Dipnoi we see, as in many other features in these fishes, a distinct foreshadowing of conditions occurring in the higher groups of vertebrates. The Cyclostomes possess a distinct though small pair of hemispheres. In the Selachians the relatively archaic *Notidanidae*[45] possess a pair of thick-walled hemispheres, but in the majority of the members of the group the paired condition is obscured (fig. 29, A).

In the Teleostomes the mass of nervous matter which in other groups forms the hemispheres does not

undergo any pushing outwards except as regards the small olfactory lobes. On the contrary, it remains as a great thickening of the lateral wall of the thalamencephalon (the so-called basal ganglia), additional space for which, however, may be obtained by a considerable increase in length of the fore-brain region (cf. fig. 30, A) or by actual involution into the third ventricle (*Polypterus*).[46] The great nervous thickenings of the thalamencephalic wall bulge into its cavity and are covered over by the thin epithelial roof of the thalamencephalon which is as a consequence liable to be confused with the pallium or roof of the hemispheres with which it has nothing to do: the homologue of the pallium as of other parts of the hemisphere is contained within the lateral thickening of the thelamencephalic wall, not in its membranous roof.[47]

Associated with the parts of the fore-brain devoted to the sense of smell (especially the corpora striata) is the important system of bridging fibres forming the anterior commissure which lies near the anterior end of the floor, or in the front wall, of the primitive fore-brain. It is of great interest to note the appearance in the *Dipnoans* (*Lepidosiren* and *Protopterus*) of a corpus callosum (cf. fig. 30 B) lying dorsal to the anterior commissure and composed of fibres connected with the pallial region of the two hemispheres.

Sense Organs.—The olfactory organs are of special interest in the Selachians, where each remains through life as a widely-open, saccular involution of the ectoderm which may be prolonged backwards to the margin of the buccal cavity by an open oronasal groove, thus retaining a condition familiar in the embryo of the higher vertebrates. In Dipnoans the olfactory organ communicates with the roof of the buccal cavity by definite posterior nares as in the higher forms—the communicating passage being doubtless the morphological equivalent of the oronasal groove, although there is no direct embryological evidence for this. In the Teleostomes the olfactory organ varies from a condition of great complexity in the Crossopterygians down to a condition of almost complete atrophy in certain Teleosts (Plectognathi).[48]

The *eyes* are usually of large size. The lens is large and spherical and in the case of most Teleostomes accommodation for distant vision is effected by the lens being pulled bodily nearer the retina. This movement is brought about by the contraction of smooth muscle fibres contained in the *processus falciformis*, a projection from the choroid which terminates in contact with the lens in a swelling, the *campanula Halleri*. In *Amia* and in Teleosts a network of capillaries forming the so-called choroid gland surrounds the optic nerve just outside the retina. As a rule the eyes of fishes have a silvery, shining appearance due to the deposition of shining flakes of guanin in the outer layer of the choroid (*Argentea*) or, in the case of Selachians, in the inner layers (*tapetum*). Fishes which inhabit dark recesses, *e.g.* of caves or of the deep sea, show an enlargement, or, more frequently, a reduction, of the eyes. Certain deep-sea Teleosts possess remarkable telescopic eyes with a curious asymmetrical development of the retina.[49]

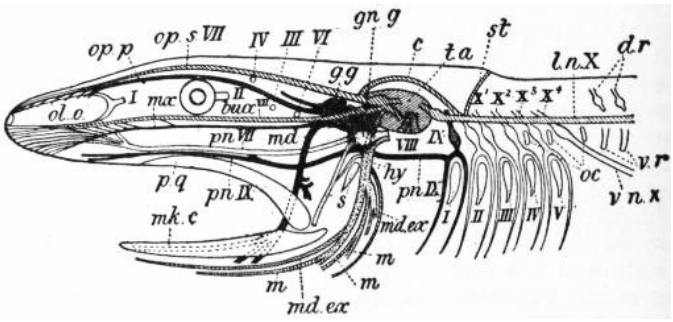
The otocyst or auditory organ agrees in its main features with that of other vertebrates. In Selachians the otocyst remains in the adult open to the exterior by the *ductus endolymphaticus*. In *Squatina*[50] this is unusually wide and correlated; with this the calcareous otoconia are replaced by sand-grains from the exterior. In Dipnoans (*Lepidosiren* and *Protopterus*) curious outgrowths arise from the ductus endolymphaticus and come to overlie the roof of the fourth ventricle, recalling the somewhat similar condition met with in certain Amphibians.

> In various Teleosts the swimbladder enters into intimate relations with the otocyst. In the simplest condition these relations consist in the prolongation forwards of the swimbladder as a blindly ending tube on either side, the blind end coming into direct contact either with the wall of the otocyst itself or with the fluid surrounding it (perilymph) through a gap in the rigid periotic capsule. A wave of compression causing a slight inward movement of the swimbladder wall will bring about a greatly magnified movement of that part of the wall which is not in relation with the external medium, viz. the part in relation with the interior of the auditory capsule. In this way the perception of delicate sound waves may be rendered much more perfect. In the Ostariophysi (Sagemehl), including the *Cyprinidae*, the *Siluridae*, the *Characinidae* and the *Gymnotidae*, a physiologically similar connexion between swimbladder and otocyst is brought about by the intervention of a chain of auditory ossicles (Weberian ossicles) formed by modification of the anterior vertebrae.[51]

Lateral Line Organs.[52]—Epidermal sense buds are scattered about in the ectoderm of fishes. A special arrangement of these in lines along the sides of the body and on the head region form the highly characteristic sense organs of the lateral line system. In *Lepidosiren* these organs retain their superficial position; in other fishes they become sunk beneath the surface into a groove, which may remain open (some Selachians), but as a rule becomes closed into a tubular channel with openings at intervals. It has been suggested that the function of this system of sense organs is connected with the perception of vibratory disturbances of comparatively large wave length in the surrounding medium.

Peripheral Nerves.—In the Cyclostomes the dorsal afferent and ventral efferent nerves are still, as in *Amphioxus*, independent, but in the gnathostomatous fishes they are, as in the higher vertebrates, combined together into typical spinal nerves.

As regards the cranial nerves the chief peculiarities of fishes relate to (1) the persistence of the branchial clefts and (2) the presence of an elaborate system of cutaneous sense organs supplied by a group of nerves (*lateralis*) connected with a centre in the brain which develops in continuity with that which receives the auditory nerve. These points may be exemplified by the arrangements in Selachians (see fig. 31). I., II., III., IV. and VI. call for no special remark.



From Bridge, *Cambridge Natural History*, vol. vii. "Fishes" (by permission of Macmillan & Co., Ltd.). After Wiedersheim, *Grundriss der vergleichenden Anatomie* (by permission of Gustav Fischer).

FIG. 31.—Diagram of Cranial nerves of a Fish. Cranial nerves and branchial clefts are numbered with Roman figures. Trigeminus black; Facialis dotted; Lateralis oblique shading; Glossopharyngeal cross-hatched; Vagus white.

bucc, Buccal.
c, Commissure between pre- and postauditory parts of lateralis system.
d.r, Dorsal roots of spinal nerves.
g.g, Gasserian ganglion.
gn.g, (Geniculate) ganglion of VII.
hy, Hyomandibular.
*l.n.*X, Lateralis vagi.
m, Motor branches of *hy*.
md, Mandibular.
md.ex, External mandibular.
mk.c, Meckel's cartilage.
mx, Maxillary.
oc, Occipitospinal.
ol.o, Olfactory organ.
op.p, Ophthalmicus profundus.
op.s, Ophthalmicus superficialis.
pn, Palatine.
pq., Palatopterygo-quadrate cartilage.
s, Spiracle.
st, Supra-temporal branch of lateralis system.
t.a, Lateralis centre in brain.
v.n, Visceral nerve.
v.r, Ventral roots.

Trigeminus (V.).—The *ophthalmicus profundus* branch (*op.p.*)—which probably is morphologically a distinct cranial nerve—passes forwards along the roof of the orbit to the skin of the snout. As it passes through the orbit it gives off the long ciliary nerves to the eyeball, and is connected with the small ciliary ganglion (also connected with III.) which in turn gives off the short ciliary nerves to the eyeball. The *ophthalmicus superficialis* (cut short in the figure) branch passes from the root ganglion of V. (Gasserian ganglion), and passes also over the orbit to the skin of the snout. It lies close to, or completely fused with, the corresponding branch of the lateralis system.

The main trunk of V. branches over the edge of the mouth into the *maxillary* (*mx.*) and *mandibular* (*md.*) divisions, the former, like the two branches already mentioned, purely sensory, the latter mixed—supplying the muscles of mastication as well as the teeth of the lower jaw and the lining of the buccal floor.

The main trunk of the *Facialis* (VII.) bifurcates over the spiracle into a pre-spiracular portion—the main portion of which passes to the mucous membrane of the palate as the palatine (*pn*VII.)—and a postspiracular portion, the hyomandibular (*hy.*) trunk which supplies the muscles of the hyoid arch and also sends a few sensory fibres to the lining of the spiracle, the floor of mouth and pharynx and the skin of the lower jaw. Combined with the main trunk of the facial are branches belonging to the *lateralis* system.

Lateralis Group of Nerves.—The *lateralis* group of nerves are charged with the innervation of the system of cutaneous sense organs and are all connected with the same central region in the medulla. A special sensory area of the ectoderm becomes involuted below the surface to form the otocyst, and the nerve fibres belonging to this form the auditory nerve (VIII.). Other portions of the *lateralis* group become mixed up with various other cranial nerves as follows:

(*a*) Facial portion.

(1) *Ophthalmicus superficialis* (*op.s.*VII.): passes to lining of nose or to the lateral line organs of the dorsal part of snout.

(2) *Buccal* (*bucc.*VII): lies close to maxillary division of V. and passes to the sensory canals of the lower side of the snout.

(3) *External mandibular* (*md.ex.*): lies in close association with the mandibular division of V., supplies the sensory canals of the lower jaw and hyoid region.

Lateralis vagi (*l.n.*X.) becomes closely associated with the vagus. It supplies the lateral line organs of the trunk.

In the lamprey and in Dipnoans the *lateralis vagi* loses its superficial position in the adult and comes into close relation with the notochord.

In Actinopterygians and at least some Selachians a *lateralis* set of fibres is associated with IX., and in the former fishes a conspicuous trunk of *lateralis* fibres passes to some or all (*Gadus*) of the fins. This has been called the *lateralis accessorius* and is apparently connected with V., VII., IX., X. and certain spinal nerves.[53]

Vagus Group (IX., X., XI.).—The *glossopharyngeus* (IX.) forks over the first branchial cleft (pretrematic and post-trematic branches) and also gives off a palatine branch (*pn.*IX.). In some cases (various Selachians, Ganoids and Teleosts) it would seem that IX. includes a few fibres of the *lateralis* group.

Vagus (X.) is shown by its multiple roots arising from the medulla and also by the character of its peripheral distribution to be a compound structure formed by the fusion of a number of originally distinct nerves. It consists of (1) a number of branchial branches (X.¹ X.² &c.), one of which forks over each gill cleft behind the hyobranchial and which may (Selachians) arise by separate roots from the medulla; (2) an intestinal branch (*v.n.*X.) arising behind the last branchial and innervating the wall of the oesophagus and stomach and it may be even the intestine throughout the greater part of its length (*Myxine*).

The *accessorius* (XI.) is not in fishes separated as a distinct nerve from the vagus.

With increased development of the brain its hinder portion, giving rise to the vagus system, has apparently come to encroach on the anterior portion of the spinal cord, with the result that a number of spinal nerves have become reduced to a less or more vestigial condition. The dorsal roots of these nerves disappear entirely in the adult, but the ventral roots persist and are to be seen arising ventrally to the vagus roots. They supply certain muscles of the pectoral fins and of the visceral arches and are known as spino-occipital nerves.[54]

> These nerves are divisible into an anterior more ancient set—the occipital nerves—and a posterior set of more recent origin—(occipito-spinal nerves). In Selachians 1-5 pairs of occipital nerves alone are recognizable: in Dipnoans 2-3 pairs of occipital and 2-3 pairs of occipito-spinal: in Ganoids 1-2 pairs occipital and 1-5 pairs occipito-spinal; in Teleosts finally the occipital nerves have entirely disappeared while there are 2 pairs of occipito-spinal. In Cyclostomes no special spino-occipital nerves have been described.

The fibres corresponding with those of the *Hypoglossus* (XII.) of higher vertebrates spring from the anterior spinal nerves, which are here, as indeed in Amphibia, still free from the cranium.

Sympathetic.—The sympathetic portion of the nervous system does not in fishes attain the same degree of differentiation as in the higher groups. In Cyclostomes it is apparently represented by a fine plexus with small ganglia found in the neighbourhood of the dorsal aorta and on the surface of the heart and receiving branches from the spinal nerves. In Selachians also a plexus occurs in the neighbourhood of the cardinal veins and extends over the viscera: it receives visceral branches from the anterior spinal nerves. In Teleosts the plexus has become condensed to form a definite sympathetic trunk on each side, extending forwards into the head and communicating with the ganglia of certain of the cranial nerves.

(J. G. K.)

V. Distribution in Time and Space

The origin of Vertebrates, and how far back in time they extend, is unknown. The earliest fishes were in all probability devoid of hard parts and traces of their existence can scarcely be expected to be found. The hypothesis that they may be derived from the early Crustaceans, or Arachnids, is chiefly based on the somewhat striking resemblance which the mailed fishes of the Silurian period (Ostracodermi) bear to the Arthropods of that remote time, a resemblance, however, very superficial and regarded by most morphologists as an interesting example of mimetic resemblance—whatever this term may be taken to mean. The minute denticles known as conodonts, which first appear in the Ordovician, were once looked upon as teeth of Cyclostomes, but their histological structure does not afford any support to the identification and they are now generally dismissed altogether from the Vertebrates. As a compensation the Lower Silurian of Russia has yielded small teeth or spines which seem to have really belonged to fishes, although their exact affinities are not known (*Palaeodus* and *Archodus* of J. V. Rohon).

It is not until we reach the Upper Silurian that satisfactory remains of unquestionable fishes are found, and here they suddenly appear in a considerable variety of forms, very unlike modern fishes in every respect, but so highly developed as to convince us that we have to search in much earlier formations for their ancestors. These Upper Silurian fishes are the *Coelolepidae*, the *Ateleaspidae*, the *Birkeniidae*, the *Pteraspidae*, the *Trematraspidae* and the *Cephalaspidae*, all referred to the Ostracophori. The three last types persist in the Devonian, in the middle of which period the Osteolepid Crossopterygii, the Dipneusti and the Arthrodira suddenly appear. The most primitive Selachian (*Cladoselache*), the Acanthodian Selachians (*Diplacanthidae*), the Chimaerids (*Ptyctodus*), and the Palaeoniscid ganoids (*Chirolepis*) appear in the Upper Devonian, along with the problematic *Palaeospondylus*.

In the Carboniferous period, the Ostracophori and Arthrodira have disappeared, the Crossopterygii and Dipneusti are still abundant, and the Selachians (*Pleuracanthus*, Acanthodians, truesharks) and Chondrostean ganoids (*Palaeoniscidae* and *Platysomidae*) are predominant. In the Upper Permian the Holostean ganoids (*Acanthophorus*) make their appearance, and the group becomes dominant in the Jurassic and the Lower Cretaceous. In the Trias, the Crossopterygii and Dipneusti dwindle in variety and the *Ceratodontidae* appear; the Chondrostean and Holostean ganoids are about equally represented, and are supplemented in the Jurassic by the first, annectant representatives of the Teleostei (*Pholidophoridae*, *Leptolepidae*). In the latter period, the Holostean ganoids are predominant, and with them we find numerous Cestraciont sharks, some primitive skates (*Squatinidae* and *Rhinobatidae*), Chimaerids and numerous Coelacanthid crossopterygians.

The fish-fauna of the Lower Cretaceous is similar to that of the Jurassic, whilst that of the Chalk and other Upper Cretaceous formations is quite modern in aspect, with only a slight admixture of Coelacanthid crossopterygians and Holostean ganoids, the Teleosteans being abundantly represented by *Elopidae*, *Albulidae*, *Halosauridae*, *Scopelidae* and *Berycidae*, many being close allies of the present inhabitants of the deep sea. At this period the spiny-rayed Teleosteans, dominant in the seas of the present day, made their first appearance.

With the Eocene, the fish-fauna has assumed the essential character which it now bears. A few Pycnodonts survive as the last representatives of typically Mesozoic ganoids, whilst in the marine deposits of Monte Bolca (Upper Eocene) the principal families of living marine fishes are represented by genera

identical with or more or less closely allied to those still existing; it is highly remarkable that forms so highly specialized as the sucking-fish or remoras, the flat-fish (*Pleuronectidae*), the Pediculati, the Plectognaths, &c., were in existence, whilst in the freshwater deposits of North America *Osteoglossidae* and *Cichlidae* were already represented. Very little is known of the freshwater fishes of the early Tertiaries. What has been preserved of them from the Oligocene and Miocene shows that they differed very slightly from their modern representatives. We may conclude that from early Tertiary times fishes were practically as they are at present. The great hiatus in our knowledge lies in the period between the Cretaceous and the Eocene.

At the present day the Teleosteans are in immense preponderance, Selachians are still well represented, the Chondrostean ganoids are confined to the rivers and lakes of the temperate zone of the northern hemisphere (*Acipenseridae*, *Polyodontidae*), the Holostean ganoids are reduced to a few species (*Lepidosteus*, *Amia*) dwelling in the fresh waters of North America, Mexico and Cuba, the Crossopterygians are represented by the isolated group *Polypteridae*, widely different from any of the known fossil forms, with about ten species inhabiting the rivers and lakes of Africa, whilst the Dipneusti linger in Australia (*Neoceratodus*), in South America (*Lepidosiren*), and in tropical Africa (*Protopterus*). The imperfections of the geological record preclude any attempt to deal with the distribution in space as regards extinct forms, but several types, at present very restricted in their habitat, once had a very wide distribution. The *Ceratodontidae*, for instance, of which only one species is now living, confined to the rivers of Queensland, has left remains in Triassic, Rhaetic, Jurassic and Cretaceous rocks of Europe, North America, Patagonia, North and South Africa, India and Australia; the *Amiidae* and *Lepidosteidae* were abundant in Europe in Eocene and Miocene times; the *Osteoglossidae*, now living in Africa, S.E. Asia and South America, occurred in North America and Europe in the Eocene.

In treating of the geographical distribution of modern fishes, it is necessary to distinguish between fresh-water and marine forms. It is, however, not easy to draw a line between these categories, as a large number of forms are able to accommodate themselves to either fresh or salt water, whilst some periodically migrate from the one into the other. On the whole, fishes may be roughly divided into the following categories:—

I. Marine fishes. A. shore-fishes; B. pelagic fishes; C. deep-sea fishes.

II. Brackish-water fishes.

III. Fresh-water fishes.

IV. Migratory fishes. A. anadromous (ascending fresh waters to spawn); B. catadromous (descending to the sea to spawn).

About two-thirds of the known recent fishes are marine. Such are nearly all the Selachians, and, among the Teleosteans, all the *Heteromi*, *Pediculati* and the great majority of *Apodes*, *Thoracostei*, *Percesoces*, *Anacanthini*, *Acanthopterygii* and *Plectognathi*. All the *Crossopterygii*, *Dipneusti*, *Opisthomi*, *Symbranchii*, and nearly all the *Ganoidei* and *Ostariophysi* are confined to fresh-water.

The three categories of marine fishes have thus been defined by Günther:—

> "1. *Shore Fishes*—that is, fishes which chiefly inhabit parts of the sea in the immediate neighbourhood of land either actually raised above, or at least but little submerged below, the surface of the water. They do not descend to any great depth,—very few to 300 fathoms, and the majority live close to the surface. The distribution of these fishes is determined, not only by the temperature of the surface water, but also by the nature of the adjacent land and its animal and vegetable products,—some being confined to flat coasts with soft or sandy bottoms, others to rocky and fissured coasts, others to living coral formations. If it were not for the frequent mechanical and involuntary removals to which these fishes are exposed, their distribution within certain limits, as it no doubt originally existed, would resemble still more that of freshwater fishes than we find it actually does at the present period.
>
> 2. *Pelagic Fishes*—that is, fishes which inhabit the surface and uppermost strata of the open ocean, and approach the shores only accidentally or occasionally (in search of prey), or periodically (for the purpose of spawning). The majority spawn in the open sea, their ova and young being always found at a great distance from the shore. With regard to their distribution, they are still subject to the influences of light and the temperature of the surface water; but they are independent of the variable local conditions which tie the shore fish to its original home, and therefore roam freely over a space which would take a freshwater or shore fish thousands of years to cover in its gradual dispersal. Such as are devoid of rapidity of motion are dispersed over similarly large areas by the oceanic currents, more slowly than the strong swimmers, but not less surely. An accurate definition, therefore, of their distribution within certain areas equivalent to the terrestrial regions is much less feasible than in the case of shore fishes.
>
> 3. *Deep-Sea Fishes*—that is, fishes which inhabit such depths of the ocean that they are but little or not at all influenced by light or the surface temperature, and which, by their organization, are prevented from reaching the surface stratum in a healthy condition. Living almost under identical tellurian conditions, the same type, the same species, may inhabit an abyssal depth under the equator as well as one near the arctic or antarctic circle; and all that we know of these fishes points to the conclusion that no separate horizontal regions can be distinguished in the abyssal fauna, and that no division into bathymetrical strata can be attempted on the base of generic much less of family characters."

A division of the world into regions according to the distribution of the shore-fishes is a much more difficult task than that of tracing continental areas. It is possible perhaps to distinguish four great divisions: the Arctic region, the Atlantic region, the Indo-Pacific region and the Antarctic region. The second and third may be again subdivided into three zones: Northern, Tropical and Southern. This appears to be a more satisfactory arrangement than that which has been proposed into three zones primarily, each again subdivided according to the different oceans. Perhaps a better division is that adopted by D. S. Jordan, who arranges the littoral fishes according to coast lines; we then have an East Atlantic area, a West Atlantic, an East Pacific and a West Pacific, the latter including the coasts of the Indian Ocean. The tropical zone, whatever be the ocean, is that in which fishes flourish in greatest abundance and where, especially about

coral-reefs, they show the greatest variety of bizarre forms and the most gorgeous coloration. The fish-fauna of the Indo-Pacific is much richer than that of the Atlantic, both as regards genera and species.

As regards the Arctic and Antarctic regions, the continuity or circumpolar distribution of the shore fishes is well established. The former is chiefly characterized by its Cottids, Cyclopterids, Zoarcids and Gadids, the latter by its Nototheniids. The theory of bipolarity receives no support from the study of the fishes.

Pelagic fishes, among which we find the largest Selachians and Teleosteans, are far less limited in their distribution, which, for many species, is nearly world-wide. Some are dependent upon currents, but the great majority being rapid swimmers able to continue their course for weeks, apparently without the necessity of rest (many sharks, scombrids, sword-fishes), pass from one ocean into the other. Most numerous between the tropics, many of these fishes occasionally wander far north and south of their habitual range, and there are few genera that are at all limited in their distribution.

Deep-sea fishes, of which between seven hundred and eight hundred species are known, belong to the most diverse groups and quite a number of families are exclusively bathybial (*Chlamydoselachidae*, *Stomiatidae*, *Alepocephalidae*, *Nemichthyidae*, *Synaphobranchidae*, *Saccopharyngidae*, *Cetomimidae*, *Halosauridae*, *Lipogenyidae*, *Notacanthidae*, *Chiasmodontidae*, *Icosteidae*, *Muraenolepididae*, *Macruridae*, *Anomalopidae*, *Podatelidae*, *Trachypteridae*, *Lophotidae*, *Ceratiidae*, *Gigantactinidae*). But they are all comparatively slight modifications of the forms living on the surface of the sea or in the shallow parts, from which they may be regarded as derived. In no instance do these types show a structure which may be termed archaic when compared with their surface allies. That these fishes are localized in their vertical distribution, between the 100-fathoms line, often taken as the arbitrary limit of the bathybial fauna, and the depth of 2750 fathoms, the lowest point whence fishes have been procured, there is little doubt. But our knowledge is still too fragmentary to allow of any general conclusions, and the same applies to the horizontal distribution. Yet the same species may occur at most distant points; as these fishes dwell beyond the influence of the sun’s rays, they are not affected by temperature, and living in the Arctic zone or under the equator makes little difference to them. A great deal of evidence has been accumulated to show the gradual transition of the surface into the bathybial forms; a large number of surface fishes have been met with in deep water (from 100 to 500 fathoms), and these animals afford no support to Alexander Agassiz’s supposition of the existence of an azoic zone between the 200-fathoms line and the bottom.

Brackish-water fishes occur also in salt and fresh water, in some localities at least, and belong to various groups of Teleosteans. Sticklebacks, gobies, grey mullets, blennies are among the best-known examples. The facility with which they accommodate themselves to changes in the medium in which they live has enabled them to spread readily over very large areas. The three-spined stickleback, for instance, occurs over nearly the whole of the cold and temperate parts of the northern hemisphere, whilst a grey mullet (*Mugil capito*) ranges without any appreciable difference in form from Scandinavia and the United States along all the Atlantic coasts to the Cape of Good Hope and Brazil. It would be hardly possible to base zoo-geographical divisions on the distribution of such forms.

The fresh-water fishes, however, invite to such attempts. How greatly their distribution differs from that of terrestrial animals has long ago been emphasized. The key to their mode of dispersal is, with few exceptions, to be found in the hydrography of the continents, latitude and climate, excepting of course very great altitudes, being inconsiderable factors, the fish-fauna of a country deriving its character from the headwaters of the river-system which flows through it. The lower Nile, for instance, is inhabited by fishes bearing a close resemblance to, or even specifically identical with, those of tropical Africa, thus strikingly contrasting with the land-fauna of its banks. The knowledge of the river-systems is, however, not sufficient for tracing areas of distribution, for we must bear in mind the movements which have taken place on the surface of the earth, owing to which present conditions may not have existed within comparatively recent times, geologically speaking; and this is where the systematic study of the aquatic animals affords scope for conclusions having a direct bearing on the physical geography of the near past. It is not possible here to enter into the discussion of the many problems which the distribution of fresh-water fishes involves; we limit ourselves to an indication of the principal regions into which the world may be divided from this point of view. The main divisions proposed by Günther in the 9th edition of the *Encyclopædia Britannica* still appear the most satisfactory. They are as follows:—

I. The Northern Zone or Holarctic Region.—Characterized by Acipenseridae. Few Siluridae. Numerous Cyprinidae, Salmonidae, Esocidae, Percidae.

1. Europaeo-Asiatic or Palaearctic Region. Characterized by absence of osseous Ganoidei; Cobitinae and Barbus numerous.

2. North American or Nearctic Region. Characterized by osseous Ganoidei and abundance of Catostominae; but no Cobitinae or Barbus.

II. The Equatorial Zone.—Characterized by the development of Siluridae.

A. Cyprinoid Division. Characterized by presence of Cyprinidae, Mastacembelidae. Anabantidae, Ophiocephalidae.

1. Indian Region. Characterized by absence of Dipneusti, Polypteridae, Mormyridae and Characinidae. Cobitinae numerous.

2. African Region. Characterized by presence of Dipneusti, Polypterid and Mormyrid; Cichlid and Characinid numerous.

B. Acyprinoid Division. Characterized by absence of Cyprinidae and the other families mentioned above.

1. Tropical American or Neotropical Region. Characterized by presence of Dipneusti; Cichlidae and Characinidae numerous; Gymnotidae and Loricariidae.

2. Tropical Pacific Region. Includes the Australian as well as the Polynesian Region. Characterized

by presence of Dipneusti. Cichlidae and Characinidae absent.

III. The Southern Zone.—Characterized by absence of Cyprinidae and scarcity of Siluridae. Haplochitonidae and Galaxiidae represent the Salmonids and Esoces of the northern zone. One region only.

1. Antarctic Region. Characterized by the small number of species; the fishes of

(*a*) The Tasmanian subregion;

(*b*) The New Zealand subregion; and

(*c*) The Patagonian or Fuegian subregion being almost identical.

Although, as expressed in the above synopsis, the resemblance between the Indian and African regions is far greater than exists between them and the other regions of the equatorial zone, attention must be drawn to the marked affinity which some of the fishes of tropical Africa show to those of South America (*Lepidosirenidae*, *Characinidae*, *Cichlidae*, *Nandidae*), an affinity which favours the supposition of a connexion between these two parts of the world in early Tertiary times.

The boundaries of Günther's regions may thus be traced, beginning with the equatorial zone, this being the richest.

Equatorial Zone.—Roughly speaking, the borders of this zoological zone coincide with the geographical limits of the tropics of Cancer and Capricorn; its characteristic forms, however, extend in undulating lines several degrees both northwards and southwards. Commencing from the west coast of Africa, the desert of the Sahara forms a boundary between the equatorial and northern zones; as the boundary approaches the Nile, it makes a sudden sweep towards the north as far as northern Syria, crosses through Persia and Afghanistan to the southern ranges of the Himalayas, and follows the course of the Yang-tse-Kiang, which receives its contingent of equatorial fishes through its southern tributaries. Its continuation through the North Pacific may be indicated by the tropic, which strikes the coast of Mexico at the southern end of the Gulf of California. Equatorial types of South America are known to extend so far northwards; and, by following the same line, the West India Islands are naturally included in this zone.

Towards the south the equatorial zone embraces the whole of Africa and Madagascar, and seems to extend still farther south in Australia, its boundary probably following the southern coast of that continent; the detailed distribution of the freshwater fishes of south-western Australia has been little studied, but the tropical fishes of that region follow the principal watercourse, the Murray river, far towards the south and probably to its mouth. The boundary-line then stretches to the north of Tasmania and New Zealand, coinciding with the tropic until it strikes the western slope of the Andes, on the South American continent, where it again bends southward to embrace the system of the Rio de la Plata.

The four regions into which the equatorial zone is divided arrange themselves into two well-marked divisions, one of which is characterized by the presence of Cyprinid fishes, combined with the development of *Labyrinthic* Percesoces (*Anabantidae* and *Ophiocephalidae*) and Mastacembelids, whilst in the other these types are absent. The boundary between the Cyprinoid and Acyprinoid division seems to follow the now exploded Wallace's line—a line drawn from the south of the Philippines between Borneo and Celebes, and farther south between Bali and Lombok. Borneo abounds in Cyprinids; from the Philippine Islands a few only are known, and in Bali two species have been found; but none are known from Celebes or Lombok, or from islands situated farther east.

The Indian region comprises Asia south of the Himalayas and the Yang-tse-Kiang, and includes the islands to the west of Celebes and Lombok. Towards the north-east the island of Formosa, which also by other parts of its fauna shows the characters of the equatorial zone, has received some characteristic Japanese freshwater fishes. Within the geographical boundaries of China the freshwater fishes of the tropics pass gradually into those of the northern zone, both being separated by a broad, debateable ground. The affluents of the great river traversing this district are more numerous from the south than from the north, and carry the southern fishes far into the temperate zone. Scarcely better defined is the boundary of this region towards the north-west, in which fishes were very poorly represented by types common to India and Africa.

The African region comprises the whole of Africa south of the Sahara. It might have been conjectured that the more temperate climate of its southern extremity would have been accompanied by a conspicuous difference in the fish fauna. But this is not the case; the difference between the tropical and southern parts of Africa consists simply in the gradual disappearance of specifically tropical forms, whilst Silurids, Cyprinids and even *Anabas* penetrate to its southern coast; no new form, except a *Galaxias* at the Cape of Good Hope, has entered to impart to South Africa a character distinct from the central portion of the continent. In the north-east the African fauna passes the isthmus of Suez and penetrates into Syria; the system of the Jordan presents so many African types that it has to be included in a description of the African region as well as of the Europaeo-Asiatic.

The boundaries of the Neotropical or Tropical American region have been sufficiently indicated in the definition of the equatorial zone. A broad and most irregular band of country, in which the South and North American forms are mixed, exists in the north.

The Tropical Pacific region includes all the islands east of Wallace's line, New Guinea, Australia (with the exception of its south-eastern portion), and all the islands of the tropical Pacific to the Sandwich group.

Northern Zone.—The boundaries of the northern zone coincide in the main with the northern limit of the equatorial zone; but they overlap the latter at different points. This happens in Syria, as well as east of it, where the mixed faunae of the Jordan and the rivers of Mesopotamia demand the inclusion of this territory in the northern zone as well as in the equatorial; in the island of Formosa, where a Salmonid and several Japanese Cyprinids flourish; and in Central America, where a *Lepidosteus*, a Cyprinid (*Sclerognathus meridionalis*), and an *Amiurus* (*A. meridionalis*) represent the North American fauna in the midst of a host of

tropical forms.

There is no separate arctic zone for freshwater fishes; ichthyic life becomes extinct towards the pole wherever the fresh water remains frozen throughout the year, or thaws for a few weeks only; and the few fishes which extend into high latitudes belong to types in no wise differing from those of the more temperate south. The highest latitude at which fishes have been obtained is 82° N. lat., whence specimens of char (*Salmo arcturus* and *Salmo naresii*) have been brought back.

The Palaearctic or Europaeo-Asiatic Region.—The western and southern boundaries of this region coincide with those of the northern zone. Bering Strait and the Kamchatka Sea have been conventionally taken as the boundary in the north, but the fishes of both coasts, so far as they are known, are not sufficiently distinct to be referred to two different regions. The Japanese islands exhibit a decided Palaearctic fish fauna with a slight influx of tropical forms in the south. In the east, as well as in the west, the distinction between the Europaeo-Asiatic and the North American regions disappears almost entirely as we advance farther towards the north. Finally, the Europaeo-Asiatic fauna mingles with African and Indian forms in Syria, Persia and Afghanistan.

The boundaries of the North American or Nearctic region have been sufficiently indicated. The main features and the distribution of this fauna are identical with those of the preceding region.

Southern Zone.—The boundaries of this zone have been indicated in the description of the equatorial zone; they overlap the southern boundaries of the latter in South Australia and South America, but we have not the means of defining the limits to which southern types extend northwards. This zone includes Tasmania, with at least a portion of south-eastern Australia (Tasmanian sub-region), New Zealand and the Auckland Islands (New Zealand sub-region), and Chile, Patagonia, Tierra del Fuego and the Falkland Islands (Fuegian sub-region). No freshwater fishes are known from Kerguelen's Land, or from islands beyond 55° S. lat.

The Tropical American region is the richest (about 1300 species); next follow the African region (about 1000), the Indian region (about 800), the Europaeo-Asiatic region (about 500), the North American region (about 400), the Tropical Pacific region (about 60); whilst the Antarctic region is quite insignificant.

Of the migratory fishes, or fishes travelling regularly from the sea to fresh waters, most, if not all, were derived from marine forms. The anadromous forms, annually or periodically ascending rivers for the purpose of spawning, such as several species of *Acipenser*, *Salmo*, *Coregonus*, *Clupea* (shads), and *Petromyzon*, are only known from the northern hemisphere, whilst the catadromous forms, spending most of their life in fresh water but resorting to the sea to breed, such as *Anguilla*, some species of *Mugil*, *Galaxias* and *Pleuronectes*, have representatives in both hemispheres.

(G. A. B.)

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3 For electric organs see W. Biedermann, *Electro-Physiology*.

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31 R. Semon, *Zool. Forschungsreisen*, Band i. § 115.

32 O. Hertwig, *Arch. mikr. Anat.* xi. (1874).

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53 For literature of lateral line organs see Cole, *Trans. Linn. Soc.*, vii. (1898).

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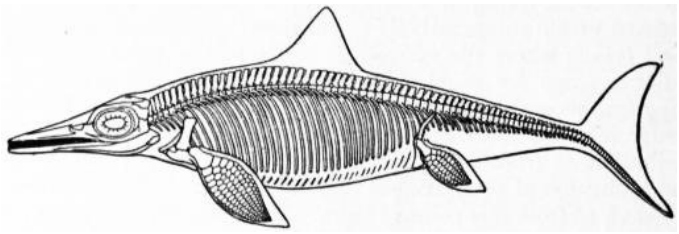
ICHTHYOPHAGI (Gr. for "fish-eaters"), the name given by ancient geographers to several coast-dwelling peoples in different parts of the world and ethnically unrelated. Nearchus mentions such a race as inhabiting the barren shores of the Mekran on the Arabian Sea; Pausanias locates them on the western coast of the Red Sea. Ptolemy speaks of fish-eaters in Ethiopia, and on the west coast of Africa; while Pliny relates the existence of such tribes on the islands in the Persian Gulf. Herodotus (book i. *c.* 200) mentions three tribes of the Babylonians who were solely fish-eaters, and in book iii. c. 19 refers to Ichthyophagi in Egypt. The existence of such tribes was confirmed by Sir Richard F. Burton (*El-Medinah*, p. 144).

ICHTHYOSAURUS, a fish or porpoise-shaped marine reptile which characterized the Mesozoic period and became extinct immediately after the deposition of the Chalk. It was named *Ichthyosaurus* (Gr. fish-lizard) by C. König in 1818 in allusion to its outward form, and is best known by nearly complete skeletons from the Lias of England and Germany. The large head is produced into a slender, pointed snout; and the jaws are provided with a row of conical teeth nearly uniform in size and deeply implanted in a continuous groove. The eye is enormous, and is surrounded by a ring of overlapping "sclerotic plates," which would serve to protect the eye-ball during diving. The vertebrae are very numerous, short and deeply biconcave, imparting great flexibility to the backbone as in fishes. The neck is so short and thick that it is practically absent. There are always two pairs of paddle-like limbs, the hinder pair never disappearing as in porpoises and other Cetacea, though often much reduced in size. A few specimens from the Upper Lias of Württemberg (in the museums of Stuttgart, Tübingen, Budapest and Chicago) exhibit remains of the skin, which is quite smooth and forms two triangular median fins, one in the middle of the back, the other at the end of the tail. The dorsal fin consists merely of skin without any internal skeleton, while the tail-fin is expanded in a vertical plane and has the lower lobe stiffened by the tapering end of the backbone, which is sharply bent downwards. Immature individuals are sometimes observable within the full-grown skeletons,

suggesting that this reptile was viviparous.



From British Museum *Guide to Fossil Reptiles and Fishes*, by permission of the Trustees.
Skeleton of *Ichthyosaurus communis*, with outline of body and fins, from the Lower Lias of Lyme Regis, Dorset; original nearly four metres in length.

The largest known species of *Ichthyosaurus* is *I. trigonodon* from the Upper Lias of Banz, Bavaria, with the head measuring about two metres in length and probably representing an animal not less than ten metres in total length. *I. platyodon*, from the English Lower Lias, seems to have been almost equally large. *I. intermedius* and *I. communis*, which are the commonest species in the English Lower Lias, rarely exceed a length of three or four metres. The species in rocks later than the Lias are known for the most part only by fragments, but the remains of Lower Cretaceous age are noteworthy for their very wide geographical distribution, having been found in Europe, the East Indies, Australia, New Zealand and South America. Allied Ichthyosaurians named *Ophthalmosaurus* and *Baptanodon*, from the Upper Jurassic of England and North America, are nearly or quite toothless and have very flexible broad paddles. The earliest known Ichthyosaurians (*Mixosaurus*), which occur in the Trias, are of diminutive size, with paddles which suggest that these marine reptiles were originally descended from land or marsh animals (see Reptiles).

Authorities.—R. Owen, *A Monograph of the Fossil Reptilia of the Liassic Formations*, part iii. (Mon. Palaeont. Soc., 1881); E. Fraas, *Die Ichthyosaurier der süddeutschen Trias- und Jura-Ablagerungen* (Tübingen, 1891). Also good figures in T. Hawkins, *The Book of the Great Sea-dragons* (London, 1840).

(A. S. Wo.)

ICHTHYOSIS, or Xeroderma, a general thickening of the whole skin and marked accumulation of the epidermic elements, with atrophy of the sebaceous glands, giving rise to a hard, dry, scaly condition, whence the names, from ἰχθύς, fish, and ξηρός, dry, δέρμα, skin. This disease generally first appears in infancy, and is probably congenital. It differs in intensity and in distribution, and is generally little amenable to any but palliative remedies, such as the regular application of oily substances. Ichthyosis lingualis ("smokers' tongue"), a variety common in heavy smokers, occurs in opaque white patches on the tongue, gums and roof of the mouth. Cancer occasionally starts from the patches. The affection is obstinate, but may disappear spontaneously.

ICKNIELD STREET. (i) The Saxon name (earlier *Icenhylt*) of a prehistoric (not Roman) "Ridgeway" along the Berkshire downs and the Chilterns, which crossed the Thames near Streatley and ended somewhere near Tring or Dunstable. In some places there are traces of a double road, one line on the hills and one in the valley below, as if for summer and winter use. No modern highroad follows it for any distance. Antiquaries have supposed that it once ran on to Royston, Newmarket and Norfolk, and have connected its name with the Iceni, the Celtic tribe inhabiting East Anglia before the Roman conquest. But the name does not occur in early documents so far east, and it has certainly nothing to do with that of the Iceni (Haverfield, *Victoria History of Norfolk*, i. 286). See further Ermine Street. (2) A Roman road which ran through Derby, Lichfield, Birmingham and Alcester is sometimes called Icknield Street and sometimes Rycknield Street. The origin of this nomenclature is very obscure (*Vict. Hist. of Warwick*, i. 239).

(F. J. H.)

ICON (through the Latinized form, from Gr. εἰκών, portrait, image), generally any image or portrait-figure, but specially the term applied to the representations in the Eastern Church of sacred personages, whether in painting or sculpture, and particularly to the small metal plaques in archaic Byzantine style, venerated by the adherents of the Greek Church. See Iconoclasts; Image-Worship; Byzantine Art. The term "iconography," once confined to the study of engravings (*q.v.*), is now applied to the history of portrait images in Christian art, though it is also used with a qualifying adjective of Greek, Roman and other art.

ICONIUM (mod. *Konia*), a city of Asia Minor, the last of the Phrygian land towards Lycaonia, was commonly reckoned to Lycaonia in the Roman time, but retained its old Phrygian connexion and population to a comparatively late date. Its natural surroundings must have made it an important town from the beginning of organized society in this region. It lies in an excellently fertile plain, 6 m. from the Pisidian mountains on the west, with mountains more distant on the north and south, while to the east the dead level plain stretches away for hundreds of miles, though the distant view is interrupted by island-like mountains. Streams from the Pisidian mountains make the land on the south-west and south of the city a garden; but on the east and north-east a great part of the naturally fertile soil is uncultivated. Trees grow nowhere except in the gardens near the city. Irrigation is necessary for productiveness, and the water-supply is now deficient. A much greater supply was available for agriculture in ancient times and might be reintroduced.

Originally a Phrygian city, as almost every authority who has come into contact with the population calls it, and as is implied in Acts xiv. 6, it was in a political sense the chief city of the Lycaonian tetrarchy added to the Galatian country about 165 B.C., and it was part of the Roman province Galatia from 25 B.C. to about A.D. 295. Then it was included in the province Pisidia (as Ammianus Marcellinus describes it) till 372, after which it formed part of the new province Lycaonia so long as the provincial division lasted. Later it was a principal city of the theme of Anatolia. It suffered much from the Arab raids in the three centuries following A.D. 660; its capture in 708 is mentioned, but it never was held as a city of the caliphs. In later Roman and Byzantine times it must have been a large and wealthy city. It was a metropolis and an archbishopric, and one of the earliest councils of the church was held there in A.D. 235. The ecclesiastical organization of Lycaonia and the country round Iconium on all sides was complete in the early 4th century, and monuments of later 3rd and 4th century Christianity are extremely numerous. The history of Christian Iconium is utterly obscure. The city was thrice visited by St Paul, probably in A.D. 47, 50 and 53; and it is the principal scene of the tale of Paul and Thecla (which though apocryphal has certainly some historical basis; see THECLA). There was a distinct Roman element in Iconium, arising doubtless from the presence of Roman traders. This was recognized by Claudius, who granted the honorary title Claudiconium, and by Hadrian, who elevated the city to the rank of a Roman colony about A.D. 130 under the name Colonia Aelia Hadriana Augusta Iconiensium. The period of its greatest splendour was after the conquest by the Seljuk Turks about 1072-1074. It soon became the capital of the Seljuk state, and one of the most brilliant cities of the world. The palace of the sultans and the mosque of Ala ed-dīn Kaikobād formerly covered great part of the Acropolis hill in the northern part of the city. Farther south there is still the great complex of buildings which form the chief seat of the Mevlevi dervishes, a sect widely spread over Anatolia. Many other splendid mosques and royal tombs adorned the city, and justified the Turkish proverb, “See all the world; but see Konia.” The walls, about 2 m. in circumference, consisted of a core of rubble and concrete, coated with ancient stones, inscriptions, sculptures and architectural marbles, forming a striking sight, which no traveller ever examined in detail. Beyond the walls extended the gardens and villas of a prosperous Oriental population, especially on the south-west towards the suburb of Meram.

When the Seljuk state broke up, and the Osmanli or Ottoman sovereignty arose, Konia decayed, its population dwindled and the splendid early Turkish buildings were suffered to go to ruin. As trade and intercourse diminished Konia grew poorer and more ruinous. The walls and the palace, still perfect in the beginning of the 19th century, were gradually pulled down for building material, and in 1882 there remained only a small part of the walls, from which all the outer stones had been removed, while the palace was a ruin. At that time and for some years later a large part of Konia was like a city of the dead. But about 1895 the advent of the Anatolian railway began to restore its prosperity. A good supply of drinking water was brought to the city by Ferid Pasha, who governed the vilayet ably for several years, till in 1903 he was 272
appointed Grand Vizier. The sacred buildings, mosques, &c., were patched up (except a few which were quite ruinous) and the walls wholly removed, but an unsightly fragment of a palace-tower still remained in 1906. In 1904-1905 the first two sections of the Bagdad railway, 117 m., to Karaman and Eregli, were built. In the city there is a branch of the Ottoman bank, a government technical school, a French Catholic mission and a school, an Armenian Protestant school for boys, an American mission school for girls, mainly Armenian, and other educational establishments.

The founder of the Mevlevi dancing dervishes, the poet Mahommed Jelal-ed-Din (Rumi), in 1307, though tempted to assume the inheritance along with the empire of the Seljuk sultan Ala ed-dīn Kaikobad III., who died without heirs, preferred to pass on the power to Osman, son of Ertogrul, and with his own hands invested Osman and girt him with the sword: this investiture was the legitimate beginning of the Osmanli authority. The heirs of Jelal-ed-Din (Rumi) were favoured by the Osmanli sultans until 1516, when Selim was on the point of destroying the Mevlevi establishment as hostile to the Osmanli and the faith; and though he did not do so the Mevlevi and their chiefs were deprived of influence and dignity. In 1829 Mahmud II. restored their dignity in part, and in 1889 Abd-ul-Hamid II. confirmed their exemption from military duty. The head of the Mevlevi dervishes (Aziz-Effendi, Hazreti-Mevlana, Mollah-Unkiar, commonly styled simply Chelebi-Effendi) has the right to gird on the sultan’s sword at his investiture, and is master of the considerable revenues of the greatest religious establishment in the empire. He has also the privilege of corresponding direct with the caliph; but otherwise is regarded as rather opposed to the Osmanli administration, and has no real power.

Iconium is distant by rail 466 m. from the Bosporus at Haidar-Pasha, and 389 from Smyrna by way of Afium-Kara-Hissar. It has recently become the seat of a considerable manufacture of carpets, owing to the cheapness of labour. The population was estimated at 44,000 in 1890, and is now probably over 50,000. Mercury mines have begun to be worked; other minerals are known to exist.

(W. M. RA.)

ICONOCLASTS (Gr. εἰκονοκλάστης: εἰκών, image, and κλάειν, to break), the name applied particularly to the opponents in the 8th and 9th centuries of the use of images in Christian cult.

As regards the attitude towards religious images assumed by the primitive Christian Church, several questions have often been treated as one which cannot be too carefully kept apart. There can be no doubt that the early Christians were unanimous in condemning heathen image-worship and the various customs, some immoral, with which it was associated. A form of iconolatry specially deprecated in the New Testament was the then prevalent adoration of the images of the reigning emperors (see Rev. xv. 2). It is also tolerably certain that, if for no other reasons besides the Judaism, obscurity, and poverty of the early converts to Christianity, the works of art seen in their meeting-houses cannot at first have been numerous. Along with these reasons would co-operate towards the exclusion of visible aids to devotion, not only the church's sacramental use of Christ's name as a name of power, and its living sense of his continued real though unseen presence, but also, during the first years, its constant expectation of his second advent as imminent. It was a common accusation brought against Jews and Christians that they had "no altars, no temples, no known images" (Min. Fel. *Oct.* c. 10), that "they set up no image or form of any god" (see Arnob. *Adv. Gent.* vi. I; similarly Celsus); and this charge was never denied; on the contrary Origen gloried in it (*c. Celsum*, bk. 7, p. 386). At a comparatively early date, indeed, we read of various Gnostic sects calling in the fine arts to aid their worship; thus Irenaeus (*Haer.* i. 25. 6), speaking of the followers of Marcellina, says that "they possess images, some of them painted, and others formed from different kinds of material; and they maintain that a likeness of Christ was made by Pilate at that time when Jesus lived among men. They crown these images, and set them up along with the images of the philosophers of the world; that is to say, with the images of Pythagoras and Plato and Aristotle and the rest. They have also other modes of honouring these images after the same manner as the Gentiles" (cf. Aug. *De Haer.* c. 7). It is also well known that the emperor Alexander Severus found a place for several Scripture characters and even for Christ in his lararium (Lamprid. *Vit. Alex. Sev.* c. 29). But there is no evidence that such a use of images extended at that period to orthodox Christian circles. The first unmistakable indication of the public use of the painter's art for directly religious ends does not occur until A.D. 306, when the synod of Elvira, Spain, decreed (can. 36) that "pictures ought not to be in a church, lest that which is worshipped and adored be painted on walls."[1] This canon is proof that the use of sacred pictures in public worship was not at the beginning of the 4th century a thing unknown within the church in Spain; and the presumption is that in other places, about the same period, the custom was looked upon with a more tolerant eye. Indications of the existence of allied forms of sacred Christian art prior to this period are not wholly wanting. It seems possible to trace some of the older and better frescos in the catacombs to a very early age; and Bible manuscripts were often copiously illuminated and illustrated even before the middle of the 4th century. An often-quoted passage from Tertullian (*De Pudic.* c. 10, cf. c. 7) shows that in his day the communion cup was wont to bear a representation of the Good Shepherd. Clement of Alexandria (*Paedag.* iii. 11) mentions the dove, fish, ship, lyre, anchor, as suitable devices for Christian signet rings. Origen (*c. Celsum*, bk. 3) repudiates graven images as only fit for demons.

During the 4th and following centuries the tendency to enlist the fine arts in the service of the church steadily advanced; not, however, so far as appears, with the formal sanction of any regular ecclesiastical authority, and certainly not without strong protests raised by more than one powerful voice. From a passage in the writings of Gregory of Nyssa (*Orat. de Laudibus Theodori Martyris*, c. 2) it is easy to see how the stories of recent martyrs would offer themselves as tempting subjects for the painter, and at the same time be considered to have received from him their best and most permanent expression; that this feeling was widespread is shown in many places by Paulinus of Nola (*ob.* 431), from whom we gather that not only martyrdoms and Bible histories, but also symbols of the Trinity were in his day freely represented pictorially. Augustine (*De Cons. Ev.* i. 10) speaks less approvingly of those who look for Christ and his apostles "on painted walls" rather than in his written word. How far the Christian feeling of the 4th and 5th centuries was from being settled in favour of the employment of the fine arts is shown by such a case as that of Eusebius of Caesarea, who, in reply to a request of Constantia, sister of Constantine, for a picture of Christ, wrote that it was unlawful to possess images pretending to represent the Saviour either in his divine or in his human nature, and added that to avoid the reproach of idolatry he had actually taken away from a lady friend the pictures of Paul and of Christ which she had.[2] Similarly Epiphanius in a letter to John, bishop of Jerusalem, tells how in a church at Anablatha near Bethel he had found a curtain painted with the image "of Christ or of some other saint," which he had torn down and ordered to be used for the burial of a pauper. The passage, however, reveals not only what Epiphanius thought on the subject, but also that such pictures must have been becoming frequent. Nilus, the disciple and defender of Chrysostom, permitted the symbol of the cross in churches and also pictorial delineations of Old and New Testament history, but deprecated other symbols, pictures of martyrs, and most of all the representation of Christ. In the time of Gregory the Great the Western Church obtained something like an authoritative declaration on the question about images, but in a sense not quite the same as that of the synod of Elvira. Serenus of Marseilles had ordered the destruction of all sacred images within his diocese; this action called forth several letters from Pope Gregory (viii. 2. III; ix. 4. 11), in which he disapproved of that course, and, drawing the distinction which has since been authoritative for the Roman Church, pointed out that—

> "It is one thing to worship a picture and another to learn from the language of a picture what that is which ought to be worshipped. What those who can read learn by means of writing, that do the uneducated learn by looking at a picture.... That, therefore, ought not to have been destroyed which had been placed in the churches, not for worship, but solely for instructing the minds of the ignorant."

With regard to the symbol of the cross, its public use dates from the time of Constantine, though, according to many Christian archaeologists it had, prior to that date, a very important place in the so-called "disciplina arcani." The introduction of the crucifix was later; originally the favourite combination was that of the figure of a lamb lying at the foot of the cross; the council of Constantinople, called "in Trullo," in 692 enjoined that this symbol should be discontinued, and that where Christ was shown in connexion with his cross he should be represented in his human nature. In the catacombs Christ is never represented hanging

on the cross, and the cross itself is only portrayed in a veiled and hesitating manner. In the Egyptian churches the cross was a pagan symbol of life borrowed by the Christians and interpreted in the pagan manner. The cross of the early Christian emperors was a *labarum* or token of victory in war, a standard for use in battle. Religious feeling in the West recoiled from the crucifix as late as the 6th century, and it was equally abhorrent to the Monophysites of the East who regarded the human nature of Christ as swallowed up in the divine. Nevertheless it seems to have originated in the East, perhaps as a protest against the extreme Monophysites, who even denied the passibility of Christ. Perhaps the Nestorians, who clung to the human aspect of Christ, introduced it about 550. From the East it soon passed to the West.

Not until the 8th century were the religious and theological questions which connect themselves with image-worship distinctly raised in the Eastern Church in their entirety. The controversy began with an address which Leo the Isaurian, in the tenth year of his reign (726), delivered in public "in favour of overthrowing the holy and venerable images," as says Theophanes (*Chronogr.*, in Migne *Patr. Gr.* 108, 816). This emperor had, in the years 717 and 718, hurled back the tide of Arab conquest which threatened to engulf Byzantium, and had also shown himself an able statesman and legislator. Born at Germanicia in Syria, and, before he mounted the throne, captain-general of the Anatolian theme, he had come under the influence of the anti-idolatrous sects, such as the Jews, Montanists, Paulicians and Manicheans, which abounded in Asia Minor, but of which he was otherwise no friend. But his religious reform was unpopular, especially among the women, who killed an official who, by the emperor's command, was destroying an image of Christ in the vestibule of the imperial palace of Chalcé. This *émeute* provoked severe reprisals, and the partisans of the images were mutilated and killed, or beaten and exiled. A rival emperor even, Agallianus, was set up, who perished in his attempt to seize Constantinople. Italy also rose in arms, and Pope Gregory II. wrote to Leo blaming his interference in religious matters, though he dissuaded the rebels in Venetia, the Exarchate and the Pentapolis from electing a new emperor and marching against Leo. In 730 Germanus the patriarch resigned rather than subscribe to a decree condemning images; later he was strangled, in exile and replaced by an iconoclast, Anastasius. Meanwhile, inside the Arab empire, John of Damascus wrote his three dogmatic discourses against the traducers of images, arguing that their use was not idolatry but only a relative worship (προσκύνησις σχετική). The next pope, Gregory III. convoked a council of ninety-three bishops, which excommunicated the iconoclasts, and the fleet which Leo sent to retaliate on the Latin peninsula was lost in a storm in the Adriatic. The most Leo was able to do was to double the tribute of Calabria and Sicily, confiscate the pope's revenues there, and impose on the bishops of south Italy a servitude to Byzantium which lasted for centuries.

Leo III. died in June 740, and then his son Constantine V. began a persecution of the image-worshippers in real earnest. In his eagerness to restore the simplicity of the primitive church he even assailed Mariolatry, intercession of saints, relics and perhaps infant baptism, to the scandal even of the iconoclast bishops themselves. His reign began with the seizure for eighteen months of Constantinople by his brother-in-law Artavasdes, who temporarily restored the images. He was captured and beheaded with his accomplices in November 742, and in February 754 Constantine held in the palace of Hieria a council of 388 bishops, mostly of the East; the patriarchs of Rome, Antioch, Alexandria and Jerusalem refused to attend. In it images were condemned, but the other equally conservative leanings of the emperor found no favour. The chief upholders of images, the patriarch Germanus, George of Cyprus and John of Damascus, were anathematized, and Christians forbidden to adore or make images or even to hide them. These decrees were obstinately resisted, especially by the monks, large numbers of whom fled to Italy. In 765 the emperor demanded of his subjects all over his empire an oath on the cross that they detested images, and St Stephen the younger, the chief upholder of them, was murdered in the streets. A regular crusade now began against monks and nuns, and images and relics were destroyed on a great scale. In parts of Asia Minor (Lydia and Caria) the monks were even forced to marry the nuns. In 769 Pope Stephen III. condemned the council of Hieria, and in 775 Constantine V. died. His son Leo IV. died in 780, leaving a widow, Irene, of Athenian birth, who seized the opportunity presented by the minority of her ten-year-old son Constantine VI. to restore the images and dispersed relics. In 784 she invited Pope Adrian I. to come and preside over a fresh council, which was to reverse that of 754 and heal the schism with Rome. In August 786 the council met, but was broken up by the imperial guards, who were Easterns and sturdy iconoclasts. Irene replaced them by a more trustworthy force, and convoked a fresh council of three hundred bishops and monks innumerable in September 787, at Nicaea in the church of St Sophia. The cult of images was now solemnly restored, iconoclast bishops deposed or reconciled, the dogmatic theory of images defined, and church discipline re-established. The order thus imposed lasted twenty-four years, until a military revolution placed a soldier of fortune, half Armenian, half Persian, named Leo, on the throne; he, like his soldiers, was persuaded that the ill-success of the Roman arms against Bulgarians and other invaders was due to the idolatry rampant at court and elsewhere. The soldiers stoned the image of Christ which Irene had set up afresh in the palace of Chalcé, and this provoked a counter-demonstration of the clergy. Leo feigned for a while to be on their side, but on the 2nd of February 815, in the sanctuary of St Sophia, publicly refused to prostrate himself before the images, with the approbation of the army and of many bishops who were iconoclasts at heart. Irene's patriarch Nicephorus was now deposed and one Theodotus, a kinsman of Constantine Copronymus, consecrated in his place on the 1st of April 815. A fresh council was soon convoked, which cursed Irene and re-enacted the decrees of 754. This reaction lasted only for a generation under Leo the Armenian, who died 820, Michael II. 820-829, and Theophilus 829-842; and was frustrated mainly by the exertions of Theodore of Studion and his monks, called the Studitae. Theodore refused to attend or recognize the new council, and was banished first to Bithynia and thence to Smyrna, whence he continued to address his appeals to the pope, to the eastern patriarchs and to his dispersed monks. He died in 826. Theophilus, the last of the iconoclast emperors, was a devoted Mariolater and controversialist who invited the monks to discuss the question of images with him, and whipped or branded them when he was out-argued; he at length banished them from the cities, and branded on the hands a painter of holy pictures, Lazarus by name, who declined to secularize his art; he also raised to the patriarchal throne John Hylilas, chief instigator of the reaction of 815. In 842 Theophilus died, leaving his wife Theodora regent; she was, like Irene, addicted to images, and chose as patriarch a monk, Methodius, whom the emperor Michael had

imprisoned for laying before him Pope Paschal I.'s letter of protest. John Hylilas was deposed and flogged in turn. A fresh council was now held which re-enacted the decrees of 787, and on the 20th of February 842 the new patriarch, the empress, clergy and court dignitaries assisted in the church of St Sophia at a solemn restoration of images which lasted until the advent of the Turks. The struggle had gone on for 116 years.

The iconoclastic movement is perhaps the most dramatic episode in Byzantine history, and the above outline of its external events must be completed by an appreciation of its deeper historical and religious significance and results. We can distinguish three parties among the combatants:—

1. The partisans of image worship. These were chiefly found in the Hellenic portions of the empire, where Greek art had once held sway. The monks were the chief champions of images, because they were illuminators and artists. Their doctors taught that the same grace of the Holy Spirit which imbued the living saint attaches after death to his relics, name, image and picture. The latter are thus no mere representations, but as it were emanations from the archetype, vehicles of the supernatural personality represented, and possessed of an inherent sacramental value and power, such as the name of Jesus had for the earliest believers. Here Christian image-worship borders on the beliefs which underlie sympathetic magic (see Image Worship).

2. The iconoclasts proper, who not only condemned image worship in the sense just explained but rejected all religious art whatever. Fleeting matter to their mind was not worthy to embody or reflect heavenly supersensuous energies denoted by the names of Christ and the saints. For the same reason they rejected relics and, as a rule, the worship of the cross. Statues of Christ, especially of him hanging on the cross, inspired the greatest horror and indignation; and this is why none of the graven images of Christ, common before the outbreak of the movement, survive. More than this—although the synod of 692 specially allowed the crucifix, yet Greek churches have discarded it ever since the 8th century.

This idea that material representation involves a profanation of divine personages, while disallowing all religious art which goes beyond scroll-work, spirals, flourishes and geometrical designs, yet admits to the full of secular art; and accordingly the iconoclastic emperors replaced the holy pictures in churches with frescoes of hunting scenes, and covered their palaces with garden scenes where men were plucking fruit and birds singing amid the foliage. Contemporary Mahommedans did the same, for it is an error to suppose that this religion was from the first hostile to profane art. At one time the mosques were covered with mosaics, analogous to those of Ravenna, depicting scenes from the life of Mahomet and the prophets. The Arabs only forbade plastic art in the 9th century, nor were their essentially Semitic scruples ever shared by the Persians.

The prejudice we are considering is closely connected with the Manichaean view of matter, which in strict consistency rejected the belief that God was really made flesh, or really died on the cross. The Manichaeans were therefore, by reason of their dualism, arch-enemies no less of Christian art than of relics and cross-worship; the Monophysites were equally so by reason of their belief that the divine nature in Christ entirely absorbed and sublated the human; they shaded off into the party of the *aphthartodoketes*, who held that his human body was incorruptible and made of ethereal fire, and that his divine nature was impassible. Their belief made them, like the Manichaeans, hostile to material portraiture of Christ, especially of his sufferings on the cross. All these nearly allied schools of Christian thought could, moreover, address, as against the image-worshippers, a very effective appeal to the Bible and to Christian antiquity. Now Egypt, Asia Minor, Armenia, western Syria and the Hauran were almost wholly given up to these forms of opinion. Accordingly in all the remains of the Christian art of the Hauran one seeks in vain for any delineation of human face or figure. The art of these countries is mainly geometrical, and allows only of monograms crowned with laurels, of peacocks, of animals gambolling amid foliage, of fruit and flowers, of crosses which are either *svastikas* of Hindu and Mycenaean type, or so lost in enveloping arabesques as to be merely decorative. Such was the only religious art permitted by the Christian sentiment of these countries, and also of the large *enclaves* of semi-Manichaean belief formed in the Balkans by the transportation thither of Armenians and Paulicians. And it is important to remark that the protagonists of iconoclasm in Byzantium came from these lands where image cult offended the deepest religious instincts of the masses. Leo the Isaurian had all the scruples of a Paulician, even to the rejection of the cult of Virgin and saints; Constantine V. was openly such. Michael Balbus was reared in Phrygia among Montanists. The soldiers and captains of the Byzantine garrisons were equally Armenians and Syrians, in whom the sight of a crucifix or image set up for worship inspired nothing but horror.

The issue of the struggle was not a complete victory even in Byzantium for the partisans of image-worship. The Iconoclasts left an indelible impress on the Christian art of the Greek Church, in so far as they put an end to the use of graven images; for the Eastern icon is a flat picture, less easily regarded than would be a statue as a nidus within which a spirit can lurk. Half the realm of creative art, that of statuary, was thus suppressed at a blow; and the other half, painting, forfeited all the grace and freedom, all the capacity of new themes, forms and colours, all the development which we see in the Latin Church. The Greeks have produced no Giotto, no Fra Angelico, no Raphael. Their artists have no choice of subjects and no initiative. Colour, dress, attitude, grouping of figures are all dictated by traditional rules, set out in regular manuals. God the Father may not be depicted at all—a restriction intelligible when we remember that the image in theory is fraught with the virtue of the archetype; but everywhere the utmost timidity is shown. What else could an artist do but make a slavish and exact copy of old pictures which worked miracles and perhaps had the reputation as well of having fallen from heaven?

3. Between these extreme parties the Roman Church took the middle way of common sense. The hair-splitting distinction of the Byzantine doctors between veneration due to images (προσκύνησις τιμητική), and the adoration (προσκύνησις λατρευτική) due to God alone, was dropped, and the utility of pictures for the illiterate emphasized. Their use was declared to be this, that they taught the ignorant through the eye what they should adore with the mind; they are not themselves to be adored. Such was Gregory the Great's teaching, and such also is the purport of the Caroline books, which embody the conclusions arrived at by the

bishops of Germany, Gaul and Aquitaine, presided over by papal legates at the council of Frankfort in 794, and incidentally also reveal the hatred and contempt of Charlemagne for the Byzantine empire as an institution, and for Irene, its ruler, as a person. The theologians whom Louis the Pious convened at Paris in 825, to answer the letter received from the iconoclast emperor Michael Balbus, were as hostile to the orthodox Greeks as to the image-worshippers, and did not scruple to censure Pope Adrian for having approved of the empress Irene's attitude. The council of Trent decided afresh in the same sense.

Two incidental results of the iconoclastic movement must be noticed, the one of less, the other of more importance. The lesser one was the flight of Greek iconolatrous monks from Asia Minor and the Levant to Sicily and Calabria, where they established convents which for centuries were the western homes of Greek learning, and in which were written not a few of the oldest Greek MSS. found in our libraries. The greater event was the scission between East and West. The fury of the West against the iconoclastic emperors was such that the whole of Italy clamoured for war. It is true that Pope Stephen II. applied in 753 to Constantine V., one of the worst destroyers of images, for aid against the Lombards, for the emperor of Byzantium was still regarded as the natural champion of the church. But Constantine refused aid, and the pope turned to the Frankish King Pippin. The die was cast. Henceforth Rome was linked with the Carolingian house in an alliance which culminated in the coronation of Charlemagne by the pope on the 25th of December 800.

In the crusading epoch the Cathars and Paulicians carried all over Europe the old iconoclastic spirit, and perhaps helped to transmit it to Wycliffe and Hus. Not the least racy clause in the document compiled about 1389 by the Wycliffites in defence of their defunct teacher is the following: "Hit semes that this offrynge ymages is a sotile cast of Antichriste and his clerkis for to drawe almes fro pore men ... certis, these ymages of hemselfe may do nouther gode nor yvel to mennis soules, but thai myghtten warme a man's body in colde, if thai were sette upon a fire."

At the period of the Reformation it was unanimously felt by the reforming party that, with the invocation of saints and the practice of reverencing their relics, the adoration of images ought also to cease. The leaders of the movement were not, however, perfectly agreed on the question as to whether these might not in some circumstances be retained in churches. Luther had no sympathy with the iconoclastic outbreaks which then occurred; he classed images in themselves as among the "adiaphora," and condemned only their cultus; so also the "Confessio Tetrapolitana" leaves Christians free to have them or not, if only due regard be had to what is expedient and edifying. The "Heidelberg Catechism," however, emphatically declares that images are not to be tolerated at all in churches.

SOURCES.—"Acts of the Seventh Ecumenical Council held in Nicaea, 787," in Mansi's *Concilia*, vols. xii. and xiii.; "Acts of the Iconoclast Council of 815," in a treatise of Nicephorus discovered by M. Serruys and printed in the *Séances Acad. des Inscript.* (May 1903); Theophanes, *Chronographia*, edit. de Boor (Leipzig, 1883-1885); and *Patr. Gr.* vol. 108. Also his "Continuators" in *Patr. Gr.* vol. 109; Nicephorus, *Chronicon*, edit. de Boor (Leipzig, 1880), and *Patr. Gr.* vol. 100; Georgius Monachus, *Chronicon*, edit. Muralt (Petersburg, 1859), and *Patr. Gr.* 110; anonymous "Life of Leo the Armenian" in *Patr. Gr.* 108; *The Book of the Kings*, by Joseph Genesios, *Patr. Gr.* 109; "Life of S. Stephanus, Junior," *Patr. Gr.* 100; "St John of Damascus," three "Sermones" against the iconoclasts, *Patr. Gr.* 95; Nicephorus Patriarch, "Antirrhetici," *Patr. Gr.* 100; Theodore Studita, "Antirrhetici," *Patr. Gr. 99*. For bibliography of contemporary hymns, letters, &c., bearing on the controversy see K. Krumbacher's *History of Byzantine Literature*, 2nd ed. p. 674. Literature: Louis Brehier, *La Querelle des images*, and *Les Origines du crucifix* (Paris, 1904); Librairie Blond, in French, each volume 60 centimes (brief but admirable); Karl Schwartzlose, *Der Bilderstreit* (Gotha, 1890); Karl Schenk, "The Emperor Leo III.," in *Byzant. Zeitschrift* (1896, German); Tel. Uspenskij, *Skizzen zur Geschichte der byzantinischen Kultur* (St Petersburg, 1892, Russian); Lombard, *Études d'histoire byzantine*; Constantine V.(Paris, 1902, *Biblioth. de l'université de Paris*, xvi.); A. Tougard, *La Persécution iconoclaste* (Paris, 1897); and *Rev. des questions historiques* (1891); Marin, *Les Moines de Constantinople* (Paris, 1897, bk. iv. *Les Moines et les empereurs iconoclastes*); Alice Gardner, Theodore of Studium (London, 1905); Louis Maimbourg, *Histoire de l'hérésie des iconoclastes* (Paris, 1679-1683); J. Daillé (Dallaeus), *De imaginibus* (Leiden, 1642, and in French, Geneva, 1641); Spanheim, *Historia imaginum* (Leiden, 1686). See also the account of this epoch in the *Histories* of Neander, Gibbon and Milman; Aug. Fr. Gfrörer, "Der Bildersturm" in *Byzantinische Geschichte 2* (1873); C. J. von Hefele, *Conciliengeschichte* 3 (1877), 366 ff. (also in English translation; Karl Krumbacher. *Byzant. Literaturgeschichte* (2nd ed. p. 1090).

(F. C. C.)

1 "Placuit picturas in ecclesia esse non debere, ne quod colitur et adoratur in parietibus depingatur." See Hefele, *Conciliengesch.* i. 170.

2 The letter, which is most probably, though not certainly, genuine, appears in the *Acta* of the second council of Nice.

ICONOSTASIS, the screen in a Greek church which divides the altar and sanctuary from the rest of the church. It is generally attached to the first eastern pier or column and rises to the level of the springing of the vault. The iconostasis or image-bearer has generally three doors, one on each side of the central door, beyond which is the principal altar. The screen is subdivided into four or five tiers, each tier decorated with a series of panels containing representations of the saints: of these only the heads, hands and feet are painted, the bodies being covered with embossed metal work, richly gilded. There is a fine example in the Russo-Greek chapel, Welbeck Street, London, which was rebuilt in 1864-1865.

ICOSAHEDRON (Gr. εἴκοσι, twenty, and ἕδρα, a face or base), in geometry, a solid enclosed by twenty faces. The "regular icosahedron" is one of the Platonic solids; the "great icosahedron" is a Kepler-Poinsot solid; and the "truncated icosahedron" is an Archimedean solid (see POLYHEDRON). In crystallography the icosahedron is a possible form, but it has not been observed; it is closely simulated by a combination of the octahedron and pentagonal dodecahedron, which has twenty triangular faces, but only eight are equilateral, the remaining twelve being isosceles (see CRYSTALLOGRAPHY).

ICTERUS, a bird so called by classical authors, and supposed by Pliny to be the same as the *Galgulus*, which is generally identified with the golden oriole (*Oriolus galbula*).[1] It signified a bird in the plumage of which yellow or green predominated, and hence Brisson did not take an unhappy liberty when he applied it in a scientific sense to some birds of the New World of which the same could be said. These are now held to constitute a distinct family, *Icteridae*, intermediate it would seem between the BUNTINGS (*q.v.*) and STARLINGS (*q.v.*); and, while many of them are called troopials (the English equivalent of the French *Troupiales*, first used by Brisson), others are known as the American GRACKLES (*q.v.*). The typical species of *Icterus* is the *Oriolus icterus* of Linnaeus, the *Icterus vulgaris* of Daudin and modern ornithologists, an inhabitant of northern Brazil, Guiana, Venezuela, occasionally visiting some of the Antilles and of the United States. Thirty-three species of the genus *Icterus* alone, and more than seventy others belonging to upwards of a score of genera, are recognized by Sclater and Salvin (*Nomenclator*, pp. 35-39) as belonging to the Neotropical Region, though a few of them emigrate to the northward in summer. *Cassicus* and *Ostinops* may perhaps be named as the most remarkable. They are nearly all gregarious birds, many of them with loud and in most cases, where they have been observed, with melodious notes, rendering them favourites in captivity, for they readily learn to whistle simple tunes. Some have a plumage wholly black, others are richly clad, as is the well-known Baltimore oriole, golden robin or hangnest of the United States, *Icterus baltimore*, whose brightly contrasted black and orange have conferred upon it the name it most commonly bears in North America, those colours being, says Catesby (*Birds of Carolina*, i. 48), the tinctures of the armorial bearings of the Calverts, Lords Baltimore, the original grantees of Maryland, but probably more correctly those of their liveries. The most divergent form of *Icteridae* seems to be that known in the United States as the meadow-lark, *Sturnella magna* or *S. ludoviciana*, a bird which in aspect and habits has considerable resemblance to the larks of the Old World, *Alaudidae*, to which, however, it has no near affinity, while *Dolichonyx oryzivorus*, the bobolink or rice-bird, with its very bunting-like bill, is not much less aberrant.

(A. N.)

1 The number of names by which this species was known in ancient times—*Chloris* or *Chlorion*, *Galbula* (akin to *Galgulus*), *Parra* and *Vireo*—may be explained by its being a common and conspicuous bird, as well as one which varied in plumage according to age and sex (see ORIOLE). Owing to its general colour, *Chloris* was in time transferred to the Greenfinch (*q.v.*), while the names *Galbula*, *Parra* and *Vireo* have since been utilized by ornithologists (see JACAMAR and JACANA).

ICTINUS, the architect of the Parthenon at Athens, of the Hall of the Mysteries at Eleusis, and of the temple of Apollo at Bassae, near Phigalia. He was thus active about 450-430 B.C. We know little else about him; but the remains of his two great temples testify to his wonderful mastery of the principles of Greek architecture.

IDA (d. 559), king of Bernicia, became king in 547, soon after the foundation of the kingdom of Bernicia by the Angles. He built the fortress of Bebbanburh, the modern Bamborough, and after his death his kingdom, which did not extend south of the Tees, passed in turn to six of his sons. The surname of "Flame-Bearer," sometimes applied to him, refers, however, not to Ida, but to his son Theodric (d. 587).

See J. R. Green, *Making of England*, vol. i. (London, 1897).

IDAHO, a western state of the United States of America, situated between 42° and 49° N. lat. and 111° and 117° W. long. It is bounded N. by British Columbia and Montana, E. by Montana and Wyoming, S. by Utah and Nevada, and W. by Oregon and Washington. Its total area is 83,888 sq. m., of which 83,354 sq. m. are land surface, and of this 41,851.55 sq. m. were in July 1908 unappropriated and unreserved public lands of the United States, and 31,775.7 sq. m. were forest reserves, of which 15,153.5 sq. m. were reserved between the 1st of July 1906 and the 1st of July 1907.

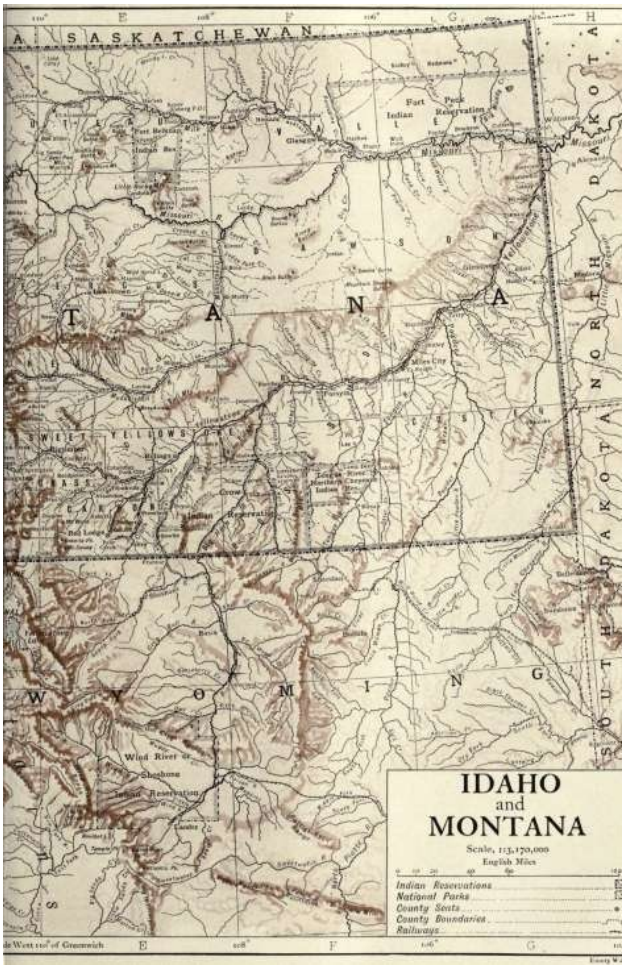
Physical Features.—Idaho's elevation above sea-level varies from 738 ft. (at Lewiston, Nez Perce county) to 12,078 ft. (Hyndman Peak, on the boundary between Custer and Blaine counties), and its mean elevation is about 4500 ft. The S.E. corner of the wedge-shaped surface of the state is a part of the Great Basin region of the United States. The remainder of the state is divided by a line running S.E. and N.W., the smaller section, to the N. and E., belonging to the Rocky Mountain region, and the larger, S. and W. of this imaginary line, being a part of the Columbia Plateau region. The topography of the Great Basin region in Idaho is similar to that of the same region in other states (see NEVADA); in Idaho it forms a very small part of the state; its mountains are practically a part of the Wasatch Range of Utah; and the southward drainage of the region (into Great Salt Lake, by Bear river) also separates it from the other parts of the state. The Rocky Mountain region of Idaho is bounded by most of the state's irregular E. boundary—the Bitter Root, the Cœur d'Alene and the Cabinet ranges being parts of the Rocky Mountain System. The Rocky Mountain region reaches across the N. part of the state (the Panhandle), and well into the middle of the state farther S., where the region is widest and where the Salmon River range is the principal one. The region is made up in general of high ranges deeply glaciated, preserving some remnants of ancient glaciers, and having fine "Alpine" scenery, with many sharp peaks and ridges, **U**-shaped valleys, cirques, lakes and waterfalls. In the third physiographic region, the Columbia plateau, are the Saw Tooth, Boisé, Owyhee and other rugged ranges, especially on the S. and W. borders of the region. The most prominent features of this part of the state are the arid Snake river plains and three mountain-like elevations—Big, Middle and East Buttes—that rise from their midst. The plains extend from near the S.E. corner of the state in a curved course to the W. and N.W. for about 350 m. over a belt 50 to 75 m. wide, and cover about 30,000 sq. m. Where they cross the W. border at Lewiston is the lowest elevation in the state, 738 ft. above the sea. Instead of being one plain formed by erosion, this region is rather a series of plains built up with sheets of lava, several thousand feet deep, varying considerably in elevation and in smoothness of surface according to the nature of the lava, and being greater in area than any other lava beds in North America except those of the Columbia river, which are of similar formation and, with the Snake river plains, form the Columbia plateau. Many volcanic cones mark the surface, but by far the most prominent among them are Big Butte, which rises precipitously 2350 ft. above the plain (7659 ft. above the sea) in the E. part of Blaine county, and East Butte, 700 ft. above the plain, in the N.W. part of Bingham county. Middle Butte (400 ft. above the plain, also in Bingham county) is an upraised block of stratified basalt. The Snake river (which receives all the drainage of Idaho except small amounts taken by the Spokane, the Pend Oreille and the Kootenai in the N., all emptying directly into the Columbia, and by some minor streams of the S.E. that empty into Great Salt Lake, Utah) rises in Yellowstone National Park a few miles from the heads of the Madison fork of the Missouri, which flows to the Gulf of Mexico, and the Green fork of the Colorado, which flows to the Gulf of California. It flows S.W. and then W. for about 800 m. in a tremendous cañon across southern Idaho; turns N. and runs for 200 m. as the boundary between Idaho and Oregon (and for a short distance between Idaho and Washington); turns again at Lewiston (where it ceases to be the boundary, and where the Clearwater empties into it) to the W. into a deep narrow valley, and joins the Columbia in S.E. Washington. Practically all the valley of the Snake from Idaho Falls in S.E. Idaho (Bingham county) to the mouth is of cañon character, with walls from a few hundred to 6000 ft. in height (about 650 m. in Idaho). The finest parts are among the most magnificent in the west; among its falls are the American (Oneida and Blaine counties), and the Shoshone and the Salmon (Lincoln county). At the Shoshone Falls the river makes a sudden plunge of nearly 200 ft., and the Falls have been compared with the Niagara and Zambezi; a short distance back of the main fall is a cataract of 125 ft., the Bridal Veil. Between Henry's Fork and Malade (or Big Wood) river, a distance of 200 m., the river apparently has no northern tributaries; but several streams, as the Camas, Medicine Lodge and Birch creeks, and Big and Little Lost rivers, which fail to penetrate the plain of the Snake after reaching its border, are believed to join it through subterranean channels. The more important affluents are the North Fork in the E., the Raft, Salmon Falls and the Bruneau in the S., the Owyhee and the Payette in the S.W., and the Salmon and Clearwater in the W. The scenery on some of these tributaries is almost as beautiful as that of the Snake, though lacking the grandeur of its greater scale. In 1904 electricity, generated by water-power from the rivers, notably the Snake, began to be utilized in mining operations. Scattered among the mountains are numerous (glacial) lakes. In the N. are: Cœur d'Alene Lake, in Kootenai county, about 30 m. long and from 2 to 4 m. wide, drained by the Spokane river; Priest Lake, in Bonner county, 20 m. long and about 10 m. wide; and mostly in Bonner, but partly in Kootenai county, a widening of Clark Fork, Lake Pend Oreille, 60 m. long and from 3 to 15 m. wide, which is spanned by a trestle of the Northern Pacific 8400 ft. long. Bear Lake, in the extreme S.E., lies partly in Utah. Mineral springs and hot springs are also a notable feature of Idaho's physiography, being found in Washington, Ada, Blaine, Bannock, Cassia, Owyhee, Oneida, Nez Perce, Kootenai, Shoshone and Fremont counties. At Soda Springs in Bannock county are scores of springs whose waters, some ice cold and some warm, contain magnesia, soda, iron, sulphur, &c.; near Hailey, Blaine county, water with a temperature of 144° F. is discharged from numerous springs; and at Boisé, water with a temperature of 165° is obtained from wells.

The fauna and flora of Idaho are similar in general to those of the other states in the north-western part of the United States.

Climate.—The mean annual temperature of Idaho from 1898 to 1903 was 45.5° F. There are several distinct climate zones within the state. North of Clearwater river the climate is comparatively mild, the maximum in 1902 (96° F.) being lower than the highest temperature in the state and the minimum (−16°) higher than the lowest temperature registered. The mildest region of the state is the Snake river basin between Twin Falls and Lewiston, and the valley of the Boisé, Payette and Weiser rivers; here the mean annual temperature in 1902 was 52° F., the maximum was 106° F., and the minimum was −13° F. In the Upper Snake basin, in the Camas prairie and Lost river regions, the climate is much colder, the highest temperature in 1902 being 101° and the lowest −35° F. The mean annual rainfall for the entire state in 1903 was 16.60 in.; the highest amount recorded was at Murray, Shoshone county (37.70 in.) and the lowest was at Garnet, Elmore county (5.69 in.).

Agriculture.—The principal source of wealth in Idaho was in 1900 agriculture, but it had long been secondary to mining, and its development had been impeded by certain natural disadvantages. Except for the broad valleys of the Panhandle, where the soils are black in colour and rich in vegetable mould, the surface of the state is arid; the Snake river valley is a vast lava bed, covered with deposits of salt and sand, or soils of volcanic origin. And, apart from this, the farming country was long without transport facilities.

The fertile northern plateaus, the Camas and Nez Perce prairies and the Palouse country—a wonderful region for growing the *durum* or macaroni wheat—until 1898 had no market nearer than Lewiston, 50-70 m. away; and even in 1898, when the railway was built, large parts of the region were not tapped by it, and were as much as 30 m. from any shipping point, for the road had followed the Clearwater. In the arid southern region, also, there was no railway until 1885, when the Oregon Short Line was begun. Like limitations in N. and S. had like effects: for years the country was devoted to live-stock, which could be driven to a distant market. Timothy was grown in the northern, and alfalfa in the southern region as a forage crop. Even at this earliest period, irrigation, simple and individual, had begun in the southern section, the head waters of the few streams in this district being soon surrounded by farms. Co-operation and colonization followed, and more ditching was done, co-operative irrigation canals were constructed with some elaborate and large dams and head gates. The Carey Act (1894) and the Federal Reclamation Act (1902) introduced the most important period of irrigation. Under the Carey Act the Twin Falls project, deriving water from the Snake river near Twin Falls, and irrigating more than 200,000 acres, was completed in 1903-1905. The great projects undertaken with Federal aid were: the Minidoka, in Lincoln and Cassia counties, of which survey began in March 1903 and construction in December 1904, and which was completed in 1907, commanding an irrigable area of 130,000-150,000 acres,[1] and has a diversion dam (rock-fill type) 600 ft. long, and 130 m. of canals and 100 m. of laterals; the larger Payette-Boisé project in Ada, Canyon and Owyhee counties (372,000 acres irrigable; 300,000 now desert; 60% privately owned), whose principal features are the Payette dam (rock-fill), 100 ft. high and 400 ft. long, and the Boisé dam (masonry), 33 ft. high and 400 ft. long, 200 m. of canals, 100 m. of laterals, a tunnel 1100 ft. long and 12,500 h.p. transmitted 29 m., 3000 h.p. being necessary to pump to a height of 50-90 ft. water for the irrigation of 15,000 acres; and the Dubois project, the largest in the state, on which survey and reconnaissance work were done in 1903-1904, which requires storage sites on the North Fork of the Snake and on nearly all the important branches of the North Fork, and whose field is 200,000—250,000 acres, almost entirely Federal property, in the W. end of Fremont county between Mud Lake and the lower end of Big Lost river. A further step in irrigation is the utilization of underground waters: in the Big Camas Prairie region, Blaine county, water 10 ft. below the surface is tapped and pumped by electricity generated from the only surface water of the region, Camas Creek. In 1899 the value of the crops and other agricultural products of the irrigated region amounted to more than seven-tenths of the total for the state. In 1907, according to the *Report* of the state commissioner of immigration, 1,559,915 irrigated acres were under cultivation, and 3,266,386 acres were “covered” by canals 3789 m. long and costing $11,257,023.



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Up to 1900 the most prosperous period (absolutely) in the agricultural development of the state was the last decade of the 19th century; the relative increase, however, was greater between 1880 and 1890. The number of farms increased from 1885 in 1880 to 6603 in 1890 and to 17,471 in 1900; the farm acreage from 327,798 in 1880 to 1,302,256 in 1890 and to 3,204,903 acres in 1900; the irrigated area (exclusive of farms on Indian reservations) from 217,005 acres in 1889 to 602,568 acres in 1899; the value of products increased from $1,515,314 in 1879 to $3,848,930 in 1889, and to $18,051,625 in 1899; the value of farm

land with improvements (including buildings) from $2,832,890 in 1880 to $17,431,580 in 1890 and $42,318,183 in 1900; the value of implements and machinery from $363,930 in 1880 to $1,172,460 in 1890 and to $3,295,045 in 1900; and that of live-stock from $4,023,800 in 1880 to $7,253,490 in 1890 and to $21,657,974 in 1900. In 1900 the average size of farms was 183.4 acres. Cultivation by owners is the prevailing form of tenure, 91.3% of the farms being so operated in 1900 (2.3% by cash tenants and 6.4% by share tenants). As illustrative of agricultural conditions the contrast of the products of farms operated by Indians, Chinese and whites is of considerable interest, the value of products (not fed to live-stock) per acre of the 563 Indian farms being in 1899 $1.40, that of the 16,876 white farms $4.67, and that of the 23 Chinese farms intensively cultivated and devoted to market vegetables $69.83.

The income from agriculture in 1899 was almost equally divided between crops ($8,951,440) and animal products ($8,784,364)—in that year forest products were valued at $315,821. Of the crops, hay and forage were the most valuable ($4,238,993), yielding 47.4% of the total value of crops, an increase of more than 200% over that of 1889, and in 1907, according to the *Year-book* of the Department of Agriculture, the crop was valued at $8,585,000. Wheat, which in 1899 ranked second ($2,131,953), showed an increase of more than 400% in the decade, and the farm value of the crop of 1907, according to the *Year-book* of the United States Department of Agriculture, was $5,788,000; the value of the barley crop in 1899 ($312,730) also increased more than 400% over that of 1889, and in 1907 the farm value of the product, according to the same authority, was $1,265,000; the value of the oat crop in 1899 ($702,955) showed an increase of more than 300% in the decade, and the value of the product in 1907, according to the United States Department of Agriculture, was $2,397,000.

More than one-half of the cereal crop in 1905 was produced in the prairie and plateau region of Nez Perce and Latah counties. The production of orchard fruits (apples, cherries, peaches, pears, plums and prunes) increased greatly from 1889 to 1899; the six counties of Ada, Canyon (probably the leading fruit county of the state), Latah (famous for apples), Washington, Owyhee and Nez Perce had in 1900 89% of the plum and prune trees, 85% of all pear trees, 78% of all cherry trees, and 74% of all apple trees in the state, and in 1906 it was estimated by the State Commissioner of Immigration that there were nearly 48,000 acres of land devoted to orchard fruits in Idaho. Viticulture is of importance, particularly in the Lewiston valley. In 1906, 234,000 tons of sugar beets were raised, and fields in the Boisé valley raised 30 tons per acre.

Of the animal products in 1899, the most valuable was live-stock sold during the year ($3,909,454); the stock-raising industry was carried on most extensively in the S.E. part of the state. Wool ranked second in value ($2,210,790), and according to the estimate of the National Association of Wool Manufactures for 1907, Idaho ranked fourth among the wool-producing states in number of sheep (2,500,000), third in wool, washed and unwashed (17,250,000 lb.), and fourth in scoured wool (5,692,500 lb.). In January 1908, according to the *Year-book* of the Department of Agriculture, the number and farm values of live-stock were: milch cows, 69,000, valued at $2,208,000, and other neat cattle, 344,000, valued at $5,848,000; horses, 150,000, $11,250,000; sheep, 3,575,000, $12,691,000; and swine, 130,000, $910,000. According to state reports for 1906, most of the neat cattle were then on ranges in Lemhi, Idaho, Washington, Cassia and Owyhee counties; Nez Perce, Canyon, Fremont, Idaho, and Washington counties had the largest number of horses; Owyhee, Blaine and Canyon counties had the largest numbers of sheep, and Idaho and Nez Perce counties were the principal swine-raising regions. The pasture lands of the state have been greatly decreased by the increase of forest reserves, especially by the large reservations made in 1906-1907.

Mining.—The mineral resource of Idaho are second only to the agricultural; indeed it was primarily the discovery of the immense value of the deposits of gold and silver about 1860 that led to the settlement of Idaho Territory. In Idaho, as elsewhere, the first form of mining was a very lucrative working of placer deposits; this gave way to vein mining and a greatly reduced production of gold and silver after 1878, on account of the exhaustion of the placers. Then came an adjustment to new conditions and a gradual increase of the product. The total mineral product in 1906, according to the State Mine Inspector, was valued at $24,138,317. The total gold production of Idaho from 1860 to 1906 has been estimated at $250,000,000, of which a large part was produced in the Idaho Basin, the region lying between the N. fork of the Boisé and the S. fork of the Payette rivers. In 1901-1902 rich gold deposits were discovered in the Thunder Mountain district in Idaho county. The counties with the largest production of gold in 1907 (state report) were Owyhee ($362,742), Boisé ($282,444), Custer ($210,900) and Idaho; the total for the state was $1,075,618 in 1905; in 1906 it was $1,149,100; and in 1907, according to state reports, $1,373,031. The total of the state for silver in 1905 was $5,242,172; in 1906 it was $6,042,606; in 1907, according to state reports, it was $5,546,554. The richest deposits of silver are those of Wood river and of the Cœur d'Alene district in Shoshone county (opened up in 1886); the county's product in 1906 was valued at $5,322,706, an increase of $917,743 over the preceding year; in 1907 it was $4,780,093, according to state reports. The production of the next richest county, Owyhee, in 1907, was less than one tenth that of Shoshone county, which yields, besides, about one half of the lead mined in the United States, its product of lead being valued at $9,851,076 in 1904, at $14,365,265 in 1906, and at $12,232,233 (state report) in 1907. Idaho was the first of the states in its output of lead from 1896, when it first passed Colorado in rank, to 1906, excepting the year 1899, when Colorado again was first; the value of the lead mined in 1906 was $14,535,823, and of that mined in 1907 (state report), $12,470,375. High grade copper ores have been produced in the Seven Devils and Washington districts of Washington county; there are deposits, little developed up to 1906, in Lemhi county (which was almost inaccessible by railway) and in Bannock county; the copper mined in 1905 was valued at $1,134,846, and in 1907, according to state reports, at $2,241,177, of which about two-thirds was the output of the Cœur d'Alene district in Shoshone county. Zinc occurs in the Cœur d'Alene district, at Hailey, Blaine county and elsewhere; according to the state reports, the state's output in 1906 was valued at $91,426 and in 1907 at $534,087. Other minerals of economic value are sandstone, quarried at Boisé, Ada county, at Preston, Oneida county, and at Goshen, Prospect and Idaho Falls, Bingham county, valued at $22,265 in 1905, and at $11,969 in 1906; limestone, valued at $14,105 in 1905 and at $12,600 in 1906, used entirely for the local manufacture of lime, part of which was used in the manufacture of sugar; and coal, in the Horseshoe Bend and Jerusalem districts in Boisé county, in Lemhi county near Salmon City, and in E. Bingham and Fremont counties, with an output in 1906 of 5365 tons, valued at $18,538 as compared with 20 and 10 tons respectively in 1899 and 1900. Minerals developed slightly, or not at all, are granite, valued at $1500 in 1905; surface salt, in the arid and semi-arid regions; nickel and cobalt, in Lemhi county; tungsten, near Murray, Shoshone county; monazite and zircon, in certain sands; and some pumice.

Manufactures.—The manufactures of Idaho in 1900 were relatively unimportant, the value of all products of establishments under the "factory system" being $3,001,442; in 1905 the value of such manufactured products had increased 192.2%, to $8,768,743. The manufacturing establishments were limited to the supply of local demands. The principal industries were devoted to lumber and timber products, valued at $908,670 in 1900, and in 1905 at $2,834,506, 211.9% more. In 1906 the Weyerhauser Syndicate built at Potlatch, a town built by the syndicate in Latah county, a lumber mill, supposed to be the largest in the United States, with a daily capacity of 750,000 ft. In Bonner county there are great mills at Sand Point and at Bonner's Ferry. In these and the other 93 saw-mills in the state in 1905 steam generated by the waste wood was the common power. The raw material for these products was secured from the 35,000 sq. m. of timber land in the state (6164 sq. m. having been reserved up to 1905, and 31,775.7 sq. m. up to April 1907 by the United States government); four-fifths of the cut in 1900 was yellow pine. Flour and grist mill products ranked second among the manufactures, being valued at $1,584,473 in 1905, an increase of nearly 116% over the product in 1900; and steam-car construction and repairs ranked third, with a value of $913,670 in 1905 and $523,631 in 1900. In 1903-1904 the cultivation of sugar beets and the manufacture of beet sugar were undertaken, and manufacturing establishments for that purpose were installed at Idaho Falls and Blackfoot (Bingham county), at Sugar, or Sugar City (Fremont county), a place built up about the sugar refineries, and at Nampa, Canyon county. In 1906 between 57,000,000 and 64,000,000 ℔ of beet sugar were refined in the state. Brick-making was of little more than local importance in 1906, the largest kilns being at Boisé, Sand Point and Cœur d'Alene City. Lime is made at Orofino, Shoshone county, and at Hope, Bonner county.

Communications.—The total railway mileage in January 1909 was 2,022.04 m., an increase from 206 m. in 1880 and 946 m. in 1890. The Great Northern, the Northern Pacific, and the Oregon Railway & Navigation lines cross the N. part of the state; the Oregon Short Line crosses the S., and the Union Pacific, which owns the Oregon Railway & Navigation and the Oregon Short Line roads, crosses the eastern part. The constitution declares that railways are public highways, that the legislature has authority to regulate rates, and that discrimination in tolls shall not be allowed.

Population.—The population of Idaho in 1870 was 14,999; in 1880 it was 32,610, an increase of 117.4%; in 1890 it was 88,548, an increase of 158.8%; in 1900 161,772 (82.7% increase); and in 1910 325,594 (101.3% increase). Of the inhabitants 15.2% were in 1900 foreign-born and 4.5% were coloured, the coloured population consisting of 293 negroes, 1291 Japanese, 1467 Chinese and 4226 Indians. The Indians lived principally in three reservations, the Fort Hall and Lemhi reservations (1350 sq. m. and 100 sq. m. respectively), in S.E. and E. Idaho, being occupied by the Shoshone, Bannock and Sheef-eater tribes, and the Cœur d'Alene reservation (632 sq. m.), in the N.W., by the Cœur d'Alene and Spokane tribes. The former Nez Perce reservation, in the N.W. part of the state, was abolished in 1895, and the Nez Perces were put under the supervision of the superintendent of the Indian School at Fort Lapwai, about 12 m. E. of Lewiston, in Nez Perce county. Of these tribes, the Nez Perce and Cœur d'Alene were self-supporting; the other tribes were in 1900 dependent upon the United States government for 30% of their rations. Of the 24,604 foreign-born inhabitants of the state, 3943 were from England, 2974 were from Germany, 2528 were Canadian English, 2822 were from Sweden, and 1633 were from Ireland, various other countries being represented by smaller numbers. The urban population of Idaho in 1900 (*i.e.* the population of places having 4000 or more inhabitants) was 6.2% of the whole. There were thirty-three incorporated cities, towns and villages, but only five had a population exceeding 2000; these were Boisé (5957), Pocatello (4046), Lewiston (2425), Moscow (2484) and Wallace (2265). In 1906 it was estimated that the total membership of all religious denominations was 74,578, and that there were 32,425 Latter-Day Saints or Mormons (266 of the Reorganized Church), 18,057 Roman Catholics, 5884 Methodist Episcopalians (5313 of the Northern Church), 3770 Presbyterians (3698 of the Northern Church), 3206 Disciples of Christ, and 2374 Baptists (2331 of the Northern Convention).

Government.—The present constitution of Idaho was adopted in 1889. The government is similar in outline to that of the other states of the United States. The executive officials serve for a term of two years. Besides being citizens of the United States and residents of the state for two years preceding their election the governor, lieutenant-governor and attorney-general must each be at least thirty years of age, and the secretary of state, state auditor, treasurer and superintendent of education must be at least twenty-five years old. The governor's veto may be overridden by a two-thirds vote of the legislature; the governor, secretary of state, and the attorney-general constitute a Board of Pardons and a Board of State Prison Commissioners. The legislature meets biennially; its members, who must be citizens of the United States and electors of the state for one year preceding their election, are chosen biennially; the number of senators may never exceed twenty-four, that of representatives sixty; each county is entitled to at least one representative. The judiciary consists of a supreme court of three judges, elected every six years, and circuit and probate courts, the five district judges being elected every four years. Suffrage requirements are citizenship in the United States, registration and residence in the state for six months and in the county for thirty days immediately before election, but mental deficiency, conviction of infamous crimes (without restoration to rights of citizenship), bribery or attempt at bribery, bigamy, living in "what is known as patriarchal, plural or celestial marriage," or teaching its validity or belonging to any organization which teaches polygamy,[2] are disqualifications. Chinese or persons of Mongolian descent not born in the United States are also excluded from suffrage rights. Women, however, since 1897, have had the right to vote and to hold office, and they are subject to jury service. An Australian ballot law was passed in 1891. The constitution forbids the chartering of corporations except according to general laws. In 1909 a direct primary elections law was passed which required a majority of all votes to nominate, and, to make a majority possible, provided for preferential (or second-choice) voting, such votes to be canvassed and added to the first-choice vote for each candidate if there be no majority by the first-choice vote. The right of eminent domain over all corporations is reserved to the state; and no corporation may issue stock except for labour, service rendered, or money paid in. The waters of the state are, by the constitution of the state, devoted to the public use, contrary to the common law theory of riparian rights. By statute (1891) it has been provided that in civil actions three-fourths of a jury may render a verdict, and in misdemeanour cases five-sixths may give a verdict. Life insurance agents not residents of Idaho cannot write policies in the state.

Divorces may be obtained after residence of six months on the ground of adultery, cruelty, desertion or neglect for one year, habitual drunkenness for the same period, felony or insanity. There are a state penitentiary at Boisé, an Industrial Training School at St Anthony, an Insane Asylum at Blackfoot, and a North Idaho Insane Asylum at Orofino. The care of all defectives was let by contract to other states until 1906, when a state school for the deaf and blind was opened in Boisé. No bureau of charities is in existence, but there is a Labor Commission, and a Commissioner of Immigration and a Commissioner of Public Lands to investigate the industrial resources. The offices of State Engineer and Inspector of Mines have been created.

Education.—The public schools in 1905-1906 had an enrolment of 62,726, or 81.5% of the population between 5 and 21 years of age. The average length of school term was 6-8 months, the average expenditure (year ending Aug. 31, 1906) for instruction for each child was $19.29, and the expenditure for all school purposes was $1,008,481. There was a compulsory attendance law, which, however, was not enforced. Higher education is provided by the University of Idaho, established in 1899 at Moscow, Latah county, which confers degrees in arts, science, music and engineering, and offers free tuition. In 1907-1908 the institution had 41 instructors and 426 regular and 58 special students. In 1901 the Academy of Idaho, another state institution with industrial and technical courses and a preparatory department, was established at Pocatello, Bannock county, to be a connecting link between the public schools and the university. There are two state normal schools, one at Lewiston and the other at Albion. The only private institution of college rank in 1908 was the College of Caldwell (Presbyterian, opened 1891) at Caldwell, Canyon county, with 65 students in 1906-1907. There are Catholic academies at Boisé and Cœur d'Alene and a convent, Our Lady of Lourdes, at Wallace, Shoshone county, opened in 1905; Mormon schools at Paris (Bear Lake county), Preston (Oneida county), Rexburg (Fremont county), and Oakley (Cassia county); a Methodist Episcopal school (1906) at Weiser (Washington county); and a Protestant Episcopal school at Boisé (1892). The Idaho Industrial Institute (non-denominational; incorporated in 1899) is at Weiser.

Finance.—The finances of Idaho are in excellent condition. The bonded debt on the 30th of September 1908 was $1,364,000. The revenue system is based on the general property tax and there is a State Board of Equalization. Each year $100,000 is set aside for the sinking fund for the payment of outstanding bonds as fast as they become due. The constitution provides that the rate of taxation shall never exceed 10 mills for each dollar of assessed valuation, that when the taxable property amounts to $50,000,000 the rate shall not exceed 5 mills, when it reaches $100,000,000, 3 mills shall be the limit, and when it reaches $300,000,000 the rate shall not exceed 1½ mills; but a greater rate may be established by a vote of the people. No public debt (exclusive of the debt of the Territory of Idaho at the date of its admission to the Union as a state) may be created that exceeds 1½% of the assessed valuation (except in case of war, &c.); the state cannot lend its credit to any corporation, municipality or individual; nor can any county, city or town lend its credit or become a stockholder in any company (except for municipal works).

History.—The first recorded exploration of Idaho by white men was made by Lewis and Clark, who passed along the Snake river to its junction with the Columbia; in 1805 the site of Fort Lemhi in Lemhi county was a rendezvous for two divisions of the Lewis and Clark expedition; later, the united divisions reached a village of the Nez Perce Indians near the south fork of the Clearwater river, where they found traces of visits by other white men. In 1810 Fort Henry, on the Snake river, was established by the Missouri Fur Company, and in the following year a party under the auspices of the Pacific Fur Company descended the Snake river to the Columbia. In 1834 Fort Hall in E. Idaho (Bingham county) was founded. It acquired prominence as the meeting-point of a number of trails to the extreme western parts of North America. Missions to the Indians were also established, both by the Catholics and by the Protestants. But the permanent settlements date from the revelation of Idaho's mineral resources in 1860, when the Cœur d'Alene, Palouses and Nez Perces were in the North, and the Blackfoots, Bannocks and Shoshones in the South. While trading with these Indians, Capt. Pierce learned in the summer of 1860 that there was gold in Idaho. He found it on Orofino Creek, and a great influx followed—coming to Orofino, Newsome, Elk City, Florence, where the ore was especially rich, and Warren. The news of the discovery of the Boisé Basin spread far and wide, and Idaho City, Placerville, Buena Vista, Centreville and Pioneerville grew up. The territory now constituting Idaho was comprised in the Territory of Oregon from 1848 to 1853; from 1853 to 1859 the southern portion of the present state was a part of Oregon, the northern a part of Washington Territory; from 1859 to 1863 the territory was within the bounds of Washington Territory. In 1863 the Territory of Idaho was organized; it included Montana until 1864, and a part of Wyoming until 1868, when the area of the Territory of Idaho was practically the same as that of the present state. Idaho was admitted into the Union as a state in 1890. There have been a few serious Indian outbreaks in Idaho. In 1856 the Cœur d'Alenes, Palouses and Spokanes went on the war-path; in April 1857 they put to flight a small force under Col. Edward Tenner Steptoe; but the punitive expedition led by Col. George Wright (1803-1865) was a success. In 1877 the Nez Perces, led by Chief Joseph, refused to go on the reservation set apart for them, defeated a small body of regulars, were pursued by Major-General O. O. Howard, reinforced by frontier volunteers, and in September and October were defeated and retreated into Northern Montana, where they were captured by Major-General Nelson A. Miles. Occasional labour troubles have been very severe in the Cœur d'Alene region, where the attempt in 1892 of the Mine Owners' Association to discriminate in wages between miners and surfacemen brought on a union strike. Rioting followed the introduction of non-union men, the Frisco Mill was blown up, and many non-union miners were killed. The militia was called out and regular troops were hurried to Shoshone county from Fort Sherman, Idaho and Fort Missoula, Montana. These soon quieted the district. But the restlessness of the region caused more trouble in 1899. The famous Bunker Hill and Sullivan mines were wrecked, late in April, by union men. Federal troops, called for by Governor Frank Steunenberg, again took charge, and about 800 suspected men in the district were arrested and shut up in a stockade known as the "bull-pen." Ten prisoners, convicted of destroying the property of the mine-owners, were sentenced to twenty-two months in jail. The feeling among the union men was bitter against Steunenberg, who was assassinated on the 30th of December 1905. The trial in 1907 of Charles H. Haywood, secretary of the Western Federation of Miners, who was charged with conspiracy in connexion with the murder, attracted national attention; it resulted in Haywood's acquittal. Before 1897 the administration of the state was controlled by the Republican party; but in 1896 Democrats, Populists and

those Republicans who believed in free coinage of silver united, and until 1902 elected a majority of all candidates for state offices. In 1902, 1904, 1906 and 1908 a Republican state ticket was elected.

GOVERNORS

Territorial.

William H. Wallace	1863
W. B. Daniels, Secretary, Acting Governor	1863-1864
Caleb Lyon	1864-1865
C. de Witt Smith, Secretary, Acting Governor	1865
Horace C. Gilson ” ”	1865-1866
S. R. Howlett ” ”	1866
David W. Ballard	1866-1870
E. J. Curtis, Acting Governor	1870
Thomas W. Bennett	1871-1875
D. P. Thompson	1875-1876
Mason Brayman	1876-1880
John B. Neil	1880-1883
John N. Irwin	1883-1884
William M. Bunn	1884-1885
Edward A. Stevenson	1885-1889
George L. Shoup	1889-1890

STATE GOVERNORS

George L. Shoup,[3] Republican	1890
Norman B. Wiley, Acting Governor	1890-1892
William J. McConnell, Republican	1893-1897
Frank Steunenberg, Democrat Populist	1897-1901
Frank W. Hunt, ” ”	1901-1903
John T. Morrison, Republican	1903-1905
Frank R. Gooding, ”	1905-1909
James H. Brady, ”	1909-

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1 Of these 80,000 acres are reached directly—72,000 N., and 8000 S. of the Snake river; and from 50,000 to 70,000 acres more are above the level of the canals and will have water pumped to them by the 11,000-30,000 h.p. developed.

2 This disqualification and much other legislation were due to the large Mormon population in Idaho. In 1884-1885 all county and precinct officers were required to take a test oath abjuring bigamy, polygamy, or celestial marriage; and under this law in 1888 three members of the territorial legislature were deprived of their seats as ineligible. An act of 1889, when the Mormons constituted over 20% of the population, forbade in the case of any who had since the 1st of January 1888 practised, taught, aided or encouraged polygamy or bigamy, their registration or voting until two years after they had taken a test oath renouncing such practices, and until they had satisfied the District Court that in the two years preceding they had been guilty of no such practices. The Constitutional Convention which met at Boisé in July-August 1889 was strongly anti-Mormon, and the Constitution it framed was approved by a popular vote of 12,398 out of 14,184. The United States Supreme Court decided the anti-Mormon legislation case of Davis v. Beason in favour of the Idaho legislature. In 1893 the disqualification was made no longer retroactive, the two-year clause was omitted, and the test oath covered only present renunciation of polygamy.

3 Governor Shoup resigned in December to take his seat in the U.S. Senate.

IDAR, or EDAR, a native state of India, forming part of the Mahi Kantha agency, within the Gujarat division of Bombay. It has an area of 1669 sq. m., and a population (1901) of 168,557, showing a decrease of 44% in the decade as the result of famine. Estimated gross revenue, £29,000; tribute to the gaekwar of Baroda, £2000. In 1901 the raja and his posthumous son both died, and the succession devolved upon Sir Pertab Singh (*q.v.*) of Jodhpur. The line of railway from Ahmedabad through Parantij runs mainly through this state. Much of the territory is held by kinsmen of the raja on feudal tenure. The products are grain, oil-seeds and sugar-cane. The town of Idar is 64 m. N.E. of Ahmedabad. Pop. (1901) 7085. It was formerly the capital, but Ahmednagar (pop. 3200) is the present capital.

IDAS, in Greek legend, son of Aphareus of the royal house of Messene, brother of Lynceus. He is only mentioned in a single passage in Homer (*Iliad*, ix. 556 sqq.), where he is called the strongest of men on earth. He carried off Marpessa, daughter of Evenus, as his wife and dared to bend his bow against Apollo, who was also her suitor. Zeus intervened, and left the choice to Marpessa, who declared in favour of Idas, fearing that the god might desert her when she grew old (Apollodorus i. 7). The Apharetidae are best known for their fight with the Dioscuri. A quarrel had arisen about the division of a herd of cattle which the four had stolen. Idas claimed the whole of the booty as the victor in a contest of eating, and drove the cattle off to Messene. The Dioscuri overtook him and lay in wait in a hollow oak. But Lynceus, whose keenness of sight was proverbial, saw Castor through the trunk and warned his brother, who thereupon slew the mortal Castor; finally, Pollux slew Lynceus, and Idas was struck by lightning (Apollodorus iii. 11; Pindar, *Nem.*, x. 60; Pausanias iv. 3. 1). According to others, the Dioscuri had carried off the daughters of Leucippus, who had been betrothed to the Apharetidae (Ovid, *Fasti*, v. 699; Theocritus xxii. 137). The scene of the combat is placed near the grave of Aphareus at Messene, at Aphidna in Attica, or in Laconia; and there are other variations of detail in the accounts (see also Hyginus, *Fab.* 80). Idas and Lynceus were originally gods of light, probably the sun and moon, the herd of cattle (for the possession of which they strove with the Dioscuri) representing the heavenly bodies. The annihilation of the Apharetidae in the legend indicates the subordinate position held by the Messenians after the loss of their independence and subjugation by Sparta, the Dioscuri being distinctly Spartan, as the Apharetidae were Messenian heroes. The grave of Idas and Lynceus was shown at Sparta, according to Pausanias (iii. 13. 1), whose own opinion, however, is that they were buried in Messenia. On the chest of Cypselus, Marpessa is represented as following Idas from the temple of Apollo (by whom, according to some, she had been carried off), and there was a painting by Polygnotus of the rape of the Leucippidae in the temple of the Dioscuri at Athens.

In the article Greek Art, fig. 66 (Pl. iv.) represents Idas and the Dioscuri driving off cattle.

IDDESLEIGH, STAFFORD HENRY NORTHCOTE, 1st Earl of (1818-1887), British statesman, was born in London, on the 27th of October 1818. His ancestors had long been settled in Devonshire, their pedigree, according to Burke, being traceable to the beginning of the 12th century. After a successful career at Balliol College, Oxford, he became in 1843 private secretary to Mr Gladstone at the board of trade. He was afterwards legal secretary to the board; and after acting as one of the secretaries to the Great Exhibition of 1851, co-operated with Sir Charles Trevelyan in framing the report which revolutionized the conditions of appointment to the Civil Service. He succeeded his grandfather, Sir Stafford Henry Northcote, as 8th baronet in 1851. He entered Parliament in 1855 as Conservative M.P. for Dudley, and was elected for Stamford in 1858, a seat which he exchanged in 1866 for North Devon. Steadily supporting his party, he became president of the board of trade in 1866, secretary of state for India in 1867, and chancellor of the exchequer in 1874. In the interval between these last two appointments he had been one of the commissioners for the settlement of the "Alabama" difficulty with the United States, and on Mr Disraeli's elevation to the House of Lords in 1876 he became leader of the Conservative party in the Commons. As a finance minister he was largely dominated by the lines of policy laid down by Mr Gladstone; but he distinguished himself by his dealings with the Debt, especially his introduction of the New Sinking Fund (1876), by which he fixed the annual charge for the Debt in such a way as to provide for a regular series of payments off the capital. His temper as leader was, however, too gentle to satisfy the more ardent spirits among his own followers, and party cabals (in which Lord Randolph Churchill—who had made a dead set at the "old gang," and especially Sir Stafford Northcote—took a leading part) led to Sir Stafford's transfer to the Lords in 1885, when Lord Salisbury became prime minister. Taking the titles of earl of Iddesleigh and Viscount St Cyres, he was included in the cabinet as first lord of the treasury. In Lord Salisbury's 1886 ministry he became secretary of state for foreign affairs, but the arrangement was not a comfortable one, and his resignation had just been decided upon when on the 12th of January 1887 he died very suddenly at Lord Salisbury's official residence in Downing Street. Lord Iddesleigh was elected lord rector of Edinburgh University in 1883, in which capacity he addressed the students on the subject of "Desultory Reading." He had little leisure for letters, but amongst his works were *Twenty Years of Financial Policy* (1862), a valuable study of Gladstonian finance, and *Lectures and Essays* (1887). His *Life* by Andrew Lang appeared in 1890. Lord Iddesleigh married in 1843 Cecilia Frances Farrer (d. 1910) (sister of Thomas, 1st Lord Farrer), by whom he had seven sons and three daughters.

He was succeeded as 2nd earl by his eldest son, Walter Stafford Northcote (1845-), who for some years was his father's private secretary. He was chairman of the Inland Revenue Board from 1877 to 1892; and is also known as a novelist. His eldest son Stafford Henry Northcote, Viscount St Cyres (1869-), was educated at Eton and Merton College Oxford. After taking a 1st class in History, he was elected a senior student of Christ Church, where he resided for a while as tutor and lecturer. His interest in the development of religious thought led him to devote himself specially to the history of the Roman Catholic Church in the 17th century, the first-fruits of which was his *François de Fénelon* (London, 1901); eight years later he published his *Pascal* (*ib.* 1909).

The second son of the 1st earl of Iddesleigh, Stafford Henry Northcote, 1st Baron Northcote (b. 1846), was educated at Eton and at Merton College, Oxford. He became a clerk in the foreign office in 1868, acted as private secretary to Lord Salisbury, and was attached to the embassy at Constantinople from 1876 to 1877. From 1877 to 1880 he was secretary to the chancellor of the exchequer, was financial secretary to the war office from 1885 to 1886, surveyor-general of ordnance, 1886 to 1887, and charity commissioner, 1891 to 1892. In 1887 he was created a baronet. In 1880 he was elected M.P. for Exeter as a Conservative, and retained the seat until 1899, when he was appointed governor of Bombay (1899-1903), being created a peer in 1900. Lord Northcote was appointed governor-general of the Commonwealth of Australia in 1903, and

held this post till 1908. He married in 1873 Alice, adopted daughter of the 1st Lord Mount Stephen.

IDEA (Gr. ἰδέα, connected with ἰδεῖν, to see; cf. Lat. *species* from *specere*, to look at), a term used both popularly and in philosophical terminology with the general sense of "mental picture." To have no *idea* how a thing happened is to be without a mental picture of an occurrence. In this general sense it is synonymous with concept (*q.v.*) in its popular usage. In philosophy the term "idea" is common to all languages and periods, but there is scarcely any term which has been used with so many different shades of meaning. Plato used it in the sphere of metaphysics for the eternally existing reality, the archetype, of which the objects of sense are more or less imperfect copies. Chairs may be of different forms, sizes, colours and so forth, but "laid up in the mind of God" there is the one permanent *idea* or type, of which the many physical chairs are derived with various degrees of imperfection. From this doctrine it follows that these *ideas* are the sole reality (see further IDEALISM); in opposition to it are the empirical thinkers of all time who find reality in particular physical objects (see HYLOZOISM, EMPIRICISM, &c.). In striking contrast to Plato's use is that of John Locke, who defines "idea" as "whatever is the object of understanding when a man thinks" (*Essay on the Human Understanding* (I.), vi. 8). Here the term is applied not to the mental process, but to anything whether physical or intellectual which is the object of it. Hume differs from Locke by limiting "idea" to the more or less vague mental reconstructions of perceptions, the perceptual process being described as an "impression." Wundt widens the term to include "conscious representation of some object or process of the external world." In so doing he includes not only ideas of memory and imagination, but also perceptual processes, whereas other psychologists confine the term to the first two groups. G. F. Stout and J. M. Baldwin, in the *Dictionary of Philosophy and Psychology*, i. 498, define "idea" as "the reproduction with a more or less adequate image, of an object not actually present to the senses." They point out that an idea 281 and a perception are by various authorities contrasted in various ways. "Difference in degree of intensity," "comparative absence of bodily movement on the part of the subject," "comparative dependence on mental activity," are suggested by psychologists as characteristic of an idea as compared with a perception.

It should be observed that an idea, in the narrower and generally accepted sense of a mental reproduction, is frequently composite. That is, as in the example given above of the idea of chair, a great many objects, differing materially in detail, all call a single idea. When a man, for example, has obtained an idea of chairs in general by comparison with which he can say "This is a chair, that is a stool," he has what is known as an "abstract idea" distinct from the reproduction in his mind of any particular chair (see ABSTRACTION). Furthermore a complex idea may not have any corresponding physical object, though its particular constituent elements may severally be the reproductions of actual perceptions. Thus the idea of a centaur is a complex mental picture composed of the ideas of man and horse, that of a mermaid of a woman and a fish.

See PSYCHOLOGY.

IDEALISM (from Gr. ἰδέα, archetype or model, through Fr. *idéalisme*), a term generally used for the attitude of mind which is prone to represent things in an imaginative light and to lay emphasis exclusively or primarily on abstract perfection (*i.e.* in "ideals"). With this meaning the philosophical use of the term has little in common.

To understand the philosophical theory that has come to be known under this title, we may ask (1) what in general it is and how it is differentiated from other theories of knowledge and reality, (2) how it has risen in the history of philosophy, (3) what position it occupies at present in the world of speculation.

1. *General Definition of Idealism.*—Idealism as a philosophical doctrine conceives of knowledge or experience as a process in which the two factors of subject and object stand in a relation of entire interdependence on each other as warp and woof. Apart from the activity of the self or subject in sensory reaction, memory and association, imagination, judgment and inference, there can be no world of objects. A thing-in-itself which is not a thing to some consciousness is an entirely unrealizable, because self-contradictory, conception. But this is only one side of the truth. It is equally true that a subject apart from an object is unintelligible. As the object exists through the constructive activity of the subject, so the subject lives in the construction of the object. To seek for the true self in any region into which its opposite in the form of a not-self does not enter is to grasp a shadow. It is in seeking to realize its own ideas in the world of knowledge, feeling and action that the mind comes into possession of itself; it is in becoming permeated and transformed by the mind's ideas that the world develops the fullness of its reality as object.

Thus defined, idealism is opposed to ordinary common-sense dualism, which regards knowledge or experience as the result of the more or less accidental relation between two separate and independent entities—the mind and its ideas on one side, the thing with its attributes on the other—that serve to limit and condition each other from without. It is equally opposed to the doctrine which represents the subject itself and its state and judgments as the single immediate datum of consciousness, and all else, whether the objects of an external world or person other than the individual subject whose states are known to itself, as having a merely problematic existence resting upon analogy or other process of indirect inference. This theory is sometimes known as idealism. But it falls short of idealism as above defined in that it recognizes

only one side of the antithesis of subject and object, and so falls short of the doctrine which takes its stand on the complete correlativity of the two factors in experience. It is for this reason that it is sometimes known as subjective or incomplete idealism. Finally the theory defined is opposed to all forms of realism, whether in the older form which sought to reduce mind to a function of matter, or in any of the newer forms which seek for the ultimate essence of both mind and matter in some unknown force or energy which, while in itself it is neither, yet contains the potentiality of both. It is true that in some modern developments of idealism the ultimate reality is conceived of in an impersonal way, but it is usually added that this ultimate or absolute being is not something lower but higher than self-conscious personality, including it as a more fully developed form may be said to include a more elementary.

2. *Origin and Development of Idealism.*—In its self-conscious form idealism is a modern doctrine. In it the self or subject may be said to have come to its rights. This was possible in any complete sense only after the introspective movement represented by the middle ages had done its work, and the thought of the individual mind and will as possessed of relative independence had worked itself out into some degree of clearness. In this respect Descartes' dictum—*cogito ergo sum*—may be said to have struck the keynote of modern philosophy, and all subsequent speculation to have been merely a prolonged commentary upon it. While in its completer form it is thus a doctrine distinctive of modern times, idealism has its roots far back in the history of thought. One of the chief proofs that has been urged of the truth of its point of view is the persistency with which it has always asserted itself at a certain stage in philosophical reflection and as the solution of certain recurrent speculative difficulties. All thought starts from the ordinary dualism or pluralism which conceives of the world as consisting of the juxtaposition of mutually independent things and persons. The first movement is in the direction of dispelling this appearance of independence. They are seen to be united under the relation of cause and effect, determining and determined, which turns out to mean that they are merely passing manifestations of some single entity or energy which constitutes the real unknown essence of the things that come before our knowledge. In the pantheism that thus takes the place of the old dualism there seems no place left for the individual. Mind and will in their individual manifestations fade into the general background of appearance without significance except as a link in a fated chain. Deliverance from the pantheistic conception of the universe comes through the recognition of the central place occupied by thought and purpose in the actual world, and, as a consequence of this, of the illegitimacy of the abstraction whereby material energy is taken for the ultimate reality.

Ancient idealism: Socrates.

The first illustration of this movement on a large scale was given in the Socratic reaction against the pantheistic conclusions of early Greek philosophy (see Ionian School). The whole movement of which Socrates was a part may be said to have been in the direction of the assertion of the rights of the subject. Its keynote is to be found in the Protagorean "man is the measure." This seems to have been interpreted by its author and by the Sophists in general in a subjective sense, with the result that it became the motto of a sceptical and individualistic movement in contemporary philosophy and ethics. It was not less against this form of idealism than against the determinism of the early physicists that Socrates protested. Along two lines the thought of Socrates led to idealistic conclusions which may be said to have formed the basis of all subsequent advance. (1) He perceived the importance of the universal or conceptual element in knowledge, and thus at a single stroke broke through the hard realism of ordinary common sense, disproved all forms of naturalism that were founded on the denial of the reality of thought, and cut away the ground from a merely sensational and subjective idealism. This is what Aristotle means by claiming for Socrates that he was the founder of definition. (2) He taught that life was explicable only as a system of ends. Goodness consists in the knowledge of what these are. It is by his hold upon them that the individual is able to give unity and reality to his will. In expounding these ideas Socrates limited himself to the sphere of practice. Moreover, the end or ideal of the practical life was conceived of in too vague a way to be of much practical use. His principle, however, was essentially sound, and led directly to the Platonic Idealism. Plato extended the Socratic discovery to the whole of reality and while seeking to see the pre-Socratics with the eyes of Socrates sought "to see Socrates with the eyes of the pre-Socratics." Not only were the virtues to be explained by their relation to a common or universal good which only intelligence could apprehend, but there was nothing in all the furniture of heaven or earth which in like manner did not receive reality from the share it had in such an intelligible idea or essence. But these ideas are themselves intelligible only in relation to one another and to the whole. Accordingly Plato conceived of them as forming a system and finding their reality in the degree in which they embody the one all-embracing idea and conceived of not under the form of an efficient but of a final cause, an inner principle of action or tendency in things to realize the fullness of their own nature which in the last resort was identical with the nature of the whole. This Plato expressed in the myth of the Sun, but the garment of mythology in which Plato clothed his idealism, beautiful as it is in itself and full of suggestion, covered an essential weakness. The more Plato dwelt upon his world of ideas, the more they seemed to recede from the world of reality, standing over against it as principles of condemnation instead of revealing themselves in it. In this way the Good was made to appear as an end imposed upon things from without by a creative intelligence instead of as an inner principle of adaptation.

Plato

On one side of his thought Aristotle represents a reaction against idealism and a return to the position of common-sense dualism, but on another, and this the deeper side, he represents the attempt to restore the theory in a more satisfactory form. His account of the process of knowledge in his logical treatises exhibits the idealistic bent in its clearest form. This is as far removed as possible either from dualism or from empiricism. The universal is the real; it is that which gives coherence and individuality to the particulars of sense which apart from it are like the routed or disbanded units of an army. Still more manifestly in his *Ethics* and *Politics Aristotle* makes it clear that it is the common or universal will that gives substance and reality to the individual. In spite of these and other anticipations of a fuller idealism, the idea remains as a form imposed from without on a reality otherwise conceived of as independent of it. As we advance from the logic to the metaphysics and from that to his ontology, it becomes clear that the concepts are only "categories" or predicates of a reality lying outside of them, and there is an ultimate division between the world as the object or matter of thought and the

Aristotle.

thinking or moving principle which gives its life. It is this that gives the Aristotelian doctrine in its more abstract statements an air of uncertainty. Yet besides the particular contribution that Aristotle made to idealistic philosophy in his logical and ethical interpretations, he advanced the case in two directions, (*a*) He made it clear that no explanation of the world could be satisfactory that was not based on the notion of continuity in the sense of an order of existence in which the reality of the lower was to be sought for in the extent to which it gave expression to the potentialities of its own nature—which were also the potentialities of the whole of which it was a part. (*b*) From this it followed that difficult as we might find it to explain the relation of terms so remote from each other as sense and thought, the particular and the universal, matter and mind, these oppositions cannot in their nature be absolute. These truths, however, were hidden from Aristotle's successors, who for the most part lost the thread which Socrates had put into their hand. When the authority of Aristotle was again invoked, it was its dualistic and formal, not its idealistic and metaphysical, side that was in harmony with the spirit of the age. Apart from one or two of the greatest minds, notably Dante, what appealed to the thinkers of the middle ages was not the idea of reality as a progressive self-revelation of an inner principle working through nature and human life, but the formal principles of classification which it seemed to offer for a material of thought and action given from another source.

Modern Idealism.

Modern like ancient idealism came into being as a correction of the view that threatened to resolve the world of matter and mind alike into the changing manifestations of some single non-spiritual force or substance. While, however, ancient philosophy may be said to have been unilinear, modern philosophy had a twofold origin, and till the time of Kant may be said to have pursued two independent courses.

All philosophy is the search for reality and rational certainty as opposed to mere formalism on the one hand, to authority and dogmatism on the other. In this sense modern philosophy had a common root in revolt against medievalism. In England this revolt sought for the certainty and clearness that reason requires In the assurance of an outer world given to immediate sense experience; on the continent of Europe, in the assurance of an inner world given immediately in thought. Though starting from apparently opposite poles and following widely different courses the two movements led more or less directly to the same results. It is easy to understand how English empiricism issued at once in the trenchant naturalism of Hobbes. It is less comprehensible how the Cartesian philosophy from the starting-point of thought allied itself with a similar point of view. This can be understood only by a study of the details of Descartes' philosophy (see Cartesianism). Suffice it to say that in spite of its spiritualistic starting-point its general result was to give a stimulus to the prevailing scientific tendency as represented by Galileo, Kepler and Harvey to the principle of mechanical explanations of the phenomena of the universe. True it was precisely against this that Descartes' immediate successors struggled. But the time-spirit was too strong for them. Determinism had other forms besides that of a crude materialism, and the direction that Malebranche succeeded in giving to speculation led only to the more complete denial of freedom and individuality in the all-devouring pantheism of Spinoza.

Berkeley.

The foundations of idealism in the modern sense were laid by the thinkers who sought breathing room for mind and will in a deeper analysis of the relations of the subject to the world that it knows. From the outset English philosophy had a leaning to the psychological point of view, and Locke was only carrying on the tradition of his predecessors and particularly of Hobbes in definitely accepting it as the basis of his *Essay*. It was, however, Berkeley who first sought to utilize the conclusions that were implicit in Locke's starting-point to disprove "the systems of impious and profane persons which exclude all freedom, intelligence, and design from the formation of things, and instead thereof make a self-existent, stupid, unthinking substance the root and origin of all beings." Berkeley's statement of the view that all knowledge is relative to the subject—that no object can be known except under the form which our powers of sense-perception, our memory and imagination, our notions and inference, give it—is still the most striking and convincing that we possess. To have established this position was a great step in speculation. Henceforth ordinary dogmatic dualism was excluded from philosophy; any attempt to revive it, whether with Dr Johnson by an appeal to common prejudice, or, in the more reflective Johnsonianism of the 18th-century Scottish philosophers, must be an anachronism. Equally impossible was it thenceforth to assert the mediate or immediate certainty of material substance as the cause either of events in nature or of sensations in ourselves. But with these advances came the danger of falling into error from which common-sense dualism and naturalistic monism were free. From the point of view which Berkeley had inherited from Locke it seemed to follow that not only material substance, but the whole conception of a world of objects, is at most an inference from subjective modifications which are the only immediately certain objects of knowledge. The implications of such a view were first clearly apparent when Hume showed that on the basis of it there seemed to be nothing that we could confidently affirm except the order of our own impressions and ideas. This being so, not only were physics and mathematics impossible as sciences of necessary objective truth, but our apparent consciousness of a permanent self and object alike must be delusive.

Kant.

It was these paradoxes that Kant sought to rebut by a more thoroughgoing criticism of the basis of knowledge the substance of which is summed up in his celebrated Refutation of Idealism,[1] wherein he sought to undermine Hume's scepticism by carrying it one step further and demonstrating that not only is all knowledge of self or object excluded, but the consciousness of any series of impressions and ideas is itself impossible except in relation to some external permanent and universally accepted world of objects.

Leibnitz.

But Kant's refutation of subjective idealism and his vindication of the place of the object can be fully understood only when we take into account the other defect in the teaching of his predecessors that he sought in his *Critique* to correct. In continental philosophy the reaction against mechanical and pantheistic explanations of the universe found even more definite utterance than in English psychological empiricism in the metaphysical system of Leibnitz, whose theory of self-determined monads can be understood only when taken in the light of the assertion of the rights of the

subject against the substance of Spinoza and the atoms of the materialist. But Leibnitz also anticipated Kant in seeking to correct the empirical point of view of the English philosophers. True, sense-given material is necessary in order that we may have thought. “But by what means,” he asks, “can experience and the senses give ideas? Has the soul windows? Is it like a writing tablet? Is it like wax? It is plain that all those who think thus of the soul make it at bottom corporeal. True, nothing is in the intellect which has not been in the senses, but we must add except the intellect itself. The soul contains the notions of being, substance, unity, identity, cause, perception, reasoning and many others which the senses cannot give” (*Nouveaux essais*, ii. 1). But Leibnitz’s conception of the priority of spirit had too little foundation, and the different elements he sought to combine were too loosely related to one another to stand the strain of the two forces of empiricism and materialism that were opposed to his idealism. More particularly by the confusion in which he left the relation between the two logical principles of identity and of sufficient reason underlying respectively analytic and synthetic, deductive and inductive thought, he may be said to have undermined in another way the idealism he strove to establish. It was in seeking to close up the fissure in his system represented by this dualism that his successors succeeded only in adding weakness to weakness by reducing the principle of sufficient reason to that of formal identity (see Wolff) and representing all thought as in essence analytic. From this it immediately followed that, so far as the connexion of our experiences of the external world does not show itself irreducible to that of formal identity, it must remain unintelligible. As empiricism had foundered on the difficulty of showing how our thoughts could be an object of sense experience, so Leibnitzian formalism foundered on that of understanding how the material of sense could be an object of thought. On one view as on the other scientific demonstration was impossible.

Kant.

The extremity to which philosophy had been brought by empiricism on the one hand and formalism on the other was Kant’s opportunity. Leibnitz’s principle of the “nisi intellectus ipse” was expanded by him into a demonstration the completest yet effected by philosophy of the part played by the subject not merely in the manipulation of the material of experience but in the actual constitution of the object that is known. On the other hand he insisted on the synthetic character of this activity without which it was impossible to get beyond the circle of our own thoughts. The parts of the *Critique of Pure Reason*, more particularly the “Deduction of the Categories” in which this theory is worked out, may be said to have laid the foundation of modern idealism—“articulum stantis aut cadentis doctrinae.” In spite of the defects of Kant’s statement—to which it is necessary to return—the place of the concepts and ideals of the mind and the synthetic organizing activity which these involve was established with a trenchancy which has been acknowledged by all schools alike. The “Copernican revolution” which he claimed to have effected may be said to have become the starting-point of all modern philosophy. Yet the divergent uses that have been made of it witness to the ambiguity of his statement which is traceable to the fact that Kant was himself too deeply rooted in the thought of his predecessors and carried with him too much of their spirit to be able entirely to free himself from their assumptions and abstractions. His philosophy was more like Michaelangelo’s famous sculpture of the Dawn, a spirit yet encumbered with the stubble of the material from which it was hewn, than a clear cut figure with unmistakable outlines. Chief among these encumbering presuppositions was that of a fundamental distinction between perception and conception and consequent upon it between the synthetic and the analytic use of thought. It is upon this in the last resort that the distinction between the phenomenal world of our experience and a noumenal world beyond it is founded. Kant perceives that “perception without conception is blind, conception without perception is empty,” but if he goes so far ought he not to have gone still further and inquired whether there can be any perception at all without a concept, any concept which does not presuppose a precept, and, if this is impossible, whether the distinction between a world of appearance which is known and a world of things-in-themselves which is not, is not illusory?

Hegel.

It was by asking precisely these questions that Hegel gave the finishing strokes to the Kantian philosophy. The starting-point of all valid philosophy must be the perception that the essence of all conscious apprehension is the union of opposites—of which that of subject and object is the most fundamental and all-pervasive. True, before differences can be united they must have been separated, but this merely proves that differentiation or analysis is only one factor in a single process. Equally fundamental is the element of synthesis. Nor is it possible at any point in knowledge to prove the existence of a merely given in whose construction the thinking subject has played no part nor a merely thinking subject in whose structure the object is not an organic factor. In coming, as at a certain point in its development it does, to the consciousness of an object, the mind does not find itself in the presence of an opponent, or of anything essentially alien to itself but of that which gives content and stability to its own existence. True, the stability it seems to find in it is incomplete. The object cannot rest in the form of its immediate appearance without involving us in contradiction. The sun does not “rise,” the dew does not “fall.” But this only means that the unity between subject and object to which the gift of consciousness commits us is incompletely realized in that appearance: the apparent truth has to submit to correction and supplementation before it can be accepted as real truth. It does not mean that there is anywhere a mere fact which is not also an interpretation nor an interpreting mind whose ideas have no hold upon fact. From this it follows that ultimate or absolute reality is to be sought not beyond the region of experience, but in the fullest and most harmonious statement of the facts of our experience. True a completely harmonious world whether of theory or of practice remains an ideal. But the fact that we have already in part realized the ideal and that the degree in which we have realized it is the degree in which we may regard our experience as trustworthy, is proof that the ideal is no mere idea as Kant taught, but the very substance of reality.

Stumbling blocks in Hegel’s statements.

Intelligible as this development of Kantian idealism seems in the light of subsequent philosophy, the first statement of it in Hegel was not free from obscurity. The unity of opposites translated into its most abstract terms as the “identity of being and not-being,” the principle that the “real is the rational,” the apparent substitution of “bloodless” categories for the substance of concrete reality gave it an air of paradox in the eyes of metaphysicians while physicists were scandalized by the premature attempts at a complete philosophy of nature and history. For this Hegel was doubtless partly to blame. But philosophical critics of his own and a later day are not

hereby absolved from a certain perversity in interpreting these doctrines in a sense precisely opposite to that in which they were intended. The doctrine of the unity of contraries so far from being the denial of the law of non-contradiction is founded on an absolute reliance upon it. Freed from paradox it means that in every object of thought there are different aspects or elements each of which if brought separately into consciousness may be so emphasized as to appear to contradict another. Unity may be made to contradict diversity, permanence change, the particular the universal, individuality relatedness. Ordinary consciousness ignores these "latent fires"; ordinary discussion brings them to light and divides men into factions and parties over them; philosophy not because it denies but because it acknowledges the law of non-contradiction as supreme is pledged to seek a point of view from which they may be seen to be in essential harmony with one another as different sides of the same truth. The "rationality of the real" has in like manner been interpreted as intended to sanctify the existing order. Hegel undoubtedly meant to affirm that the actual was rational in the face of the philosophy which set up subjective feeling and reason against it. But idealism has insisted from the time of Plato on the distinction between what is actual in time and space and the reality that can only partially be revealed in it. Hegel carried this principle further than had yet been done. His phrase does not therefore sanctify the established fact but, on the contrary, declares that it partakes of reality only so far as it embodies the ideal of a coherent and stable system which it is not. As little is idealism responsible for any attempt to pass off logical abstractions for concrete reality. The "Logic" of Hegel is merely the continuation of Kant's "Deduction" of the categories and ideas of the reason which has generally been recognized as the soberest of attempts to set forth the presuppositions which underlie all experience. "What Hegel attempts to show is just that the categories by which thought must determine its object are stages in a process that, beginning with the idea of 'Being,' the simplest of all determinations is driven on by its own dialectic till it reaches the idea of self-consciousness. In other words the intelligence when it once begins to define an object for itself, finds itself launched on a movement of self-asserting synthesis in which it cannot stop until it had recognized that the unity of the object with itself involves its unity with all other objects and with the mind that knows it. Hence, whatever we begin by saying, we must ultimately say 'mind'" (Caird, *Kant*, i. 443).

> While the form in which these doctrines were stated proved fatal to them in the country of their birth, they took deep root in the next generation in English philosophy. Here the stone that the builders rejected was made the head of the corner. The influences which led to this result were manifold. From the side of literature the way was prepared for it by the genius of Coleridge, Wordsworth and Carlyle; from the side of morals and politics by the profound discontent of the constructive spirit of the century with the disintegrating conceptions inherited from utilitarianism. In taking root in England idealism had to contend against the traditional empiricism represented by Mill on the one hand and the pseudo-Kantianism which was rendered current by Mansel and Hamilton on the other. As contrasted with the first it stood for the necessity of recognizing a universal or ideal element as a constitutive factor in all experience whether cognitive or volitional; as contrasted with the latter for the ultimate unity of subject and object, knowledge and reality, and therefore for the denial of the existence of any thing-in-itself for ever outside the range of experience. Its polemic against the philosophy of experience has exposed it to general misunderstanding, as though it claimed some a priori path to truth. In reality it stands for a more thoroughgoing and consistent application of the test of experience. The defect of English empiricism from the outset had been the uncritical acceptance of the metaphysical dogma of a pure unadulterated sense-experience as the criterion of truth. This assumption idealism examines and rejects in the name of experience itself. Similarly it only carried the doctrine of relativity to its logical conclusion in denying that there could be any absolute relativity. Object stands in essential relation to subject, subject to object. This being so, it is wholly illogical to seek for any test of the truth and reality of either except in the form which that relation itself takes. In its subsequent development idealism in England has passed through several clearly marked stages which may be distinguished as (*a*) that of exploration and tentative exposition in the writings of J. F. Ferrier,[2] J. Hutchison Stirling,[3] Benjamin Jowett,[4] W. T. Harris;[5] (*b*) of confident application to the central problems of logic, ethics and politics, fine art and religion, and as a principle of constructive criticism and interpretation chiefly in T. H. Green,[6] E. Caird,[7] B. Bosanquet;[8] (*c*) of vigorous effort to develop on fresh lines its underlying metaphysics in F. H. Bradley,[9] J. M. E. McTaggart,[10] A. E. Taylor,[11] Josiah Royce[12] and others. Under the influence of these writers idealism, as above expounded though with difference of interpretation in individual writers, may be said towards the end of the 19th century to have been on its way to becoming the leading philosophy in the British Isles and America.

3. *Reaction against Traditional Idealism.*—But it was not to be expected that the position idealism had thus won for itself would remain long unchallenged. It had its roots in a literature and in forms of thought remote from the common track; it had been formulated before the great advances in psychology which marked the course of the century; its latest word seemed to involve consequences that brought it into conflict with the vital interest the human mind has in freedom and the possibility of real initiation. It is not, therefore, surprising that there should have been a vigorous reaction. This has taken mainly two opposite forms. On the one hand the attack has come from the old ground of the danger that is threatened to the reality of the external world and may be said to be in the interest of the object. On the other hand the theory has been attacked in the interest of the subject on the ground that in the statuesque world of ideas into which it introduces us it leaves no room for the element of movement and process which recent psychology and metaphysic alike have taught us underlies all life. The conflict of idealism with these two lines of criticism—the accusation of subjectivism on the one side of intellectualism and rigid objectivism on the other—may be said to have constituted the history of Anglo-Saxon philosophy during the first decade of the 20th century.

New Dualism and Pragmatism.

I. Whatever is to be said of ancient Idealism, the modern doctrine may be said notably in Kant to have been in the main a vindication of the subjective factor in knowledge. But that space and time, matter and cause should owe their origin to the action of the mind has always seemed paradoxical to common sense. Nor is the impression which its enunciation in Kant made, likely to have been lightened in this country by the connexion that was sure to be traced between Berkeleyanism and the new teaching or by the form which the doctrine received at the hands of T. H. Green, its leading English representative between 1870 and 1880. If what is real in things is ultimately nothing but their relations, and if relations are inconceivable

apart from the relating mind, what is this but the dissolution of the solid ground of external reality which my consciousness seems to assure me underlies and eludes all the conceptual network by which I try to bring one part of my experience into connexion with another? It is quite true that modern idealists like Berkeley himself have sought to save themselves from the gulf of subjectivism by calling in the aid of a universal or infinite mind or by an appeal to a total or absolute experience to which our own is relative. But the former device is too obviously a *deus ex machina*, the purpose of which would be equally well served by supposing with Fichte the individual self to be endowed with the power of subconsciously extraditing a world which returns to it in consciousness under the form of a foreign creation. The appeal to an Absolute on the other hand is only to substitute one difficulty for another. For granting that it places the centre of reality outside the individual self it does so only at the price of reducing the reality of the latter to an appearance; and if only one thing is real what becomes of the many different things which again my consciousness assures me are the one world with which I can have any practical concern? To meet these difficulties and give back to us the assurance of the substantiality of the world without us it has therefore been thought necessary to maintain two propositions which are taken to be the refutation of idealism. (1) There is given to us immediately in knowledge a world entirely independent of and different from our own impressions on the one hand and the conceptions by which we seek to establish relations between them upon the other. The relation of these impressions (and for the matter of that of their inter-relations among themselves) to our minds is only one out of many. As a leading writer puts it: "There is such a thing as greenness having various relations, among others that of being perceived."[13] (2) Things may be, and may be known to be simply different. They may exclude one another, exist so to speak in a condition of armed neutrality to one another, without being positively thereby related to one another or altered by any change taking place in any of them. As the same writer puts it: "There is such a thing as numerical difference, different from conceptual difference,"[14] or expressing the same thing in other words "there are relations not grounded in the nature of the related terms."

In this double-barrelled criticism it is important to distinguish what is really relevant. Whatever the shortcomings of individual writers may be, modern idealism differs, as we have seen, from the arrested idealism of Berkeley precisely in the point on which dualism insists. In all knowledge we are in touch not merely with the self and its passing states, but with a real object which is different from them. On this head there is no difference, and idealism need have no difficulty in accepting all that its opponents here contend. The difference between the two theories does not consist in any difference of emphasis on the objective side of knowledge, but in the standard by which the nature of the object is to be tested—the difference is logical not metaphysical—it concerns the definition of truth or falsity in the knowledge of the reality which both admit. To idealism there can be no ultimate test, but the possibility of giving any fact which claims to be true its place in a coherent system of mutually related truths. To this dualism opposes the doctrine that truth and falsehood are a matter of mere immediate intuition: "There is no problem at all in truth and falsehood, some propositions are true and some false just as some roses are red and some white."[15] The issue between the two theories under this head may here be left with the remark that it is a curious comment on the logic of dualism that setting out to vindicate the reality of an objective standard of truth it should end in the most subjective of all the way a thing appears to the individual. The criticism that applies to the first of the above contentions applies *mutatis mutandis* to the second. As idealism differs from Berkeleyanism in asserting the reality of an "external" world so it differs from Spinozism in asserting the reality of difference within it. Determination is not merely negation. On this head there need be no quarrel between it and dualism. Ours is a many-sided, a many-coloured world. The point of conflict again lies in the nature and ground of the assigned differences. Dualism meets the assertion of absolute unity by the counter assertion of mere difference. But if it is an error to treat the unity of the world as its only real aspect, it is equally an error to treat its differences as something ultimately irreducible. No philosophy founded on this assumption is likely to maintain itself against the twofold evidence of modern psychology and modern logic. According to the first the world, whether looked at from the side of our perception or from the side of the object perceived, can be made intelligible only when we accept it for what it is as a real continuity. Differences, of course, there are; and, if we like to say so, every difference is unique, but this does not mean that they are given in absolute independence of everything else, "fired at us out of a cannon." They bear a definite relation to the structure of our physical and psychical nature, and correspond to definite needs of the subject that manifests itself therein. Similarly from the side of logic. It is not the teaching of idealism alone but of the facts which logical analysis has brought home to us that all difference in the last resort finds its ground in the quality or content of the things differentiated, and that this difference of content shows in turn a double strand, the strand of sameness and the strand of otherness—that *in* which and that *by* which they differ from one another. Idealism has, of course, no quarrel with numerical difference. All difference has its numerical aspect: two different things are always two both in knowledge and in reality. What it cannot accept is the doctrine that there are two things which are two in themselves apart from that which makes them two—which are not two *of something*. So far from establishing the truth for which dualism is itself concerned—the reality of all differences—such a theory can end only in a scepticism as to the reality of any difference. It is difficult to see what real difference there can be between things which are differences of nothing.

II. More widespread and of more serious import is the attack from the other side to which since the publication of A. Seth's *Hegelianism and Personality* (1887) and W. James's *Will to Believe* (1903) idealism has been subjected. Here also it is important to distinguish what is relevant from what is irrelevant in the line of criticism represented by these writers. There need be no contradiction between idealism and a reasonable pragmatism. In so far as the older doctrine is open to the charge of neglecting the conative and teleological side of experience it can afford to be grateful to its critics for recalling it to its own eponymous principle of the priority of the "ideal" to the "idea," of *needs* to the conception of their object. The real issue comes into view in the attempt, undertaken in the interest of freedom, to substitute for the notion of the world as a cosmos pervaded by no discernible principle and in its essence indifferent to the form impressed upon it by its active parts.

To the older idealism as to the new the essence of mind or spirit is freedom. But the guarantee of freedom

is to be sought for not in the denial of law, but in the whole nature of mind and its relation to the structure of experience. *Without mind no orderly world*: only through the action of the subject and its "ideas" are the confused and incoherent data of sense-perception (themselves shot through with both strands) built up into that system of things we call Nature, and which stands out against the subject as the body stands out against the soul whose functioning may be said to have created it. On the other hand, *without the world no mind*: only through the action of the environment upon the subject is the idealizing activity in which it finds its being called into existence. Herein lies the paradox which is also the deepest truth of our spiritual life. In interpreting its environment first as a world of things that seem to stand in a relation of exclusion to one another and to itself, then as a natural system governed by rigid mechanical necessity, the mind can yet feel that in its very opposition the world is akin to it, bone of its bone and flesh of its flesh. What is true of mind is true of will. Idealism starts from the relativity of the world to purposive consciousness. But this again may be so stated as to represent only one side of the truth. It is equally true that the will is relative to the world of objects and interests to which it is attached through instincts and feelings, habits and sentiments. In isolation from its object the will is as much an abstraction as thought apart from the world of percepts, memories and associations which give it content and stability. And just as mind does not lose but gain in individuality in proportion as it parts with any claim to the capricious determination of what its world shall be, and becomes dominated by the conception of an order which is immutable so the will becomes free and "personal" in proportion as it identifies itself with objects and interests, and subordinates itself to laws and requirements which involve the suppression of all that is merely arbitrary and subjective. Here, too, subject and object grow together. The power and vitality of the one is the power and vitality of the other, and this is so because they are not two things with separate roots but are both rooted in a common reality which, while it includes, is more than either.

Passing by these contentions as unmeaning or irrelevant and seeing nothing but irreconcilable contradiction between the conceptions of the world as immutable law and a self-determining subject pragmatism (*q.v.*) seeks other means of vindicating the reality of freedom. It agrees with older forms of libertarianism in taking its stand on the fact of spontaneity as primary and self-evidencing, but it is not content to assert its existence side by side with rigidly determined sequence. It carries the war into the camp of the enemy by seeking to demonstrate that the completely determined action which is set over against freedom as the basis of explanation in the material world is merely a hypothesis which, while it serves sufficiently well the limited purpose for which it is devised, is incapable of verification in the ultimate constituents of physical nature. There seems in fact nothing to prevent us from holding that while natural laws express the average tendencies of multitudes they give no clue to the movement of individuals. Some have gone farther and argued that from the nature of the case no causal explanation of any real change in the world of things is possible. A cause is that which contains the effect ("causa aequat effectum"), but this is precisely what can never be proved with respect to anything that is claimed as a real cause in the concrete world. Everywhere the effect reveals an element which is indiscoverable in the cause with the result that the identity we seek for ever eludes us. Even the resultant of mechanical forces refuses to resolve itself into its constituents. In the "resultant" there is a new direction, and with it a new quality the component forces of which no analysis can discover.[16]

It is not here possible to do more than indicate what appear to be the valid elements in these two conflicting interpretations of the requirements of a true idealism. On behalf of the older it may be confidently affirmed that no solution is likely to find general acceptance which involves the rejection of the conception of unity and intelligible order as the primary principle of our world. The assertion of this principle by Kant was, we have seen, the corner-stone of idealistic philosophy in general, underlying as it does the conception of a permanent subject not less than that of a permanent object. As little from the side of knowledge is it likely that any theory will find acceptance which reduces all thought to a process of analysis and the discovery of abstract identity. There is no logical principle which requires that we should derive qualitative change by logical analysis from quantitative difference. Everywhere experience is synthetic: it gives us multiplicity in unity. Explanation of it does not require the annihilation of all differences but the apprehension of them in organic relation to one another and to the whole to which they belong. It was, as we have seen, this conception of thought as essentially synthetic for which Kant paved the way in his polemic against the formalism of his continental predecessors. The revival as in the above argument of the idea that the function of thought is the elimination of difference, and that rational connexion must fail where absolute identity is indiscoverable merely shows how imperfectly Kant's lesson has been learned by some of those who prophesy in his name.

Finally, apart from these more academic arguments there is an undoubted paradox in a theory which, at a moment when in whatever direction we look the best inspiration in poetry, sociology and physical science comes from the idea of the unity of the world, gives in its adhesion to pluralism on the ground of its preponderating practical value.

On the other hand, idealism would be false to itself if it interpreted the unity which it thus seeks to establish in any sense that is incompatible with the validity of moral distinctions and human responsibility in the fullest sense of the term. It would on its side be, indeed, a paradox if at a time when the validity of human ideals and the responsibility of nations and individuals to realize them is more universally recognized than ever before on our planet, the philosophical theory which hitherto has been chiefly identified with their vindication should be turned against them. Yet the depth and extent of the dissatisfaction are sufficient evidence that the most recent developments are not free from ambiguity on this vital issue.

What is thus suggested is not a rash departure from the general point of view of idealism (by its achievements in every field to which it has been applied, "stat mole sua") but a cautious inquiry into the possibility of reaching a conception of the world in which a place can be found at once for the idea of unity and determination and of movement and freedom. Any attempt here to anticipate what the course of an idealism inspired by such a spirit of caution and comprehension is likely to be cannot but appear dogmatic.

Yet it may be permitted to make a suggestion. Taking for granted the unity of the world idealism is committed to interpret it as spiritual as a unity of spirits. This is implied in the phrase by which it has sought to signalize its break with Spinozism: "from substance to subject." The universal or infinite is one that

realizes itself in finite particular minds and wills, not as accidents or imperfections of it, but as its essential form. These on their side, to be subject in the true sense must be conceived of as possessing a life which is truly their own, the expression of their own nature as self-determinant. In saying subject we say self, in saying self we say free creator. No conception of the infinite can therefore be true which does not leave room for movement, process, free creation. Oldness, sameness, permanence of principle and direction, these must be, otherwise there is *nothing*; but newness of embodiment, existence, realization also, otherwise nothing *is*.

Now it is just to these implications in the idea of spirit that some of the prominent recent expositions of Idealism seem to have failed to do justice. They have failed particularly when they have left the idea of "determination" unpurged of the suggestion of time succession. The very word lends itself to this mistake. Idealists have gone beyond others in asserting that the subject in the sense of a being which merely repeats what has gone before is timeless. This involves that its activity cannot be truly conceived of as included in an antecedent, as an effect in a cause or one term of an equation in the other. As the activity of a subject or spirit it is essentially a new birth. It is this failure that has led to the present revolt against a "block universe." But the difficulty is not to be met by running to the, opposite extreme in the assertion of a loose and ramshackle one. This is merely another way of perpetuating the mistake of allowing the notion of determination by an *other* or a preceding to continue to dominate us in a region where we have in reality passed from it to the notion of determination by self or by self-acknowledged ideals. As the correction from the one side consists in a more whole-hearted acceptance of the conception of determination by an ideal as the essence of mind, so from the other side it must consist in the recognition of the valuelessness of a freedom which does not mean submission to a self-chosen, though not self-created, law.

The solution here suggested is probably more likely to meet with opposition from the side of Idealism than of Pragmatism. It involves, it will be said, the reality of time, the dependence of the Infinite in the finite, and therewith a departure from the whole line of Hegelian thought. (1) It does surely involve the reality of time in the sense that it involves the reality of existence, which it is agreed is process. Without process the eternal is not complete or, if eternity means completeness, is not truly eternal. Our mistake lies in abstraction of the one from the other, which, as always, ends in confusion of the one with the other. Truth lies in giving each its place. Not only does eternity assert the conception of the hour but the hour asserts the conception of eternity—with what adequacy is another question. (2) The second of the above objections takes its point from the contradiction to religious consciousness which seems to be involved. This is certainly a mistake. Religious consciousness asserts, no doubt, that God is necessary to the soul: from Him as its inspiration, to Him as its ideal are all things. But it asserts with equal emphasis that the soul is necessary to God. To declare itself an unnecessary creation is surely on the part of the individual soul the height of impiety. God lives in the soul as it in Him. He also might say, from it as His offspring, to it as the object of His outgoing love are all things. (3) It is a mistake to attribute to Hegel the doctrine that time is an illusion. If in a well-known passage (*Logic* § 212) he seems to countenance the Spinoxistic view he immediately corrects it by assigning an "actualizing force" to this illusion and making it a "necessary dynamic element of truth." Consistently with this we have the conclusion stated in the succeeding section on the Will. "Good, the final end of the world, has being only while it constantly produces itself. And the world of the spirit and the world of nature continue to have this distinction, that the latter moves only in a recurring cycle while the former certainly also makes progress." The mistake is not Hegel's but ours. It is to be remedied not by giving up the idea of the Infinite but by ceasing to think of the Infinite as of a being endowed with a static perfection which the finite will merely reproduces, and definitely recognizing the forward effort of the finite as an essential element in Its self-expression. If there be any truth in this suggestion it seems likely that the last word of idealism, like the first, will prove to be that the type of the highest reality is to be sought for not in any fixed Parmenidean circle of achieved being but in an ideal of good which while never fully expressed under the form of time can never become actual and so fulfil itself under any other.

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See also Ethics and Metaphysics.

(J. H. Mu.)

1 *Kritik d. reinen Vernunft*, p. 197 (ed. Hartenstein).

2 *Institutes of Metaphysics* (1854); *Works* (1866).

3 *Secret of Hegel* (1865).

4 *Dialogues of Plato* (1871).

5 *Journal of Spec. Phil.* (1867).

6 Hume's *Phil. Works* (1875).

7 *Critical account of the Phil. of Kant* (1877).

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10 *Studies in Hegelian Cosmology* (1901).

11 *Elements of Metaphysics* (1903).

12 *The World and the individual* (1901).

13 See *Mind*, New Series, xii. p. 433 sqq.

14 *Proceedings* of the Aristotelian Society (1900-1901), p. 110.

15 *Mind*, New Series, xiii. p. 523; cf. 204, 350.

16 The most striking statement of this argument is to be found in Boutroux's treatise *De la contingence des lois de la nature*, first published in 1874 and reprinted without alteration in 1905. The same general line of thought underlies James Ward's *Naturalism and Agnosticism* (2nd ed., 1903), and A. J. Balfour's *Foundations of Belief* (8th ed., 1901). H. Bergson's works on the other hand contain the elements of a reconstruction similar in spirit to the suggestions of the present article.

IDELER, CHRISTIAN LUDWIG (1766-1846), German chronologist and astronomer, was born near Perleberg on the 21st of September 1766. After holding various official posts under the Prussian government he became professor at the university of Berlin in 1821, and eighteen years later foreign member of the Institute of France. From 1816 to 1822 he was tutor to the young princes William Frederick and Charles. He died in Berlin on the 10th of August 1846. He devoted his life chiefly to the examination of ancient systems of chronology. In 1825-1826 he published his great work, *Handbuch der mathematischen und technischen Chronologie* (2 vols.; 2nd ed., 1883), re-edited as *Lehrbuch der Chronologie* (1831); a supplementary volume, *Die Zeitrechnung der Chinesen*, appeared in 1839. Beside these important works he wrote also *Untersuchungen über d. Ursprung und d. Bedeutung d. Sternnamen* (1809) and *Über d. Ursprung d. Thierkreises* (1838). With Nolte he published handbooks on English and French language and literature. His son, Julius Ludwig Ideler (1809-1842), wrote *Meteorologia veterum Graecorum et Romanorum* (1832).

IDENTIFICATION (Lat. *idem*, the same), the process of proving any one's identity, *i.e.* that he is the man he purports to be, or—if he is pretending to be some one else—the man he really is; or in case of dispute, that he is the man he is alleged to be. As more strenuous efforts have been made for the pursuit of criminals, and more and more severe penalties are inflicted on old offenders, means of identification have become essential, and various processes have been tried to secure that desirable end. For a long time they continued to be most imperfect; nothing better was devised than rough and ready methods of recognition depending upon the memories of officers of the law or the personal impressions of witnesses concerned in the case, supplemented in more recent years by photographs, not always a safe and unerring guide. The machinery employed was cumbrous, wasteful of time and costly. Detective policemen were marched in a body to inspect arrested prisoners in the exercising yards of the prison. Accused persons were placed in the midst of a number of others of approximately like figure and appearance, and the prosecutor and witnesses were called in one by one to pick out the offender. Inquiries, with a detailed description of distinctive marks, and photographs were circulated far and wide to local police forces. Officers, police and prison wardens were despatched in person to give evidence of identity at distant courts. Mis-identification was by no means rare. Many remarkable cases may be quoted. One of the most notable was that of the Frenchman Lesurques, in the days of the Directory, who was positively identified as having robbed the Lyons mail and suffered death, protesting his innocence of the crime, which was afterwards brought home to another man, Duboscq, and this terrible judicial error proved to be the result of the extraordinary likeness between the two men. Another curious case is to be found in American records, when a man was indicted for bigamy as James Hoag, who averred that he was really Thomas Parker. There was a marvellous conflict of testimony, even wives and families and personal friends being misled, and there was a narrow escape of mis-identification. The leading modern case in England is that of Adolf Beck (1905). Beck (who eventually died at the end of 1909) was arrested on the complaint of a number of women who positively swore to his identity as Smith, a man who had defrauded them. An ex-policeman who had originally arrested Smith also swore that Beck was the same man. There was a grave miscarriage of justice. Beck was sentenced to penal servitude, and although a closer examination of the personal marks showed that Beck could not possibly be Smith, it was only after a scandalous delay, due to the obstinacy of responsible officials, that relief was afforded. It has to be admitted that evidence as to identity based on personal impressions is perhaps of all classes of evidence the least to be relied upon.

Such elements of uncertainty cannot easily be eliminated from any system of jurisprudence, but some improvements in the methods of identification have been introduced in recent years. The first was in the adoption of anthropometry (*q.v.*), which was invented by the French savant, A. Bertillon. The reasons that led to its general supersession may be summed up in its costliness, the demand for superior skill in subordinate agents and the liability to errors not easy to trace and correct. A still more potent reason remained, the comparative failure of results. It was found in the first four years of its use in England and Wales that an almost inappreciable number of identifications were effected by the anthropometric system; namely, 152 in 1898, 243 in 1899, 462 in 1900, and 503 in 1901, the year in which it was supplemented by the use of "finger prints" (*q.v.*). The figures soon increased by leaps and bounds. In 1902 the total number of searches among the records were 6826 and the identifications 1722 for London and the provinces; in 1903 the searches were 11,919, the identifications 3642; for the first half of 1904 the searches were 6697 and the identifications 2335. In India and some of the colonies the results were still more remarkable; the recognitions in 1903 were 9512, and 17,289 in 1904. Were returns available from other countries very similar figures would no doubt be shown. Among these countries are Ireland, Australasia, Ceylon, South Africa, and many great cities of the United States; and the system is extending to Germany, Austria-Hungary and other parts of Europe.

The record of finger prints in England and Wales is kept by the Metropolitan police at New Scotland Yard. They were at first limited to persons convicted at courts at quarter sessions and assizes and to all persons sentenced at minor courts to more than a month without option of fine for serious offences. The finger prints when taken by prison warders are forwarded to London for registration and reference on demand. The total number of finger-print slips was 70,000 in 1904, and weekly additions were being made at the rate of 350 slips. The advantages of the record system need not be emphasized. By its means identification is prompt, inevitable and absolutely accurate. By forwarding the finger prints of all remanded prisoners to New Scotland Yard, their antecedents are established beyond all hesitation.

In past times identification of criminals who had passed through the hands of the law was compassed by branding, imprinting by a hot iron, or tattooing with an indelible sign, such as a crown, fleur de lys or initials upon the shoulder or other part of the body. This practice, long since abandoned, was in a measure continued in the British army, when offenders against military law were ordered by sentence of court-martial to be marked with "D" for deserter and "B.C." bad character; this ensured their recognition and prevented re-enlistment; but all such penalties have now disappeared.

(A. G.)

IDEOGRAPH (Gr. ἰδέα, idea, and γράφειν, to write), a symbol or character painted, written or inscribed, representing ideas and not sounds; such a form of writing is found in Chinese and in most of the Egyptian hieroglyphs (see WRITING).

IDIOBLAST (Gr. ἴδιος, peculiar, and βλαστός, a shoot), a botanical term for an individual cell which is distinguished by its shape, size or contents, such as the stone-cells in the soft tissue of a pear.

IDIOM (Gr. ἰδίωμα, something peculiar and personal; ἴδιος, one's own, personal), a form of expression whether in words, grammatical construction, phraseology, &c., which is peculiar to a language; sometimes also a special variety of a particular language, a dialect.

IDIOSYNCRASY (Gr. ἰδιοσυγρασία, peculiar habit of body or temperament; ἴδιος, one's own, and σύγκρασις, blending, tempering, from συγκεράννυσθαι, to put together, compound, mix), a physical or mental condition peculiar to an individual usually taking the form of a special susceptibility to particular stimuli; thus it is an idiosyncrasy of one individual that abnormal sensations of discomfort should be excited by certain odours or colours, by the presence in the room of a cat, &c.; similarly certain persons are found to be peculiarly responsive or irresponsive to the action of particular drugs. The word is also used, generally, of any eccentricity or peculiarity of character, appearance, &c.

IDOLATRY, the worship (Gr. λατρεία) of idols (Gr. εἴδωλον), *i.e.* images or other objects, believed to represent or be the abode of a superhuman personality. The term is often used generically to include such varied, forms as litholatry, dendrolatry, pyrolatry, zoolatry and even necrolatry. In an age when the study of religion was practically confined to Judaism and Christianity, idolatry was regarded as a degeneration from an uncorrupt primeval faith, but the comparative and historical investigation of religion has shown it to be rather a stage of an upward movement, and that by no means the earliest. It is not found, for instance, among Bushmen, Fuegians, Eskimos, while it reached a high development among the great civilizations of the ancient world in both hemispheres.[1] Its earliest stages are to be sought in naturism and animism. To give concreteness to the vague ideas thus worshipped the idol, at first rough and crude, comes to the help of the savage, and in course of time through inability to distinguish subjective and objective, comes to be identified with the idea it originally symbolized. The degraded form of animism known as fetichism is usually the direct antecedent of idolatry. A fetich is adored, not for itself, but for the spirit who dwells in it and works through it. Fetiches of stone or wood were at a very early age shaped and polished or coloured and ornamented. A new step was taken when the top of the log or stone was shaped like a human head; the rest of the body soon followed. The process can be followed with some distinctness in Greece. Sometimes, as in Babylonia and India, the representation combined human and animal forms, but the human figure is the predominant model; man makes God after his own image.

Idols may be private and personal like the teraphim of the Hebrews or the little figures found in early Egyptian tombs, or—a late development, public and tribal or national. Some, like the ancestral images among the Maoris, are the intermittent abodes of the spirits of the dead.

As the earlier stages in the development of the religious consciousness persist and are often manifest in idolatry, so in the higher stages, when men have attained loftier spiritual ideas, idolatry itself survives and is abundantly visible as a reactionary tendency. The history of the Jewish people whom the prophets sought, for long in vain, to wean from worshipping images is an illustration: so too the vulgarities of modern popular Hinduism contrasted with the lofty teaching of the Indian sacred books.

In the New Testament the word εἰδωλολατρεία (*idololatria*, afterwards shortened occasionally to εἰδολατρεία, *idolatria*) occurs in all four times, viz. in 1 Cor. x. 14; Gal. v. 20; 1 Peter iv. 3; Col. iii. 5. In the last of these passages it is used to describe the sin of covetousness or "mammon-worship." In the other places it indicates with the utmost generality all the rites and practices of those special forms of paganism with which Christianity first came into collision. It can only be understood by reference to the LXX., where εἴδωλον (like the word "idol" in A.V.) occasionally translates indifferently no fewer than sixteen words by which in the Old Testament the objects of what the later Jews called "strange worship" (עבודה זרה) are denoted (see *Encyclopaedia Biblica*). In the widest acceptation of the word, idolatry in any form is absolutely forbidden in the second commandment, which runs "Thou shalt not make unto thee a graven image; [and] to no visible shape in heaven above, or in the earth beneath, or in the water under the earth, shalt thou bow down or render service" (see Decalogue). For some account of the questions connected with the breaches of this law which are recorded in the history of the Israelites see the article Jews; those differences as to the interpretation of the prohibition which have so seriously divided Christendom are discussed under the head of Iconoclasts.

In the ancient church, idolatry was naturally reckoned among those *magna crimina* or great crimes against the first and second commandments which involved the highest ecclesiastical censures. Not only were those who had gone openly to heathen temples and partaken in the sacrifices (*sacrificati*) or burnt incense (*thurificati*) held guilty of this crime; the same charge, in various degrees, was incurred by those whose renunciation of idolatry had been private merely, or who otherwise had used unworthy means to evade persecution, by those also who had feigned themselves mad to avoid sacrificing, by all promoters and encouragers of idolatrous rites, and by idol makers, incense sellers and architects or builders of structures connected with idol worship. Idolatry was made a crime against the state by the laws of Constantius (*Cod. Theod.* xvi. 10. 4, 6), forbidding all sacrifices on pain of death, and still more by the statutes of Theodosius (*Cod. Theod.* xvi. 10. 12) enacted in 392, in which sacrifice and divination were declared treasonable and punishable with death; the use of lights, incense, garlands and libations was to involve the forfeiture of house and land where they were used; and all who entered heathen temples were to be fined. See Bingham, *Antiqq.* bk. xvi. c. 4.

See also Image-worship; and on the whole question, Religion.

1 According to Varro the Romans had no animal or human image of a god for 170 years after the founding of the city; Herodotus (i. 131) says the Persians had no temples or idols before Artaxerxes I.; Lucian (*De sacrif.* 11) bears similar testimony for Greece and as to idols (*Dea Syr.* 3) for Egypt. Eusebius (*Praep. Evang.* i. 9) sums up the theory of antiquity in his statement "the oldest peoples had no idols." Images of the gods indeed presuppose a definiteness of conception and powers of discrimination that could only be the result of history and reflection. The iconic age everywhere succeeded to an era in which the objects of worship were aniconic, *e.g.* wooden posts, stone steles, cones.

IDOMENEUS, in Greek legend, son of Deucalion, grandson of Minos and Pasiphaë, and king of Crete. As a descendant of Zeus and famous for his beauty, he was one of the suitors of Helen; hence, after her abduction by Paris, he took part in the Trojan War, in which he distinguished himself by his bravery. He is mentioned as a special favourite of Agamemnon (*Iliad*, iv. 257). According to Homer (*Odyssey*, iii. 191), he returned home safely with all his countrymen who had survived the war, but later legend connects him with an incident similar to that of Jephtha's daughter. Having been overtaken by a violent storm, to ensure his

safety he vowed to sacrifice to Poseidon the first living thing that met him when he landed on his native shore. This proved to be his son, whom he slew in accordance with his vow; whereupon a plague broke out in the island, and Idomeneus was driven out. He fled to the district of Sallentum in Calabria, and subsequently to Colophon in Asia Minor, where he settled near the temple of the Clarian Apollo and was buried on Mount Cercaphus (Virgil, *Aeneid*, iii. 121, 400, 531, and Servius on those passages). But the Cretans showed his grave at Cnossus, where he was worshipped as a hero with Meriones (Diod. Sic. v. 79).

IDRIA, a mining town in Carniola, Austria, 25 m. W. of Laibach. Pop. (1900) 5772. It is situated in a narrow Alpine valley, on the river Idria, an affluent of the Isonzo, and owes its prosperity to the rich mines of quicksilver which were accidentally discovered in 1497. Since 1580 they have been under the management of the government. The mercurial ore lies in a bed of clay slate, and is found both mingled with schist and in the form of cinnabar. A special excellence of the ore is the greatness of the yield of pure metal compared with the amount of the refuse. As regards the quantity annually extracted, the mines of Idria rank second to those of Almaden in Spain, which are the richest in the world.

IDRIALIN, a mineral wax accompanying the mercury ore in Idria. According to Goldschmidt it can be extracted by means of xylol, amyl alcohol or turpentine; also without decomposition, by distillation in a current of hydrogen, or carbon dioxide. It is a white crystalline body, very difficultly fusible, boiling above 440° C. (824° F.), of the composition $C_{40}H_{28}O$. Its solution in glacial acetic acid, by oxidation with chromic acid, yielded a red powdery solid and a fatty acid fusing at 62° C., and exhibiting all the characters of a mixture of palmitic and stearic acids.

IDRISI, or Edrisi [Abu Abdallah Mahommed Ibn Mahommed Ibn Abdallah Ibn Idrisi, *c.* A.D. 1099-1154], Arabic geographer. Very little is known of his life. Having left Islamic lands and become the courtier and panegyrist of a Christian prince, though himself a descendant of the Prophet, he was probably regarded by strict Moslems as a scandal, whose name should not, if possible, be mentioned. His great-grandfather, Idrisi II., "Biamrillah," a member of the great princely house which had reigned for a time as caliphs in north-west Africa, was prince of Malaga, and likewise laid claim to the supreme title (Commander of the Faithful). After his death in 1055, Malaga was seized by Granada (1057), and the Idrisi family then probably migrated to Ceuta, where a freedman of theirs held power. Here the geographer appears to have been born in A.H. 493 (A.D. 1099). He is said to have studied at Cordova, and this tradition is confirmed by his elaborate and enthusiastic description of that city in his geography. From this work we know that he had visited, at some period of his life before A.D. 1154, both Lisbon and the mines of Andalusia. He had also once resided near Morocco city, and once was at (Algerian) Constantine. More precisely, he tells us that in A.D. 1117 he went to see the cave of the Seven Sleepers at Ephesus; he probably travelled extensively in Asia Minor. From doubtful readings in his text some have inferred that he had seen part of the coasts of France and England. We do not know when Roger II. of Sicily (1101-1154) invited him to his court, but it must have been between 1125 and 1150. Idrisi made for the Norman king a celestial sphere and a disk representing the known world of his day—both in silver. These only absorbed one-third of the metal that had been given him for the work, but Roger bestowed on him the remaining two-thirds as a present, adding to this 100,000 pieces of money and the cargo of a richly-laden ship from Barcelona. Roger next enlisted Idrisi's services in the compilation of a fresh description of the "inhabited earth" from observation, and not merely from books. The king and his geographer chose emissaries whom they sent out into various countries to observe, record and design; as they returned, Idrisi inserted in the new geography the information they brought. Thus was gradually completed (by the month of Shawwal, A.H. 548 = mid-January, A.D. 1154), the famous work, best known, from its patron and originator, as *Al Rojari*, but whose fullest title seems to have been, *The going out of a Curious Man to explore the Regions of the Globe, its Provinces, Islands, Cities and their Dimensions and Situation*. This has been abbreviated to *The Amusement of him who desires to traverse the Earth*, or *The Relaxation of a Curious Mind*. The title of *Nubian Geography*, based upon Sionita and Hezronita's misreading of a passage relating to Nubia and the Nile, is entirely unwarranted and misleading. The *Rogerian Treatise* contains a full description of the world as far as it was known to the author. The "inhabited earth" is divided into seven "climates," beginning at the equinoctial line, and extending northwards to the limit at which the earth was supposed to be rendered uninhabitable by cold. Each climate is then divided by perpendicular lines into eleven equal parts, beginning with the western coast of Africa and ending with the eastern coast of Asia. The whole world is thus formed into seventy-seven equal square compartments. The geographer begins with the first part of the first climate, including the westernmost part of the Sahara and a small (north-westerly) section of the Sudan (of which a vague knowledge had now been acquired by the Moslems of Barbary), and thence proceeds eastward through the different divisions of this climate till he finds its termination in the Sea of China. He then returns to the first part of the second climate, and so proceeds till he reaches the eleventh part of the seventh climate, which terminates in north-

east Asia, as he conceives that continent. The inconveniences of the arrangement (ignoring all divisions, physical, political, linguistic or religious, which did not coincide with those of his "climates") are obvious.

Though Idrisi was in such close relations with one of the most civilized of Christian courts and states, we find few traces of his influence on European thought and knowledge. The chief exception is perhaps in the delineation of Africa in the world-maps of Marino Sanuto (*q.v.*) and Pietro Vesconte. His account of the voyage of the *Maghrurin* or "Deceived Men" of Lisbon in the Atlantic (a voyage on which they seem to have visited Madeira and one of the Canaries) may have had some effect in stimulating the later ocean enterprise of Christian mariners; but we have no direct evidence of this. Idrisi's Ptolemaic leanings give a distinctly retrograde character to certain parts of his work, such as east Africa and south Asia; and, in spite of the record of the Lisbon Wanderers, he fully shares the common Moslem dread of the black, viscous, stormy and wind-swept waters of the western ocean, whose limits no one knew, and over which thick and perpetual darkness brooded. At the same time his breadth of view, his clear recognition of scientific truths (such as the roundness of the world) and his wide knowledge and intelligent application of preceding work (such as that of Ptolemy, Masudi and Al Jayhani) must not be forgotten. He also preserves and embodies a considerable amount of private and special information—especially as to Scandinavia (in whose delineation he far surpasses his predecessors), portions of the African coast, the river Niger (whose name is perhaps first to be found, after Ptolemy's doubtful Nigeir, in Idrisi), portions of the African coast, Egypt, Syria, Italy, France, the Adriatic shore-lands, Germany and the Atlantic islands. No other Arabic work contains a larger assortment of valuable geographical facts; unfortunately the place-names are often illegible or hopelessly corrupted in the manuscripts. Idrisi's world-map, with all its shortcomings, is perhaps the best product of that strangely feeble thing—the Mahommedan cartography of the middle ages.

Besides the *Rojari*, Idrisi wrote another work, largely geographical, cited by Abulfida as *The Book of Kingdoms*, but apparently entitled by its author *The Gardens of Humanity and the Amusement of the Soul*. This was composed for William the Bad (1154-1166), son and successor of Roger II., but is now lost. He likewise wrote, according to Ibn Said, on *Medicaments*, and composed verses, which are referred to by the Sicilian Mahommedan poet Ibn Bashrun.

Two manuscripts of Idrisi exist in the Bibliothèque Nationale, Paris, and other two in the Bodleian Library, Oxford. One of the English MSS., brought from Egypt by Greaves, is illustrated by a map of the known world, and by thirty-three sectional maps (for each part of the first three climates). The second manuscript, brought by Pococke from Syria, bears the date of A.H. 906, or A.D. 1500. It consists of 320 leaves, and is illustrated by one general and seventy-seven particular maps, the latter consequently including all the parts of every climate. The general map was published by Dr Vincent in his *Periplus of the Erythraean Sea*. A copy of Idrisi's work in the Escorial was destroyed by the fire of 1671.

An epitome of Idrisi's geography, in the original Arabic, was printed, with many errors, in 1592 at the Medicean press in Rome, from a MS. preserved in the Grand Ducal library at Florence (*De geographia universali. Hortulus cultissimus ...*). Even the description of Mecca is here omitted. Pococke supplied it from his MS. In many bibliographical works this impression has been wrongly characterized as one of the rarest of books. In 1619 two Maronite scholars, Gabriel Sionita, and Joannes Hezronita, published at Paris a Latin translation of this epitome (*Geographia Nubiensis, id est, accuratissima totius orbis in VII. climata divisi descriptio*). Besides its many inaccuracies of detail, this edition, by its unlucky title of *Nubian Geography*, started a fresh and fundamental error as to Idrisi's origin; this was founded on a misreading of a passage where Idrisi describes the Nile passing into Egypt through Nubia—not "*terram nostram*," as this version gives, but "*terram illius*" is here the true translation. George Hieronymus Velschius, a German scholar, had prepared a copy of the Arabic original, with a Latin translation, which he purposed to have illustrated with notes; but death interrupted this design, and his manuscript remains in the university library of Jena. Casiri (*Bib. Ar. Hisp.* ii. 13) mentions that he had determined to re-edit this work, but he appears never to have executed his intention. The part relating to Africa was ably edited by Johann Melchior Hartmann (*Commentatio de geographia Africae Edrisiana*, Göttingen, 1791, and *Edrisii Africa*, Göttingen, 1796), Here are collected the notices of each region in other Moslem writers, so as to form, for the time, a fairly complete body of Arabic geography as to Africa. Hartmann afterwards published Idrisi's Spain (*Hispania*, Marburg, 3 vols., 1802-1818).

An (indifferent) French translation of the whole of Idrisi's geography (the only complete version which has yet appeared), based on one of the MSS. of the Bibliothèque Nationale, Paris, was published by Amédée Jaubert in 1836-1840, and forms volumes v. and vi. of the *Recueil de voyages* issued by the Paris Société de Géographie; but a good and complete edition of the original text is still a desideratum. A number of Oriental scholars at Leiden determined in 1861 to undertake the task. Spain and western Europe were assigned to Dozy; eastern Europe and western Asia to Engelmann; central and eastern Asia to Defrémery; and Africa to de Goeje. The first portion of the work appeared in 1866, under the title of *Description de l'Afrique et de l'Espagne par Edrisi, texte arabe, publié avec une traduction, des notes et un glossaire par R. Dozy et M. J. de Goeje* (Leiden, E. J. Brill, 1866); but the other collaborators did not furnish their quota. Other parts of Idrisi's work have been separately edited; *e.g.* "Spain" (*Descripcion de España de ... Aledris*), by J. A. Condé, in Arabic and Spanish (Madrid, 1799); "Sicily" (*Descrizione della Sicilia ... di Elidris*), by P. D. Magri and F. Tardia (Palermo, 1764); "Italy" (*Italia descritta nel "libro del Re Ruggero," compilato da Edrisi*), by M. Amari and C. Schiaparelli, in Arabic and Italian (Rome, 1883); "Syria" (*Syria descripta a ... El Edrisio ...*), by E. F. C. Rosenmüller, in Arabic and Latin, 1825, and (*Idrisii ... Syria*), by J. Gildemeister (Bonn, 1885) (the last a Beilage to vol. viii. of the *Zeitschrift d. deutsch. Palästina-Vereins*). See also M. Casiri, *Bibliotheca Arabico-Hispana Escurialensis* (2 vols., Madrid, 1760-1770); V. Lagus, "Idrisii notitiam terrarum Balticarum ex commerciis Scandinavorum et Italorum ... ortam esse" in *Atti del IV° Congresso internaz. degli orientalisti in Firenze*, p. 395 (Florence, 1880); R. A. Brandel "Om och ur den arabiske geografen Idrisi," *Akad. afhand.* (Upsala, 1894).

(C. R. B.)

IDUMAEA (Ἰδουμαῖα), the Greek equivalent of Edom (אדום), a territory which, in the works of the Biblical writers, is considered to lie S.E. of the Dead Sea, between the land of Moab and the Gulf of Akaba. Its name, which is connected with the root meaning "red," is probably applied in reference to the red sandstone ranges of the mountains of Petra.[1] This etymology, however, is not certain. The apparently theophorous name Obed-Edom (2 Sam. vi. 10) shows that Edom is the name of a divinity. Of this there is other evidence; a Leiden papyrus names Etum as the wife of the Semitic fire-god Reshpu.

The early history of Edom is hidden in darkness. The Egyptian references to it are few, and do not give us much light regarding its early inhabitants. In the early records of the Pentateuch, the country is often referred to by the name of Seir, the general name for the whole range of mountains on the east side of the Jordan-Araba depression south of the Dead Sea. These mountains were occupied, so early as we can find any record, by a cave-dwelling aboriginal race known as Horites, who were smitten by the much-discussed king Chedorlaomer (Gen. xiv. 6) and according to Deut. ii. 22 were driven out by the Semitic tribes of Esau's descendants. The Horites are to us little more than a name, though the discovery of cave-dwellers of very early date at Gezer in the excavations of 1902-1905 has enabled us to form some idea as to their probable culture-status and physical character.

The occupants of Edom during practically the whole period of Biblical history were the Bedouin tribes which claimed descent through Esau from Abraham, and were acknowledged by the Israelites (Deut. xxiii. 7) as kin. That they intermarried with the earlier stock is suggested by the passage in Gen. xxxvi. 2, naming, as one of the wives of Esau, Oholibamah, daughter of Zibeon the Horite (corrected by verse 20). Among the peculiarities of the Edomites was government by certain officials known as אלופים[2] which the English versions (by too close a reminiscence of the Vulgate *duces*) translate "dukes." The now naturalized word "sheikhs" would be the exact rendering. In addition to this Bedouin organization there was the curious institution of an elective monarchy, some of whose kings are catalogued in Gen. xxxvi. 31-39 and 1 Chron. i. 43-54. These kings reigned at some date anterior to the time of Saul. No deductions as to their chronology can be based on the silence regarding them in Moses' song, Exodus xv. 15. There was a king in Edom (Num. xx. 14) who refused passage to the Israelites in their wanderings.

The history of the relations of the Edomites and Israelites may be briefly summarized. Saul, whose chief herdsman, Doeg, was an Edomite (1 Sam. xxi. 7), fought successfully against them (1 Sam. xiv. 47). Joab (1 Kings xi. 16) or Abishai, as his deputy (1 Chron. xviii. 11, 13), occupied Edom for six months and devastated it; it was garrisoned and permanently held by David (2 Sam. viii. 14). But a refugee named Hadad, who escaped as a child to Egypt and grew up at the court of the Egyptian king, returned in Solomon's reign and made a series of reprisal raids on the Israelite territory (1 Kings xi. 14). This did not prevent Solomon introducing Edomites into his harem (1 Kings xi. 1) and maintaining a navy at Ezion-geber, at the head of the Gulf of Akaba (1 Kings ix. 26). Indeed, until the time of Jehoram, when the land revolted (2 Kings viii. 20, 22), Edom was a dependency of Judah, ruled by a viceroy (1 Kings xxii. 47). An attempt at recovering their independence was temporarily quelled in a campaign by Amaziah (2 Kings xiv. 7), and Azariah his successor was able to renew the sea trade of the Gulf of Akaba (2 Kings xiv. 22) which had probably languished since the wreck of Jehoshaphat's ships (1 Kings xxii. 48); but the ancient kingdom had been re-established by the time of Ahaz, and the king's name, Kaush-Malak, is recorded by Tiglath Pileser. He made raids on the territory of Judah (2 Chron. xxviii. 17). The kingdom, however, was short-lived, and it was soon absorbed into the vassalage of Assyria.

The later history of Edom is curious. By the constant westward pressure of the eastern Arabs, which (after the restraining force of the great Mesopotamian kingdoms was weakened) assumed irresistible strength, the ancient Edomites were forced across the Jordan-Araba depression, and with their name migrated to the south of western Palestine. In 1 Maccabees v. 65 we find them at Hebron, and this is one of the first indications that we discover of the cis-Jordanic Idumaea of Josephus and the Talmud.

Josephus used the name Idumaea as including not only Gobalitis, the original Mount Seir, but also Amalekitis, the land of Amalek, west of this, and Akrabatine, the ancient Acrabbim, S.W. of the Dead Sea. In *War* IV. viii. 1, he mentions two villages "in the very midst of Idumaea," named Betaris and Caphartobas. The first of these is the modern Beit Jibrin (see Eleutheropolis), the second is Tuffūḥ, near Hebron. Jerome describes Idumaea as extending from Beit Jibrin to Petra, and ascribes the great caves at the former place to cave-dwellers like the aboriginal Horites. Ptolemy's account presents us with the last stage, in which the name Idumaea is entirely restricted to the cis-Jordanic district, and the old trans-Jordanic region is absorbed in Arabia.

The Idumaean Antipater was appointed by Julius Caesar procurator of Judaea, Samaria and Galilee, as a reward for services rendered against Pompey. He was the father of Herod the Great, whose family thus was Idumaean in origin. (See Palestine.)

(R. A. S. M.)

1 A curious etymological speculation connects the name with the story of Esau's begging for Jacob's pottage, Gen. xxv. 30.

2 The same word is used in the anonymous prophecy incorporated in the book of Zachariah (xii. 5), and in one or two other places as well, of *Hebrew* leaders.

IDUN, or Iduna, in Scandinavian mythology, the goddess of youth and spring. She was daughter of the dwarf Svald and wife of Bragi. She was keeper of the golden apples, the eating of which preserved to the gods their eternal youth. Loki, the evil spirit, kidnapped her and the apples, but was forced by the gods to

restore her liberty. Idun personifies the year between March and September, and her myth represents the annual imprisonment of spring by winter.

IDYL, or IDYLL (Gr. εἰδύλλιον, a descriptive piece, from εἶδος, a shape or style; Lat. *idyllium*), a short poem of a pastoral or rural character, in which something of the element of landscape is preserved or felt. The earliest commentators of antiquity used the term to designate a great variety of brief and homely poems, in which the description of natural objects was introduced, but the pastoral idea came into existence in connexion with the Alexandrian school, and particularly with Theocritus, Bion and Moschus, in the 3rd century before Christ. It appears, however, that εἰδύλλιον was not, even then, used consciously as the name of a form of verse, but as a diminutive of εἶδος, and merely signified "a little piece in the style of" whatever adjective might follow. Thus the idyls of the pastoral poets were εἰδύλλια αἰπολικά, little pieces in the goatherd style. We possess ten of the so-called "Idyls" of Theocritus, and these are the type from which the popular idea of this kind of poem is taken. But it is observable that there is nothing in the technical character of these ten very diverse pieces which leads us to suppose that the poet intended them to be regarded as typical. In fact, if he had been asked whether a poem was or was not an idyl he would doubtless have been unable to comprehend the question. As a matter of fact, the first of his poems, the celebrated "Dirge for Daphnis," has become the prototype, not of the modern idyl, but of the modern elegy, and the not less famous "Festival of Adonis" is a realistic mime. It was the six little epical romances, if they may be so called, which started the conception of the idyl of Theocritus. It must be remembered, however, that there is nothing in ancient literature which justifies the notion of a form of verse recognized as an "idyl." In the 4th century after Christ the word seems to have become accepted in Latin as covering short descriptive poems of very diverse characters, for the early MSS. of Ausonius contain a section of "Edyllia," which embraces some of the most admirable of the miscellaneous pieces of that writer. But that Ausonius himself called his poems "idyls" is highly doubtful. Indeed, it is not certain that the heading is not a mistake for "Epyllia." The word was revived at the Renaissance and applied rather vaguely to Latin and Greek imitations of Theocritus and of Virgil. It was also applied to modern poems of a romantic and pastoral character published by such writers as Tasso in Italy, Montemayor in Portugal and Ronsard in French. In 1658 the English critic, Edward Phillips, defined an "idyl" as "a kind of eclogue," but it was seldom used to describe a modern poem. Mme Deshoulières published a series of seven *Idylles* in 1675, and Boileau makes a vague reference to the form. The sentimental German idyls of Salomon Gessner (in prose, 1758) and Voss (in hexameters, 1800) were modelled on Theocritus. Goethe's *Alexis und Dora* is an idyl. It appears that the very general use, or abuse, of the word in the second half of the 19th century, both in English and French, arises from the popularity of two works, curiously enough almost identical in date, by two eminent and popular poets. The *Idylles héroïques* (1858) of Victor de Laprade and the *Idylls* of the King (1859) of Tennyson enjoyed a success in either country which led to a wide imitation of the title among those who had, perhaps, a very inexact idea of its meaning. Among modern Germans, Berthold Auerbach and Jeremias Gotthelf have been prominent as the composers of sentimental idyls founded on anecdotes of village-life. On the whole, it is impossible to admit that the idyl has a place among definite literary forms. Its character is vague and has often been purely sentimental, and our conception of it is further obscured by the fact that though the noun carries no bucolic idea with it in English, the adjective ("idyllic") has come to be synonymous with pastoral and rustic.

(E. G.)

IFFLAND, AUGUST WILHELM (1759-1814), German actor and dramatic author, was born at Hanover on the 19th of April 1759. His father intended his son to be a clergyman, but the boy preferred the stage, and at eighteen ran away to Gotha in order to prepare himself for a theatrical career. He was fortunate enough to receive instruction from Hans Ekhof, and made such rapid progress that he was able in 1779 to accept an engagement at the theatre in Mannheim, then rising into prominence. He soon stood high in his profession, and extended his reputation by frequently playing in other towns. In 1796 he settled in Berlin, where he became director of the national theatre of Prussia; and in 1811 he was made general director of all representations before royalty. Iffland produced the classical works of Goethe and Schiller with conscientious care; but he had little understanding for the drama of the romantic writers. The form of play in which he was most at home, both as actor and playwright, was the domestic drama, the sentimental play of everyday life. His works are almost entirely destitute of imagination; but they display a thorough mastery of the technical necessities of the stage, and a remarkable power of devising effective situations. His best characters are simple and natural, fond of domestic life, but too much given to the utterance of sentimental commonplace. His best-known plays are *Die Jäger*, *Dienstpflicht*, *Die Advokaten*, *Die Mündel* and *Die Hagestolzen*. Iffland was also a dramatic critic, and German actors place high value on the reasonings and hints respecting their art in his *Almanach für Theater und Theaterfreunde*. In 1798-1802 he issued his *Dramatischen Werke* in 16 volumes, to which he added an autobiography (*Meine theatralische Laufbahn*). In 1807-1809 Iffland brought out two volumes of *Neue dramatische Werke*. Selections from his writings were afterwards published, one in 11 (Leipzig, 1827-1828), the other in 10 volumes (Leipzig, 1844, and again 1860). As an actor, he was conspicuous for his brilliant portrayal of comedy parts. His fine gentlemen, polished men of the world, and distinguished princes were models of perfection, and showed none of the traces of elaborate study which were noticed in his interpretation of tragedy. He especially excelled in presenting those types of middle-class life which appear in his own comedies. Iffland died at Berlin on the

22nd of September 1814. A bronze portrait statue of him was erected in front of the Mannheim theatre in 1864.

See K. Duncker, *Iffland in seinen Schriften als Künstler, Lehrer, und Direktor der Berliner Bühne* (1859); W. Koffka, *Iffland und Dalberg* (1865); and Lampe, *Studien über Iffland als Dramatiker* (Celle, 1899). Iffland's interesting autobiography, *Meine theatralische Laufbahn*, was republished by H. Holstein in 1885.

IGLAU (Czech *Jihlava*), a town of Austria, in Moravia, 56 m. N.W. of Brünn by rail. Pop. (1900) 24,387, of whom 4200 are Czechs and the remainder Germans. Iglau is situated on the Iglawa, close to the Bohemian frontier, and is one of the oldest towns in Moravia, being the centre of a German-speaking enclave. Among the principal buildings are the churches of St Jakob, St Ignatius, St John and St Paul, the town-hall, and the barracks formed from a monastery suppressed under the emperor Joseph II. There is also a fine cemetery, containing some remarkable monuments. It has the principal tobacco and cigar factory of the state monopoly, which employs about 2500 hands, and has besides a large and important textile and glass industry, corn and saw-mills, pottery and brewing. Fairs are periodically held in the town; and the trade in timber, cereals, and linen and woollen goods is generally brisk.

Iglau is an old mining town where, according to legend, the silver mines were worked so early as 799. King Ottakar I. (1198-1230) established here a mining-office and a mint. At a very early date it enjoyed exceptional privileges, which were confirmed by King Wenceslaus I. in the year 1250. The town-hall contains a collection of municipal and mining laws dating as far back as 1389. At Iglau, on the 5th of July 1436, the treaty was made with the Hussites, by which the emperor Sigismund was acknowledged king of Bohemia. A granite column near the town marks the spot where Ferdinand I., in 1527, swore fidelity to the Bohemian states. During the Thirty Years' War Iglau was twice captured by the Swedes. In 1742 it fell into the hands of the Prussians, and in December 1805 the Bavarians under Wrede were defeated near the town.

IGLESIAS, a town and episcopal see of Sardinia in the province of Cagliari, from which it is 34 m. W.N.W. by rail, 620 ft. above sea-level. Pop. (1901) 10,436 (town), 20,874 (commune). It is finely situated among the mountains in the S.W. portion of the island, and is chiefly important as the centre of a mining district; it has a government school for mining engineers. The minerals are conveyed by a small railway via Monteponi (with its large lead and zinc mine) to Portovesme (15 m. S.W. of Iglesias in the sheltered gulf of Carloforte), near Portoscuso, where they are shipped. The total amount of the minerals extracted in Sardinia in 1905 was 170,236 tons and their value £765,054 (chiefly consisting of 99,749 tons of calamine zinc, 26,051 of blende zinc, 24,798 tons of lead and 15,429 tons of lignite): the greater part of them—118,009 tons—was exported from Portoscuso by sea and most of the rest from Cagliari, the zinc going mainly to Antwerp, and in a less proportion to Bordeaux and Dunkirk, while the lead is sent to Pertusola near Spezia, to be smelted. At Portoscuso is also a tunny fishery.

The cathedral of Iglesias, built by the Pisans, has a good façade (restored); the interior is late Spanish Gothic. San Francesco is a fine Gothic church with a gallery over the entrance, while Sta Chiara and the church of the Capuchins (the former dating from 1285) show a transition between Romanesque and Gothic. The battlemented town walls are well preserved and picturesque; the castle, built in 1325, now contains a glass factory. The church of Nostra Signora del Buon Cammino above the town (1080 ft.) commands a fine view.

IGNATIEV, NICHOLAS PAVLOVICH, Count (1832-1908), Russian diplomatist, was born at St Petersburg on the 29th of January 1832. His father, Captain Paul Ignatiev, had been taken into favour by the tsar Nicholas I., owing to his fidelity on the occasion of the military conspiracy in 1825; and the grand duke Alexander (afterwards tsar) stood sponsor at the boy's baptism. At the age of seventeen he became an officer of the Guards. His diplomatic career began at the congress of Paris, after the Crimean War, where he took an active part as military attaché in the negotiations regarding the rectification of the Russian frontier on the Lower Danube. Two years later (1858) he was sent with a small escort on a dangerous mission to Khiva and Bokhara. The khan of Khiva laid a plan for detaining him as a hostage, but he eluded the danger and returned safely, after concluding with the khan of Bokhara a treaty of friendship. His next diplomatic exploit was in the Far East, as plenipotentiary to the court of Peking. When the Chinese government was terrified by the advance of the Anglo-French expedition of 1860 and the burning of the Summer Palace, he worked on their fears so dexterously that he obtained for Russia not only the left bank of the Amur, the original object of the mission, but also a large extent of territory and sea-coast south of that river. This success was supposed to prove his capacity for dealing with Orientals, and paved his way to the post of ambassador at Constantinople, which he occupied from 1864 till 1877. Here his chief aim was to liberate from Turkish domination and bring under the influence of Russia the Christian nationalities in general and the Bulgarians in particular. His restless activity in this field, mostly of a semi-official and secret character,

culminated in the Russo-Turkish war of 1877-1878, at the close of which he negotiated with the Turkish plenipotentiaries the treaty of San Stefano. As the war which he had done so much to bring about did not eventually secure for Russia advantages commensurate with the sacrifices involved, he fell into disfavour, and retired from active service. Shortly after the accession of Alexander III. in 1881, he was appointed minister of the interior on the understanding that he would carry out a nationalist, reactionary policy, but his shifty ways and his administrative incapacity so displeased his imperial master that he was dismissed in the following year. After that time he exercised no important influence in public affairs. He died on the 3rd of July 1908.

IGNATIUS (Ἰγνάτιος), bishop of Antioch, one of the "Apostolic Fathers." No one connected with the history of the early Christian Church is more famous than Ignatius, and yet among the leading churchmen of the time there is scarcely one about whose career we know so little. Our only trustworthy information is derived from the letters which he wrote to various churches on his last journey from Antioch to Rome, and from the short epistle of Polycarp to the Philippians. The earlier patristic writers seem to have known no more than we do. Irenaeus, for instance, gives a quotation from his Epistle to the Romans and does not appear to know (or if he knew he has forgotten) the name of the author, since he describes him (*Adv. haer.* v. 28. 4) as "one of those belonging to us" (τις τῶν ἡμετέρων). If Eusebius possessed any knowledge about Ignatius apart from the letters he never reveals it. The only shred of extra information which he gives us is the statement that Ignatius "was the second successor of Peter in the bishopric of Antioch" (*Eccles. hist.* iii. 36). Of course in later times a cloud of tradition arose, but none of it bears the least evidence of trustworthiness. The martyrologies, from which the account of his martyrdom that used to appear in uncritical church histories is taken, are full of anachronisms and impossibilities. There are two main types—the Roman and the Syrian—out of which the others are compounded. They contradict each other in many points and even their own statements in different places are sometimes quite irreconcilable. Any truth that the narrative may contain is hopelessly overlaid with fiction. We are therefore limited to the Epistles for our information, and before we can use even these we are confronted with a most complex critical problem, a problem which for ages aroused the most bitter controversy, but which happily now, thanks to the labours of Zahn, Lightfoot, Harnack and Funk, may be said to have reached a satisfactory solution.

I. *The Problem of the Three Recensions.*—The Ignatian problem arises from the fact that we possess three different recensions of the Epistles. (*a*) *The short recension* (often called the Vossian) contains the letters to the Ephesians, Magnesians, Trallians, Romans, Philadelphians, Smyrnaeans and to Polycarp. This recension was derived in its Greek form from the famous Medicean MS. at Florence and first published by Vossius in 1646 (see *Theol. Literaturzeitung*, 1906, 596 f., for an early papyrus fragment in the Berlin Museum, containing *Ad Smyrn.* iii. fin. xii. init.). In the Medicean MS. the Epistle to the Romans is missing, but a Greek version of this epistle was discovered by Ruinart, embedded in a *martyrium*, in the National Library at Paris and published in 1689. There are also (1) a Latin version made by Robert Grosseteste, bishop of Lincoln, about 1250, and published by Ussher in 1644—two years before the Vossian edition appeared; (2) an Armenian version which was derived from a Syriac not earlier than the 5th century and published at Constantinople in 1783; (3) some fragments of a Syriac version published in Cureton's edition of Ignatius; (4) fragments of a Coptic version first published in Lightfoot's work (ii. 859-882). (*b*) *The long recension* contains the seven Epistles mentioned above in an expanded form and several additional letters besides. The Greek form of the recension, which has been preserved in ten MSS., has thirteen letters, the additional ones being to the Tarsians, the Philippians, the Antiochians, to Hero, to Mary of Cassobola and a letter of Mary to Ignatius. The Latin form, of which there are thirteen extant MSS., omits the letter of Mary of Cassobola, but adds to the list the Laus Heronis, two Epistles to the apostle John, one to the Virgin Mary and one from Mary to Ignatius. (*c*) *The Syriac or Curetonian recension* contains only three Epistles, viz. to Polycarp, to the Romans, and to the Ephesians, and these when compared with the same letters in the short and long recensions are found to be considerably abbreviated. The Syriac recension was made by William Cureton in 1845 from three Syriac MSS. which had recently been brought from the Nitrian desert and deposited in the British Museum. One of these MSS. belongs to the 6th century, the other two are later. Summed up in a word, therefore, the Ignatian problem is this: which of these three recensions (if any) represents the actual work of Ignatius?

II. *History of the Controversy.*—The history of the controversy may be divided into three periods: (*a*) up to the discovery of the short recension in 1646; (*b*) between 1646 and the discovery of the Syriac recension in 1845; (*c*) from 1845 to the present day. In the first stage the controversy was theological rather than critical. The Reformation raised the question as to the authority of the papacy and the hierarchy. Roman Catholic scholars used the interpolated Ignatian Epistles very freely in their defence and derived many of their arguments from them, while Protestant scholars threw discredit on these Epistles. The Magdeburg centuriators expressed the gravest doubts as to their genuineness, and Calvin declared that "nothing was more foul than those fairy tales (*naeniis*) published under the name of Ignatius!" It should be stated, however, that one Roman Catholic scholar, Denys Petau (Petavius), admitted that the letters were interpolated, while the Protestant Vedelius acknowledged the seven letters mentioned by Eusebius. In England the Ignatian Epistles took an important place in the episcopalian controversy in the 17th century. Their genuineness was defended by the leading Anglican writers, *e.g.* Whitgift, Hooker and Andrewes, and vigorously challenged by Dissenters, *e.g.* the five Presbyterian ministers who wrote under the name of Smectymnuus and John Milton.[1] The second period is marked by the recognition of the superiority of the Vossian recension. This was speedily demonstrated, though some attempts were made, notably by Jean Morin or Morinus (about 1656), Whiston (in 1711) and Meier (in 1836), to resuscitate the long recension. Many Protestants still maintained that the new recension, like the old, was a forgery. The chief attack came

from Jean Daillé, who in his famous work (1666) drew up no fewer than sixty-six objections to the genuineness of the Ignatian literature. He was answered by Pearson, who in his *Vindiciae epistolarum S. Ignatii* (1672) completely vindicated the authenticity of the Vossian Epistles. No further attack of any importance was made till the time of Baur, who like Daillé rejected both recensions. In the third stage—inaugurated in 1845 by Cureton's work—the controversy has ranged round the relative claims of the Vossian and the Curetonian recensions. Scholars have been divided into three camps, viz. (1) those who followed Cureton in maintaining that the three Syriac Epistles alone were the genuine work of Ignatius. Among them may be mentioned the names of Bunsen, A. Ritschl, R. A. Lipsius, E. de Pressensé, H. Ewald, Milman, Bohringer. (2) Those who accepted the genuineness of the Vossian recension and regarded the Curetonian as an abbreviation of it, *e.g.* Petermann, Denzinger, Uhlhorn, Merx, and in more recent times Th. Zahn, J. B. Lightfoot, Ad. Harnack and F. X. Funk. (3) Those who denied the authenticity of both recensions, *e.g.* Baur and Hilgenfeld and in recent times van Manen,[2] Völter[3] and van Loon.[4] The result of more than half a century's discussion has been to restore the Vossian recension to the premier position.

III. *The Origin of the Long Recension.*—The arguments against the genuineness of the long recension are decisive. (1) It conflicts with the statement of Eusebius. (2) The first trace of its use occurs in Anastasius of Antioch (A.D. 598) and Stephen Gobarus (*c.* 575-600). (3) The ecclesiastical system of the letters implies a date not earlier than the 4th century. (4) The recension has been proved to be dependent on the *Apostolical Constitutions*. (5) The doctrinal atmosphere implies the existence of Arian and Apollinarian heresies. (6) The added passages reveal a difference in style which stamps them at once as interpolations. There are several different theories with regard to the origin of the recension. Some, *e.g.* Leclerc, Newman and Zahn, think that the writer was an Arian and that the additions were made in the interest of Arianism. Funk, on the other hand, regards the writer as an Apollinarian. Lightfoot opposes both views and suggests that it is better "to conceive of him as writing with a conciliatory aim."

IV. *The Objections to the Curetonian Recension.*—The objections to the Syriac recension, though not so decisive, are strong enough to carry conviction with them. (1) We have the express statement of Eusebius that Ignatius wrote seven Epistles. (2) There are statements in Polycarp's Epistle which cannot be explained from the three Syriac Epistles. (3) The omitted portions are proved by Lightfoot after an elaborate analysis to be written in the same style as the rest of the epistles and could not therefore have been later interpolations. (4) The Curetonian letters are often abrupt and broken and show signs of abridgment. (5) The discovery of the Armenian version proves the existence of an earlier Syriac recension corresponding to the Vossian of which the Curetonian may be an abbreviation. It seems impossible to account for the origin of the Curetonian recension on theological grounds. The theory that the abridgment was made in the interests of Eutychianism or Monophysitism cannot be substantiated.

V. *The Date and Genuineness of the Vossian Epistles.*—We are left therefore with the seven Epistles. Are they the genuine work of Ignatius, and, if so, at what date were they written? The main objections are as follows: (1) The conveyance of a condemned prisoner to Rome to be put to death in the amphitheatre is unlikely on historical grounds, and the route taken is improbable for geographical reasons. This objection has very little solid basis. (2) The heresies against which Ignatius contends imply the rise of the later Gnostic and Docetic sects. It is quite certain, however, that Docetism was in existence in the 1st century (cf. 1 John), while many of the principles of Gnosticism were in vogue long before the great Gnostic sects arose (cf. the Pastoral Epistles). There is nothing in Ignatius which implies a knowledge of the teaching of Basilides or Valentinus. In fact, as Harnack says: "No Christian writer after 140 could have described the false teachers in the way that Ignatius does." (3) The ecclesiastical system of Ignatius is too developed to have arisen as early as the time of Trajan. At first sight this objection seems to be almost fatal. But we have to remember that the bishops of Ignatius are not bishops in the modern sense of the word at all, but simply pastors of churches. They are not mentioned at all in two Epistles, viz. *Romans* and *Philippians*, which seems to imply that this form of government was not universal. It is only when we read modern ecclesiastical ideas into Ignatius that the objection has much weight. To sum up, as Uhlhorn says: "The collective mass of internal evidence against the genuineness of the letters ... is insufficient to counterbalance the testimony of the Epistle of Polycarp in their favour. He who would prove the Epistles of Ignatius to be spurious must begin by proving the Epistle of Polycarp to be spurious, and such an undertaking is not likely to succeed." This being so, there is no reason for rejecting the opinion of Eusebius that the Epistles were written in the reign of Trajan. Harnack, who formerly dated them about 140, now says that they were written in the latter years of Trajan, or possibly a little later (117-125). The majority of scholars place them a few years earlier (110-117).[5]

The letters of Ignatius unfortunately, unlike the Epistles of St Paul, contain scant autobiographical material. We are told absolutely nothing about the history of his career. The fact that like St Paul he describes himself as an ἔκτρωμα (*Rom.* 9), and that he speaks of himself as "the last of the Antiochene Christians" (*Trall.* 13; *Smyrn.* xi.), seems to suggest that he had been converted from paganism somewhat late in life and that the process of conversion had been abrupt and violent. He bore the surname of Theophorus, *i.e.* "God-clad" or "bearing God." Later tradition regarded the word as a passive form ("God-borne") and explained it by the romantic theory that Ignatius was the child whom Christ took in his arms (Mark ix. 36-37). The date at which he became bishop of Antioch cannot be determined. At the time when the Epistles were written he had just been sentenced to death, and was being sent in charge of a band of soldiers to Rome to fight the beasts in the amphitheatre. The fact that he was condemned to the amphitheatre proves that he could not have been a Roman citizen. We lose sight of him at Troas, but the presumption is that he was martyred at Rome, though we have no early evidence of this.

But if the Epistles tell us little of the life of Ignatius, they give us an excellent picture of the man himself, and are a mirror in which we see reflected certain ideals of the life and thought of the day. Ignatius, as Schaff says, "is the incarnation of three closely connected ideas: the glory of martyrdom, the omnipotence of episcopacy, and the hatred of heresy and schism."

1. Zeal for martyrdom in later days became a disease in the Church, but in the case of Ignatius it is the

mark of a hero. The heroic note runs through all the Epistles; thus he says:

> "I bid all men know that of my own free will I die for God, unless ye should hinder me.... Let me be given to the wild beasts, for through them I can attain unto God. I am God's wheat, and I am ground by the wild beasts that I may be found the pure bread of Christ. Entice the wild beasts that they may become my sepulchre...; come fire and cross and grapplings with wild beasts, wrenching of bones, hacking of limbs, crushings of my whole body; only be it mine to attain unto Jesus Christ" (*Rom.* 4-5).

2. Ignatius constantly contends for the recognition of the authority of the ministers of the church. "Do nothing," he writes to the Magnesians, "without the bishop and the presbyters." The "three orders" are essential to the church, without them no church is worthy of the name (cf. *Trall.* 3). "It is not lawful apart from the bishop either to baptize or to hold a love-feast" (*Smyrn.* 8). Respect is due to the bishop as to God, to the presbyters as the council of God and the college of apostles, to the deacons as to Jesus Christ (*Trall.* 3). These terms must not, of course, be taken in their developed modern sense. The "bishop" of Ignatius seems to represent the modern pastor of a church. As Zahn has shown, Ignatius is not striving to introduce a special form of ministry, nor is he endeavouring to substitute one form for another. His particular interest is not so much in the form of ministry as in the unity of the church. It is this that is his chief concern. Centrifugal forces were at work. Differences of theological opinion were arising. Churches had a tendency to split up into sections. The age of the apostles had passed away and their successors did not inherit their authority. The unity of the churches was in danger. Ignatius was resisting this fatal tendency which threatened ruin to the faith. The only remedy for it in those days was to exalt the authority of the ministry and make it the centre of church life. It should be noted that (1) there is no trace of the later doctrine of apostolical succession; (2) the ministry is never sacerdotal in the letters of Ignatius. As Lightfoot puts it: "The ecclesiastical order was enforced by him (Ignatius) almost solely as a security for doctrinal purity. The threefold ministry was the husk, the shell, which protected the precious kernel of the truth" (i. 40).

3. Ignatius fights most vehemently against the current forms of heresy. The chief danger to the church came from the Docetists who denied the reality of the humanity of Christ and ascribed to him a phantom body. Hence we find Ignatius laying the utmost stress on the fact that Christ "was *truly* born and ate and drank, was *truly* persecuted under Pontius Pilate ... was *truly* raised from the dead" (*Trall.* 9). "I know that He was in the flesh even after the resurrection, and when He came to Peter and his company, He said to them, 'Lay hold and handle me, and see that I am not an incorporeal spirit'" (*Smyrn.* 3). Equally emphatic is Ignatius's protest against a return to Judaism. "It is monstrous to talk of Jesus Christ and to practise Judaism, for Christianity did not believe in Judaism but Judaism in Christianity" (*Magn.* 10).

Reference must also be made to a few of the more characteristic points in the theology of Ignatius. As far as Christology is concerned, besides the insistence on the reality of the humanity of Christ already mentioned, there are two other points which call for notice. (1) Ignatius is the earliest writer outside the New Testament to describe Christ under the categories of current philosophy; cf. the famous passage in *Eph.* 7, "There is one only physician, of flesh and of spirit (σαρκικὸς καὶ πνευματικός), generate and ingenerate (γεννητὸς καὶ ἀγέννητος), God in man, true life in death, son of Mary and son of God, first passible and then impassible" (πρῶτον παθητὸς καὶ ἀπαθής). (2) Ignatius is also the first writer outside the New Testament to mention the Virgin Birth, upon which he lays the utmost stress. "Hidden from the prince of this world were the virginity of Mary and her child-bearing and likewise also the death of the Lord, three mysteries to be cried aloud, the which were wrought in the silence of God" (*Eph.* 19). Here, it will be observed, we have the nucleus of the later doctrine of the deception of Satan. In regard to the Eucharist also later ideas occur in Ignatius. It is termed a μυστήριον (*Trall.* 2), and the influence of the Greek mysteries is seen in such language as that used in *Eph.* 20, where Ignatius describes the Eucharistic bread as "the medicine of immortality and the antidote against death." When Ignatius says too that "the heretics abstain from Eucharist because they do not allow that the Eucharist is the flesh of Christ," the words seem to imply that materialistic ideas were beginning to find an entrance into the church (*Smyr.* 6). Other points that call for special notice are: (1) Ignatius's rather extravagant angelology. In one place for instance he speaks of himself as being able to comprehend heavenly things and "the arrays of angels and the musterings of principalities" (*Trall.* 5). (2) His view of the Old Testament. In one important passage Ignatius emphatically states his belief in the supremacy of Christ even over "the archives" of the faith, *i.e.* the Old Testament: "As for me, my archives—my inviolable archives—are Jesus Christ, His cross, His death, His resurrection and faith through Him" (*Philadel.* 8).

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(H. T. A.)

1 In his short treatise "Of Prelatical Episcopacy," works iii. p. 72 (Pickering, 1851).

2 *Theologisch. Tijdschrift* (1892), 625-633.

3 *Ib.* (1886) 114-136; *Die Ignatianischen Briefe* (1892).

4 *Ib.* (1893) 275-316.

5 But there are still a few scholars, *e.g.* van Manen and Völter, who prefer a date about 150 or later; van Loon goes as late as 175. See article "Old-Christian Literature," *Ency. Bib.* iii. col. 3488.

IGNORAMUS (Latin for "we do not know," "we take no notice of"), properly an English law term for the

endorsement on the bill of indictment made by a grand jury when they “throw out” the bill, *i.e.* when they do not consider that the case should go to a petty jury. The expression is now obsolete, “not a true bill,” “no bill,” being used. The expressions “ignoramus jury,” “ignoramus Whig,” &c., were common in the political satires and pamphlets of the years following on the throwing out of the bill for high treason against the 2nd earl of Shaftesbury in 1681. The application of the term to an ignorant person dates from the early part of the 17th century. The *New English Dictionary* quotes two examples illustrating the early connexion of the term with the law or lawyers. George Ruggle (1575-1622) in 1615 wrote a Latin play with the title Ignoramus, the name being also that of the chief character in it, intended for one Francis Brakin, the recorder of Cambridge. It is a satire against the ignorance and pettifogging of the common lawyers of the day. It was answered by a prose tract (not printed till 1648) by one Robert Callis, serjeant-at-law. This bore the title of *The Case and Argument against Sir Ignoramus of Cambridge*.

IGNORANCE (Lat. *ignorantia*, from *ignorare*, not to know), want of knowledge, a state of mind which in law has important consequences. A well-known legal maxim runs: *ignorantia juris non excusat* (“ignorance of the law does not excuse”). With this is sometimes coupled another maxim: *ignorantia facti excusat* (“ignorance of the fact excuses”). That every one who has capacity to understand the law is presumed to know it is a very necessary principle, for otherwise the courts would be continually occupied in endeavouring to solve problems which by their very impracticability would render the administration of justice next to impossible. It would be necessary for the court to engage in endless inquiries as to the true inwardness of a man’s mind, whether his state of ignorance existed at the time of the commission of the offence, whether such a condition of mind was inevitable or brought about merely by indifference on his part. Therefore, in English, as in Roman law, ignorance of the law is no ground for avoiding the consequences of an act. So far as regards criminal offences, the maxim as to *ignorantia juris* admits of no exception, even in the case of a foreigner temporarily in England, who is likely to be ignorant of English law. In Roman law the harshness of the rule was mitigated in the case of women, soldiers and persons under the age of twenty-five, unless they had good legal advice within reach (*Dig.* xxii. 6. 9). Ignorance of a matter of fact may in general be alleged in avoidance of the consequences of acts and agreements, but such ignorance cannot be pleaded where it is the duty of a person to know, or where, having the means of knowledge at his disposal, he wilfully or negligently fails to avail himself of it (see Contract).

In logic, ignorance is that state of mind which for want of evidence is equally unable to affirm or deny one thing or another. Doubt, on the other hand, can neither affirm nor deny because the evidence seems equally strong for both. For *Ignoratio Elenchi* (ignorance of the refutation) see Fallacy.

IGNORANTINES (*Frères Ignorantins*), a name given to the Brethren of the Christian Schools (*Frères des Écoles Chrétiennes*), a religious fraternity founded at Reims in 1680, and formally organized in 1683, by the priest Jean Baptiste de la Salle, for the purpose of affording a free education, especially in religion, to the children of the poor. In addition to the three simple vows of chastity, poverty and obedience, the brothers were required to give their services without any remuneration and to wear a special habit of coarse black material, consisting of a cassock, a hooded cloak with hanging sleeves and a broad-brimmed hat. The name Ignorantine was given from a clause in the rules of the order forbidding the admission of priests with a theological education. Other popular names applied to the order are *Frères de Saint-Yon*, from the house at Rouen, which was their headquarters from 1705 till 1770, *Frères à quatre bras*, from their hanging sleeves, and *Frères Fouetteurs*, from their former use of the whip (*fouet*) in punishments. The order, approved by Pope Benedict XIII. in 1724, rapidly spread over France, and although dissolved by the National Assembly’s decree in February 1790, was recalled by Napoleon I. in 1804, and formally recognized by the French government in 1808. Since then its members have penetrated into nearly every country of Europe, and into America, Asia and Africa. They number about 14,000 members and have over 2000 schools, and are the strongest Roman Catholic male order. Though not officially connected with the Jesuits, their organization and discipline are very similar.

See J. B. Blain, *La Vie du vénérable J. B. de la Salle* (Versailles, 1887).

IGUALADA, a town of north-eastern Spain, in the province of Barcelona, on the left bank of the river Noya, a right-hand tributary of the Llobregat, and at the northern terminus of the Igualada-Martorell-Barcelona railway. Pop. (1900) 10,442. Igualada is the central market of a rich agricultural and wine-producing district. It consists of an old town with narrow and irregular streets and the remains of a fortress and ramparts, and a new town which possesses regular and spacious streets and many fine houses. The local industries, chiefly developed since 1880, include the manufacture of cotton, linen, wool, ribbons, cloth, chocolate, soap, brandies, leather, cards and nails. The famous mountain and convent of Montserrat or Monserrat (*q.v.*) is 12 m. E.

IGUANA, systematically *Iguanidae* (Spanish quivalent of Carib *iwana*), a family of pleurodont lizards, comprising about 50 genera and 300 species. With three exceptions, all the genera of this extensive family belong to the New World, being specially characteristic of the Neotropical region, where they occur as far south as Patagonia, while extending northward into the warmer parts of the Nearctic regions as far as California and British Columbia. The exceptional genera are *Brachylophus* in the Fiji Islands, *Hoplurus* and *Chalarodon* in Madagascar. The iguanas are characterized by the peculiar form of their teeth, these being round at the root and blade-like, with serrated edges towards the tip, resembling in this respect the gigantic extinct reptile *Iguanodon*. The typical forms belonging to this family are distinguished by the large dewlap or pouch situated beneath the head and neck, and by the crest, composed of slender elongated scales, which extends in gradually diminishing height from the nape of the neck to the extremity of the tail. The latter organ is very long, slender and compressed. The tongue is generally short and not deeply divided at its extremity, nor is its base retracted into a sheath; it is always moist and covered with a glutinous secretion. The prevailing colour of the iguanas is green; and, as the majority of them are arboreal in their habits, such colouring is generally regarded as protective. Those on the other hand which reside on the ground have much duller, although as a rule equally protective hues. Some iguanas, however (*e.g. Anolis carolinensis*), possess, to an extent only exceeded by the chameleon, the power of changing their colours, their brilliant green becoming transformed under the influence of fear or irritation, into more sombre hues and even into black. They differ greatly in size, from a few inches to several feet in length.

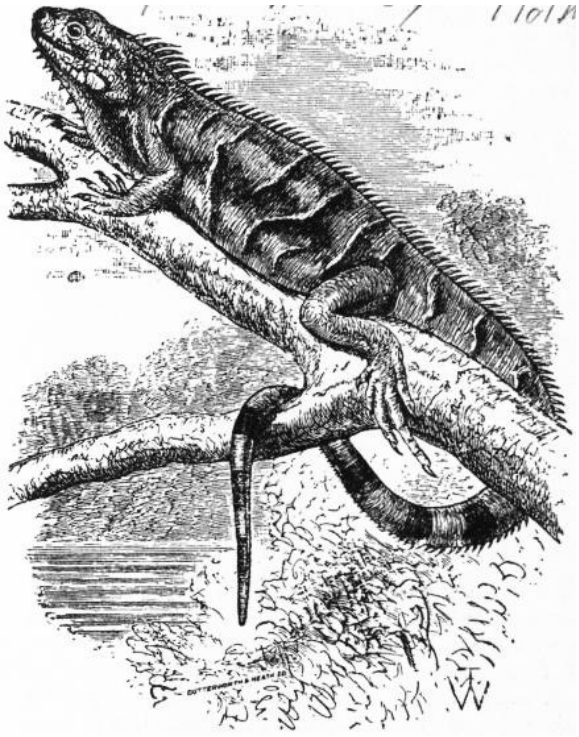


Fig. 1.—Iguana.

One of the largest and most widely distributed is the common iguana (*Iguana tuberculata*), which occurs in the tropical parts of Central and South America and the West Indies, with the closely allied *I. rhinolophus*. It attains a length of 6 ft., weighing then perhaps 30 lb, and is of a greenish colour, occasionally mixed with brown, while the tail is surrounded with alternate rings of those colours. Its food consists of vegetable substances, mostly leaves, which it obtains from the forest trees among whose branches it lives and in the hollows of which it deposits its eggs. These are of an oblong shape about 1½ in. in length, and are said by travellers to be very pleasant eating, especially when taken raw, and mixed with farina. They are timid, defenceless animals, depending for safety on the comparative inaccessibility of their arboreal haunts, and their protective colouring, which is rendered even more effective by their remaining still on the approach of danger. But the favourite resorts of the iguana are trees which overhang the water, into which they let themselves fall with a splash, whatever the height of the tree, and then swim away, or hide at the bottom for many minutes. Otherwise they exhibit few signs of animal intelligence. “The iguana,” says H. W. Bates (*The Naturalist on the Amazons*), “is one of the stupidest animals I ever met. The one I caught dropped helplessly from a tree just ahead of me; it turned round for a moment to have an idiotic stare at the intruder and then set off running along the path. I ran after it and it then stopped as a timid dog would do, crouching down and permitting me to seize it by the neck and carry it off.” Along with several other species, notably *Ctenosura acanthinura*, which is omnivorous, likewise called iguana, the common iguana, is much sought after in tropical America; the natives esteem its flesh a delicacy, and capture it by slipping a noose round its neck as it sits in fancied security on the branch of a tree.

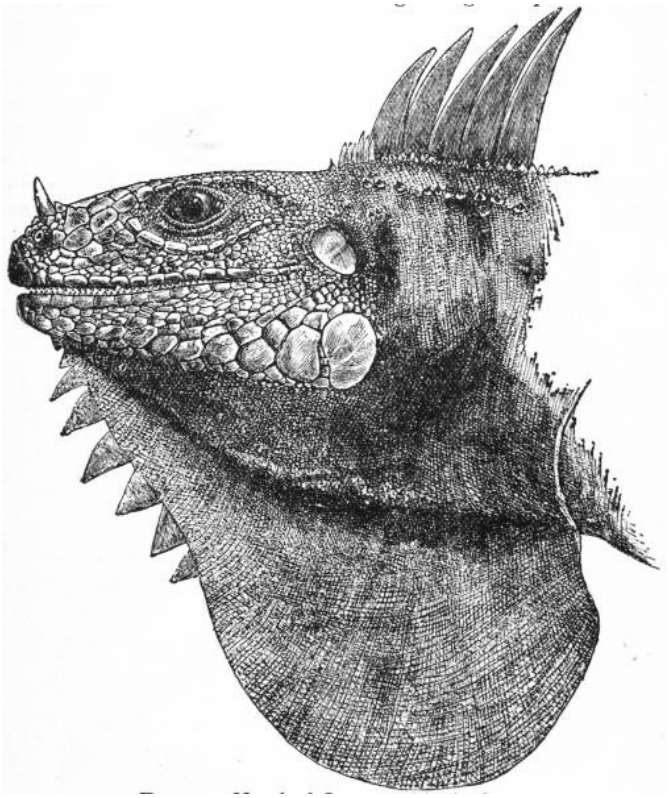
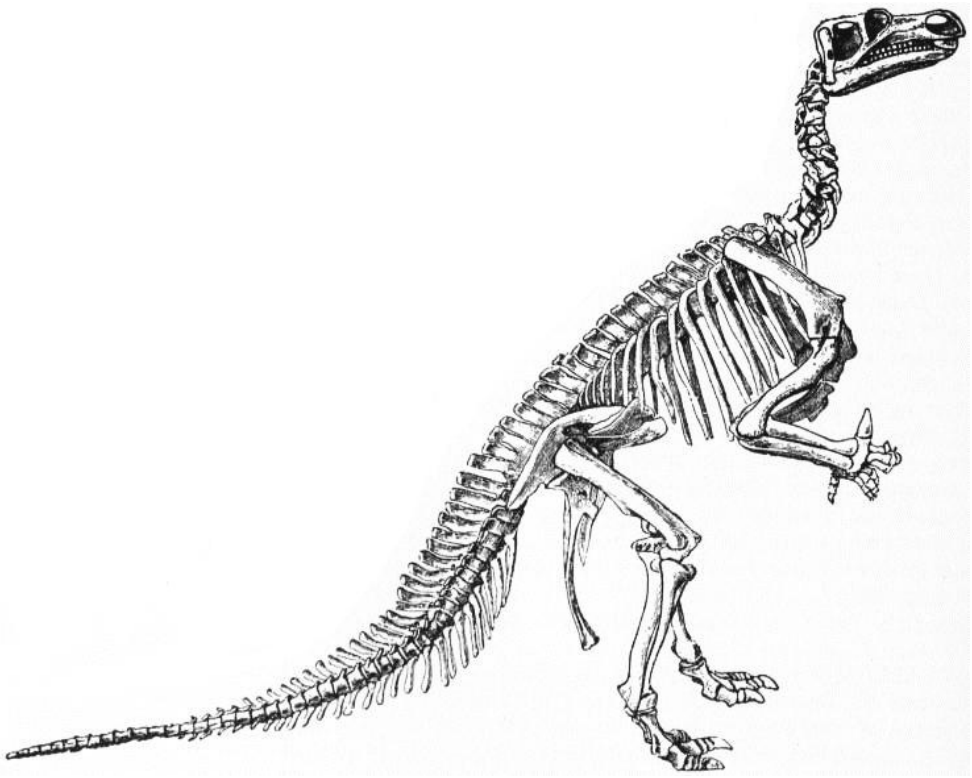


FIG. 2.—Head of *Iguana rhinolophus*.

Although chiefly arboreal, many of the iguanas take readily to the water; and there is at least one species, *Amblyrhynchus cristatus*, which leads for the most part an aquatic life. These marine lizards occur only in the Galapagos Islands, where they are never seen more than 20 yds. inland, while they may often be observed in companies several hundreds of yards from the shore, swimming with great facility by means of their flattened tails. Their feet are all more or less webbed, but in swimming they are said to keep these organs motionless by their sides. Their food consists of marine vegetation, to obtain which they dive beneath the water, where they are able to remain, without coming to the surface to breathe, for a very considerable time. Though they are thus the most aquatic of lizards, Darwin, who studied their habits during his visit to those islands, states that when frightened they will not enter the water. Driven along a narrow ledge of rock to the edge of the sea, they preferred capture to escape by swimming, while if thrown into the water they immediately returned to the point from which they started. A land species belonging to the allied genus *Conolophus* also occurs in the Galapagos, which differs from most of its kind in forming burrows in the ground.

IGUANODON, a large extinct herbivorous land reptile from the Wealden formation of western Europe, almost completely known by numerous skeletons from Bernissart, near Mons, Belgium. It is a typical representative of the ornithopodous (Gr. for bird-footed) Dinosauria. The head is large and laterally compressed with a blunt snout, nearly terminal nostrils and relatively small eyes. The sides of the jaws are provided with a close series of grinding teeth, which are often worn down to stumps; the front of the jaws forms a toothless beak, which would be encased originally in a horny sheath. When unworn the teeth are spatulate and crimped or serrated round the edge, closely resembling those of the existing Central American lizard, *Iguana*—hence the name *Iguanodon* (Gr. Iguana-tooth) proposed by Mantell, the discoverer of this reptile, in 1825. The bodies of the vertebrae are solid; and they are convexo-concave (*i.e. opisthocoelous*) in the neck and anterior part of the back, where there must have been much freedom of motion. The hindquarters are comparatively large and heavy, while the tail is long, deep and more or less laterally compressed, evidently adapted for swimming. The small and mobile fore-limbs bear four complete fingers, with the thumb reduced to a bony spur. The pelvis and hind-limbs much resemble those of a running bird, such as those of an emu or the extinct moa; but the basal bones (metatarsals) of the three-toed foot remain separate throughout life, thus differing from those of the running birds, which are firmly fused together even in the young adult. No external armour has been found. The reptile doubtless frequented marshes, feeding on the succulent vegetation, and often swimming in the water. Footprints prove that when on land it walked habitually on its hind-limbs.



Skeleton of *Iguanadon bernissartensis*. (After Dollo.)

The earliest remains of *Iguanodon* were found by Dr G. A. Mantell in the Wealden formation of Sussex, and a large part of the skeleton, lacking the head, was subsequently discovered in a block of ragstone in the Lower Greensand near Maidstone, Kent. These fossils, which are now in the British Museum, were interpreted by Dr Mantell, who made comparisons with the skeleton of *Iguana*, on the erroneous supposition that the resemblance in the teeth denoted some relationship to this existing lizard. Several of the bones, however, could not be understood until the much later discoveries of Mr S. H. Beckles in the Wealden cliffs near Hastings; and an accurate knowledge of the skeleton was only obtained when many complete specimens were disinterred by the Belgian government from the Wealden beds at Bernissart, near Mons, during the years 1877-1880. These skeletons, which now form the most striking feature of the Brussels Museum, evidently represent a large troop of animals which were suddenly destroyed and buried in a deep ravine or gully. The typical species, *Iguanodon mantelli*, measures 5 to 6 metres in length, while *I. bernissartensis* (see fig.) attains a length of 8 to 10 metres. They are found both at Bernissart and in the south of England, while other species are also known from Sussex. Nearly complete skeletons of allied reptiles have been discovered in the Jurassic and Cretaceous rocks of North America. 297

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(A. S. WO.)

IGUVIUM (mod. Gubbio, *q.v.*), a town of Umbria, situated among the mountains, about 23 m. N.N.E. of Perusia and connected with it by a by-road, which joined the Via Flaminia near the temple of Jupiter Appenninus, at the modern Scheggia. It appears to have been an important place in pre-Roman times, both from its coins and from the celebrated *tabulae Iguvinae* (see below).

We find it in possession of a treaty with Rome, similar to that of the Camertes Umbri; and in 167 B.C. it was used as a place of safe custody for the Illyrian King Gentius and his sons (Livy xlv. 43). After the Social War, in which it took no part, it received Roman citizenship. At that epoch it must have received full citizen rights since it was included in the tribus Clustumina (*C.I.L.* xi. *e.g.* 5838). In 49 B.C. it was occupied by Minucius Thermus on behalf of Pompey, but he abandoned the town. Under the empire we hear almost nothing of it. Silius Italicus mentions it as subject to fogs. A bishop of Iguvium is mentioned as early as A.D. 413. It was taken and destroyed by the Goths in 552, but rebuilt with the help of Narses. The Umbrian town had three gates only, and probably lay on the steep mountain side as the present town does, while the Roman city lay in the lower ground. Here is the theatre, which, as an inscription records, was restored by Cn. Satrius Rufus in the time of Augustus. The diameter of the orchestra is 76½ ft. and of the whole 230 ft., so that it is a building of considerable size; the stage is well preserved and so are parts of the external arcades of the auditorium. Not far off are ruins probably of ancient baths, and the concrete core of a large tomb with a vaulted chamber within.

(T. AS.)

Of Latin inscriptions (*C.I.L.* xi. 5803-5926) found at Iguvium two or three are of Augustan date, but none seem to be earlier. A Latin inscription of Iguvium (*C.I.L.* xi. 5824) mentions a priest whose functions are characteristic of the place "L. Veturius Rufio avispex extispecus, sacerdos publicus et privatus."

The ancient town is chiefly celebrated for the famous *Iguvine* (less correctly *Eugubine*) *Tables*, which

were discovered there in 1444, bought by the municipality in 1456, and are still preserved in the town hall. A Dominican, Leandro Alberti (*Descrizione d'Italia*, 1550), states that they were originally nine in number, and an independent authority, Antonio Concioli (*Statuta civitatis Eugubii*, 1673), states that two of the nine were taken to Venice in 1540 and never reappeared. The existing seven were first published in a careful but largely mistaken transcript by Buonarotti in 1724, as an appendix to Dempster's *De Etruria Regali*.[1]

The first real advance towards their interpretation was made by Otfried Müller (*Die Etrusker*, 1828), who pointed out that though their alphabet was akin to the Etruscan their language was Italic. Lepsius, in his essay *De tabulis Eugubinis* (1833), finally determined the value of the Umbrian signs and the received order of the Tables, pointing out that those in Latin alphabet were the latest. He subsequently published what may be called the *editio princeps* in 1841. The first edition, with a full commentary based on scientific principles, was that of Aufrecht and Kirchhoff in 1849-1851, and on this all subsequent interpretations are based (Bréal, Paris, 1875; Bücheler, *Umbrica*, Bonn, 1883, a reprint and enlargement of articles in Fleckeisen's *Jahrbuch*, 1875, pp. 127 and 313). The text is everywhere perfectly legible, and is excellently represented in photographs by the marquis Ranghiasci-Brancaleone, published with Bréal's edition.

Language.—The dialect in which this ancient set of liturgies is written is usually known as Umbrian, as it is the only monument we possess of any length of the tongue spoken in the Umbrian district before it was latinized (see UMBRIA). The name, however, is certainly too wide, since an inscription from Tuder of, probably, the 3rd century B.C. (R. S. Conway, *The Italic Dialects*, 352) shows a final *-s* and a medial *-d-*, both apparently preserved from the changes which befell these sounds, as we shall see, in the dialect of Iguvium. On the other hand, inscriptions of Fulginia and Assisium (ibid. 354-355) agree very well, so far as they go, with Iguvine. It is especially necessary to make clear that the language known as Umbrian is that of a certain limited area, which cannot yet be shown to have extended very far beyond the eastern half of the Tiber valley (from Interamna Nahartium to Urvinum Mataurense), because the term is often used by archaeologists with a far wider connotation to include all the Italic, pre-Etruscan inhabitants of upper Italy; Professor Ridgeway, for instance, in his *Early Age of Greece*, frequently speaks of the "Umbrians" as the race to which belonged the Villanova culture of the Early Iron age. It is now one of the most urgent problems in the history of Italy to determine the actual historical relation (see further ROME: *History*, *ad. init.*) between the Ὀμβροί of, say, Herodotus and the language of Iguvium, of which we may now offer some description, using the term Umbrian strictly in this sense.

Under the headings LATIN LANGUAGE and OSCA LINGUA there have been collected (1) the points which separate all the Italic languages from their nearest congeners, and (2) those which separate Osco-Umbrian from Latin. We have now to notice (3) the points in which Umbrian has diverged from Oscan. The first of them antedates by six or seven centuries the similar change in the Romance languages (see ROMANCE LANGUAGES).

(1) The palatalization of *k* and *g* before a following *i* or *e*, or consonant *i* as in *tiçit* (*i.e. diçit*) = Lat. *decet*; *muieto* past part. passive (pronounced as though the *i* were an English or French *j*) beside Umb. imperative *mugatu*, Lat. *mugire*.

(2) The loss of final *-d*, *e.g.* in the abl. sing. fem. Umb. *tōtā* = Osc. *toutād*.

(3) The change of *d* between vowels to a sound akin to *r*, written by a special symbol ꟈ (*ḍ*) in Umbrian alphabet and by RS in Latin alphabet, *e.g. teḍa* in Umbrian alphabet = *dirsa* in Latin alphabet (see below), "let him give," exactly equivalent to Paelignian *dida* (see PAELIGNI).

(4) The change of *-s-* to *-r-* between vowels as in *erom*, "esse" = Osc. *ezum*, and the gen. plur. fem. ending in *-aru* = Lat. *-arum*, Osc. *-azum*.

To this there appear a long string of exceptions, *e.g. asa* = Lat. *ara*. These are generally regarded as mere archaisms, and unfortunately the majority of them are in words of whose origin and meaning very little is known, so that (for all we can tell) in many the *-s-* may represent *-ss-* or *-ps-* as in *osatu* = Lat. *operato*, cf. Osc. *opsaom*.

(5) The change of final *-ns* to *-f* as in the acc. plur. masc. *vitluf* = Lat. *vitulōs*.

(6) In the latest stage of the dialect (see below) the change of final *-s* to *-r*, as in abl. plur. *arver*, *arviis*, *i.e.* "arvorum frugibus."

(7) The decay of all diphthongs; *ai*, *oi*, *ei* all become a monophthong variously written *e* and *i* (rarely *ei*), as in the dat. sing. fem. *tote*, "civitati"; dat. sing. masc. *pople*, "populo"; loc. sing. masc. *onse* (from **om(e)sei*), "in umero." So *au*, *eu*, *ou* all become *ō*, as in *ote* = Osc. *auti*, Lat. *aut*.

(8) The change of initial *l* to *v*, as in *vutu* = Lat. *lavito*.

Owing to the peculiar character of the Tables no grammatical statement about Umbrian is free from difficulty; and these bare outlines of its phonology must be supplemented by reference to the lucid discussion in C. D. Buck's *Oscan and Umbrian Grammar* (Boston, 1904), or to the earlier and admirably complete *Oskischumbrische Grammatik* of R. von Planta (Strassburg, 1892-1897). Some of the most important questions are discussed by R. S. Conway in *The Italic Dialects*, vol. ii. p. 495 seq.

Save for the consequences of these phonetic changes, Umbrian morphology and syntax exhibit no divergence from Oscan that need be mentioned here, save perhaps two peculiar perfect-formations with *-l-* and *-nçi-*; as in *ampelust*, fut. perf. "impenderit," *combifiançiust*, "nuntiaverit" (or the like). Full accounts of the accidence and syntax, so far as it is represented in the inscriptions, will be found in the grammars of Buck and von Planta already mentioned, and in the second volume of Conway, *op. cit.*

Chronology. (I.) *The Relative Dates of the Tables.*—At least four periods in the history of the dialect can be distinguished in the records we have left to us, by the help of the successive changes (*a*) in alphabet and (*b*) in language, which the Tables exhibit. Of these only the outstanding features can be mentioned here; for a fuller discussion the reader must be referred to *The Italic Dialects*, pp. 400 sqq.

(*a*) *Changes in Alphabet.*—Observe first that Tables I., II., III. and IV., and the first two inscriptions of V.

are in Umbrian character; the Latin alphabet is used in the *Claverniur* paragraph (V. iii.), and the whole of VI. (*a* and *b*) and VII. (*a* and *b*).

What we may call the normal Umbrian alphabet (in which *e.g.* Table I. *a* is written) consists of the following signs, the writing being always from right to left: 𐌀 *a*, 𐌁 *b*, 𐌒 ḍ (*i.e.* a sound akin to *r* derived from *d*), 𐌄 *e*, 𐌅 *v*, 𐌆 *z*, 𐌇 *h*, 𐌉 *i*, 𐌊 *k* and 𐌂 *g*, 𐌋 *l*, 𐌌 *m*, 𐌍 *n*, 𐌐 *p*, 𐌓 *r*, 𐌔 *s*, 𐌕 *t* and *d*, V *u* and *o*, 𐌖 *f*, 𐌃 *š* (*i.e.* a voiceless palatal consonant.) 298

In the Latin alphabet, in which Tables VI. and VII. and the third inscription of Table V. are written, *d* is represented by RS, *g* by G, but *k* by C, *d* by D, *t* by T, *v* and *u* by V but *o* by O, ś by Ś, though the diacritic is often omitted. The interpunct is double with the Umbrian alphabet, single and medial with the Latin.

Tables VI. and VII., then, and V. iii., were written later than the rest. But even in the earlier group certain variations appear.

The latest form of the Umbrian alphabet is that of Table V. i. and ii., where the abbreviated form of *m* (Λ) and the angular and undivided form of *k* (𐌊 not 𐌉) are especially characteristic.

Nearest to this is that of Tables III. and IV., which form a single document; then that of I. (*a*) and (*b*); earliest would seem that of II. (*a*) and II. (*b*). In II. *a*, 18 and 24, we have the archaic letter *san* (M = *s*) of the abecedaria (E. S. Roberts, *Int. Gr. Epig.* pp. 17 ff.), which appears in no other Italic nor in any Chalcidian inscription, though it survived longer in Etruscan and Venetic use. Against this may be set the use of ⊙ for *t* in I. *b* 1, but this appears also in IV. 20 and should be called rather Etruscan than archaic. These characteristics of II. *a* and *b* would be in themselves too slight to prove an earlier date, but they have perhaps some weight as confirming the evidence of the language.

(*b*) *Changes in Language.*—The evidence of date derived from changes in the language is more difficult to formulate, and the inquiry calls for the most diligent use of scientific method and critical judgment. Its intricacy lies in the character of the documents before us—religious formularies consisting partly of matter established in usage long before they were written down in their present shape, partly of additions made at the time of writing. The best example of this is furnished by the expansion and modernisation of the subject-matter of Table I. into Tables VI. and VII.*a*. Hence we frequently meet with forms which had passed out of the language that was spoken at the time they were engraved, side by side with their equivalents in that language. We may distinguish four periods, as follows:

1. The first period is represented, not by any complete table, but by the old unmodernised forms of Tables III. and IV., which show the original guttural plosives unpalatalized, *e.g. kebu* = Lat. *cibum*.

2. In the second period the gutturals have been palatalized, but there yet is no change of final *s* to *r*. This is represented by the rest of III. and IV. and by II. (*a* and *b*).

3. In the third period final *s* has everywhere become *r*. This appears in V. (i. and ii. and also iii.). Table I. is a copy or redraft made from older documents during this period. This is shown by the occasional appearance of *r* instead of final *s*.

4. Soon after the dialect had reached its latest form, the Latin alphabet was adopted. Tables VI. and VII.*a* contain an expanded form of the same liturgical direction as Table I.

It is probable that further research will amend this classification in detail, but its main lines are generally accepted.

(II.) *Actual Date of the Tables.*—Only the leading points can be mentioned here.

(i.) The Latin alphabet of the latest Tables resembles that of the *Tabula Bantina*, and might have been engraved at almost any time between 150 B.C. and 50 B.C. It is quite likely that the closer relations with Rome, which began after the Social War, led to the adoption of the Latin alphabet. Hence we should infer that the Tables in Umbrian alphabet were at all events older than 90 B.C.

(ii.) For an upper limit of date, in default of definite evidence, it seems imprudent to go back beyond the 5th century B.C., since neither in Rome nor Campania have we any evidence of public written documents of any earlier century. When more is known of the earliest Etruscan inscriptions it may become possible to date the Iguvine Tables by their alphabetic peculiarities as compared with their mother-alphabet, the Etruscan. The “Tuscan name” is denounced in the comprehensive curse of Table VI. *b*, 53-60, and we may infer that the town of Iguvium was independent but in fear of the Etruscans at the time when the curse was first composed. The absence of all mention of either Gauls or Romans seems to prove that this time was at least earlier than 400 B.C.; and the curse may have been composed long before it was written down.

The chief sources in which further information may be sought have been already mentioned.

(R. S. C.)

1 A portion of this article is taken by permission from R. S. Conway’s *Italic Dialects* (Camb. Univ. Press, 1897).

IJOLITE (derived from the first syllable of the Finnish words *Jiwaru*, *Jijoki*, &c., common as geographical names in the Kola peninsula, and the Gr. λίθος, a stone), a rock consisting essentially of nepheline and augite, and of great rarity, but of considerable importance from a mineralogical and petrographical standpoint. It occurs in various parts of the Kola peninsula in north Finland on the shores of the White Sea. The pyroxene is morphic, yellow or green, and is surrounded by formless areas of nepheline. The accessory minerals are apatite, cancrinite, calcite, titanite and jiwaarite, a dark-brown titaniferous variety of melanite-garnet. This rock is the plutonic and holocrystalline analogue of the nephelenites and nepheline-dolerites; it bears the same relation to them as the nepheline-syenites have to the phonolites. It is worth mentioning that

a leucite-augite rock, resembling ijolite except in containing leucite in place of nepheline, is known to occur at Shonkin Creek, near Fort Benton, Montana, and has been called missourite.

IKI, an island belonging to Japan, lying off the north-western coast of Kiushiu, in 33° 45′ N. lat. and 129° 40′ E. long. It has a circumference of 86 m., an area of 51 sq. m., and a population of 36,530. The island is, for the most part, a tableland about 500 ft. above sea-level. The anchorage is at Gonoura, on the south-west. A part of Kublai Khan's Mongols landed at Iki when about to invade Japan in the 13th century, for it lies in the direct route from Korea to Japan via Tsushima. In the immediate vicinity are several rocky islets.

ILAGAN, the capital of the province of Isabela, Luzon, Philippine Islands, on an elevated site at the confluence of the Pinacanauan river with the Grande de Cagayan, about 200 m. N.N.E. of Manila. Pop. (1903) 16,008. The neighbouring country is the largest tobacco-producing section in the Philippines.

ILCHESTER, a market town in the southern parliamentary division of Somersetshire, England, in the valley of the river Ivel or Yeo, 5 m. N.W. of Yeovil. It is connected by a stone bridge with the village of Northover on the other side of the river. Ilchester has lost the importance it once possessed, and had in 1901 a population of only 564, but its historical interest is considerable. The parish church of St Mary is Early English and Perpendicular, with a small octagonal tower, but has been largely restored in modern times. The town possesses almshouses founded in 1426, a picturesque cross, and a curious ancient mace of the former corporation.

Ilchester (*Cair Pensavelcoit*, *Ischalis*, *Ivelcestre*, *Yevelchester*) was a fortified British settlement, and subsequently a military station of the Romans, whose Fosse Way passed through it. Its importance continued in Saxon times, and in 1086 it was a royal borough with 107 burgesses. In 1180 a gild merchant was established, and the county gaol was completed in 1188. Henry II. granted a charter, confirmed by John in 1203, which gave Ilchester the same liberties as Winchester, with freedom from tolls and from being impleaded without the walls, the fee farm being fixed at £26, 10s. 0d. The bailiffs of Ilchester are mentioned before 1230. The borough was incorporated in 1556, the fee farm being reduced to £8. Ilchester was the centre of the county administration from the reign of Edward III. until the 19th century, when the change from road to rail travelling completed the decay of the town. Its place has been taken by Taunton. The corporation was abolished in 1886. Parliamentary representation began in 1298, and the town continued to return two members until 1832. A fair on the 29th of August was granted by the charter of 1203. Other fairs on the 27th of December, the 21st of July, and the Monday before Palm Sunday, were held under a charter of 1289. The latter, fixed as the 25th of March, was still held at the end of the 18th century, but there is now no fair. The Wednesday market dates from before the Conquest. The manufacture of thread lace was replaced by silk weaving about 1750, but this has decayed.

ÎLE-DE-FRANCE, an old district of France, forming a kind of island, bounded by the Seine, the Marne, the Beuvronne, the Thève and the Oise. In this sense the name is not found in written documents before 1429; but in the second half of the 15th century it designated a wide military province of government, bounded N. by Picardy, W. by Normandy, S. by Orléanais and Nivernais, and E. by Champagne. Its capital was Paris. From the territory of Île-de-France were formed under the Revolution the department of the Seine, together with the greater part of Seine-et-Oise, Seine-et-Marne, Oise and Aisne, and a small part of Loiret and Nièvre. (The term Île-de-France is also used for Mauritius, *q.v.*).

See A. Longnon, "L'Île-de-France, son origine, ses limites, ses gouverneurs," in the *Mémoires de la Société de l'histoire de Paris et de l'Île-de-France*, vol. i. (1875).

ILETSK, formerly *Fort Iletskaya Zashchita*, a town of Russia, in the government of Orenburg, 48 m. S. of the town of Orenburg by the railway to Tashkent, near the Ilek river, a tributary of the Ural. Pop. 11,802 in 1897. A thick bed of excellent rock-salt is worked here to the extent of about 100,000 tons annually. The

place is resorted to for its salt, mud and brine baths, and its koumiss cures.

ILFELD, a town in Germany, in the Prussian province of Hanover, situated at the south foot of the Harz, at the entrance to the Bährethal, 8 m. N. from Nordhausen by the railway to Wernigerode. Pop. 1600. It contains an Evangelical church, a celebrated gymnasium, once a monasterial school, with a fine library, and manufactures of parquet-flooring, paper and plaster of Paris, while another industry in the town is brewing. It is also of some repute as a health resort.

Ilfeld, as a town, dates from the 14th century, when it sprang up round a Benedictine monastery. Founded about 1190 this latter was reformed in 1545, and a year later converted into the school mentioned above, which under the rectorship of Michael Neander (1525-1595) enjoyed a reputation for scholarship which it has maintained until to-day.

See Förstemann, *Monumenta rerum Ilfeldensium* (Nordhausen, 1843); M. Neander, *Bericht vom Kloster Ilfeld*, edited by Bouterwek (Göttingen, 1873); and K. Meyer, *Geschichte des Klosters Ilfeld* (Leipzig, 1897).

ILFORD [Great Ilford], an urban district in the Romford parliamentary division of Essex, England, on the Roding, 7 m. E.N.E. of London by the Great Eastern railway. Pop. (1891) 10,913, (1901) 41,234. A portion of Hainault Forest lies within the parish. The hospital of St Mary and St Thomas, founded in the 12th century as a leper hospital, now contains almshouses and a chapel, and belongs to the marquess of Salisbury, who as “Master” is required to maintain a chaplain and six aged inmates. The chapel appears to be of the date of this foundation. Claybury Hall is a lunatic asylum (1893) of the London County Council. There are large photographic material works and paper mills. Little Ilford is a parish on the opposite (west) side of the Roding. The church of St Mary retains Norman portions, and has a curious monumental brass commemorating a boy in school-going clothes (1517). Pop. (1901) 17,915.

ILFRACOMBE, a seaport and watering-place in the Barnstaple parliamentary division of Devonshire, England, on the Bristol Channel, 225 m. W. by S. of London by the London & South-Western railway. Pop. of urban district (1901) 8557. The picturesque old town, built on the cliffs above its harbour, consists of one street stretching for about a mile through a network of lanes. Behind it rise the terraces of a more modern town, commanding a fine view across the Channel. With its beautiful scenery and temperate climate, Ilfracombe is frequented by visitors both in summer and winter. Grand rugged cliffs line the coast; while, inland, the country is celebrated for the rich colouring of its woods and glens. Wooded heights form a semicircle round the town, which is protected from sea winds by Capstone Hill. Along the inner face of this rock has been cut the Victoria Promenade, a long walk roofed with glass and used for concerts. The restored church of Holy Trinity dates originally from the 12th century. Sea-bathing is insecure, and is confined to a few small coves, approached by tunnels hewn through the rock. The harbour, a natural recess among the cliffs, is sheltered on the east by Hilsborough Head, where there are some alleged Celtic remains; on the west by Lantern Hill, where the ancient chapel of St Nicholas has been transformed into a lighthouse. In summer, passenger steamers run to and from Ilfracombe pier; but the shipping trade generally has declined, though herring fisheries are carried on with success. In the latter part of the 13th century Ilfracombe obtained a grant for holding a fair and market, and in the reign of Edward III. it was a place of such importance as to supply him with six ships and ninety-six men for his armament against Calais. During the Civil War, being garrisoned for the Roundheads, it was in 1644 captured by the Royalists, but in 1646 it fell into the hands of Fairfax.

ILHAVO, a seaport in the district of Aveiro, formerly included in the province of Beira, Portugal, 3 m. S.W. of Aveiro (*q.v.*), on the lagoon of Aveiro, an inlet of the Atlantic Ocean. Pop. (1900) 12,617. Ilhavo is inhabited chiefly by fishermen, but has a celebrated manufactory of glass and porcelain, the Vista-Alegre, at which the art of glass-cutting has reached a high degree of perfection. Salt is largely exported. Ilhavo is celebrated for the beauty of its women. It is said to have been founded by Greek colonists about 400 B.C., but this tradition is of doubtful validity.

ILI, one of the principal rivers of Central Asia, in the Russian province of Semiryechensk. The head-stream, called the Tekez, rises at an altitude of 11,600 ft. E. of Lake Issyk-kul, in 82° 25′ E. and 43° 23′ N., on the W. slopes of mount Kash-katur. At first it flows eastward and north-eastward, until, after emerging from the mountains, it meets the Kungez, and then, assuming the name of Ili, it turns westwards and flows between the Trans-Ili Ala-tau mountains on the south and the Boro-khoro and Talki ranges on the north for about 300 m. to Iliysk. The valley between 79° 30′ and 82° E. is 50 m. wide, and the portion above the town of Kulja (Old Kulja) is fertile and populous, Taranchi villages following each other in rapid succession, and the pastures being well stocked with sheep and cattle and horses. At Iliysk the river turns north-west, and after traversing a region of desert and marsh falls by at least seven mouths into the Balkash Lake, the first bifurcation of the delta taking place about 115 m. up the river. But it is only the southern arm of the delta that permanently carries water. The total length of the river is over 900 m. From Old Kulja to New Kulja the Ili is navigable for at most only two and a half months in the year, and even then considerable difficulty is occasioned by the shoals and sandbanks. From New Kulja to Iliysk (280 m.) navigation is easy when the water is high, and practicable even at its lowest for small boats. At Iliysk there is a ferry on the road from Kopal to Vyernyi. The principal tributaries of the Ili are the Kash, Chilik and Charyn. A vast number of streams flow towards it from the mountains on both sides, but most of them are used up by the irrigation canals and never reach their goal. The wealth of coal in the valley is said to be great, and when the Chinese owned the country they worked gold and silver with profit. Fort Ili or Iliysk, a modern Russian establishment, must not be confounded with Ili, the old capital of the Chinese province of the same name. The latter, otherwise known as Hoi-yuan-chen, New Kulja (Gulja), or Manchu Kulja, was formerly a city of 70,000 inhabitants, but now lies completely deserted. Old Kulja, Tatar Kulja or Nin-yuan, is now the principal town of the district. The Chinese district of Ili formerly included the whole of the valley of the Ili river as far as Issyk-kul, but now only its upper part. Its present area is about 27,000 sq. m. and its population probably 70,000. It belongs administratively to the province of Sin-kiang or East Turkestan. (See KULJA.)

ILION, a village of Herkimer county, New York, U.S.A., about 12 m. S.E. of Utica, on the S. bank of the Mohawk river. Pop. (1890) 4057; (1900) 5138 (755 foreign-born); (1905, state census) 5924; (1910) 6588. It is served by the New York Central & Hudson river, and the West Shore railways, by the Utica & Mohawk Valley Electric railroad, and by the Erie canal. It has a public library (1868) of about 13,500 volumes, a public hospital and a village hall. The village owns its water-works and its electric-lighting plant. Its principal manufactures are Remington typewriters and Remington fire-arms (notably the Remington rifle); other manufactures are filing cabinets and cases and library and office furniture (the Clark & Baker Co.), knit goods, carriages and harness, and store fixtures. In 1828 Eliphalet Remington (1793-1861) established here a small factory for the manufacture of rifles. He invented, and, with the assistance of his sons, Philo (1816-1889), Samuel and Eliphalet, improved the famous Remington rifle, which was adopted by several European governments, and was supplied in large numbers to the United States army. In 1856 the company added the manufacture of farming tools, in 1870 sewing-machines, and in 1874 typewriters. The last-named industry was sold to the Wyckoff, Seamans & Benedict Company in 1886, and soon afterwards, on the failure of the original Remington company, the fire-arms factory was bought by a New York City firm. A store was established on the present site of Ilion as early as 1816, but the village really dates from the completion of the Erie canal in 1825. On the canal list it was called Steele’s Creek, but it was also known as Morgan’s Landing, and from 1830 to 1843 as Remington’s Corners. The post-office, which was established in 1845, was named Remington, in honour of Eliphalet Remington; but later the present name was adopted. The village was incorporated in 1852. Ilion is a part of the township of German Flats (pop. in 1900, 8663; in 1910, 10,160), settled by Palatinate Germans about 1725. The township was the scene of several Indian raids during the French and Indian War and the War of Independence. Here General Herkimer began his advance to raise the siege of Fort Schuyler (1777), and subsequently Ilion was the rendezvous of Benedict Arnold’s force during the same campaign.

ILKESTON, a market town and municipal borough, in the Ilkeston parliamentary division of Derbyshire, England, 9 m. E.N.E. of Derby, on the Midland and the Great Northern railways. Pop. (1891) 19,744, (1901) 25,384. It is situated on a hill commanding fine views of the Erewash valley. The church of St Mary is Norman and Early English, and has a fine chancel screen dating from the later part of the 13th century. The manufactures of the town are principally hosiery and lace, and various kinds of stoneware. Coal and iron are wrought in the neighbourhood. An alkaline mineral spring, resembling the seltzer water of Germany, was discovered in 1830, and baths were then erected, which, however, were subsequently closed. The town, which is very ancient, being mentioned in Domesday, obtained a grant for a market and fair in 1251, and received its charter of incorporation in 1887. It is governed by a mayor, 6 aldermen and 18 councillors. Area, 2526 acres.

ILKLEY, an urban district in the Otley parliamentary division of the West Riding of Yorkshire, England, 16 m. N.W. from Leeds, on the Midland and the North-Eastern railways. Pop. of urban district (1901) 7455. It is beautifully situated in the upper part of the valley of the Wharfe, and owing to the fine scenery of the neighbourhood, and to the bracing air of the high moorlands above the valley, has become a favourite health resort. Here and at Ben Rhydding, 1 m. E., are several hydropathic establishments. The church of All Saints is in the main Decorated, largely restored in 1860. Three ancient sculptured crosses are preserved in the churchyard. The institutions include a museum of local antiquities, a grammar school, the Siemens Convalescent Home and the Ilkley Bath Charitable Institution. The fine remains of Bolton Abbey lie in the Wharfe valley, 5 m. above Ilkley. Ilkley has been identified with the *Olicana* of Ptolemy, one of the towns of the British tribe of the Brigantes. There was a Roman fort near the present church of All Saints, and the site has yielded inscriptions and other small remains. Numerous relics are preserved in the museum.

ILL, a river of Germany, entirely within the imperial territory of Alsace-Lorraine. It rises on a north foothill of the Jura, S.W. of Basel, and flows N.N.E. parallel with the Rhine, which it enters from the left, 9 m. below Strassburg. Its course lies for the most part through low meadowland; and the stream, which is 123 m. long, receives numerous small affluents, which pour out of the short narrow valleys of the Vosges. It is navigable from Ladhof near Colmar to its confluence with the Rhine, a distance of 59 m. It is on this river, and not on the Rhine, that the principal towns of Upper Alsace are situated, *e.g.* Mülhausen, Colmarl, Schlettstadt and Strassburg. The Ill feeds two important canals, the Rhine-Marne canal and the Rhine-Rhone canal, both starting from the neighbourhood of Strassburg.

ILLAWARRA, a beautiful and fertile district of New South Wales, Australia, extending from a point 33 m. S. of Sydney, along the coast southwards for 40 m. to Shoalhaven. It is thickly populated, and supplies Sydney with the greater part of its dairy produce. There are also numerous collieries, producing coal of superior quality, and iron ore, fireclay and freestone are plentiful. The Illawarra Lake, a salt lagoon, 9 m. long and 3 m. wide, is encircled by hills and is connected with the sea by a narrow channel; quantities of fish are caught in it and wild fowl are abundant along its shores. The chief towns in the district are Wollongong, Kiama, Clifton and Shellharbour.

ILLE-ET-VILAINE, a maritime department of north-western France, formed in 1790 out of the eastern part of the old province of Brittany. Pop. (1906) 611,805. Area 2699 sq. m. It is bounded N. by the English Channel, the Bay of St Michel and the department of Manche; E. by Mayenne; S. by Loire-Inférieure; and W. by Morbihan and Côtes-du-Nord. The territory of Ille-et-Vilaine constitutes a depression bordered by hills which reach their maximum altitudes (over 800 ft.) in the N.E. and W. of the department. The centre of this depression, which separates the hills of Brittany from those of Normandy, is occupied by Rennes, capital of the department and an important junction of roads, rivers and railways. The department takes its name from its two principal rivers, the Ille and the Vilaine. The former joins the Vilaine at Rennes after a course of 18 m. through the centre of the department; and the latter, which rises in Mayenne, flows westwards as far as Rennes, where it turns abruptly south. The stream is tidal up to the port of Redon, and is navigable for barges as far as Rennes. The Vilaine receives the Meu and the Seiche, which are both navigable. There are two other navigable streams, the Airon and the Rance, the long estuary of which falls almost entirely within the department. The Ille-et-Rance canal connects the town of Rennes with those of Dinan and St Malo. The greater portion of the shore of the Bay of St Michel is covered by the Marsh of Dol, valuable agricultural land, which is protected from the inroads of the sea by dykes. Towards the open channel the coast is rocky. Small lakes are frequent in the interior of the department. The climate is temperate, humid and free from sudden changes. The south-west winds, while they keep the temperature mild, also bring frequent showers, and in spring and autumn thick fogs prevail. The soil is thin and not very fertile, but has been improved by the use of artificial manure. Cereals of all kinds are grown, but the principal are wheat, buckwheat, oats and barley. Potatoes, early vegetables, flax and hemp are also largely grown, and tobacco is cultivated in the arrondissement of St Malo. Apples and pears are the principal fruit, and the cider of the canton of Dol has a high reputation. Cheese is made in considerable quantities, and the butter of Rennes is amongst the best in France. Large numbers of horses and cattle are raised. Mines of iron, lead and zinc (Pont-Péan) and quarries of slate, granite, &c., are worked. There are flour and saw-mills, brick works, boat-building yards, iron and copper foundries and forges, dyeworks, and a widespread tanning industry. Sail-cloth, rope, pottery, boots and shoes (Fougères), edge-tools, nails, farming implements, paper and furniture are also among the products of the department. The chief ports are St Malo and St Servan. Fishing is very active on the coast, and St Malo, St Servan and Cancale equip fleets for the Newfoundland cod-banks. There are also important oyster-fisheries in the Bay of St Michel, especially at Cancale. The little town of Dinard is well known as a fashionable bathing-resort. Exports include agricultural products, butter, mine-posts and dried fish; imports, live-stock, coal, timber, building materials and American wheat. The department is served by

the Western railway, and has over 130 m. of navigable waterway. The population is of less distinctively Celtic origin than the Bretons of Western Brittany, between whom and the Normans and Angevins it forms a transitional group. Ille-et-Vilaine is divided into the arrondissements of Fougères, St Malo, Montfort-sur-Meu, Redon, Rennes and Vitré, with 43 cantons and 360 communes. The chief town is Rennes, which is the seat of an archbishop and of a court of appeal, headquarters of the X. army corps, and the centre of an académie (educational division).

In addition to the capital, Fougères, St Malo, St Servan, Redon, Vitré, Dol, Dinard and Cancale are the towns of chief importance and are separately noticed. At Combourg there is a picturesque château of the 14th and 15th centuries where Chateaubriand passed a portion of his early life. St Aubin-du-Cormier has the ruins of an important feudal fortress of the 13th century built by the dukes of Brittany for the protection of their eastern frontier. Montfort-sur-Meu has a cylindrical keep of the 15th century which is a survival of its old ramparts.

ILLEGITIMACY (from "illegitimate," Lat. *illegitimus*, not in accordance with law, hence born out of lawful wedlock), the state of being of illegitimate birth. The law dealing with the legitimation of children born out of wedlock will be found under Legitimacy and Legitimation. How far the prevalence of illegitimacy in any community can be taken as a guide to the morality of that community is a much disputed question. The phenomenon itself varies so much in different localities, even in localities where the same factors seem to prevail, that affirmative conclusions are for the most part impossible to draw. In the United Kingdom, where the figures differ considerably for the three countries—England, Scotland, Ireland—the reasons that might be assigned for the differences are negatived if applied on the same lines, as they might well be, to certain other countries. Then again, racial, climatic and social differences must be allowed for, and the influence of legislation is to be taken into account. The fact that in some countries marriage is forbidden until a man has completed his military service, in another, that consent of parents is requisite, in another, that "once a bastard always a bastard" is the rule, while in yet another that the merest of subsequent formalities will legitimize the offspring, must account in some degree for variations in figures.

Table I.—*Illegitimate Births per 1000 Births (excluding still-born).*

	1876-1880.	1881-1885.	1886-1890.	1891-1895.	1896-1900.	1901-1905.
England and Wales	48	48	46	42	41	40
Scotland	85	83	81	74	68	64
Ireland	24	27	28	36	36	26
Denmark	101	100	95	94	96	101
Norway	84	81	75	71	74	..
Sweden	100	102	103	105	113	..
Finland	73	70	65	65	66	..
Russia	28	27	27	27	27	..
Austria	138	145	147	146	141	..
Hungary	73	79	82	85	90	94
Switzerland	47	48	47	46	45	..
Germany	87	92	92	91	90	84
Netherlands	31	30	32	31	27	23
Belgium	74	82	87	88	80	68
France	72	78	83	87	88	88
Portugal	..	..	123	122	121	..
Spain	..	..	..	..	49	44
Italy	72	76	74	69	62	56
New South Wales	42	44	49	60	69	70
Victoria	43	46	49	60	69	70
Queensland	39	41	44	48	59	65
South Australia	..	22	25	30	38	41
West Australia	..	..	..	48	51	42
Tasmania	..	44	38	46	57	..
New Zealand	23	29	32	38	44	45

Table I. gives the number of illegitimate births per 1000 births in various countries of the world for quinquennial periods. It is to be noted that still-born births are excluded, as in the United Kingdom (contrary to the practice prevailing in most European countries) registration of such births is not compulsory. The United States is omitted, as there is no national system of registration of births.

This method of measuring illegitimacy by ascertaining the proportion of illegitimate births in every thousand births is a fairly accurate one, but there is another valuable one which is often applied, that of comparing the number of illegitimate births with each thousand unmarried females at the child-bearing age the "corrected" rate as opposed to the "crude," as it is usually termed. This is given for certain countries in Table II.

Table II.—*Illegitimate Births to 1000 Unmarried and Widowed Females, aged 15-49 years.*

Country.	1846-55.	1856-65.	1866-75.	1876-85.	1886-95.	1896-1905.
England and Wales	17	18	16	13	10	8

Scotland	..	22	23	20	17	13
Ireland	..	..	5	4	5	3
Denmark	..	28	27	26	24	23
Sweden	20	22	23	22	22	..
Germany	..	..	..	28	27	26
Netherlands	..	..	10	9	9	6
Belgium	16	16	17	19	17	17
France	15	17	17	16	17	18
Italy	..	..	..	24	24	19

The generally accepted idea that the inhabitants of the warmer countries of the south of Europe are more ardent in temperament has at least no support as shown in the figures in Table I., where we find a higher rate of illegitimacy in Sweden and Denmark than in Spain or Italy. Religion, however, must be taken into account as having a strong influence in preventing unchastity, though it cannot be concluded that any particular creed is more powerful in this direction than another; for example, the figures for Austria and Ireland are very different. It cannot be said, either, that figures bear out the statement that where there is a high rate of illegitimacy there is little prostitution. It is more probable that in a country where the standard of living is low, and early marriages are the rule, the illegitimate birth-rate will be low. As regards England and Wales, the illegitimate birth-rate has been steadily declining for many years, not only in actual numbers, but also in proportion to the population.

TABLE III.—*England and Wales.*

Year.	Illegitimate Births.	Proportion to 1000 of population.	Illegitimate Births in 1000 Births.
1860	43,693	2.2	64
1865	46,585	2.2	62
1870	44,737	2.0	56
1875	40,813	1.7	48
1880	42,542	1.6	48
1885	42,793	1.6	48
1890	38,412	1.3	44
1895	38,836	1.3	42
1900	36,814	1.1	40
1905	37,515	1.1	40
1907	36,189	1.0	39

The corrected rate bears out the result shown in Table III as follows:

TABLE IV.—*England and Wales. Illegitimate Birth-rate calculated on the Unmarried and Widowed Female Population, aged 15-45 years.*

	Rate per 1000.	Compared with rate in 1876-1880, taken as 100.
1876-1880	14.4	100.0
1881-1885	13.5	93.8
1886-1890	11.8	81.9
1891-1895	10.1	70.1
1896-1900	9.2	63.9
1901-1905	8.4	58.3
1906	8.1	56.3
1907	7.8	54.2

TABLE V.—*England and Wales. Illegitimate Births to 1000 Births.*

	Ten years 1897-1906.	1907.		Ten years 1897-1906.	1907.		Ten years 1897-1906.	1907.
Bedford	49	53	Leicestershire	40	39	Wilts	41	42
Berks	47	48	Lincolnshire	55	54	Worcester	37	38
Bucks	40	44	London	37	38	Yorks—		
Cambridge	48	53	Middlesex	30	28	E. Riding	52	49
Chester	41	39	Monmouth	29	27	N. ”	53	45
Cornwall	50	48	Norfolk	62	65	W. ”	43	41
Cumberland	61	58	Northampton	41	42			
Derby	41	41	Northumberland	39	38	Anglesey	81	75
Devon	39	39	Nottingham	50	49	Brecon	44	40
Dorset	40	37	Oxford	53	56	Cardigan	64	61
Durham	34	37	Rutland	46	70	Carmarthen	37	41
Essex	28	27	Shropshire	64	61	Carnarvon	60	72
Gloucester	36	36	Somerset	37	35	Denbigh	49	47
Hants	40	36	Stafford	40	38	Flint	42	42
Hereford	66	66	Suffolk	56	62	Glamorgan	26	26
Hertford	40	42	Surrey	38	37	Merioneth	71	77
Huntingdon	49	46	Sussex	52	52	Montgomery	76	73

Kent	40	41	Warwick	32	30	Pembroke	52	47
Lancashire	38	37	Westmorland	61	62	Radnor	66	67

TABLE VI.—*Annual Illegitimate Birth-rates in each Registration County of England and Wales, 1970-1907.*

Registration Counties.	Illegitimate Births to 1000 Unmarried and Widowed Females aged 15-45 years.							Decrease per cent in each County between the period 1870-1872 and 1907.
	Three-year Periods.					Years.		
	1870-1872.	1880-1882.	1890-1892.	1900-1902.	1903-1905.	1906.	1907.	
England and Wales	17.0	14.1	10.5	8.5	8.3	8.1	7.8	54.1
London	10.3	9.8	8.1	6.9	6.9	6.8	6.4	37.9
Bedford	21.1	18.0	11.2	8.4	8.0	8.2	8.7	58.8
Berks	16.8	13.4	10.3	8.7	8.6	8.1	8.4	50.0
Bucks	19.0	16.5	12.6	9.1	8.9	7.3	8.8	53.7
Cambridge	19.3	15.6	12.4	9.6	10.1	9.7	10.4	46.1
Chester	17.5	14.2	10.3	7.7	7.3	7.2	6.9	60.6
Cornwall	16.5	14.8	11.2	8.6	8.1	7.5	7.5	54.5
Cumberland	29.2	23.9	18.6	12.3	12.3	12.3	11.0	62.3
Derby	22.5	17.7	12.8	10.0	10.0	10.0	9.4	58.2
Devon	14.0	10.6	8.1	6.7	6.5	6.7	6.1	56.4
Dorset	14.2	13.1	9.6	7.2	7.2	8.1	6.4	54.9
Durham	24.0	18.0	13.8	11.1	11.1	10.8	11.6	51.7
Essex	16.2	12.7	9.1	7.3	7.1	6.7	6.4	60.5
Gloucester	12.9	11.6	8.2	6.3	6.1	6.8	5.8	55.0
Hants	13.6	11.8	8.5	7.3	7.1	6.9	6.4	52.9
Hereford	21.4	19.0	13.4	11.2	11.5	10.3	11.0	48.6
Hertford	18.4	15.3	10.4	7.0	7.2	6.6	7.5	59.2
Huntingdon	19.8	14.0	12.9	10.9	9.7	9.7	9.7	51.0
Kent	14.7	12.1	9.3	7.5	7.6	7.5	7.2	51.0
Lancashire	16.2	13.6	10.2	7.9	7.8	7.5	7.2	55.6
Leicestershire	19.9	16.1	11.4	8.6	7.9	7.5	7.3	63.3
Lincolnshire	22.3	18.5	14.2	12.2	12.1	12.7	11.9	46.6
Middlesex	9.4	9.4	6.5	5.9	6.0	6.1	5.7	39.4
Monmouth	18.6	15.9	11.3	10.2	9.1	9.6	9.3	50.0
Norfolk	27.3	22.6	16.7	13.4	13.4	12.5	12.8	53.1
Northampton	18.7	15.9	11.7	9.1	8.8	9.0	7.7	58.8
Northumberland	21.1	17.9	12.4	10.2	10.0	10.4	9.3	55.9
Nottingham	24.5	21.7	15.4	13.7	12.6	12.0	11.9	51.4
Oxford	19.0	15.4	10.4	9.0	9.1	9.3	9.2	51.6
Rutland	18.1	12.7	7.9	7.2	6.8	9.0	11.4	37.0
Salop	28.2	21.8	16.6	12.8	13.4	13.0	11.8	58.2
Somerset	13.3	11.3	7.4	6.0	6.0	5.4	5.5	58.6
Stafford	24.6	19.4	14.5	11.2	11.4	10.9	10.1	58.9
Suffolk	22.0	17.8	14.0	12.0	11.7	12.4	12.5	43.2
Surrey	9.5	8.5	6.6	5.9	5.7	5.9	5.7	40.0
Sussex	13.7	11.5	8.7	7.2	7.0	6.5	6.4	53.3
Warwick	14.9	13.2	9.7	7.6	7.5	6.6	6.8	54.4
Westmorland	21.9	17.9	13.1	8.6	9.1	8.5	7.8	64.4
Wilts	17.1	14.7	10.3	9.2	8.7	8.6	9.3	45.6
Worcester	16.3	13.7	9.2	7.2	6.8	6.6	6.6	59.5
Yorks—								
E. Riding	23.0	18.2	14.3	12.2	11.7	12.2	10.6	53.9
N. Riding	27.7	20.2	15.4	12.1	11.6	11.9	10.2	63.2
W. Riding	20.4	16.1	11.4	9.4	9.2	8.8	8.1	60.3
Anglesey	19.7	16.7	15.7	16.1	14.9	13.3	12.9	34.5
Brecon	19.9	18.0	12.5	10.1	9.2	9.2	8.3	58.3
Cardigan	16.0	14.8	11.8	8.9	7.8	6.3	7.3	54.4
Carmarthen	18.2	13.9	9.4	7.7	8.2	7.7	8.9	51.1
Carnarvon	18.3	13.9	12.7	10.3	9.6	9.4	10.5	42.6
Denbigh	21.1	17.6	13.4	12.3	11.6	13.5	10.3	51.2
Flint	18.7	18.4	13.1	9.7	11.2	11.9	11.0	41.2
Glamorgan	17.7	13.5	10.3	8.5	9.1	8.9	8.4	52.5
Merioneth	24.4	19.5	16.4	13.5	13.4	13.2	12.7	48.0
Montgomery	29.5	24.3	16.7	13.1	13.4	12.6	11.7	60.3
Pembroke	21.6	15.9	12.4	8.9	10.2	10.7	8.4	61.1
Radnor	41.8	33.2	20.1	14.4	13.4	8.3	11.3	73.0

TABLE VII.—*Rate of Illegitimacy per 1000 Births.*

Belfast	31	Liverpool	54
Birmingham	35	Manchester	28
Bradford	40	Middlesboro’	25
Bristol	31	Newcastle	36
Cork	18	Nottingham	60
Dublin	28	Portsmouth	33
Edinburgh	69	Salford	28
Glasgow	63	Sunderland	30
Leeds	54		

TABLE VIII.—*Scotland 1906.*

Total Births.	Legitimate.	Illegitimate.	Births per 1000 of pop.	Percentage of Illegitimate to Total Births.
132,005	122,699	9306	27.93	7.05

	Illegitimate Births.	Percentage of Illegitimate to Total Births.		Illegitimate Births.	Percentage of Illegitimate to Total Births.
1860	9,736	9.22	1895	9,204	7.28
1865	11,262	9.96	1900	8,534	6.49
1870	11,108	9.63	1901	8,359	6.32
1875	10,786	8.73	1902	8,300	6.28
1880	10,589	8.50	1903	8,295	6.21
1885	10,680	8.47	1904	9,010	6.79
1890	9,241	7.60	1905	9,082	6.91
			1906	9,306	7.05

TABLE IX.—*Scotland 1906.*

	Illegitimate Births		Illegitimate Births per 1000 of Unmarried Women and Widows between 15 and 45.
	No.	Per 1000 of Pop.	
Districts:			
Principal Town	4318	7.14	
Large Town	1029	5.58	
Small Town	1724	6.23	
Mainland-rural	2099	9.08	
Insular-rural	136	5.88	
Shetland	31	5.30	7.0
Orkney	29	5.99	7.7
Caithness	84	9.96	19.4
Sutherland	28	6.81	10.1
Ross and Cromarty	74	4.40	6.9
Inverness	145	8.02	11.5
Nairn	18	10.29	13.2
Elgin (or Moray)	169	15.66	26.3
Banff	202	12.93	25.4
Aberdeen	1083	12.38	24.2
Kincardine	93	8.15	17.0
Forfar	676	9.43	14.2
Perth	215	7.93	10.8
Fife	308	4.56	9.7
Kinross	20	9.95	22.2
Clackmannan	53	6.69	10.9
Stirling	235	4.91	13.2
Dumbarton	163	4.14	9.7
Argyll	148	10.07	12.7
Bute	30	8.36	9.2
Renfrew	410	4.46	8.5
Ayr	499	6.23	14.3
Lanark	2872	6.28	15.9
Linlithgow	99	3.88	15.4
Edinburgh	930	7.23	11.0
Haddington	66	5.92	11.8
Berwick	60	9.63	12.7
Peebles	21	6.18	7.9
Selkirk	46	9.13	11.5
Roxburgh	83	8.67	9.8
Dumfries	218	12.51	19.9
Kirkcudbright	92	10.71	15.7
Wigtoun	106	12.79	22.5
Scotland	9306	7.05	14.1

Table V. gives the illegitimate births to 1000 births in England and Wales for the ten years 1897-1906 and for the year 1907. Table VI. gives the "corrected" rate for certain three-year periods. In connexion with these tables the following extract from the Registrar-General's *Report* for 1907 (p. xxx.) is important.

> "It is difficult to explain the variations in the rates of illegitimacy in the several counties. It may be stated generally that the proportion of illegitimate children cannot alone serve as a standard of morality. Broadly speaking, however, the single and widowed women in London, in the counties south of the Thames, and in the south-western counties have comparatively few illegitimate children; on the other hand, the number of illegitimate children is comparatively high in Shropshire, in Herefordshire, in Staffordshire, in Nottinghamshire, in Cumberland, in North Wales, and also in nearly all the counties on the eastern seaboard, viz. Suffolk, Norfolk, Lincolnshire, the East and North Ridings of Yorkshire, and Durham. In the Registrar-General's Report for the year 1851 it was assumed that there was an indirect connexion between female illiteracy and illegitimacy. This may have been the case in the middle of the last century, but there is no conclusive evidence that such is the case at the present day. The proportions of illegitimacy and the

proportions of married women who signed the marriage register by mark are relatively high in Staffordshire, in North Wales, in Durham and in the North Riding of Yorkshire; on the other hand, in Norfolk, in Suffolk and in Lincolnshire there is a comparatively high proportion of illegitimacy and a low proportion of illiteracy."

TABLE X.—*Ireland. Proportion per cent of Illegitimate Births.*

	1903.	1904.	1905.	1906.	1907.
Ireland	2.6	2.5	2.6	2.6	2.5
Leinster	2.6	2.6	2.7	2.7	2.7
Munster	2.3	2.2	2.3	2.2	2.1
Ulster	3.3	3.4	3.5	3.5	3.3
Connaught	0.5	0.7	0.7	0.7	0.6

TABLE XI.—*Ireland 1907.*

County.	No. of Illegitimate Births.	Per cent of Total Births.
Leinster—		
Carlow	27	3.56
Dublin	34	1.15
Dublin Co. Borough	314	3.29
Kildare	22	1.46
Kilkenny	54	3.29
King's	24	2.07
Longford	11	1.23
Louth	27	2.01
Meath	30	2.27
Queen's	18	1.70
Westmeath	19	1.57
Wexford	89	4.11
Wicklow	37	2.91
Munster—		
Clare	23	1.04
Cork Co. and Co. Borough	151	1.69
Kerry	51	1.34
Limerick Co. and Co. Borough	107	3.14
Tipperary N.R.	19	1.49
Tipperary S.R.	66	3.32
Waterford Co. and Co. Borough	68	3.69
Ulster—		
Antrim	230	5.08
Armagh	99	3.49
Belfast Co. Borough	355	3.13
Cavan	27	1.54
Donegal	54	1.36
Fermanagh	41	3.15
Londonderry Co. and Borough	145	4.35
Monaghan	24	1.55
Tyrone	116	3.80
Connaught—		
Galway	32	.80
Leitrim	10	.77
Mayo	21	.45
Roscommon	9	.50
Sligo	9	.52
Leinster	716	2.67
Munster	495	2.11
Ulster	1272	3.32
Connaught	81	.60
	2564	

This latter conclusion may be carried further by saying that in those European countries where elementary education is most common, the rate of illegitimacy is high, and that it is low in the more illiterate parts, *e.g.* Ireland and Brittany.

It has been said that one of the contributory causes of illegitimacy is the contamination of great cities; statistics, however, disprove this, there being more illegitimacy in the rural districts. Table VII. gives the rate of illegitimacy in some of the principal towns of the United Kingdom.

That poverty is a determining factor in causing illegitimacy the following figures, giving the rate of illegitimacy in the poorest parts of London and in certain well-to-do parts, clearly disprove:—

Rate of Illegitimacy per 1000 Births.

London.	1901.	1903.	1905.	1907.
Stepney	12	9	18	10
Bethnal Green	13	15	13	11

Mile End Old Town	15	13	16	15
Whitechapel	22	24	19	19
St George's, Hanover Sq.	40	45	45	45
Kensington	48	44	49	54
Fulham	43	42	45	40
Marylebone	182	186	198	182

Tables VIII. and IX. give the rate of illegitimacy for the various counties of Scotland, and Table X. the rate for Ireland.

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(T. A. I.)

ILLER, a river of Bavaria, rising in the south-west extremity of the kingdom, among the Algäuer Alps. Taking a northerly course, it quits the mountains at Immenstadt, and, flowing by Kempten, from which point it is navigable for rafts, forms for some distance the boundary between Bavaria and Württemberg, and eventually strikes the Danube (right bank) just above Ulm. Its total length is 103 m.

ILLINOIS, a North Central state of the United States of America, situated between 37° and 42° 30′ N. lat. and 87° 35′ and 91° 40′ W. long. It is bounded N. by Wisconsin, E. by Lake Michigan and Indiana, S.E. and S. by the Ohio river, which separates it from Kentucky, and S.W. and W. by the Mississippi river, which separates it from Missouri and Iowa. The Enabling Act of Congress, which provided for the organization of Illinois Territory into a state, extended its jurisdiction to the middle of Lake Michigan and the Mississippi river; consequently the total area of the state is 58,329 sq. m., of which 2337 sq. m. are water surface, though the official figures of the United States Geological Survey, which does not take into account this extension of jurisdiction, are 56,665 sq. m.

Physiography.—Physiographically, the state (except the extreme southern point) lies wholly in the Prairie Plains region. The N.E. corner is by some placed in the "Great Lakes District." The southern point touches the Coastal Plain Belt at its northward extension called the "Mississippi Embayment." The surface of Illinois is an inclined plane, whose general slope is toward the S. and S.W. The average elevation above sea-level is about 600 ft.; the highest elevation is Charles Mound (1257 ft.), on the Illinois-Wisconsin boundary line, one of a chain of hills that crosses Jo Daviess, Stephenson, Winnebago, Boone and McHenry counties. An elevation from 6 to 10 m. wide crosses the southern part of the state from Grand Tower, in Jackson county, on the Mississippi to Shawneetown, in Gallatin county, on the Ohio, the highest point being 1047 ft. above the sea; from Grand Tower N. along the Mississippi to the mouth of the Illinois there is a slight elevation and there is another elevation of minor importance along the Wabash. Many of the river bluffs rise to an unusual height, Starved Rock, near Ottawa, in La Salle county, being 150 ft. above the bed of the Illinois river. Cave in Rock, on the Ohio, in Hardin county, was once the resort of river pirates. The country S. of the elevation (mentioned above) between Grand Tower and Shawneetown was originally covered with forests.

The drainage of Illinois is far better than its low elevation and comparatively level surface would suggest. There are more than 275 streams in the state, grouped in two river systems, one having the Mississippi, which receives three-fourths of the waters of Illinois, as outlet, the other being tributary to the Wabash or Ohio rivers. The most important river is the Illinois, which, formed by the junction of the Des Plaines and the Kankakee, in the N.E. part of Grundy county, crosses the N. central and W. portions of the state, draining 24,726 sq. m. At some points, notably at Lake Peoria, it broadens into vast expanses resembling lakes. The Kaskaskia, in the S., notable for its variations in volume, and the Rock, in the N., are the other important rivers emptying into the Mississippi; the Embarrass and Little Wabash, the Saline and Cache in the E., are the important tributaries of the Wabash and Ohio rivers. The Chicago river, a short stream 1 m. long, formed by the union of its N. and S. branches, naturally flowed into Lake Michigan, but by the construction of the Chicago Drainage Canal its waters were turned in 1900 so that they ultimately flow into the Mississippi.

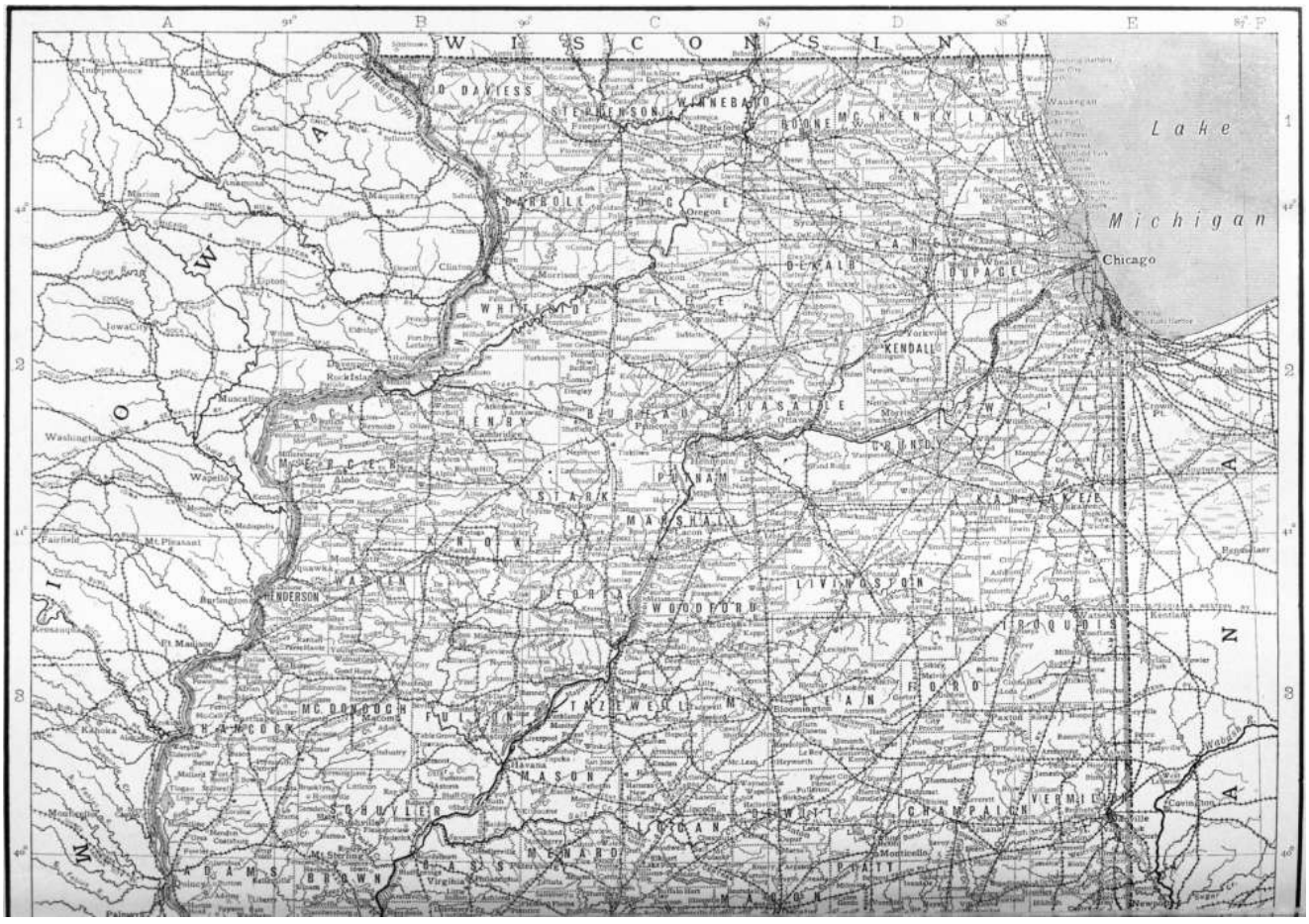
The soil of Illinois is remarkable for its fertility. The surface soils are composed of drift deposits, varying from 10 to 200 ft. in depth; they are often overlaid with a black loam 10 to 15 in. deep, and in a large portion of the state there is a subsoil of yellow clay. The soil of the prairies is darker and coarser than that of the forests, but all differences disappear with cultivation. The soil of the river valleys is alluvial and especially fertile, the "American Bottom," extending along the Mississippi from Alton to Chester, having been in cultivation for more than 150 years. Along the river bluffs there is a silicious deposit called loess, which is well suited to the cultivation of fruits and vegetables. In general the N. part of the state is especially suited to the cultivation of hay, the N. and central parts to Indian corn, the E. to oats, and the S.W. to wheat.

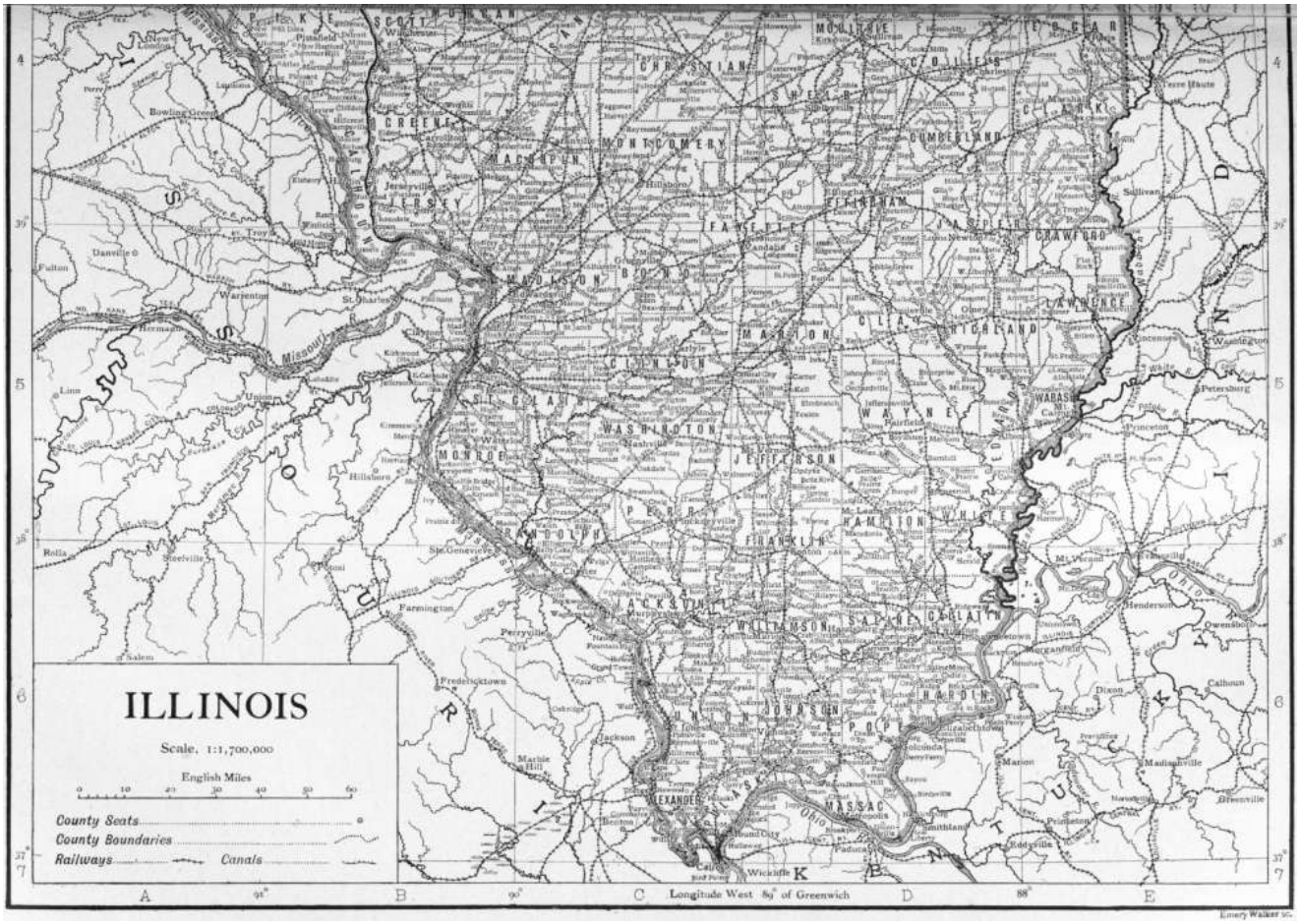
Climate.—The climate of Illinois is notable for its extremes of temperature. The warm winds which sweep up the Mississippi Valley from the Gulf of Mexico are responsible for the extremes of heat, and the Arctic winds of the north, which find no mountain range to break their strength, cause the extremes of cold. The mean annual temperature at Winnebago, near the N. border, is 47° F., and it increases to the southward at the rate of about 2° for every degree of latitude, being 52° F. at Springfield, and 58° F. in Cairo, at the S.

extremity. The lowest temperature ever recorded in the state was −32° F., in February 1905, at Ashton in the N.W. and the highest was 115° F., in July 1901, at Centralia, in the S., making a maximum range of 147° F. The range of extremes is considerably greater in the N. than in the S.; for example, at Winnebago extremes have ranged from −26° F. to 110° F. or 136° F., but at Cairo they have ranged only from −16° F. to 106° F. or 122° F. The mean annual precipitation is about 39 in. in the S. counties, but this decreases to the northward, being about 36 in. in the central counties and 34 in. along the N. border. The mean annual snowfall increases from 12 in. at the S. extremity to approximately 40 in. in the N. counties. In the N. the precipitation is 44.8% greater in spring and summer than it is in autumn and winter, but in the S. only 26.17% greater. At Cairo the prevailing winds are southerly during all months except February, and as far north as Springfield they are southerly from April to January; but throughout the N. half of the state, except along the shore of Lake Michigan, where they vary from N.E. to S.W., the winds are mostly from the W. or N.W. from October to March and very variable for the remainder of the year. The dampness and miasma, to which so many of the early settlers' fatal "chills and fever" were due, have practically disappeared before modern methods of sanitary drainage.

Fauna and Flora.—The fauna and flora, which are similar to those of the other North Central States of North America, impressed the early explorers with their richness and variety. "We have seen nothing like this for the fertility of the land, its prairies, woods, and wild cattle," wrote Père Jacques Marquette of the Illinois region, and later explorers also bore witness to the richness of the country. Many of the original wild animals, such as the bison, bear, beaver, deer and lynx, have disappeared; wolves, foxes and mink are rare; but rabbits, squirrels and raccoons are still common. The fish are mainly the coarser species, such as carp, buffalo-fish and white perch; of better food fish, the principal varieties are bass (black, striped and rock), crappie, pike, "jack salmon" or wall-eyed pike, and sun fish. The yield of the fisheries in 1900 was valued at $388,876. The most important fisheries on the Illinois river and its tributaries were at Havana, Pekin and Peoria, which in 1907-1908 were represented by a total catch of about 10,000,000 lb., out of a total for this river system of 17,570,000 lb. The flora is varied. Great numbers of grasses and flowering plants which once beautified the prairie landscape are still found on uncultivated lands, and there are about 80 species of trees, of which the oak, hickory, maple and ash are the most common. The cypress is found only in the S. and the tamarack only in the N. The forest area, estimated at 10,200 sq. m. in 1900, is almost wholly in the southern counties, and nearly all the trees which the northern half of the state had before the coming of the whites were along the banks of streams. Among wild fruits are the cherry, plum, grape, strawberry, blackberry and raspberry.

Industry and Commerce.—The fertility of the soil, the mineral wealth and the transportation facilities have given Illinois a vast economic development. In 1900 more than seven-tenths of the inhabitants in gainful occupations were engaged in agriculture (25.6%), manufactures and mechanical pursuits (26.7%), and trade and transportation (22%).





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Historically and comparatively, agriculture is the most important industry. In 1900 about nine-tenths of the total land area was inclosed in farms; the value of farm property ($2,004,316,897) was greater than that of any other state; as regards the total value of farm products in 1899 Illinois was surpassed only by Iowa; in the value of crops Illinois led all the states, and the values of property and of products were respectively 35.6% and 87.1% greater than at the end of the preceding decade. During the last half of the 19th century the number of farms increased rapidly, and the average size declined from 158 acres in 1850 to 127.6 acres in 1870 and 124.2 acres in 1900. The prevailing form of tenure is that of owners, 60.7% of the farms being so operated in 1900; but during the decade 1890-1900 the number of farms cultivated by cash tenants increased 30.8%, and the number by share tenants 24.5%, while the increase of cultivation by owners was only 1%. In proportion of farm land improved (84.5%), Illinois was surpassed only by Iowa among the states. Cereals form the most important agricultural product (600,107,378 bushels in 1899—in value about three-fourths of the total agricultural products of the state). In the production of cereals Illinois surpassed the other states at the close of each decade during the last half of the 19th century except that ending in 1890, when Iowa was the leading state. Indian corn and oats are the most valuable crops. The rank of Illinois in the production of Indian corn was first in 1899 with about one-fifth of the total product of the United States, and first in 1907[1] with nearly one-tenth of the total crop of the country (9,521,000 bushels out of 99,931,000). In 1879, in 1899 and in 1905 (when it produced 132,779,762 bushels out of 953,216,197 from the entire country) it was first among the states producing oats, but it was surpassed by Iowa in 1889, 1906 and 1907; in 1907 the Illinois crop was 101,675,000 bushels. From 1850 until 1879 Illinois also led in the production of wheat; the competition of the more western states, however, caused a great decline in both acreage and production of that cereal, the state's rank in the number of bushels produced declining to third in 1889 and to fourteenth in 1899, but the crop and yield per acre in 1902 was larger than any since 1894; in 1905 the state ranked ninth, in 1906 eighth and in 1907 fifth (the crop being 40,104,000 bushels) among the wheat-growing states of the country. The rank of the state in the growing of rye also declined from second in 1879 to eighth in 1899 and to ninth in 1907 (when the crop was 1,106,000 bushels), and the rank in the growing of barley from third in 1869 to sixteenth in 1899. In 1907 the barley crop was 600,000 bushels. Hay and forage are, after cereals, the most important crops; in 1907 2,664,000 acres produced 3,730,000 tons of hay valued at $41,030,000. Potatoes and broom corn are other valuable products. The potato crop in 1907 was 13,398,000 bushels, valued at $9,647,000, and the sugar beet, first introduced during the last decade of the 19th century, gave promise of becoming one of the most important crops. From 1889 to 1899 there was a distinct decline in the production of apples and peaches, but there was a great increase in that of cherries, plums and pears. The large urban population of the state makes the animal products very valuable, Illinois ranking third in 1900 in the number of dairy cows, and in the farm value of dairy products; indeed, all classes of live stock, except sheep, increased in number from 1850 to 1900, and at the end of the latter year Illinois was surpassed only by Iowa in the number of horses and swine; in 1909 there were more horses in Illinois than in Iowa. Important influences in the agricultural development of the state have been the formation of Farmers' Institutes, organized in 1895, a Corn Breeders' Association in 1898, and the introduction of fertilizers, the use of which in 1899 was nearly seven times the amount in 1889, and the study of soils, carried on by the State Department of Agriculture and the United States Department of Agriculture.

The growth of manufacturing in Illinois during the last half of the 19th century, due largely to the development of her exceptional transportation facilities, was the most rapid and remarkable in the industrial history of the United States. In 1850 the state ranked fifteenth, in 1860 eighth, in 1870 sixth, in 1880 fourth, in 1890 and again in 1900 third, in the value of its manufactures. The average increases of invested capital and products for each decade from 1850-1900 were, respectively, 189.26% and 152.9%; in 1900 the capital invested ($776,829,598, of which $732,829,771 was in establishments under the “factory system”), and the product ($1,259,730,168, of which $1,120,868,308 was from establishments under the “factory system”), showed unusually small percentages of increase over those for 1890 (54.7% and 38.6% respectively); and in 1905 the capital and product of establishments under the “factory system” were respectively $975,844,799 and $1,410,342,129, showing increases of 33.2% and 25.8% over the corresponding figures for 1900.

The most important industry was the wholesale slaughtering and packing of meats, which yielded 22.9% of the total manufactured product of the state in 1900, and 22.5% of the total in 1905. From 1870 to 1905 Illinois surpassed the other states in this industry, yielding in 1900 and in 1905 more than one-third of the total product of the United States. The increase in the value of the product in this industry in Illinois between 1900 and 1905 was over 10%. An interesting phase of the industry is the secondary enterprises that have developed from it, nearly all portions of the slaughtered animal being finally put to use. The blood is converted into clarifying material, the entrails are used for sausage coverings, the hoofs and small bones furnish the raw material for the manufacture of glue, the large bones are carved into knife handles, and the horns into combs, the fats are made to yield butterine, lard and soap, and the hides and hair are used in the manufacture of mattresses and felts.

The manufacture of iron and steel products, and of products depending upon iron and steel as raw material, is second in importance. The iron for these industries is secured from the Lake Superior region, the coal and limestone from mines within the state. Indeed, in the manufacture of iron and steel, Illinois was surpassed in 1900 only by Pennsylvania and Ohio, the 1900 product being valued at $60,303,144; but the value of foundry and machine shop products was even greater ($63,878,352). In 1905 the iron and steel product had increased in value since 1900 44.9%, to $87,352,761; the foundry and machine shop products 25.2%, to $79,961,482; and the wire product showed even greater increase, largely because of a difference of classification in the two censuses, the value in 1905 being $14,099,566, as against $2,879,188 in 1900, showing an increase of nearly 390%. The development of agriculture, by creating a demand for improved farm machinery, has stimulated the inventive genius; in many cases blacksmith shops have been transformed into machinery factories; also well-established companies of the eastern states have been induced to remove to Illinois by the low prices of iron and wood, due to cheap transportation rates on the Great Lakes. Consequently, in 1890, in 1900 and again in 1905, Illinois surpassed any one of the other states in the production of agricultural implements, the product in 1900 being valued at $42,033,796, or 41.5% of the total output of agricultural machinery in the United States; and in 1905 with a value of $38,412,452 it represented 34.3% of the product of the entire country. In the building of railway cars by manufacturing corporations, Illinois also led the states in 1900 and in 1905, the product being valued at $24,845,606 in 1900 and at $30,926,464 (an increase of nearly one-fourth) in 1905; and in construction by railway companies was second in 1900, with a product valued at $16,580,424, which had increased 53.7% in 1905, when the product was valued at $25,491,209. The greatest increase of products between 1890 and 1900 was in the manufacture of electrical apparatus (2400%), in which the increase in value of product was 37.2% between 1900 and 1905.

Another class of manufactures consists of those dependent upon agricultural products for raw material. Of these, the manufacture of distilled liquors was in 1900 and in 1905 the most important, Illinois leading the other states; the value of the 1900 product, which was nearly 12% less than that of 1890, was increased by 41.6%, to $54,101,805, in 1905. Peoria, the centre of the industry, is the largest producer of whisky and high-class wines of the cities in the United States. There were also, in 1900, 35 direct and other indirect products made from Indian corn by glucose plants, which consumed one-fifth of the Indian corn product of the state, and the value of these products was $18,122,814; in 1905 it was only $14,532,180. Of other manufactures dependent upon agriculture, flour and grist mill products declined between 1890 and 1900, but between 1900 and 1905 increased 39.6% to a value of $39,892,127. The manufacture of cheese, butter and condensed milk increased 60% between 1890 and 1900, but between 1900 and 1905 only 3.1%, the product in 1905 being valued at $13,276,533.

Other prosperous industries are the manufacture of lumber and timber products (the raw material being floated down the Mississippi river from the forests of other states), whose output increased from 1890 to 1900 nearly 50%, but declined slightly between 1900 and 1905; of furniture ($22,131,846 in 1905; $15,285,475 in 1900; showing an increase of 44.8%), and of musical instruments ($13,323,358 in 1905; $8,156,445 in 1900; an increase of 63.3% in the period), in both of which Illinois was second in 1900 and in 1905; book and job printing, in which the state ranked second in 1900 ($28,293,684 in 1905; $19,761,780 in 1900; an increase of 43.2%), newspaper and periodical printing ($28,644,981 in 1905; $19,404,955 in 1900; an increase of 47.6%), in which it ranked third in 1900; and the manufacture of clothing, boots and shoes. The value of the clothing manufactured in 1905 was $67,439,617 (men’s $55,202,999; women’s $12,236,618), an increase of 30.1% over 1900. The great manufacturing centre is Chicago, where more than seven-tenths of the manufactured products of the state were produced in 1900, and more than two-thirds in 1905.

In this development of manufactures, the mineral resources have been an important influence, nearly one-fourth (23.6%) of the manufactured product in 1900 depending upon minerals for raw material. Although the iron ore, for the iron and steel industry, is furnished by the mines of the Lake Superior region, bituminous coal and limestone are supplied by the Illinois deposits. The great central coal field of North America extends into Illinois from Indiana as far N. as a line from the N. boundary of Grundy county to Rock Island, W. from Rock Island to Henderson county, then S.W. to the southern part of Jackson county, when it runs S. into Kentucky, thus including more than three-fourths (42,900 sq. m.) of the land surface of the state. In 1679 Hennepin reported deposits of coal near what is now Ottawa on the Illinois; there was some mining in 1810 on the Big Muddy river in Jackson county; and in 1833, 6000 tons were mined. In 1907 (according to state authorities) coal was produced in 52 counties, Williamson, Sangamon, St Clair, Macoupin and Madison giving the largest yield. In that year the tonnage was 51,317,146, and the value of the total

product $54,687,882; in 1908 the value of the state's product of coal was exceeded only by that of Pennsylvania (nearly six times as great). Nearly 30% of all coal mined in the state was mined by machinery in 1907. The output of petroleum in Illinois was long unimportant. The first serious attempts to find oil and gas in the state were in the 'fifties of the 19th century. In 1889 the yield of petroleum was 1460 barrels. In 1902 it was only 200 barrels, nearly all of which came from Litchfield, Montgomery county (where oil had been found in commercial quantities in 1886), and Washington, Tazewell county, in the west central part of the state; at this time it was used locally for lubricating purposes. There had been some drilling in Clark county in 1865, and in 1904 this field was again worked at Westfield. In 1905 the total output of the state was 181,084 barrels; in 1906 the amount increased to 4,397,050 barrels, valued at $3,274,818; and in 1907, according to state reports, the output was 24,281,973 barrels, being nearly as great as that of the Appalachian field. The petroleum-producing area of commercial importance is a strip of land about 80 m. long and 2 or 3 to 10 or 12 m. wide in the S.E. part of the state, centring about Crawford county. In April 1906 the first pipe lines for petroleum in Illinois were laid; before that time all shipments had been in tank cars. In connexion with petroleum, natural gas has been found, especially in Clark and Crawford counties; in 1906 the state's product of natural gas was valued at $87,211. Limestone is found in about 30 counties, principally Cook, Will and Kankakee; the value of the product in 1906 was $2,942,331. Clay and clay products of the state were valued in 1906 at $12,765,453. Deposits of lead and zinc have been discovered and worked in Jo Daviess county, near Galena and Elizabeth, in the N.W. part of the state. A southern district, including parts of Hardin, Pope and Saline counties, has produced, incidentally to fluorspar, some lead, the maximum amount being 176,387 lb from the Fairview mine in 1866-1867. In 1905 the zinc from the entire state was valued at $5,499,508; the lead product in 1906 was valued at $65,208. Sandstone, quarried in 10 counties, was valued in 1905 at $29,115 and in 1906 at $19,125. Pope and Hardin counties were the only sources of fluorspar in the United States from 1842 until 1898, when fluorspar began to be mined in Kentucky; in 1906 the output was 28,268 tons, valued at $160,623, and in 1905 33,275 tons, valued at $220,206. The centre of the fluorspar district was Rosiclare in Hardin county. The cement deposits are also of value, natural cement being valued at $118,221 and Portland cement at $2,461,494 in 1906. Iron ore has been discovered. Glass sand is obtained from the Illinois river valley in La Salle county; in 1906 it was valued at $156,684, making the state in this product second only to Pennsylvania and West Virginia (in 1905 it was second only to Pennsylvania). The value of the total mineral product of the state in 1906 was estimated at $121,188,306.[2]

Communications.—Transportation facilities have been an important factor in the economic development of Illinois. The first European settlers, who were French, came by way of the Great Lakes, and established intimate relations with New Orleans by the Mississippi river. The American settlers came by way of the Ohio river, and the immigrants from the New England and Eastern states found their way to Illinois over the Erie Canal and the Great Lakes. The first transportation problem was to connect Lake Michigan and the Mississippi river; this was accomplished by building the Illinois & Michigan canal to La Salle, at the head of the navigation on the Illinois river, a work which was begun in 1836 and completed in 1848 under the auspices of the state. In 1890 the Sanitary District of Chicago undertook the construction of a canal from Chicago to Joliet, where the new canal joins the Illinois & Michigan canal; this canal is 24 ft. deep and 160 ft. wide. The Federal government completed in October 1907 the construction of a new canal, the Illinois & Mississippi, popularly known as the Hennepin, from Hennepin to Rock river (just above the mouth of Green river), 7 ft. deep, 52 ft. wide (at bottom), and 80 ft. wide at the water-line. This canal provides, with the Illinois & Michigan canal and the Illinois river, an improved waterway from Chicago to the Mississippi river, and greatly increases the commercial and industrial importance of the "twin cities" of Sterling and Rock Falls, where the Rock river is dammed by a dam nearly 1500 ft. long, making the main feeder for the canal. This feeder, formally opened in 1907, runs nearly due S. to a point on the canal N.W. of Sheffield and N.E. of Mineral; there are important locks on either side of this junction. At the general election in November 1908 the people of Illinois authorized the issue of bonds to the amount of $20,000,000 to provide for the canalizing of the Desplaines and Illinois rivers as far as the city of Utica, on the latter river, and connecting with the channel of the Chicago Sanitary District at Joliet. The situation of Illinois between the Great Lakes and the Appalachian Mountains has made it a natural gateway for railroads connecting the North Atlantic and the far Western states. The first railway constructed in the West was the Northern-Cross railroad from Meredosia on the Illinois river to Springfield, completed in 1842; during the last thirty years of the 19th century Illinois had a larger railway mileage than any of the American states, her mileage in January 1909 amounting to 12,215.63 m., second only to that of Texas. A Railway and Warehouse Commission has authority to fix freight and passenger rates for each road. It is the oldest commission with such power in the United States, and the litigation with railways which followed its establishment in 1871 fully demonstrated the public character of the railway business and was the precedent for the policy of state control elsewhere.[3]

Population.—In 1870 and 1880 Illinois was fourth among the states of the United States in population; but in 1890, in 1900, and in 1910, its rank was third, the figures for the last three years named being respectively 3,826,351, 4,821,550, and 5,638,591.[4] The increase from 1880 to 1890 was 24.3%; from 1890 to 1900, 26%. Of the population in 1900, 98.2% was white, 79.9% was native-born, and 51.2% was of foreign parentage (either one or both parents foreign-born). The principal foreign element was German, the Teutonic immigration being especially large in the decade ending in 1860; the immigrants from the United Kingdom were second in importance, those from the Scandinavian countries third, and those from southern Europe fourth. The urban population, on the basis of places having 4000 inhabitants or more, was 51% of the total; indeed the population of Cook county, in which the city of Chicago is situated, was two-fifths of the total population of the state; during the decade of the Civil War (1860-1870) the population of the state increased only 48.4%, and that of Cook county about 140%, while from 1870 to 1900 the increase of all counties, excluding Cook, was about 36%, the increase in Chicago was about 468%. Of the 930 incorporated cities, towns and villages, 614 had less than 1000 inhabitants, 27 more than 5000 and less than 10,000, 14 more than 10,000 and less than 20,000, 4 more than 20,000 and less than 25,000, and 7 more than 25,000. These seven were Chicago (1,698,575), the second city in population in the United States, Peoria (56,100), Quincy (36,252), Springfield (34,159), Rockford (31,051), East St Louis (29,655), and Joliet (29,353). In

1906 it was estimated that the total number of communicants of all denominations was 2,077,197, and that of this total 932,084 were Roman Catholics, 263,344 were Methodist (235,092 of the Northern Church, 7198 of the Southern Church, 9833 of the African Methodist Episcopal Church, 5512 of the Methodist Protestant Church, and 3597 of the Free Methodist Church of North America), 202,566 were Lutherans (113,527 of the Evangelical Lutheran Synodical Conference, 36,366 of the General Council of the Evangelical Lutheran Church, 14,768 of the General Synod of the Evangelical Lutheran Church, and 14,005 of the Evangelical Lutheran Synod of Iowa and other states), 152,870 were Baptists (118,884 of the Northern Convention, 16,081 of the National (Colored) Baptist Convention, 7755 Free Baptists, 6671 General Baptists, and 5163 Primitive Baptists), 115,602 were Presbyterian (86,251 of the Northern Church, 17,208 of the Cumberland Church (now a part of the Northern Church), and 9555 of the United Presbyterian Church), 101,516 were Disciples of Christ, 50,973 were members of the German Evangelical Synod of North America, 54,875 were Congregationalists, and 36,364 were Protestant Episcopalians.

Government.—Illinois has been governed under four constitutions, a Territorial constitution of 1812, and three State constitutions of 1818, 1848 and 1870 (subsequently amended). Amendments may be made by a Constitutional Convention or a two-thirds vote of all the members elected to the legislature, ratification by the people being required in either instance. To call a Constitutional Convention it is necessary that a majority popular vote concur in the demand therefor of two-thirds of the members of each house of the General Assembly. The executive officials hold office for four years, with the exception of the treasurer, whose term of service is two years. The governor must be at least thirty years of age, and he must also have been a citizen of the United States and of Illinois for the five years preceding his election. His veto may be over-ridden by a two-thirds vote of all the members elected to the legislature. Members of the legislature, which meets biennially, are chosen by districts, three representatives and one senator from each of the 51 districts, 18 of which are in Cook county. The term of senators is four years, that of representatives two years; and in the election of representatives since 1870 there has been a provision for “minority” representation, under which by cumulative voting each voter may cast as many votes for one candidate as there are representatives to be chosen, or he may distribute his votes (giving three votes to one candidate, or 1½ votes each to two candidates, or one vote each to three candidates), the candidate or candidates receiving the highest number of votes being elected. A similar system of cumulative voting for aldermen may be provided for by ordinance of councils in cities organized under the general state law of 1872. Requisites for membership in the General Assembly are citizenship in the United States; residence in Illinois for five years, two of which must have been just preceding the candidate’s election; and an age of 25 years for senators, and of 21 years for representatives. Conviction for bribery, perjury or other infamous crime, or failure (in the case of a collector or holder of public moneys) to account for and pay over all moneys due from him are disqualifications; and before entering upon the duties of his office each member of the legislature must take a prescribed oath that he has neither given nor promised anything to influence voters at the election, and that he will not accept, directly or indirectly, “money or other valuable thing from any corporation, company or person” for his vote or influence upon proposed legislation. Special legislation is prohibited when general laws are applicable, and special and local legislation is forbidden in any of twenty-three enumerated cases, among which are divorce, changing of an individual’s name or the name of a place, and the grant to a corporation of the right to build railways or to exercise any exclusive franchise or privilege. The judiciary consists of a supreme court of 7 members elected for a term of 9 years; a circuit court of 54 judges, 3 for each of 18 judicial districts, elected for 6 years; and four appellate courts—one for Cook county (which has also a “branch appellate court,” both the court and the branch court being presided over by three circuit judges appointed by the Supreme Court) and three other districts, each with three judges appointed in the same way. In Cook county a criminal court, and the supreme court of Cook county (originally the supreme court of Chicago), supplement the work of the circuit court. There are also county courts, consisting of one judge who serves for four years; in some counties probate courts have been established, and in counties of more than 500,000 population juvenile courts for the trial and care of delinquent children are provided for.

The local government of Illinois includes both county and township systems. The earliest American settlers came from the Southern States and naturally introduced the county system; but the increase of population from the New England and Middle States led to a recognition of township organization in the constitution of 1848, and this form of government, at first prevalent only in the northern counties, is now found in most of the middle and southern counties. Cook county, although it has a township system, is governed, like those counties in which townships are not found, by a Board of Commissioners, elected by the townships and the city of Chicago. A general law of 1872 provides for the organization of municipalities, only cities and villages being recognized, though there are still some “towns” which have failed to reorganize under the new law. City charters are granted only to such municipalities as have a population of at least 1000.

Requirements for suffrage are age of 21 years or more, citizenship in the United States, and residence in the state for one year, in the county ninety days, and the election precinct thirty days preceding the exercise of suffrage. Women are permitted to vote for certain school officials and the trustees of the State University. Disfranchisement is brought about by conviction for bribery, felony or infamous crime, and an attempt to vote after such conviction is a felony.

The relation of the state to corporations and industrial problems has been a subject of important legislation. The constitution declares that the state’s rights of eminent domain shall never be so abridged as to prevent the legislature from taking the property and franchises of incorporated companies and subjecting them to the public necessity in a way similar to the treatment of individuals. In 1903 the legislature authorized the municipal ownership of public service corporations, and in 1905 the city of Chicago took steps to acquire ownership of its street railways—a movement which seemed to have spent its force in 1907, when the municipal ownership candidates were defeated in the city’s elections—and in 1902 the right of that city to regulate the price of gas was recognized by the United States Circuit Court of Appeals. Railways organized or doing business in the state are required by the constitution to have a public office where books

for public inspection are kept, showing the amount of stock, its owners, and the amount of the road's liabilities and assets. No railway company may now issue stock except for money, labour, or property actually received and applied to purposes for which the corporation was organized. In 1907 a law went into effect making two cents a mile a maximum railway fare. An anti-trust law of 1893 exempted from the definition of trust combinations those formed by producers of agricultural products and live stock, but the United States Supreme Court in 1902 declared the statute unconstitutional as class legislation. According to a revised mining law of 1899 (subsequently amended), all mines are required to be in charge of certified mine managers, mine examiners, and hoisting engineers, when the services of the engineers are necessary; and every mine must have an escapement shaft distinct from the hoisting shaft. The number of men permitted to work in any mine not having an escapement shaft cannot, in any circumstances, exceed ten during the time in which the escapement or connexion is being completed.

Economic conditions have also led to an increase of administrative boards. A State Civil Service Commission was created by an act of the General Assembly of 1905. A Bureau of Labor Statistics (1879), whose members are styled Commissioners of Labor, makes a study of economic and financial problems and publishes biennial reports; a Mining Board (1883) and an inspector of factories and workshops (since 1893) have for their duty the enforcement of labour legislation. There are also a State Food Commission (1899) and a Live Stock Commission (1885). A Board of Arbitration (1895) has authority to make and publish investigations of all facts relating to strikes and lock-outs, to issue subpoenas for the attendance and testifying of witnesses, and "to adjust strikes or lock-outs by mediation or conciliation, without a formal submission to arbitration."

The employment of children under 14 years of age in factories or mines, and working employees under 16 years of age for more than 60 hours a week, are forbidden by statute. The state has an excellent "Juvenile Court Law," which came into force on the 1st of July 1899 and has done much good, especially in Chicago. The law recognized that a child should not be treated like a mature malefactor, and provided that there should be no criminal procedure, that the child should not be imprisoned or prosecuted, that his interests should be protected by a probation officer, that he should be discharged unless found dependent, delinquent or truant, and in such case that he should be turned over to the care of an approved individual or charitable society. This law applies to counties having a minimum population of 500,000. The legal rate of interest is 5%, but this may be increased to 7% by written contract. A homestead owned and occupied by a householder having a family is exempt (to the amount of $1000) from liability for debts, except taxes upon, and purchase money for, the same. Personal property to the value of $300 also is exempt from liability for debt. Grounds for divorce are impotence of either party at time of marriage, previous marriage, adultery, wilful desertion for two years, habitual drunkenness, attempt on life, extreme and repeated cruelty, and conviction of felony or other infamous crime. The marriage of cousins of the first degree is declared incestuous and void. In June 1907 the Supreme Court of Illinois declared the sale of liquor not a common right and "sale without license a criminal offence," thus forcing clubs to close their bars or take out licences.

> The charitable institutions of the state are under the management of local trustees appointed by the governor. They are under the supervision of the Board of State Commissioners of Public Charities (five non-salaried members appointed by the governor); in 1908 there were 18 institutions under its jurisdiction. Of these, seven were hospitals for the insane—six for specific parts of the state, viz. northern at Elgin, eastern at Kankakee, central at Jacksonville, southern at Anna, western at Watertown, and general at South Bartonville, and one at Chester for insane criminals. The others were the State Psychopathic Institute at Kankakee (established in 1907 as part of the insane service) for systematic study of mental and nervous diseases; one at Lincoln having charge of feeble-minded children; two institutions for the blind—a school at Jacksonville and an industrial home at Marshall Boulevard and 19th Street, Chicago; a home for soldiers and sailors (Quincy), one for soldiers' orphans (Normal), and one for soldiers' widows (Wilmington); a school for the deaf (Jacksonville), and an eye and ear infirmary (Chicago). The Board of Charities also had supervision of the State Training School for (delinquent) Girls (1893) at Geneva, and of the St Charles School for (delinquent) Boys (1901) at St Charles.
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> The trustees of each penal institution are appointed by the governor, and the commissioners of the two penitentiaries and the managers of the state reformatory compose a Board of Prison Industries. There were in 1908 two penitentiaries, one at Joliet and one at Chester, and, in addition to the two reformatory institutions for young offenders under the supervision of the Board of Charities, there is a State Reformatory for boys at Pontiac. The indeterminate sentence and parole systems are important features of the treatment of criminals. All but two of the counties have almshouses. In 1908, in some counties, the care of paupers was still let by contract to the lowest bidder or the superintendent was paid between $1.00 and $1.80—seldom more than $1.50—a week for each patient, and he paid a small (or no) rent on the county farm. Complete state control of the insane and the introduction of modern hospital and curative treatment in the state asylums (or hospitals) are gradually taking the place of county care for the insane and of antiquated custodial treatment in and political control of the state asylums—changes largely due to the action of Governor Deneen, who appointed in 1906 a Board of Charities pledged to reform. By a law of 1905 all employed in such institutions were put on a civil service basis. In 1907-1908, $1,500,000 was spent in rehabilitating old buildings and in buying new land and erecting buildings.

Education.—Public education in Illinois had its genesis in the land of the North-West Territory reserved for educational purposes by the Ordinance of 1787. The first state school law, which provided for state taxation for public schools, was enacted in 1825. The section providing for taxation, however, was repealed, but free schools supported by the sale of land reserved for education and by local taxation were established as early as 1834. In 1855 a second school law providing for a state school tax was enacted, and this is the foundation of the existing public school system; the constitution of 1870 also requires the legislature to provide a thorough and efficient system of public schools. In 1907-1908 the total school revenue, nine-tenths of which was derived from local taxation and the remainder chiefly from a state appropriation (for the year in question, $1,057,000) including the proceeds derived from permanent school funds secured by the gift and sale of public lands on the part of the United States Government, was $39,989,510.22. The

attendance in some school of all children from 7 to 16 years of age is compulsory, and of the population of school age (1,500,066) 988,078 were enrolled in public schools. The average length of the school term in 1908 was 7.8 months, and the average monthly salary of teachers was $82.12 for men and $60.76 for women.

The state provides for higher education in the University of Illinois, situated in the cities of Champaign and Urbana. It was founded in 1867, through the United States land grant of 1862, as the Illinois Industrial University, and received its present name in 1885; since 1870 it has been co-educational. Associated with the University are the State Laboratory of Natural History, the State Water Survey, the State Geological Survey, the State Entomologist's Office, and Agricultural and Engineering Experiment Stations. The University confers degrees in arts, science, engineering, agriculture, law, medicine, pharmacy, dentistry, music, and library science; besides the usual subjects, it has a course in ceramics. The University publishes *Bulletins* of the Agricultural and Engineering Experiment Stations; *Reports* of the State Water Survey, of the State Natural History Survey, of the State Geological Survey, and of the State Entomologist's Office; *University Studies*; and *The Journal of English and Germanic Philology*. The schools of medicine, pharmacy and dentistry are in Chicago. The faculty in 1907 numbered 408, and the total enrolment of students in 1907-1908 was 4743 (of whom 991 were women), distributed (with 13 duplicates in the classification) as follows: Graduate School, 203; Undergraduate Colleges, 2812; Summer Session, 367; College of Law, 186; College of Medicine, 476; College of Dentistry, 76; School of Pharmacy, 259; Academy, 377. In 1908 the University had a library of 103,000 volumes. The trustees of the institution, who have legislative power only, are the governor, the President of the Board of Agriculture, the State Superintendent of Public Instruction, and nine others elected by the people. There were in 1907 more than forty other universities and colleges in the state, the most important being the University of Chicago, North-western University at Evanston, Illinois Wesleyan University at Bloomington, Knox College, Galesburg, and Illinois College at Jacksonville. There were also six normal colleges, five of them public: the Southern Illinois State Normal College at Carbondale, the Eastern Illinois State Normal School at Charleston, the Western Illinois State Normal School at Macomb, the Chicago Normal School at Chicago, the Northern Illinois State Normal School at DeKalb, and the Illinois State Normal University at Normal.

Finance.—The total receipts for the biennial period ending the 30th of September 1908 were $19,588,842.06, and the disbursements were $21,278,805.27; and on the 1st of October 1908 there was a balance in the treasury of $3,859,263.44. The bonded debt on the same date was $17,500; these bonds ceased to bear interest in 1882, but although called in by the governor they have never been presented for payment. The system of revenue is based upon the general property tax; the local assessment of all real and personal property is required, with the aim of recording all kinds of property upon the assessment rolls. Boards of Revision and Boards of Supervision then equalize the assessments in the counties and townships, while a State Board of Equalization seeks to equalize the total valuation of the various counties. The tendency is for property valuations to decline, the estimated valuation from 1873 to 1893 decreasing 27% in Cook county and 39% in the other counties, while the assessments from 1888 to 1898 were in inverse ratio to the increase of wealth. There has also been great inequality in valuations, the increase of valuation in Cook county made in compliance with the revenue law of 1898 being $200,000,000, while that for the rest of the state was only $4,000,000. Among other sources of revenue are an inheritance tax, which yields approximately $1,000,000 a year, and 7% of the annual gross earnings of the Illinois Central railway, given in return for the state aid in the construction of the road. The constitution prohibits the state from lending its credit or making appropriations in aid of any corporation, association or individual, and from constructing internal improvements, and the counties, townships, and other political units cannot incur indebtedness in excess of 5% of their assessed property valuation. The legislature may not contract a debt of more than $250,000 except to suppress treason, war or invasion, and no legislative appropriation may extend longer than the succeeding legislature. General banking laws must be submitted to the people for ratification.

History.—Illinois is the French form of Iliniwek, the name of a confederacy of Algonquian tribes. The first exploration by Europeans was that of the French. In 1659 Pierre Radisson and Medard Chouart des Groseilliers seem to have reached the upper Mississippi. It is certain that in 1673 part of the region known as the Illinois country was explored to some extent by two Frenchmen, Louis Joliet and Jacques Marquette, a Jesuit father. Marquette, under orders to begin a mission to the Indians, who were known to the French by their visits to the French settlements in the Lake Superior region, and Joliet, who acted under orders of Jean Talon, Intendant of Canada, ascended the Fox river, crossed the portage between it and the Wisconsin river, and followed that stream to the Mississippi, which they descended to a point below the mouth of the Arkansas. On their return journey they ascended the Illinois river as far as Lake Peoria; they then crossed the portage to Lake Michigan, and in 1675 Marquette founded a mission at the Indian town of Kaskaskia, near the present Utica, Ill. In 1679 the explorer La Salle, desiring to find the mouth of the Mississippi and to extend the domain of France in America, ascended the St Joseph river, crossed the portage separating it from the Kankakee, which he descended to the Illinois, and built in the neighbourhood of Lake Peoria a fort which he called Fort Crevecœur. The vicissitudes of the expedition, the necessity for him to return to Canada for tools to construct a large river-boat, and opposition in Canada to his plans, prevented him from reaching the mouth of the Illinois until the 6th of February 1682. After such preliminary explorations, the French made permanent settlements, which had their origin in the missions of the Jesuits and the bartering posts of the French traders. Chief of these were Kaskaskia, established near the mouth of the Kaskaskia river, about 1720; Cahokia, a little below the mouth of the Missouri river, founded at about the same time; and Fort Chartres, on the Mississippi between Cahokia and Kaskaskia, founded in 1720 to be a link in a chain of fortifications intended to extend from the St Lawrence to the Gulf of Mexico. A monument of the labours of the missionaries is a manuscript dictionary (*c.* 1720) of the language of the Illinois, with catechism and prayers, probably the work of Father Le Boulanger.

In 1712 the Illinois river was made the N. boundary of the French province of Louisiana, which was granted to Antoine Crozat (1655-1738), and in 1721 the seventh civil and military district of that province was named Illinois, which included more than one-half of the present state, the country between the

Arkansas river and the line 43° N. lat., as well as the country between the Rocky Mountains and the Mississippi; but in 1723 the region around the Wabash river was formed into a separate district. The trade of the Illinois country was now diverted to the settlements in the lower Mississippi river, but the French, although they were successful in gaining the confidence and friendship of the Indians, failed to develop the resources of the country. By the treaty of Paris, 1763, France ceded to Great Britain her claims to the country between the Ohio and Mississippi rivers, but on account of the resistance of Pontiac, a chief of the Ottawas who drew into conspiracy most of the tribes between the Ottawa river and the lower Mississippi, the English were not able to take possession of the country until 1765, when the French flag was finally lowered at Fort Chartres.

The policy of the British government was not favourable to the economic development of the newly-acquired country, since it was feared that its prosperity might react against the trade and industry of Great Britain. But in 1769 and the succeeding years of English control, this policy was relaxed, and immigration from the seaboard colonies, especially from Virginia, began. In 1771 the people of the Illinois country, through a meeting at Kaskaskia, demanded a form of self-government similar to that of Connecticut. The petition was rejected by General Thomas Gage; and Thomas Legge, earl of Dartmouth (1731-1801), Secretary of State for Plantations and President of the Board of Trade, drew up a plan of government for Illinois in which all officials were appointed by the crown. This, however, was never operative, for in 1774, by the famous Quebec Act, the Illinois country was annexed to the province of Quebec, and at the same time the jurisdiction of the French civil law was recognized. These facts explain the considerable sympathy in Illinois for the colonial cause in the War of Independence. Most of the inhabitants, however, were French, and these were Loyalists. Consequently, the British government withdrew their troops from the Illinois country. The English authorities instigated the Indians to make attacks upon the frontiers of the American colonies, and this led to one of the most important events in the history of the Illinois country, the capture of the British posts of Cahokia and Kaskaskia in 1778, and in the following year of Vincennes (Indiana), by George Rogers Clark (*q.v.*), who acted under orders of Patrick Henry, Governor of Virginia. These conquests had much to do with the securing by the United States of the country W. of the Alleghanies and N. of the Ohio in the treaty of Paris, 1783.

The Virginia House of Delegates, in 1778, extended the civil jurisdiction of Virginia to the north-west, and appointed Captain John Todd (1750-1782), of Kentucky, governor of the entire territory north of the Ohio, organized as “The County of Illinois”; the judges of the courts at Cahokia, Kaskaskia, and Vincennes, who had been appointed under the British administration, were now chosen by election; but this government was confined to the old French settlements and was entirely inefficient. In 1787, Virginia and the other states having relinquished their claims to the country west of the Alleghanies, the North-West Territory was organized by Congress by the famous Ordinance of 1787. Two years later St Clair county was formed out of the S.W. part of the Illinois country, while the E. portion and the settlements around Vincennes (Indiana) were united into the county of Knox, and in 1795 the S. part of St Clair county was organized into Randolph county, with Kaskaskia as the seat of administration. In 1800 the Illinois country was included in the Territory of Indiana, and in 1809 the W. part of Indiana from Vincennes N. to Canada was organized as the Territory of Illinois; it included, besides the present territory of the state, all of Wisconsin except the N. part of the Green Bay peninsula, a considerable part of Michigan, and all of Minnesota E. of the Mississippi. In 1812, by permission of Congress, a representative assembly was chosen, a Territorial constitution was adopted, and the Territorial delegate in Congress was elected directly by the people.

In 1818 Illinois became a state of the American Union, the Enabling Act fixing the line 42° 30’ as the N. boundary, instead of that provided by the Ordinance of 1787, which passed through the S. bend of Lake Michigan. The reason given for this change was that if the Mississippi and Ohio rivers were the only outlets of Illinois trade, the interests of the state would become identified with those of the southern states; but if an outlet by Lake Michigan were provided, closer relations would be established with the northern and middle states, and so “additional security for the perpetuity of the Union” would be afforded.

Among the first problems of the new state were those relating to lands and Indians. Throughout the Territorial period there was conflict between French and English land claims. In 1804 Congress established land offices at Kaskaskia and Vincennes to examine existing claims and to eliminate conflict with future grants; in 1812 new offices were established at Shawneetown and Edwardsville for the sale of public lands; and in 1816 more than 500,000 acres were sold. In 1818, however, many citizens were in debt for their lands, and “squatters” invaded the rights of settlers. Congress therefore reduced the price of land from $2 to $1.25 per acre, and adopted the policy of pre-emption, preference being given to the claims of existing settlers. The Indians, however, resisted measures looking toward the extinguishment of their claims to the country. Their dissatisfaction with the treaties signed in 1795 and 1804 caused them to espouse the British cause in the War of 1812, and in 1812 they overpowered a body of soldiers and settlers who had abandoned Fort Dearborn (See Chicago). For a number of years after the end of the conflict, the Indians were comparatively peaceful; but in 1831 the delay of the Sauk and Foxes in withdrawing from the lands in northern Illinois, caused Governor John Reynolds (1788-1865) to call out the militia. The following year Black Hawk, a Sauk leader, opened an unsuccessful war in northern Illinois and Wisconsin (the Black Hawk War); and by 1833 all Indians in Illinois had been removed from the state.

The financial and industrial policy of the state was unfortunate. Money being scarce, the legislature in 1819 chartered a state bank which was authorized to do business on the credit of the state. In a few years the bank failed, and the state in 1831 borrowed money to redeem the depreciated notes issued by the bank. A second state bank was chartered in 1835; two years later it suspended payment, and in 1843 the legislature provided for its liquidation. The state also undertook to establish a system of internal improvements, granting a loan for the construction of the Illinois and Michigan canal in 1836, and in 1837 appropriating $10,000,000 for the building of railroads and other improvements. The experiment proved unsuccessful; the state’s credit declined and a heavy debt was incurred, and in 1840 the policy of aiding public improvements was abandoned. Through the efforts of Governor Thomas Ford (1800-1850) a movement to repudiate the state debt was defeated, and a plan was adopted by which the entire debt could

be reduced without excessive taxation, and by 1880 practically the entire debt was extinguished.

A notable incident in the history of the state was the immigration of the Mormons from Missouri, about 1840. Their principal settlements were in Hancock county. They succeeded in securing favours from the legislature, and their city of Nauvoo had courts and a military organization that was independent of state control. Political intrigue, claims of independence from the state, as well as charges of polygamy and lawless conduct, aroused such intense opposition to the sect that in 1844 a civil war broke out in Hancock county which resulted in the murder of Joseph Smith and the removal of the Mormons from Illinois in 1846.

The slavery question, however, was the problem of lasting political importance. Slaves had been brought into the Illinois country by the French, and Governor Arthur St Clair (1734-1818) interpreted the article of the Ordinance of 1787, which forbade slavery in the North-West Territory, as a prohibition of the introduction of slaves into the Territory, not an interference with existing conditions. The idea also arose that while negroes could not become slaves, they could be held as indentured servants, and such servitude was recognized in the Indiana Code of 1803, the Illinois constitution of 1818, and Statutes of 1819; indeed there would probably have been a recognition of slavery in the constitution of 1818 had it not been feared that such recognition would have prevented the admission of the state to the Union. In 1823 the legislature referred to the people a resolution for a constitutional convention to amend the constitution. The aim, not expressed, was the legalization of slavery. Although a majority of the public men of the state, indeed probably a majority of the entire population, was either born in the Southern states or descended from Southern people, the resolution of the legislature was rejected, the leader of the opposition being Governor Edward Coles (1786-1868), a Virginia slave-holder, who had freed his slaves on coming to Illinois, and at least one half the votes against the proposed amendment of the constitution were cast by men of Southern birth. The opposition to slavery, however, was at first economic, not philanthropic. In 1837 there was only one abolition society in the state, but chiefly through the agitation of Elijah P. Lovejoy (see Alton), the abolition sentiment grew. In 1842 the moral issue had become political, and the Liberty Party was organized, which in 1848 united with the Free Soil Party; but as the Whig Party approved the policy of non-extension of slavery, these parties did not succeed so well united as under separate existence. In 1854, however, the Liberty and Free Soil parties, the Democrats opposed to the Kansas-Nebraska Bill, and some Whigs united, secured a majority in the legislature, and elected Lyman Trumbull United States senator. Two years later these elements formally organized as the Republican Party, though that name had been used locally in 1854, and elected their candidates for state offices. This was the first time that the Democratic Party had been defeated, its organization having been in control since the admission of Illinois to the Union. An important influence in this political revolution was a change in the character of the population. Until 1848 the Southern element predominated in the population, but after that year the immigration from the Northern states was greater than that from the South, and the foreign element also increased.[5] The opposition to slavery continued to be political and economic rather than philanthropic. The constitution of 1848, which abolished slavery, also forbade the immigration of slaves into the state.[6] In 1858 occurred the famous contest for the office of United States senator between Stephen A. Douglas (Democrat) and Abraham Lincoln (Republican). Douglas was elected, but the vote showed that Illinois was becoming more Northern in sympathy, and two years later Lincoln, then candidate for the presidency, carried the state.

The policy of Illinois in the early period of secession was one of marked loyalty to the Union; even in the S. part of the state, where there was a strong feeling against national interference with slavery, the majority of the people had no sympathy with the pro-slavery men in their efforts to dissolve the Union. The legislature of 1861 provided for a war fund of $2,000,000; and Capt. James H. Stokes (1814-1890) of Chicago transferred a large amount of munitions of war from St Louis, where the secession sentiment was strong, to Alton. The state contributed 255,092 men to the Federal armies. From 1862-1864, however, there was considerable opposition to a continuance of the war. This was at first political; the legislature of 1862 was Democratic, and for political purposes that body adopted resolutions against further conflict, and recommended an armistice, and a national convention to conclude peace. The same year a convention, whose duty was to revise the constitution, met. It declared that the law which called it into being was no longer binding, and that it was supreme in all matters incident to amending the constitution. Among its acts was the assumption of the right of ratifying a proposed amendment to the constitution of the United States which prohibited Congress from interfering with the institution of slavery within a state, although the right of ratification belonged to the legislature. The convention also inserted clauses preventing negroes and mulattoes from immigrating into the state and from voting and holding office; and although the constitution as a whole was rejected by the people, these clauses were ratified. In 1863 more pronounced opposition to the policy of the National Government developed. A mass meeting, which met at Springfield in July, at the instance of the Democratic Party, adopted resolutions that condemned the suspension of the writ of Habeas Corpus, endorsed the doctrine of state sovereignty, demanded a national assembly to determine terms of peace, and asked President Lincoln to withdraw the proclamation that emancipated the slaves, and so to permit the people of Illinois to fight only for “Union, the Constitution and the enforcement of the laws.” The Knights of the Golden Circle, and other secret societies, whose aims were the promulgation of state sovereignty and the extension of aid to the Confederate states, began to flourish, and it is said that in 1864 there were 50,000 members of the Sons of Liberty in the state. Captain T. Henry Hines, of the Confederate army, was appointed by Jefferson Davis to co-operate with these societies. For a time his headquarters were in Chicago, and an elaborate attempt to liberate Confederate prisoners in Chicago (known as the Camp Douglas Conspiracy) was thwarted by a discovery of the plans. In the elections of 1864 the Republicans and Union Democrats united, and after an exciting campaign they were successful. The new legislature was the first among the legislatures of the states to ratify (on the 1st of February 1865) the Thirteenth Amendment.

From the close of the Civil War until the end of the 19th century the Republican Party was generally dominant, but the trend of political development was not without interest. In 1872 many prominent men of the state joined the Liberal Republican Party, among them Governor John M. Palmer, Senator Lyman Trumbull and Gustavus Koerner (1809-1896), one of the most prominent representatives of the German element in Illinois. The organization united locally, as in national politics, with the Democratic Party, with

equally ineffective results. Economic depression gave the Granger Movement considerable popularity, and an outgrowth of the Granger organization was the Independent Reform Party, of 1874, which advocated retrenchment of expenses, the state regulation of railways and a tariff for revenue only. A Democratic Liberal Party was organized in the same year, one of its leaders being Governor Palmer; consequently no party had a majority in the legislature elected in 1874. In 1876 the Greenback Party, the successor in Illinois of the Independent Reform Party, secured a strong following; although its candidate for governor was endorsed by the Democrats, the Republicans regained control of the state administration.

The relations between capital and labour have resulted in serious conditions, the number of strikes from 1880-1901 having been 2640, and the number of lock-outs 95. In 1885 the governor found it necessary to use the state militia to suppress riots in Will and Cook counties occasioned by the strikes of quarrymen, and the following year the militia was again called out to suppress riots in St Clair and Cook counties caused by the widespread strike of railway employees. The most noted instance of military interference was in 1894, when President Grover Cleveland sent United States troops to Chicago to prevent strikers and rioters from interfering with the transmission of the United States mails.

Municipal problems have also reacted upon state politics. From 1897 to 1903 the efforts of the Street Railway Companies of Chicago to extend their franchise, and of the city of Chicago to secure municipal control of its street railway system, resulted in the statute of 1903, which provided for municipal ownership. But the proposed issue under this law of bonds with which Chicago was to purchase or construct railways would have increased the city's bonded indebtedness beyond its constitutional limit, and was therefore declared unconstitutional in April 1907 by the supreme court of the state.

A law of 1901 provided for a system of initiative whereby any question of public policy might be submitted to popular vote upon the signature of a written petition therefor by one-tenth of the registered voters of the state; such a petition must be filed at least 60 days before the election day when it is to be voted upon, and not more than three questions by initiative may be voted on at the same election; to become operative a measure must receive a majority of all votes cast in the election. Under this act, in 1902, there was a favourable vote (451,319 to 76,975) for the adoption of measures requisite to securing the election of United States senators by popular and direct vote, and in 1903 the legislature of the state (which in 1891 had asked Congress to submit such an amendment) adopted a joint resolution asking Congress to call a convention to propose such an amendment to the Federal Constitution; in 1904 there was a majority of all the votes cast in the election for an amendment to the primary laws providing that voters may vote at state primaries under the Australian ballot. The direct primary law, however, which was passed immediately afterwards by the legislature, was declared unconstitutional by the supreme court of the state, as were a second law of the same sort passed soon afterwards and a third law of 1908, which provided for direct nominations of all officers and an "advisory" nomination of United States senators.

American Governors of Illinois

Territorial.		
Ninian Edwards	1809-1818	
State.		
Shadrach Bond	1818-1822	Democrat
Edward Coles	1822-1826	”
Ninian Edwards	1826-1830	”
John Reynolds	1830-1834	”
Wm. L. D. Ewing (acting)	1834	”
Joseph Duncan	1834-1838	”
Thomas Carlin	1838-1842	”
Thomas Ford	1842-1846	”
Augustus C. French	1846-1853[7]	”
Joel A. Matteson	1853-1857	”
William H. Bissell	1857-1860	Republican
John Wood (acting)	1860-1861	”
Richard Yates	1861-1865	”
Richard J. Oglesby	1865-1869	”
John M. Palmer	1869-1873	”
Richard J. Oglesby	1873	”
John L. Beveridge (acting)	1873-1877	”
Shelby M. Cullom	1877-1883	”
John M. Hamilton (acting)	1883-1885	”
Richard J. Oglesby	1885-1889	”
Joseph W. Fifer	1889-1893	”
John P. Altgeld	1893-1897	Democrat
John R. Tanner	1897-1901	Republican
Richard Yates	1901-1905	”
Charles S. Deneen	1905-	”

Bibliography.—There is no complete bibliography of the varied and extensive literature relating to Illinois; but Richard Bowker's *State Publications*, part ii. (New York, 1902), and the chapters of E. B. Greene's *The Government of Illinois* (New York, 1904) contain useful lists of documents, monographs and books. Physiography is well described in *The Illinois Glacial Lobe* (U.S. Geological Survey, Monograph, xxxviii.) and *The Water Resources of Illinois* (U.S. Geological Survey, Annual Report, xviii.). The Illinois State Laboratory of Natural History, connected with the State University, has published S. A. Forbes and R. E. Richardson's *Fishes of Illinois* (Urbana, 1909). Information concerning economic conditions may be derived from the volumes of the *Twelfth Census of the United States*, which treat of Agriculture, Manufactures and Mines and Quarries: a summary of agricultural conditions may be found in *Census Bulletin No. 213*. Constitutional and administrative problems are discussed in Elliott Anthony's *Constitutional History of Illinois*; Greene's *The*

Government of Illinois, and H. P. Judson's *The Government of Illinois* (New York, 1900). Among the reports of the state officials, those of the Railroad and Ware House Commission, of the Bureau of Labor Statistics, and of the Commissioners of Charity are especially valuable. There is an historical study of the problem of taxation, entitled, "History of the Struggle in Illinois to realize Equality in Taxation," by H. B. Hurd, in the *Publications of the Michigan Political Science Association* (1901). Local government is described by Albert Shaw, *Local Government in Illinois* (Johns Hopkins University Studies, vol. i. No. 10). The *Blue Book of the State of Illinois* (Springfield, 1903); H. B. Hurd's Revised Statutes of Illinois (Chicago, 1903), and Starr and Curtis, *Annotated Statutes of the State of Illinois* (Chicago, 1896), are also of value.

The standard histories of the state are J. Moses, *Illinois, Historical and Statistical* (2 vols., Chicago, 1889); and H. Davidson and B. Stuvé, *Complete History of Illinois* (Springfield, 1874). Edward G. Mason's *Chapters from Illinois History* (Chicago, 1901) is of interest for the French explorations and the colonial period. C. E. Boyd in "The County of Illinois" (*American Hist. Rev.* vol. iv.), "Record Book and Papers of John Todd" (*Chicago Historical Society, Collections*, iv.), C. E. Carter, *Great Britain and the Illinois Country, 1763-1774* (Washington, 1910), R. L. Schuyler, *The Transition of Illinois to American Government* (New York, 1909), and W. H. Smith in *The St Clair Papers* (Cincinnati, 1882), and the *Territorial Records of Illinois* ("Publications of the State Historical Library," No. 3) are important for the period until 1818. Governor Thomas Ford's *History of Illinois* (Chicago, 1854), and Governor John Reynolds's *My Own Times* (1855), are contemporary sources for 1818-1846; they should be supplemented by N. W. Edwards's *History of Illinois (1778-1833)* and *Life of Ninian Edwards* (Springfield, 1870), E. B. Washburne's *Edwards Papers* (Chicago, 1884), C. H. Garnett's *State Banks of Issue in Illinois* (Univ. of Ill., 1898), and N. G. Harris's *History of Negro Servitude in Illinois* (Chicago, 1904). C. E. Carr's *The Illini* (Chicago, 1904) is a study of conditions in Illinois from 1850-1860. W. W. Lusk's *Politics and Politicians of Illinois, the Illinois Constitutional Convention* (1862), *the Granger Movement in Illinois*, and *Illinois Railway Legislation and Common Control* (University of Illinois Studies), *Street Railway Legislation in Illinois* (*Atlantic Monthly*, vol. xciii.), are of value for conditions after 1860. The publications of the Chicago Historical Society, of the "Fergus Historical" series, of the State Historical Library, of the Wisconsin Historical Society, also the Michigan Pioneer Collections, contain valuable documents and essays.

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1 The statistics for years prior to 1900 are taken from reports of the U.S. Census, those for years after 1900 from the *Year Books* of the U.S. Department of Agriculture. It should be borne in mind that in census years, when comparison can be made, the two sets of statistics often vary considerably.

2 According to the report of the State Geological Survey, the value of the total mineral product in the state for 1907 was $152,122,648, the values of the different minerals being as follows: coal, $54,687,382; pig iron, about $52,228,000; petroleum, $16,432,947; clay and clay products, $13,351,362; zinc, $6,614,608; limestone, $4,333,651; Portland cement, $2,632,576; sand and gravel, $1,367,653; natural slag, $174,282; fluorspar, $141,971; mineral waters, $91,700; lead ore, $45,760; sandstone, $14,996; and pyrite, $5700.

3 See the so-called *McLean County Case* (67 Ill. 11), the *Neal Ruggles Case* (91 Ill. 256), *The People* v. *The Illinois Central Railroad Co.* (95 Ill. 313), and *Munn* v. *Ill.* (94 U.S. 113).

4 The populations in other census years were: (1810), 12,282; (1820), 55,211; (1830), 157,445; (1840), 476,183; (1850), 851,470; (1860), 1,711,951; (1870), 2,539,891; (1880), 3,077,871.

5 The influence of immigration and sectionalism upon Illinois politics is well illustrated by the fact that the first six governors (1818-1838) were born in the Southern states, six of the eight United States senators of that period were also Southern born, and all of the representatives, with one exception, also came to Illinois from the Southern states. After 1838 the Eastern states began to be represented among the governors, but until 1901 no governor was elected who was a native of Illinois. See E. B. Greene, *Sectional Forces in the History of Illinois* (Publications of the Historical Library of Illinois, No. 8, 1903).

6 In the slavery issue of 1848 the sentiment for abolition centred in the northern counties, the opposition in the southern.

7 Mr French's service of seven years is due to the fact that the Constitutional Convention of 1848 ordered a new election of state officials. French was re-elected Governor, beginning his new term in 1849.

ILLORIN, a province of British West Africa in the protectorate of Nigeria. It has an area of 6300 m., with an estimated population of about 250,000. Its inhabitants are of various tribes, among which the Yoruba now predominate. There are two minor emirates, Shonga and Lafiagi in this province, and a number of semi-independent towns of which the chief are Awton, Ajassa, Offa and Patiji. Under British administration the province is divided into three divisions, Illorin (central), Offa (southern) and Patiji (northern). The province is rich in agricultural and sylvan products. Among the former are tobacco, cotton, rice, peppers, ground-nuts and kolas. The latter include great quantities of shea as well as palm-oil and rubber. The capital is a town of the same name as the province. It is 160 m. in a direct line N.N.E. of Lagos, and 50 m. S.S.W. of Jebba, a port on the Niger, being connected with both places by railway. The town is surrounded by a mud wall partly in ruins, which has a circuit of some 10 m. Illorin is a great trading centre, Hausa caravans bringing goods from central Africa, and merchandise from the coasts of the Mediterranean, which is distributed from Illorin to Dahomey, Benin and the Lagos hinterland, while from the Guinea coast the trade is in the hands of the Yoruba and comes chiefly through Lagos. A variety of manufactures are carried on, including the making of leather goods, carved wooden vessels, finely plaited mats, embroidered work, shoes of yellow and red leather and pottery of various kinds. Before the establishment of British administration traders from the south, with a few selected exceptions, were prohibited from entering the city. Illorin middlemen transacted all business between the traders from the north, who were not allowed to pass to the south, and those from the south. Since the establishment of British authority the town has been thrown open, crowds of petty traders from Lagos have flocked into Illorin, and between 4000 and 5000 trade

licences are issued yearly. The British resident estimated in 1904 that at least 3000 loads of British cotton goods, which he valued at £5 a load, were imported. The population of the town is estimated at from 60,000 to 70,000. The chief buildings are the palace of the emir and the houses of the *baloguns* (war chiefs). From the centre of the town roads radiate like spokes of a wheel to the various gates. Baobabs and other shade trees are numerous. There are a number of mosques in the town, and the Mahommedans are the dominant power, but the Yoruba, who constitute the bulk of the people, are pagans.

The town of Illorin was founded, towards the close of the 18th century, by Yoruba, and rose to be the capital of one of the Yoruba kingdoms. About 1825 the kingdom, which had come under Mahommedan influence, ceased its connexion with the Yoruba states and became an emirate of the Sokoto empire. The Fula, however, maintained the Yoruba system of government, which places the chief power in a council of elders. In 1897 Illorin was occupied by the forces of the Royal Niger Company, and the emir placed himself "entirely under the protection and power of the company." After the assumption of authority by the British government in 1900, Illorin was organized for administration on the same system as the remainder of northern Nigeria. The emir took the oath of allegiance to the sovereign of Great Britain. A resident was placed at his court. Courts of justice have been established and British garrisons quartered at various places in the province. (See also Nigeria and Lagos.)

ILLUMINATED MSS.—"Illumination," in art, is a term used to signify the embellishment of written or printed text or design with colours and gold, rarely also with silver. The old form of the verb "to illuminate" was "to enlumine" (O. Fr. *enluminer*; Lat. *illuminare*, "to throw light on," "to brighten"), as used by Chaucer (*A.B.C.*, 73), "kalendres enlumyned ben they," and other medieval writers. Joinville likens the action of St Louis in adorning his kingdom with monastic foundations to a writer "qui a fait son livre qui l'enlumine d'or et d'azur"; while Dante (*Purgat.* xi. 79) alludes to this kind of decoration as "quell' arte che alluminare chiamata è in Parisi." But while the term should be strictly applied to the brilliant book-ornamentation which was developed in the later middle ages, it has been extended, by usage, to the illustration and decoration of early MSS. in general.

Early.

From remote times the practice of illustrating texts by means of pictorial representations was in vogue. The survival of papyrus rolls containing the text of the Egyptian ritual known as *The Book of the Dead*, dating back fifteen centuries B.C., and accompanied with numerous scenes painted in brilliant colours, proves how ancient was this very natural method of elucidating a written text by means of pictures. There are many passages in the writings of Latin authors showing that illustrated books were not uncommon in Rome at least in the early period of the empire; and the oldest extant paintings in ancient classical MSS. may with little hesitation be accepted as representative of the style of illustration which was practised very much earlier. But such paintings are rather illustrative than decorative, and the only strictly ornamental adjuncts are the frames in which they are set. Yet independent decoration appears in a primitive form in the papyri and the earliest vellum MSS. At the head or at the end of the text designs composed of cross-hatchings, cables, dotted patterns and scrolls, sometimes with birds or simple domestic objects, are found. The early practice of writing the initial lines or even the entire text of a volume in gold or coloured inks, and of staining with purple and of gilding the vellum, while it undoubtedly enhanced the decorative aspect, does not properly fall within the scope of this article; it concerns the material rather than the artistic element of the MS. (See Manuscripts, Palaeography.)

It will be seen, then, that in the earliest examples of book decorations we find the germs of the two lines on which that decoration was destined to develop in the illuminated MSS. of the middle ages: the illustrative picture was the precursor of the medieval miniature (the technical term for a picture in an illuminated MS.); and the independent simple ornament was to expand into the brilliant initial letters and borders of illumination. And yet, while the miniature has a career of its own in artistic development which may be more conveniently dealt with under a separate heading (see Miniature), its decorative qualities are so closely bound up with those of the initial and border that an historical description of illumination must give full recognition to its prominent position in the general scheme of book-ornamentation of the middle ages.

The first examples to come under consideration are the few surviving MSS. of early origin which, preserving as they do the classical tradition, form the connecting link between the art of the Roman empire and that of the middle ages. The most ancient of these, it is now agreed, is the fragmentary copy of the *Iliad*, on vellum, in the Ambrosian Library of Milan, which consists of cuttings of the coloured drawings with which the volume was adorned in illustration of the various scenes of the poem. The MS. may have been executed in Italy, and there is good reason to assign the fragments to the 3rd century. The character of the art is quite classical, bearing comparison with that of the wall-paintings of Pompeii and the catacombs. Equally classical in their style are the fifty illustrative pictures of the Vatican Virgil, known as the *Schedae Vaticanae*, of the 4th century; but in these we find an advance on the Homeric fragments in the direction of decoration, for gilt shading is here employed to heighten the lights, and the frames in which the pictures are set are ornamented with gilt lozenges. A second famous MS. of Virgil in the Vatican library is the *Codex Romanus*, a curious instance of rough and clumsy art, with its series of illustrations copied by an unskilful hand from earlier classical models. And a still later example of persistence of the classical tradition is seen in the long roll of the book of Joshua, also in the Vatican, perhaps of the 10th century, which is filled with a series of outline drawings of considerable merit, copied from an earlier MS. But all such MSS. exhibit little tendency to decoration, and if the book ornamentation of the early middle ages had been practised only in the western empire and not also at Constantinople, it is very doubtful if the brilliant illumination which was afterwards developed would have ever existed.

THE LINDISFARNE GOSPELS.—ABOUT A.D. 700.
(British Museum. Cotton MS., Nero D. iv. f. 211.)

When the centre of government passed eastward, Roman art came under Oriental influence with its sense of splendour, and developed the style known as Byzantine which, in its earlier stages, and until it became stereotyped in character, was broad in its drawing, on classical lines, and brilliant in its colouring, and which introduced a profuse application of gold in the details of ornament. Reacting on the art of the west, the influence of the Byzantine or Greek school is not only prominent in such early works as the mosaics of Ravenna, but it has also left its mark in the peculiar character of Italian pictorial art of the middle ages.

Byzantine.

Very few examples of early Byzantine work in MSS. have survived; but two fragmentary leaves (Brit. Mus., Add. MS. 5111) of tables of the Eusebian canons, which must have stood at the beginning of a copy of the Gospels, executed no doubt in the Eastern capital in the 6th century, are sufficient to exemplify the splendour of ornament which might be lavished on book decoration at that date. The surface of the vellum is entirely gilt, and the ornamental designs are in classical style and painted in bright colours. Two well-known MSS., the Genesis of the Imperial Library of Vienna, of the latter part of the 6th century, and the Gospels of Rossano in southern Italy, of the same period, both containing series of illustrative paintings of a semi-classical type, are very interesting specimens of Byzantine art; but they depend on their purple vellum and their silver-written texts to claim a place among highly ornamented MSS., for the paintings themselves are devoid of gold. On the other hand, the Greek MS. of Genesis, of the 5th or 6th century, which once formed part of the Cottonian collection in the British Museum, but which was almost totally destroyed by fire, was

of a more artistic character: the drawing of its miniatures was of great merit and classical in style, and gold shading was largely employed in the details. The famous MS. of Dioscorides at Vienna, executed in the year 472, is another excellent example of the early Byzantine school, its series of paintings at the beginning of the volume well maintaining the classical sentiment.

From such early examples Byzantine art advanced to a maturer style in the 9th and 10th centuries, two MSS. in the Bibliothèque Nationale of Paris being types of the best work of this time. These are: the copy of the sermons of Gregory Nazianzen (MS. *Grec.* 510), executed about the year 880 and containing a series of large miniatures, some being of the highest excellence; and a psalter of the 10th century (MS. Grec. 139), among whose miniatures are examples which still maintain the old sentiment of classical art in a remarkable degree, one in particular, representing David as the psalmist, being an adapted copy of a classical scene of Orpheus and the Muses. The same scene is repeated in a later Psalter in the Vatican: an instance of the repetition of favourite subjects from one century to another which is common throughout the history of medieval art. At the period of the full maturity of the Byzantine school great skill is displayed in the best examples of figure-drawing, and a fine type of head and features is found in the miniatures of such MSS. as the *Homilies of Chrysostom* at Paris, which belonged to the emperor Nicephorus III., 1078-1081, and in the best copies of the Gospels and Saints' Lives of that period, some of them being of exquisite finish. By this time also the scheme of decoration was established. Brilliant gilded backgrounds, give lustre to the miniatures. Initial letters in gold and colours are in ordinary use; but, it is to be observed, they never become very florid, but are rather meagre in outline, nor do they develop the pendants and borders which are afterwards so characteristic of the illuminated MSS. of the west. By way of general decoration, the rectangular head-pieces, which are such prominent features in Greek MSS. from the 10th to the 13th centuries, flourish in flowered and tesselated and geometric patterns in bright colours and gold. These are palpably of Oriental design, and may very well have been suggested by the woven fabrics of western Asia.

But Byzantine art was not destined to have a great history. Too self-contained and, under ecclesiastical influence, too much secluded from the contact with other ideas and other influences which are vitally necessary for healthy growth and expansion, it fell into stereotyped and formal convention and ran in narrow grooves. A general tendency was set up to paint the flesh tints in swarthy hues, to elongate and emaciate the limbs, to stiffen the gait, and generally to employ sombre colours in the miniatures, the depressing effect of which the artist seems to have felt himself compelled to relieve by rather startling contrasts of bright vermilion and lavish employment of gold. Still the initials and head-pieces continued to retain their brilliancy, of which they could scarcely be deprived without losing their *raison d'être* as decorative adjuncts. But, with all faults, fine and delicate drawing, with technical finish in the applied colours, is still characteristic of the best Greek miniatures of the 10th to 12th centuries, and the fine type of head and features of the older time remains a tradition. For example, in the Gospel lectionary, Harleian MS. 1810, in the British Museum, of the 12th century, there is a series of scenes from the life of Christ which are more than usually free from the contemporary conventionalism and which contain many figures of noble design. After the 12th century there is little in the art of Greek MSS. to detain us. The later examples, as far as they exist, are decadent and are generally lifeless copies of the earlier MSS.

Byzantine art, as seen in Greek MSS., stands apart as a thing of itself. But we shall have to consider how far and in what manner it had an influence on western art. Its reaction and influence on Italian art have been mentioned. That that influence was direct is manifest both in the style of such works as the mosaics of Italy and in the character of the paintings of the early Italian masters, and eventually in the earliest examples of the illuminated MSS. of central and southern Italy. But it is not so obvious how the influence which the eastern art of the Greek school undoubtedly exercised on the illuminated MSS. of the Frankish empire was conveyed. All things considered, however, it seems more probable that it passed westward through the medium of Italian art rather than by actual contact, except perhaps in accidental instances.

Franco-Lombardic.

We turn to the west of Europe, and we shall see how in the elaborately ornamented Frankish MSS. of the Carolingian school was combined the lingering tradition of the classical style with a new and independent element which had grown up spontaneously in the north. This new factor was the Celtic art which had its origin and was brought to perfection in the illuminated MSS. of Ireland and afterwards of Britain. It will therefore be convenient to trace the history of that school of book ornamentation. But before doing so we must dispose, in few words, of the more primitive style which preceded the Carolingian development in western continental Europe. This primitive style, which we may call the native style, as distinguished from the more artificially compounded art of the revival under Charlemagne, seems to have been widely extended throughout the Frankish empire and to have been common in Lombardy, and to some degree in Spain, as well as in France, and is known as Merovingian and Franco-Lombardic. This kind of ornamentation appears chiefly in the form of initial letters composed of birds, fishes and animals contorted into the shapes of the alphabetical letters; and in a less degree of head-pieces and borders filled with interlacings, or bands, or geometrical patterns, and even details of animal life. In these patterns, barbarous as they usually are, the influence of such artistic objects as mosaics and enamels is evident. The prevailing colours are crude green, red, orange and yellow, which hold their place with persistence through successive generations of MSS. This native style also, in course of time, came under Celtic influence, and adopted into its scheme the interlaced designs of animal forms and other details of the ornament of the north. It is therefore necessary to bear in mind that, side by side with the great series of Carolingian MSS., executed with all possible magnificence, there was existent this native school producing its examples of a more rustic character, which must be taken into account when studying the development of the later national style in France, in the 10th and succeeding centuries.

Celtic

To turn now to the Celtic style of ornament in MSS. This we find in full development in Ireland as early as the 7th century. The Irish school of book ornamentation was essentially a native school working out its own ideas, created and fostered by the early civilization of the country and destined to have a profound influence on the art of Britain and eventually on that of the continent. It may be described as a mechanical art brought to the highest pitch of perfection by the most skilful and patient elaboration. Initials, borders and full-page designs are made up of interlaced ribbons, interlaced

and entangled zoomorphic creatures, intricate knots, spirals, zig-zag ornaments, and delicate interwoven patterns, together with all kinds of designs worked out in red dots—all arranged and combined together with mathematical accuracy and with exquisite precision of touch; and painted in harmonious colours in thick pigments, which lend to the whole design the appearance of enamel. Gold is never used. In the production of his designs the Irish artist evidently took for his models the objects of early metal work in which the Celtic race was so skilled, and probably, too, the classical enamels and mosaics and jewelry which had been imported and copied in the country. The finest example of early Celtic book ornamentation is the famous copy of the Gospels known as the *Book of Kells*, of the latter part of the 7th century, preserved in Trinity College, Dublin: a miracle of minute and accurate workmanship, combining in its brilliant pages an endless variety of design.

But, with all his artistic excellence, the Irish artist failed completely in figure drawing; in fact he can hardly be said to have seriously attempted it. When we contemplate, for example, the rude figures intended to represent the evangelists in early copies of the Gospels, their limbs contorted and often composed of extraordinary interlacings and convolutions, we wonder that the sense of beauty which the Irish artist indubitably possessed in an eminent degree was not shocked by such barbarous productions. The explanation is probably to be found in tradition. These figures in course of time had come to be regarded rather as details to be worked into the general scheme of the ornament of the pages in which they occur than representations of the human form, and were accordingly treated by the artist as subjects on which to exercise his ingenuity in knotting them into fantastic shapes.

Passing from Ireland, the Celtic style of book ornamentation was naturally practised in the monastic settlements of Scotland, and especially in St Columba's foundation in the island of Iona. Thence it spread to other houses in Britain. In the year 635, at the request of Oswald, king of Northumbria, Aidan, a monk of Iona, was sent to preach Christianity in that kingdom, and became the founder of the abbey and see of Lindisfarne in Holy Isle off the Northumbrian coast. Here was established by the brethren who accompanied the missionary the famous school of Lindisfarne, from which issued a wonderful series of finely written and finely ornamented MSS. in the Celtic style, some of which still survive. The most perfect is the *Lindisfarne Gospels* or *St Cuthbert's Gospels* or the *Durham Book*, as it is more commonly called from the fact of its having rested for some time at Durham after early wanderings. This MS., written in honour of St Cuthbert and completed early in the 8th century, is in the Cottonian collection in the British Museum—a beautiful example of writing, and of the Celtic style of ornament, and in perfect condition. The contact with foreign influences, unknown in Ireland, is manifested in this volume by the use of gold, but in very sparing quantity, in some of the details. An interesting point in the artistic treatment of the MS. is the style in which the figures of the four evangelists are portrayed. Here the conventional Irish method, noticed above, is abandoned; the figures are mechanical copies from Byzantine models. The artist was unskilled in such drawing and has indicated the folds of the draperies, not by shading, but by streaks of paint of contrasting colours. Explanations of such instances of the unexpected adoption of a foreign style are rarely forthcoming; but in this case there is one. The sections of the text have been identified as following the Neapolitan use. The Greek Theodore, archbishop of Canterbury, arrived in Britain in the year 688 and was accompanied by Adrian, abbot of a monastery in the island of Nisita near Naples; and they both visited Lindisfarne. There can therefore be little doubt that the Neapolitan MS. from which the text of the *Durham Book* was derived, was one which Abbot Adrian had brought with him; and it may also be assumed that his MS. also contained paintings of the evangelists in the Byzantine style, which served as models to the Northumbrian artist.

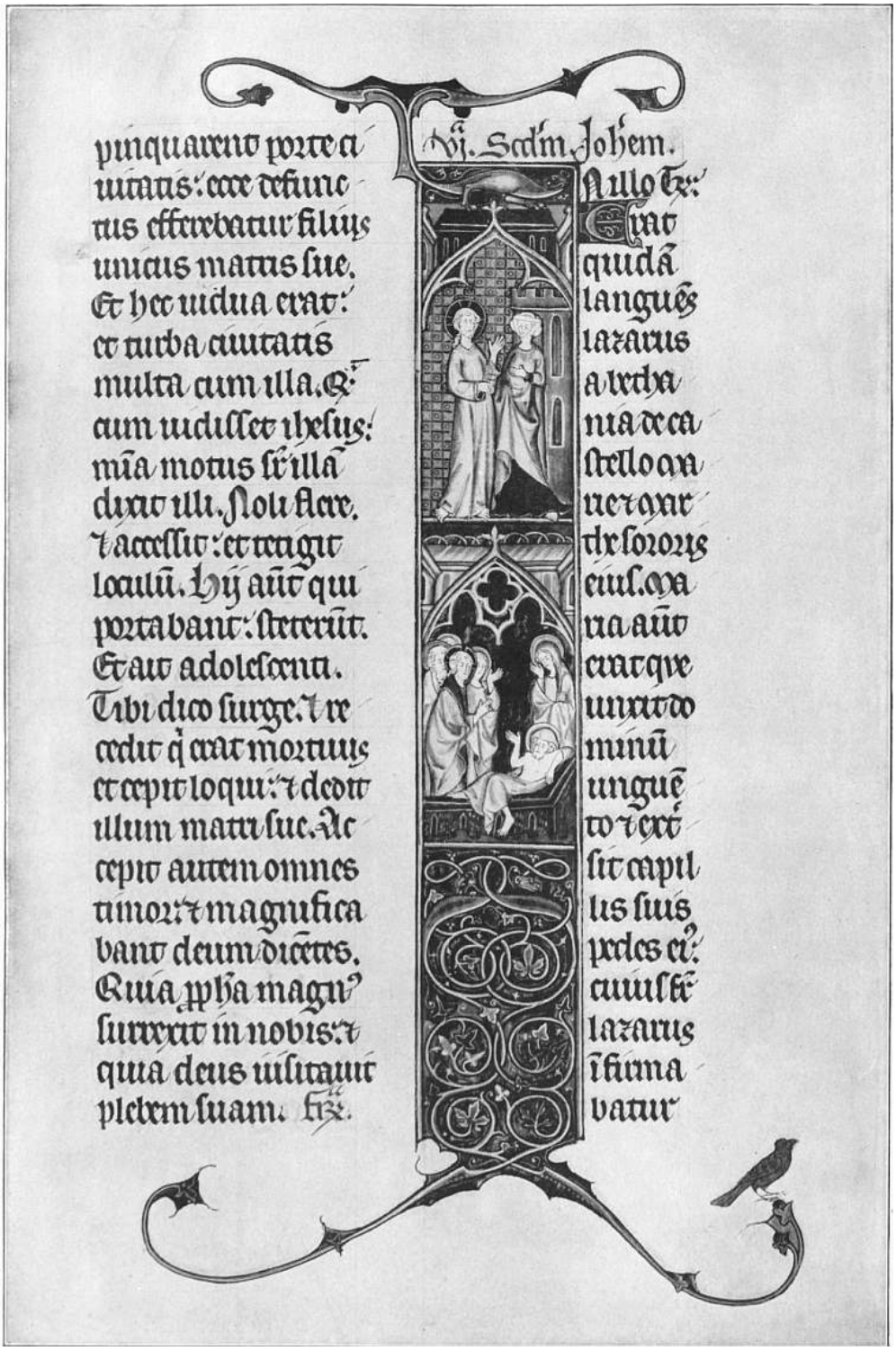
Lindisfarne Gospels.

The Celtic style was thus established through the north of England, and thence it spread to the southern parts of the country. But, for the moment, the account of its further development in Britain must be suspended in order to resume the thread of the story of the later classical influence on the illumination of MSS. of the Frankish empire. Under Charlemagne, who became emperor of the West in the year 800, art revived in many branches, and particularly in that of the writing and the illumination of MSS. During the reigns of this monarch and his immediate successors was produced a series of magnificent volumes, mostly biblical and liturgical, made resplendent by a lavish use of gold. The character of the decoration runs still, as of old, in the two lines of illustration and of pure ornament. We find a certain amount of general illustration, usually of the biblical narrative, in pictorial scenes drawn in freehand in the later classical style, and undoubtedly inspired by the western art of Rome. But those illustrations are small in number compared with the numerous examples of pure ornament. Such ornament was employed in the tables of the Eusebian canons, in the accessories of the traditional pictures of the evangelists, in the full-page designs which introduced the opening words of the several books of Bibles or Gospels, in the large initial letters profusely scattered through the volumes, in the infinite variety of borders which, in some MSS., adorned page after page. In all this ornament the debased classical element is prominently in evidence, columns and arches of variegated marbles, and leaf mouldings and other architectural details are borrowed from the Roman basilicas, to serve as decorations for text and miniature. The conventional portrait-figures of the evangelists are modelled on the Byzantine pattern, but with differences which appear to indicate an intervening influence, such as would be exercised on the eastern art by its transmission through Italy. Such figures, which indeed become, in course of time, so formal as almost to be decorative details along with their settings, grew stereotyped and passed on monotonously from artist to artist, always subject to deterioration, and were perpetuated especially in MSS. of German origin down to the 11th and 12th centuries.

Carolingian.

PSALTER OF WESTMINSTER ABBEY.—LATE TWELFTH CENTURY.
(British Museum. *Royal MS.* 2A. xxii.)

PLATE III.



LECTIONARY, OF THE USE OF PARIS. LATE THIRTEENTH CENTURY.
(British Museum. Add. M.S. 17,341.)

But it is not the debased classical decoration alone which marks the illumination of the Carolingian school. The influence of the Celtic art, which has been described, imposed itself and combined with it. This combination was due to the Englishman, Alcuin of York, who became abbot of the Benedictine house of St Martin of Tours, and who did so much to aid Charlemagne in the revival of letters. Thus, in the finest examples of the Carolingian illuminated MSS., Celtic interlaced patterns stand side by side with the designs of classical origin; and, at the same time, it is interesting to observe that the older native Merovingian style of ornament makes its presence felt, now and again, in this or that detail. But with all the artistic effort bestowed upon it, it must be conceded that Carolingian illumination, as presented in the MSS., is not always pleasing. Indeed, it is often coarse and monotonous, and there is a tendency to conceal inferiority under a dazzling abundance of gold. The leading idea of the ornament of the great MSS. was splendour. Gold was used in profusion even in the writing of the text, and silver also in a minor degree; and the vellum, stained or painted purple, enhanced the gorgeous effect of the illumination. But undoubtedly the purer style of the Celtic school balanced and restrained the tendency to coarseness; and this foreign influence naturally was stronger in some centres than in others. For example, in the abbey of Saint-Denis, near Paris, if we may draw conclusions from surviving examples, the Celtic style was in great favour. Another peculiarity in the decoration of the Carolingian MSS. is the tendency of the artist to mix his styles, and to attach details on a small scale, such as delicate sprays and flourishes, and minute objects, to large-scale initial letters, as though he felt that grossness required a corrective contrast. The art became more refined under the immediate successors of Charlemagne, and under Charles the Bald it culminated. The most famous MSS. of the Carolingian school are the *Evangeliarium*, written and illuminated by the scribe Godescalc for Charlemagne in the year 787; the *Sacramentarium* written for Drogon, son of Charlemagne and bishop of

Metz; the Gospels of the emperor Lothair, once at Tours; the first Bible of Charles the Bald, presented by Count Vivien, abbot of St Martin of Tours; the second Bible, called the Bible of Saint Denis, in Franco-Saxon style; and the so-called Gospels of Francis II. There are also in the British Museum (Harleian MS. 2788) an Evangeliarium written in gold and known as the *Codex aureus*, of this school; and a Bible of Alcuin's recension, probably executed at Tours in the middle of the 9th century, with illustrative miniatures and initial letters, but of a less elaborate degree of ornament.

After this brilliant period decadence sets in; and in the course of the 11th century Frankish illumination sinks to its lowest point, the miniatures being for the most part coarse and clumsy copies of earlier models. The colours become harsh, often assuming an unpleasant chalky appearance.

We have now to trace the development of another kind of book decoration, quite different from the florid style of gold and colours just now described, which had a lasting influence on the early art of England, where it was specially cultivated, and where it developed a character which at length became distinctively national. This is the style of outline drawing which fills so large a space in the Anglo-Saxon MSS. of the 10th and 11th centuries.

Anglo-Saxon.

We have already seen how the Celtic style of ornamentation was introduced into the north of England. Thence it appears to have spread rapidly southward. As early as the beginning of the 8th century it was practised at Canterbury, as is testified by a famous psalter in the British Museum (Cott. MS. Vespasian A. 1), in which much of the ornament is of Celtic type. But the same MS. is also witness to the presence of another influence in English art, that of the classical style of Rome, certain details of the ornament being of that character and a miniature in the MS. being altogether of the classical type. With little hesitation this element may be ascribed to MSS. brought from Rome, in the first instance by St Augustine, and afterwards by the incoming missionaries who succeeded him, and deposited in such centres as Canterbury and Winchester. But this importation of MSS. from Italy was not confined to the south. We have distinct evidence that they were brought into northern monasteries, such as those of Jarrow and Wearmouth and York. Thus the English artists of both south and north were in a position to take advantage of material from two sources; and they naturally did so. Thus we find that mingling of the Celtic and classical styles just noticed. In this way, early grown accustomed to take classical models for their drawings, the Anglo-Saxon artists were the more susceptible to the later development of the classical style of outline drawing which was next introduced into the country from the continent. The earliest MS. in which this style of drawing is exhibited in fullest detail is the volume known as the *Utrecht Psalter*, once in the Cottonian Library, in which the text of the psalms is profusely illustrated with minute pen-sketches remarkably full of detail. The period of the MS. is about the year 800; and it was probably executed in the north or north-east of France. But the special interest of the drawings is that they are evidently copies of much older models and provide a valuable link with the late classical art of some two or three centuries earlier. The work is very sketchy, the movement of the draperies indicated by lightly scribbled strokes of the pen, the limbs elongated, the shoulders humped—all characteristic features which are repeated in the later Anglo-Saxon work. The drawings of the *Utrecht Psalter* are clearly typical examples of a style which, founded on Roman models, must at one time have been widely practised in western Europe. For instance, there are traces of it in such a centre as St Gallen in Switzerland, and there are extant MSS. of the *Psychomachia* of Prudentius (a favourite work) with drawings of this character which were executed in France in the 10th century. But the style does not appear to have taken much hold on the fancy of continental artists. It was reserved for England to welcome and to make this free drawing her own, and to develop it especially in the great school of illumination at Winchester. Introduced probably in such examples as the *Utrecht Psalter* and copies of the *Psychomachia*, this free drawing of semi-classical origin had fully established itself here in the course of the 10th century, and by that time had assumed a national character. A fair number of MSS. of the 10th and 11th centuries which issued from the Winchester school are still to be seen among the collections of the British museum, in most of which the light style of outline drawing with the characteristic fluttering drapery is more or less predominant, although body colours were also freely employed in many examples. But the most elaborate specimen of Anglo-Saxon illumination of the 10th century is one belonging to the duke of Devonshire: the *Benedictional* of the see of Winchester, executed under the direction of Æthelwold, bishop from 963 to 984, which contains a series of miniatures, in this instance in body colours, but drawn in the unmistakable style of the new school. In the scheme of decoration, however, another influence is at work. As England had sent forth its early Celtic designs to modify the art of the Frankish empire, so the Carolingian style of ornament now, in its turn, makes its way into this country, and appears in the purely ornamental details of the Anglo-Saxon illuminated volumes. The frames of the miniatures are chiefly composed of conventional foliage, and the same architectural leaf-mouldings of classical origin which are seen in the foreign MSS. are here repeated. Profuse gilding also, which is frequently applied, sometimes with silver, is due to foreign influence. But this character of decoration soon assumed a national cast. Under the hands of the Anglo-Saxon artist the conventional foliage flourished with greater freedom; and the colouring which he applied was generally softer and more harmonious than that which was employed abroad. Examples of outline drawing of the best type exist in the Harleian *Psalter* (No. 2904), of the same period as the Æthelwold *Benedictional*; in the register of New Minster (Stowe MS. 944), A.D. 1016-1020; and in the Prudentius (Cotton MS. Cleop. C. viii.), executed early in the 11th century.

Norman.

With the Norman Conquest naturally great changes were effected in the illumination of English MSS., as in other branches of art; no doubt to the ultimate improvement of English draughtsmanship. Left to itself the outline drawing of the Anglo-Saxons, inclining as it did to affectation, would probably have sunk into fantastic exaggeration and feebleness. Brought more directly under Norman domination it resulted in the fine, bold freehand style which is conspicuous in MSS. executed in England in the next three centuries. Then we come to the period when the art of illumination is brought into line in the countries of western Europe, in England and in France, in Flanders and in western Germany, by the splendid outburst of artistic sentiment of the 12th century. This century is the period of large folios providing ample space in their pages for the magnificent initial letters drawn on a grand scale

which are to be seen in the great Bibles and psalters of the time. The leading feature is a wealth of foliage with twining and interlacing branches, among which human and animal life is freely introduced, the whole design being thrown into relief by brilliant colours and a generous use of gold. The figure drawing both in miniatures and initials is stiff, the figures elongated but bold, and with sweeping lines in the draperies; and a tendency to represent the latter clinging closely to the limbs is a legacy of the tradition of the later classical style. In England the school of Winchester appears to have maintained the same excellence after the Norman Conquest as before it. A remarkable MS. (Cotton, Nero C. iv.), a psalter of about the year 1160, with a series of fine miniatures, is a good example of its work. In France, Flanders and western Germany we find the same energy in producing boldly ornamented volumes, as in England; a certain heaviness of outline distinguishing the work of the Flemish and German artists from that of the English and French schools. Such MSS. as the Stavelot Bible (Brit. Mus., Add. MS. 28,107), of the close of the 11th century, the Bible of Floreffe (Add. MS. 17,737-17,738), of about the year 1160, and the Worms Bible (Harl. MS. 2803-2804), of the same time, are fine specimens of Flemish and German work.

13th Century.

It is towards the close of the 12th century and in the beginning of the 13th century that the character of illumination settles down on more conventional lines. Hitherto gold had been applied in a liquid state; now it is laid on in leaf and is highly burnished, a process which lends a brilliant effect to initial and miniature. A great change passes over the face of things. The large, bold style gives place to the minute. Volumes decrease in size; the texts are written in close-packed characters; the large and simple is superseded by the small and decorated. The period has arrived when book ornamentation becomes more settled and accurately defined within limits, and starts on the course of regulated expansion which was to run for three hundred years down to the close of the 15th century. In the 13th century the historiated or miniature initial, that is, the initial letter containing within its limits a miniature illustrating the subject of the immediate text, is established as a favourite detail of ornamentation, in addition to the regular independent miniature. Such initials form a prominent feature in the pretty little Bibles which were produced in hundreds at this period. But a still more interesting subject for study is the development of the border which was to have such a luxuriant growth in the 13th, 14th and 15th centuries. Commencing as a pendant from the initial, with terminal in form of bud or cusp, it gradually pushes its way along the margins, unfolding foliage as it proceeds, and in course of time envelopes the entire page of text in a complete framework formulating in each country a national style.

In the miniatures of the 13th century the art of England, of France, and of the Low Countries runs very much in one channel. The Flemish art, however, may be generally distinguished from the others by the heavier outline already noticed. The French art is exquisitely exact and clean-cut, and in its best examples it is the perfection of neat-handedness. English art is perhaps less exact, but makes up for any deficiency in this direction by its gracefulness. However, there is often little to choose between the productions of the three countries, and they are hard to distinguish. As an aid for such distinction, among small differences, we may notice the copper tone of French gold contrasting with the purer metal in English MSS.; and the favour shown to deep ultramarine appears to mark French work. But, besides actual illuminated miniature painting, there is also a not inconsiderable amount of freehand illustrative drawing in the MSS. In this particular the English artist maintains the excellence of work which distinguished his ancestors. Such series of delicate drawings, slightly tinted, as those to be seen in the famous Queen Mary’s Psalter (Royal MS. 2 B. vii.), and in other MSS. of the 13th and 14th centuries in the British Museum, are not surpassed by any similar drawings done at the same period in any other country. In the 13th century also comes into vogue the highly decorated diaper-work, generally of lozenges or chequered patterns in brilliant colours and brightly burnished gold. These fill the backgrounds of miniatures and initials, together with other forms of decoration, such as sheets of gold stippled or surface-drawn in various designs. Diapering continued to be practised in all three countries down into the 15th century; and in particular it is applied with exquisite effect in many of the highly-finished MSS. of the artists of Paris.

To return to the growth of the borders: these continue to be generally of one style in both England and France and in Flanders during the 13th century; but, when with the opening of the 14th century the conventional foliage begins to expand, a divergence ensues. In France and Flanders the three-pointed leaf, or ivy leaf, appears, which soon becomes fixed and flourishes as a typical detail of ornament in French illumination of the 14th and 15th centuries. In England there is less convention, and along with formal branches and leafage, natural growths, such as daisy-buds, acorns, oak leaves, nuts, &c., are also represented.

German.

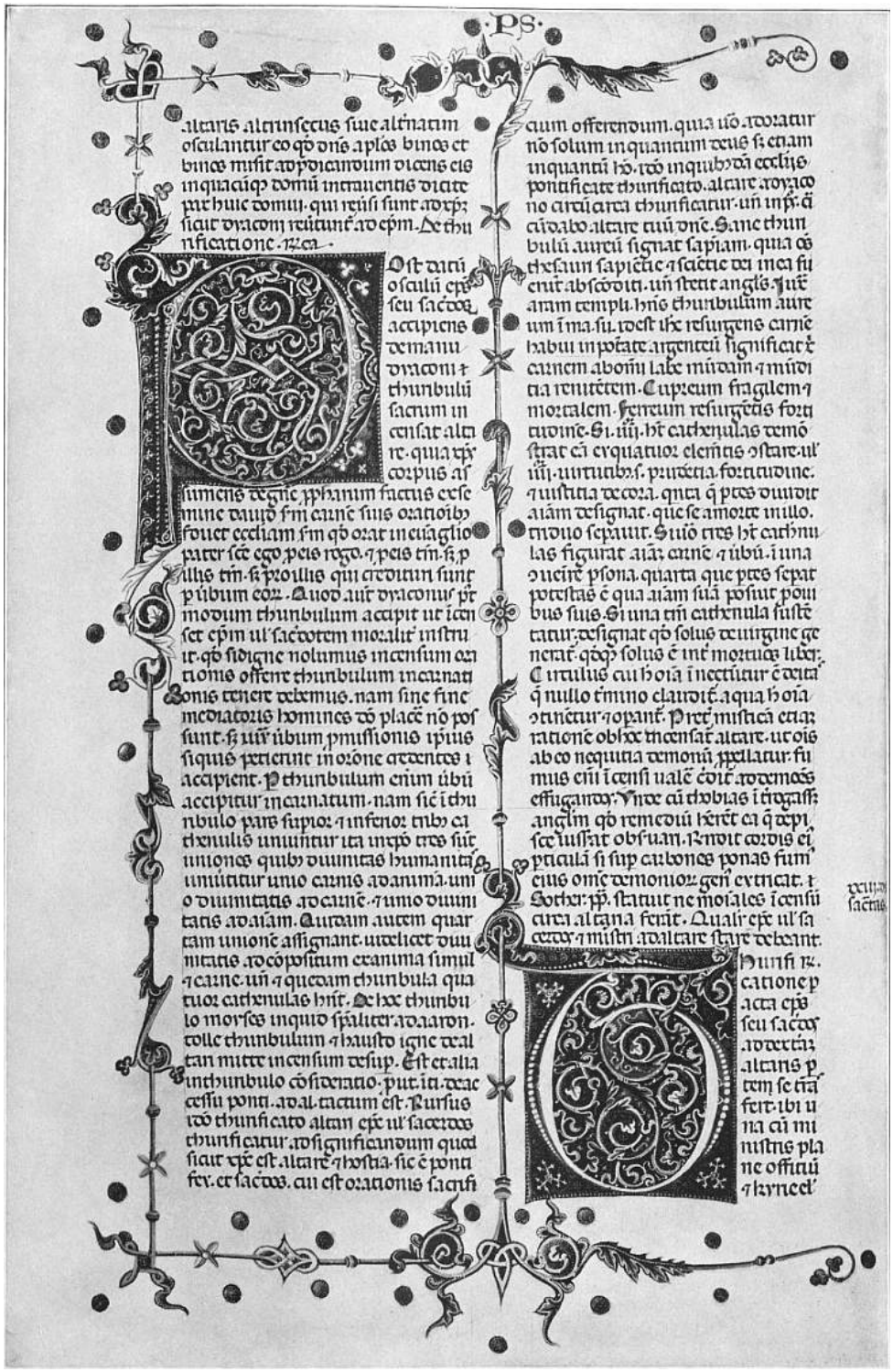
Meanwhile German illumination, which in the large MSS. of the 12th century had given high promise, in the following centuries falls away and becomes detached from the western schools, and is, as a general rule, of inferior quality, although in the 13th century fine examples are still to be met with. Dark outlines and backgrounds of highly-burnished gold are in favour. At present, however, there is not sufficient published material to enable us to pass a definite judgment on the value of German illumination in the later middle ages. But the researches of scholars are beginning to localize particular styles in certain centres. For example, in Bohemia there was a school of illumination of a higher class, which seems later to have had an influence on English art, as will be noticed presently.

Italian.

We must now turn to Italy, which has been left on one side during our examination of the art of the more western countries. In attempting to bridge the gap which severs the later classical style of Rome from the medieval art of Italy, much must be left to conjecture. That a debased classical style of drawing was employed in the earlier centuries of the middle ages we cannot doubt. Such a MS. as the Ashburnham Genesis of the 7th century, which contains pictures of a somewhat rude character but based apparently upon a recollection of the classical drawing of earlier times, and which appears to be of Italian origin, serves as a link, however slight. Coming down to a later period, the primitive native art of the Frankish empire, as we have seen, extended into northern Italy under the name of Franco-Lombardic ornamentation; and we have also seen how the art of the Byzantine school reacted on the art of the southern portion of the country. Hence, in the middle ages, the ornamentation of Italian MSS. appears to move on two leading lines. The first, which we owe to the Byzantine influence, in which figure-drawing is

the leading idea, follows the old classical method and, showing a distinctly Greek impress, leads to the style which we recognize as Italian *par excellence*, and which is seen most effectively manifested in the works of Cimabue and Giotto and of allied schools. In this style the colouring is generally opaque: the flesh tints being laid over a foundation of deep olive green, which imparts a swarthy complexion to the features—a practice also common in Byzantine art. The other line is that of the Lombardic style which, like the Celtic school of the British Isles, was an art almost exclusively of pure ornament, of intricate interlacings of arabesques and animal forms, with bright colouring and ample use of gold. The Lombardic style was employed in certain centres, as, for example, at Monte Cassino, where in the 11th, 12th and 13th centuries brilliant examples were produced. But it was not destined to stand before the other, stronger and inherently more artistic, style which was to become national. Still, its scheme of brighter colouring and of general ornament seems to have had an effect upon later productions, if we are not mistaken in recognizing something of its influence in such designs as the interlaced white vine-branch borders which are so conspicuous in Italian MSS. of the period of the Renaissance.

PLATE IV.



DURANDUS. DE DIVINIS OFFICIIS. FOURTEENTH CENTURY. Italian School.
(British Museum. Add. MS. 31,032.)

PLATE V.

VALERIUS MAXIMUS. ABOUT A.D. 1475. Executed for Philippe de Comines.
(British Museum. *Harley M.S.* 4374.)

The progress of Italian illumination in the style influenced by the Byzantine element is of particular interest in the general history of art, on account of the rapidity with which it grew to maturity, and the splendour to which it attained in the 15th century. Of the earlier centuries the existing examples are not many. That Italian artists were capable of great things as far back as the 12th century is evident from their frescoes. We may notice the curious occurrence of two very masterly paintings, the death of the Virgin and the Virgin enthroned, drawn with remarkable breadth in the Italian style, in the *Winchester Psalter* (Cottonian MS. Nero C. iv.) of the middle of that century, as a token of the possibilities of Italian illumination at that date; but generally there is little to show. Even at the beginning of the 14th century most of the specimens are of an ordinary character and betray a want of skill in striking contrast with the highly artistic productions of the Northern schools of England and France at the same period. But, though inferior artistically, Italian book ornamentation had by this time been so far influenced by the methods of those schools as to fall into line with them in the general system of decoration. The miniature, the initial, the miniature-initial and the border—all have their place and are subject to the same laws of development as in the other schools. But, once started, Italian illumination in the 14th century, especially in Florence, expanded with extraordinary energy. We may cite the Royal MS. 6, E. ix., containing an address to Robert of Anjou, king of Sicily, 1334-1342, and the Add. MS. 27,428 of legends of the saints, of about the year 1370, as instances of very fine miniature-work of the Florentine type. As the century advances, Italian illumination becomes more prolific and is extended to all classes of MSS., the large volumes of the Decretals and other law books, and still more the great folio choral books, in particular affording ample space for the artist to exercise his fancy. As was natural from the contiguity of the two

14th Century.

countries, as well as from political causes, France and Italy influenced each other in the art. In many MSS. of the Florentine school the French influence is very marked, and on the other hand, Italian influence is exercised especially in MSS. of the southern provinces of France. Italian art of this period also in some degree affected the illumination of southern German MSS.

We have also to note the occurrence in Italy in the 14th century of good illustrative outline drawings, generally tinted in light colours, and occasionally we meet with a wonderfully bright style of illumination of a lighter cast of colouring than usually prevails in Italian art: such as may be seen in a MS. of Durandus *De divinis oficiis* (Brit. Mus., Add. MS. 31,032) containing an exquisite series of initials and borders.

Taking a general view of the character of European illumination in the 14th century it may be described as an art of great invention and flexibility. The rigid exactness of the 13th century is replaced by flowing lines, just as the stiff, formal strokes of the handwriting of that century was exchanged for a more cursive and easy style. The art of each individual country now developed a national type of its own, which again branched off into the different styles of provincial schools. For example, in the eastern counties of England a very fine school of illumination, the East Anglian, was established in the first half of the century and produced a series of beautiful MSS., such as the *Arundel Psalter* (No. 83) in the British Museum.

By the end of the century the borders had developed on national lines so fully as to become, more than any other detail in the general scheme, the readiest means of identifying the country of origin. First as to the English border: the favour shown to the introduction of natural growths among the conventional foliage thrown out from the frame into which the border had by this time expanded has already been noticed. But now a new feature is introduced. The frame up to this time had consisted generally of conventional branches with bosses at the corners. Now it is divided more into compartments within which twining coils of ornament resembling cut feather-work are common details; and feathery scrolls fill the corner-bosses and are attached to other parts of the frame; while the foliage thrown out into the margin takes the form of sprays of curious lobe- or spoon-shaped and lozenge-shaped leaves or flowers, with others resembling curled feathers, and with cup- and trumpet-shaped flowers. This new style of border is contemporaneous with the appearance of a remarkably brilliant style in the miniatures, good in drawing and rich in colouring; and an explanation for the change has been sought in foreign influence. It has been suggested, with some plausibility, that this influence comes from the school of Prague, through the marriage of Richard II. with Anne of Bohemia in 1382. However this may be, there certainly is a decidedly German sentiment in the feathery scrolls just described.

Distinctive Borders.

Turning to the French border, we find towards the close of the 14th century that the early ivy-leaf pendant has now invaded all the margins and that the page is set in a conventional frame throwing off on every side sprigs and waving scrolls of the conventional ivy foliage, often also accompanied with very delicate compact tracery of minute flower-work filling the background of the frame. Nothing can be more charming than the effect of such borders, in which the general design is under perfect control. The character, too, of the French miniature of this period harmonizes thoroughly with the brilliant border, composed as it is very largely of decorative elements, such as diapered patterns and details of burnished gold. In the Low Countries, as was natural, the influence of French art continued to have great weight, at least in the western provinces where the style of illumination followed the French lead.

The Italian border in its ordinary form was of independent character, although following the methods of the West. Thrown out from the initial, it first took the form of pendants of a peculiarly heavy conventional curling foliage, associated, as progress was made, with slender rods jointed at intervals with bud-like ornaments and extending along the margins; at length expanding into a frame. The employment of gilt spots or pellets to fill spaces in the pendants and borders becomes very marked as the century advances. They are at first in a simple form, but they gradually throw out rays, and in the latter shape they become the chief constituents of one kind of border of the 15th century.

Illumination in the 15th century enters on a new phase. The balance is no longer evenly maintained between the relative values of the miniature and the border as factors in the general scheme of decoration. The influence of a new sentiment in art makes itself felt more and more; the flat treatment of the miniature gradually gives place to true laws of perspective and of figure-drawing, and to the depth and atmospheric effects of modern painting. Miniature painting in the decoration of MSS. now became more of a trade; what in old times had been done in the cloister was now done in the shop; and the professional miniaturist, working for his own fame, took the place of the nameless monk who worked for the credit of his house. Henceforth the miniature occupies a more important place than ever in the illuminated MS.; while the border, with certain important exceptions, is apt to recede into an inferior position and to become rather an ornamental adjunct to set off the miniature than a work of art claiming equality with it.

15th Century.

Continuing the survey of the several national styles, we shall have to witness the final supersession of the older styles of England and France by the later developments of Italy and Flanders. We left English illumination at the close of the 14th century strengthened by a fresh infusion of apparently a foreign, perhaps Bohemian, source. The style thus evolved marks a brilliant but short-lived epoch in English art. It is not confined to MSS., but appears also in the paintings of the time, as, for example, in the portrait of Richard II. in Westminster Abbey and in that in the Wilton triptych belonging to the earl of Pembroke. Delicate but brilliant colouring, gold worked in stippled patterns and a careful modelling of the human features are its characteristics. In MSS. also the decorative borders, of the new pattern already described, are of exceptional richness. Brilliant examples of the style, probably executed for Richard himself, may be seen in a magnificent Bible (Royal MS. 1, E. ix.), and in a series of cuttings from a missal (Add. MS. 29,704-29,705) in the British Museum. But the promise of this new school was not to be fulfilled. The same style of border decoration was carried into the 15th century, and good examples are found down to the middle of it, but a general deterioration soon sets in. Two MSS. must, however, be specially mentioned as surviving instances of the fine type of work which could still be turned out early in the century; and, curiously, they

are both the productions of one and the same illuminator, the Dominican, John Siferwas. The first is a fragmentary Lectionary (Brit. Mus., Harl. MS., 7026) executed for John, Lord Lovel of Tichmersh, who died in 1408; the other is the famous Sherborne Missal, the property of the duke of Northumberland, a large volume completed about the same time for the Benedictine abbey of Sherborne in Dorsetshire. Certainly other MSS. of equal excellence must have existed; but they have now perished. After the middle of the 15th century English illumination may be said to have ceased, for the native style disappears before foreign imported art. This failure is sufficiently accounted for by the political state of the country and the distractions of the War of the Roses.

In France the 15th century opened more auspiciously for the art of illumination. Brilliant colouring and the diapered background glittering with gold, the legacy of the previous century, still continue in favour for some time; the border, too, of ivy-leaf tracery still holds its own. But in actual drawing there are signs, as time advances, of growing carelessness, and the artist appears to think more of the effect of colour than of draughtsmanship. This was only natural at a time when the real landscape began to replace the background of diaper and conventional rocks and trees. In the first quarter of the century the school of Paris comes prominently to the front with such magnificent volumes as the Book of Hours of the regent, John Plantagenet, duke of Bedford, now in the British Museum; and the companion MS. known as the Sobieski Hours, at Windsor. In these examples, as is always the case with masterpieces, we see a great advance upon earlier methods. The miniatures are generally exquisitely painted in brilliant colours and the drawing is of a high standard; and in the borders now appear natural flowers intermingled with the conventional tracery—a new idea which was to be carried further as the century advanced. The Psalter executed at Paris for the boy-king Henry VI. (Cotton MS. Domitian A. xviii.) is another example of this school, rather of earlier type than the Bedford MS., but beautifully painted. In all three MSS. the borders show no lack of finish; they are of a high standard and are worthy of the miniatures. But perhaps the very finest miniature-work to be found in any MS. of French origin of this period is the breviary (Harl. MS. 2897) illuminated for John the Fearless, duke of Burgundy, who was assassinated in 1419. It could hardly be surpassed in refinement and minuteness of detail.

Development towards the modern methods of painting moves on rapidly with the century. First, the border in the middle period grows florid; the simpler ivy-spray design, which had held its position so long, is gradually pushed away by a growth of flowering scrolls, with flowers, birds and animal and insect life introduced in more or less profusion. But henceforward deterioration increases, and the border becomes subsidiary. In the case of miniatures following the old patterns of the devotional and liturgical books, a certain restraint still prevails; but with those in other works, histories and romances and general literature, where the paintings are devised by the fancy of the artist, the advance is rapid. The recognition of the natural landscape, the perception of atmospheric effects now guide the artist’s brush, and the modern French school of the second half of the 15th century is fairly established. The most celebrated leaders of this school were Jean Foucquet of Tours and his sons, many of whose works still bear witness to their skill. In the MSS. of this school the influence of the Flemish contemporary art is very obvious; and before the advance of that art French illumination receded. A certain hardness of surface and want of depth characterize the French work of this time, as well as the practice of employing gilt hatching to obtain the high lights. This practice is carried to excess in the latest examples of French illumination in the early part of the 16th century, when the art became mechanical and overloaded with ornament, and thus expired.

It has been seen that the Flemish school of illumination in the 13th and 14th centuries followed the French model. In the 15th century, while the old tradition continued in force for a while, the art developed on an independent line; and in the second half of the century it exercised a widespread influence on the neighbouring countries, on France, on Holland and on Germany. This development was one of the results of the industrial and artistic activity of the Low Countries at this period, when the school of the Van Eycks and their followers, and of other artists of the great and wealthy cities, such as Bruges, Antwerp, Ghent, were so prolific. The Flemish miniatures naturally followed on the lines of painting. The new style was essentially modern, freeing itself from the traditions of medieval illumination and copying nature. Under the hand of the Flemish artist the landscape attained to great perfection, softness and depth of colouring, the leading attribute of the school, lending a particular charm and sense of reality to his out-door scenes. His closer observation of nature is testified also in the purely decorative part of his work. Flowers, insects, birds and other natural objects now frequent the border, the origin of which is finally forgotten. It ceases to be a connected growth wandering round the page; it becomes a flat frame of dull gold or colour, over which isolated objects, flowers, fruits, insects, butterflies, are strewn, painted with naturalistic accuracy and often made, by means of strong shadows, to stand out in relief against the background. This practice was soon carried to florid excess, and all kinds of objects, including jewels and personal ornaments, were pressed into the service of the border, in addition to the details copied from nature. The soft beauty of the later Flemish style proved very attractive to the taste of the day, with the result that it maintained a high standard well on into the 16th century, the only rivals being the MSS. of Italian art. The names of celebrated miniaturists, such as Memlinc, Simon Bening of Ghent, Gerard of Bruges, are associated with its productions; and many famous extant examples bear witness to the excellence to which it attained. The Grimani Breviary at Venice is one of the best known MSS. of the school; but almost every national library has specimens to boast of. Among those in the British Museum may be mentioned the breviary of Queen Isabella of Spain (Add. MS. 18,851); the Book of Hours of Juana of Castille (Add. MS. 18,852); a very beautiful Book of Hours executed at Bruges (Egerton MS. 2125); another exquisite but fragmentary MS. of the same type (Add. MS. 24,098) and cuttings from a calendar of the finest execution (Add. MS. 18,855) ascribed to Bening of Ghent; a series of large sheets of genealogies of the royal houses of Portugal and Spain (Add. MS. 12,531) by the same master and others; and late additions to the Sforza Book of Hours (Add. MS. 34,294).

But, besides the brilliantly coloured style of Flemish illumination which has been described, there was another which was practised with great effect in the 15th century. This was the simpler style of drawing in white delicately shaded to indicate the contour of figures and the folds of drapery, &c., known as *grisaille* or *camaïeu gris*. It was not indeed confined to the Flemish schools, but was practised also to some extent and

to good effect in northern France, and also in Holland and other countries; but the centre of its activity appears to have been in the Low Countries. The excellence to which it attained may be seen in the MSS. of the *Miracles de Nostre Dame* now in Paris and the Bodleian Library, which were executed for Philip the Good, duke of Burgundy, in the middle of the 15th century.

Of the Dutch school of illumination, which was connected with that of Flanders, there is little to be said. Judging from existing examples, the art was generally of a more rustic and coarser type. There are, however, exceptions. A MS. in the British Museum (King's MS. 5) of the beginning of the 15th century contains scenes from the life of Christ in which the features are carefully modelled, very much after the style of English work of the same time; and some of the specimens of Dutch work in *camaïeu gris* are excellent.

German illumination in the 15th century appears to have largely copied the Flemish style; but it lost the finer qualities of its pattern, and in decoration it inclined to extravagance. Where the Flemish artist was content with single flowers gracefully placed, the German filled his borders with straggling plants and foliage and with large flourished scrolls.

Italian illumination, which had developed so rapidly in the 14th century, now advanced with accelerated pace and expanded into a variety of styles, more or less local, culminating in the exquisite productions of the classical renaissance in the latter half of the 15th century. As in the other national styles of France and Flanders, the Italian miniaturist quickly abandoned the conventional for the natural landscape; but with more character both in the figure-drawing and in the actual representation of scenery. The colouring is brilliant, not of the softness of the Flemish school, but of stronger and harder body; the outlines are firm and crisp and details well delineated. The Florentine, the Lombard, the Venetian, the Neapolitan and other schools flourished; and, though they borrowed details from each other, each had something distinctive in its scheme of colouring. The border developed on several lines. The rayed gold spots or studs or pellets, which were noticed in the 14th century, are now grouped in profusion along the margins and in the interstices of delicate flowering and other designs. Another favourite detail in the composition of both initials and borders was the twining vine tendril, generally in white or gold upon a coloured ground, apparently a revival of the interlacing Lombardic work of the 11th and 12th centuries. At first, restrained and not too complex, it fills the body of initials and short borders; then it rapidly expands, and the convolutions and interlacings become more and more elaborate. Lastly came the completed solid frame into which are introduced arabesques, vignettes, candelabras, trophies, vases, medallions, antique gems, cupids, fawns, birds, &c., and all that the fancy led by the spirit of classical renaissance could suggest. Among the principal Italian MSS. of the 15th century in the British Museum there are: a copy of *Plutarch's Lives*, with miniatures in a remarkable style (Add. MS. 22,318); Aristotle's *Ethics*, translated into Spanish by Charles, prince of Viana, probably executed in Sicily about 1458 (Add. MS. 21,120); a breviary of Santa Croce at Florence, late in the century (Add. MS. 29,735); Livy's *History of the Macedonian War*, of the Neapolitan school, late in the century (Harl. MS. 3694); and, above all, the remarkable Book of Hours of Bona Sforza of Savoy of about the year 1490 (Add. MS. 34,291); besides a fair number of MSS. exhibiting the rich colouring of the Venetian school.

Like that of the French and Flemish schools, Italian illumination survived into the 16th century, and for a time showed vigour. Very elaborate borders of the classical type and of good design were still produced. But, as in other countries, it was then a dying art. The attempt to graft illumination on to books produced by the printing press, which were now displacing the hand-written volumes with which the art had always been associated, proved, except in a few rare instances, a failure. The experiment did not succeed; and the art was dead.

It remains to say a few words respecting the book ornamentation of the Peninsula. In the earlier centuries of the middle ages there appears to have been scarcely anything worthy of note. The Mozarabic liturgies and biblical MSS. of the 9th to 12th centuries are adorned with initial letters closely allied to the primitive specimens of the Merovingian and Franco-Lombardic pattern, and coloured with the same crude tints; the larger letters also being partly composed of interlaced designs. But the style is barbaric. Such illustrative drawings as are to be found are also of a most primitive character. Moorish influence is apparent in the colours, particularly in the yellows, reds and blacks. In the later middle ages no national school of illumination was developed, owing to political conditions. When in the 15th century a demand arose for illuminated MSS., recourse was had to foreign artists. Flemish art naturally was imported, and French art on the one side and Italian art on the other accompanied it. In the breviary executed for Queen Isabella of Spain about the year 1497 (Brit. Mus., Add. MS. 18,851) we find a curious random association of miniatures and borders in both the French and the Flemish styles, the national taste for black, however, asserting itself in the borders where, in many instances, the usual coloured designs are replaced by black-tinted foliage and scrolls.

Spain.

In other outlying countries of Europe the art of illumination can scarcely be said to have existed. In Slavonic countries a recollection of the Byzantine school lingered in book ornamentation, but chiefly in a degraded and extravagant system of fantastic interlacings. In the 16th century there was a revival in Russia of the Byzantine style, and the head-pieces and other ornamental details of the 11th and 12th centuries were successfully imitated.

The consideration of oriental art does not come within the scope of this article. It may, however, be noted that in Arabic and Persian MSS. of the 13th to 16th centuries there are many examples of exquisitely drawn title-pages and other ornament of intricate detail, resplendent with colour and gold, which may be ranked with western illuminations.

AUTHORITIES.—Medieval and later works dealing in part with the technicalities of illumination are collected by Mrs Merrifield, *Original Treatises dating from the 12th to 18th Centuries on the Art of Painting* (1849); see also Theophilus, *De diversis Artibus*, ed. R. Hendrie (1847). Text-books and collections of facsimiles are Count A. de Bastard, *Peintures et ornaments des manuscrits*, a magnificent series of facsimiles, chiefly from Carolingian MSS. (1832-1869); Shaw and Madden, *Illuminated Ornaments from MSS. and early Printed*

Books (1833); Noel Humphreys and Jones, *The Illuminated Books of the Middle Ages* (1849); H. Shaw, *Handbook of Medieval Alphabets* (1853), and *The Art of Illumination* (1870); Tymms and Digby Wyatt, *The Art of Illumination* (1860); Birch and Jenner, *Early Drawings and Illuminations*, with a dictionary of subjects in MSS. in the British Museum (1879); J. H. Middleton, *Illuminated MSS. in Classical and Medieval Times* (1892); G. F. Warner, *Illuminated MSS. in the British Museum* (official publication, 1903); H. Omont, *Facsimilés des miniatures des plus anciens MSS. grecs de la Bibl. Nationale* (1902); V. de Boutovsky, *Histoire de l'ornement russe du X^e^ au XVI^e^ siècle*, including facsimiles from Byzantine MSS. (1870); J. O. Westwood, *Facsimiles of Miniatures and Ornaments of Anglo-Saxon and Irish MSS.* (1868); E. M. Thompson, *English Illuminated MSS.* (1895); *Paleografia artistica di Montecassino* (1876-1884); *Le Miniature nei codici Cassinesi* (1887); A. Haseloff, *Eine thüringisch-sächsische Malereischule des 13. Jahrhunderts* (1897); G. Schwarzenski, *Die Regensburger Buchmalerei des 10. und 11. Jahrhunderts* (1901); Sauerland and Haseloff, *Der Psalter Erzbischof Egberts von Trier* (1901).

Several of the most ancient illustrated or illuminated MSS. have been issued wholly or partially in facsimile, viz. The *Ambrosian Homer*, by A. Ceriani; the *Schedae Vaticanae* and the *Codex Romanus* of Virgil, by the Vatican Library; the Vienna Dioscorides, in the Leiden series of facsimiles; the Vienna Genesis, by Hartel and Wickhoff; the Greek Gospels of Rossano, by A. Haseloff; the Ashburnham Pentateuch, by B. von Gebhart; the Utrecht Psalter, by the Palaeographical Society.

Facsimiles from illuminated MSS. are also included in large palaeographical works such as Silvestre, *Universal Palaeography*, ed. Madden (1850); the *Facsimiles* of the Palaeographical Society (1873-1894) and of the New Palaeographical Society (1903, &c.); and the *Collezione paleografia Vaticana*, the issue of which was commenced in 1905. Excellent photographic reproductions on a reduced scale are being issued by the British Museum and by the Bibliothèque Nationale in Paris.

(E. M. T.)

ILLUMINATI (Lat. *illuminare*), a designation in use from the 15th century, and applied to, or assumed by, enthusiasts of types distinct from each other, according as the "light" claimed was viewed as directly communicated from a higher source, or as due to a clarified and exalted condition of the human intelligence. To the former class belong the *alumbrados* of Spain. Menendez Pelayo first finds the name about 1492 (in the form *aluminados*, 1498), but traces them back to a Gnostic origin, and thinks their views were promoted in Spain through influences from Italy. One of their earliest leaders, born in Salamanca, a labourer's daughter, known as La Beata de Piedrahita, came under the notice of the Inquisition in 1511, as claiming to hold colloquies with our Lord and the Virgin; having high patrons, no decision was taken against her (*Los Heterodoxos Españoles*, 1881, lib. v.). Ignatius Loyola, while studying at Salamanca (1527) was brought before an ecclesiastical commission on a charge of sympathy with the *alumbrados*, but escaped with an admonition. Others were not so fortunate. In 1529 a congregation of unlettered adherents at Toledo was visited with scourging and imprisonment. Greater rigours followed, and for about a century the *alumbrados* afforded many victims to the Inquisition, especially at Cordova. The movement (under the name of *Illuminés*) seems to have reached France from Seville in 1623, and attained some proportions in Picardy when joined (1634) by Pierre Guérin, curé of Saint-Georges de Roye, whose followers, known as Guérinets, were suppressed in 1635 (Hermant, *Hist. des hérésies*, 1717). Another and obscure body of *Illuminés* came to light in the south of France in 1722, and appears to have lingered till 1794, having affinities with those known contemporaneously in this country as "French Prophets," an offshoot of the Camisards. Of different class were the so-called Illuminati, better known as Rosicrucians, who claimed to originate in 1422, but rose into notice in 1537; a secret society, combining with the mysteries of alchemy the possession of esoteric principles of religion. Their positions are embodied in three anonymous treatises of 1614 (Richard et Giraud, *Dict. de la théol. cath.*). A short-lived movement of republican freethought, to whose adherents the name Illuminati was given, was founded on May-day 1776 by Adam Weishaupt (d. 1830), professor of Canon Law at Ingolstadt, an ex-Jesuit. The chosen title of this Order or Society was Perfectibilists (*Perfektibilisten*). Its members, pledged to obedience to their superiors, were divided into three main classes; the first including "novices," "minervals" and "lesser illuminati"; the second consisting of freemasons, "ordinary," "Scottish" and "Scottish knights"; the third or "mystery" class comprising two grades of "priest" and "regent" and of "magus" and "king." Relations with masonic lodges were established at Munich and Freising in 1780. The order had its branches in most countries of the European continent, but its total numbers never seem to have exceeded two thousand. The scheme had its attraction for literary men, such as Goethe and Herder, and even for the reigning dukes of Gotha and Weimar. Internal rupture preceded its downfall, which was effected by an edict of the Bavarian government in 1785. Later, the title Illuminati was given to the French Martinists, founded in 1754 by Martinez Pasqualis, and to their imitators, the Russian Martinists, headed about 1790 by Professor Schwartz of Moscow; both were Cabalists and allegorists, imbibing ideas from Jakob Boehme and Emmanuel Swedenborg (Bergier, *Dict. de théol.*).

See (especially for details of the movement of Weishaupt,) P. Tschackert, in Hauck's *Realencyklopädie* (1901).

(A. Go.*)

ILLUMINATION, in optics, the intensity of the light falling upon a surface. The measurement of the illumination is termed photometry (*q.v.*). The fundamental law of illumination is that if the medium be

transparent the intensity of illumination which a luminous point can produce on a surface directly exposed to it is inversely as the square of the distance. The word transparent implies that no light is absorbed or stopped. Whatever, therefore, leaves the source of light must in succession pass through each of a series of spherical surfaces described round the source as centre. The same *amount* of light falls perpendicularly on all these surfaces in succession. The amount received in a given time by a unit of surface on each is therefore inversely as the number of such units in each. But the surfaces of spheres are as the squares of their radii,—whence the proposition. (We assume here that the velocity of light is constant, and that the source gives out its light uniformly.) When the rays fall otherwise than perpendicularly on the surface, the illumination produced is proportional to the cosine of the angle of obliquity; for the area seen under a given spherical angle increases as the secant of the obliquity, the distance remaining the same.

As a corollary to this we have the further proposition that the apparent brightness of a luminous surface (seen through a transparent homogeneous medium) is the same at all distances.

The word brightness is here taken as a measure of the amount of light falling on the pupil per unit of spherical angle subtended by the luminous surface. The spherical angle subtended by any small surface whose plane is at right angles to the line of sight is inversely as the square of the distance. So also is the light received from it. Hence the brightness is the same at all distances.

The word brightness is often used (even scientifically) in another sense from that just defined. Thus we speak of a bright star, of the question—When is Venus at its brightest? &c. Strictly, such expressions are not defensible except for sources of light which (like a star) have no apparent surface, so that we cannot tell from what amount of spherical angle their light appears to come. In that case the spherical angle is, for want of knowledge, assumed to be the same for all, and therefore the brightness of each is now estimated in terms of the *whole* quantity of light we receive from it.

The function of a telescope is to increase the “apparent magnitude” of distant objects; it does not increase the “apparent brightness.” If we put out of account the loss of light by reflection at glass surfaces (or by imperfect reflection at metallic surfaces) and by absorption, and suppose that the magnifying power does not exceed the ratio of the aperture of the object-glass to that of the pupil, under which condition the pupil will be filled with light, we may say that the “apparent brightness” is absolutely unchanged by the use of a telescope. In this statement, however, two reservations must be admitted. If the object under examination, like a fixed star, have no sensible apparent magnitude, the conception of “apparent brightness” is altogether inapplicable, and we are concerned only with the total quantity of light reaching the eye. Again, it is found that the visibility of an object seen against a black background depends not only upon the “apparent brightness” but also upon the apparent magnitude. If two or three crosses of different sizes be cut out of the same piece of white paper, and be erected against a black background on the further side of a nearly dark room, the smaller ones become invisible in a light still sufficient to show the larger. Under these circumstances a suitable telescope may of course bring also the smaller objects into view. The explanation is probably to be sought in imperfect action of the lens of the eye when the pupil is dilated to the utmost. Lord Rayleigh found that in a nearly dark room he became distinctly short-sighted, a defect of which there is no trace whatever in a moderate light. If this view be correct, the brightness of the image on the retina is really less in the case of a small than in the case of a large object, although the so-called apparent brightnesses may be the same. However this may be, the utility of a night-glass is beyond dispute.

The general law that (apart from the accidental losses mentioned above) the “apparent brightness” depends only upon the area of the pupil filled with light, though often ill understood, has been established for a long time, as the following quotation from Smith’s *Optics* (Cambridge, 1738), p. 113, will show:—

> “Since the magnitude of the pupil is subject to be varied by various degrees of light, let NO be its semi-diameter when the object PL is viewed by the naked eye from the distance OP; and upon a plane that touches the eye at O, let OK be the semi-diameter of the greatest area, visible through all the glasses to another eye at P, to be found as PL was; or, which is the same thing, let OK be the semi-diameter of the greatest area inlightened by a pencil of rays flowing from P through all the glasses; and when this area is not less than the area of the pupil, the point P will appear just as bright through all the glasses as it would do if they were removed; but if the inlightened area be less than the area of the pupil, the point P will appear less bright through the glasses than if they were removed in the same proportion as the inlightened area is less than the pupil. And these proportions of apparent brightness would be accurate if all the incident rays were transmitted through the glasses to the eye, or if only an insensible part of them were stopt.”

A very important fact connected with our present subject is: The brightness of a self-luminous surface does not depend upon its inclination to the line of sight. Thus a red-hot ball of iron, free from scales of oxide, &c., appears flat in the dark; so, also, the sun, seen through mist, appears as a flat disk. This fact, however, depends ultimately upon the second law of thermodynamics (see Radiation). It may be stated, however, in another form, in which its connexion with what precedes is more obvious—The amount of radiation, in any direction, from a luminous surface is proportional to the cosine of the obliquity.

> The flow of light (if we may so call it) in straight lines from the luminous point, with constant velocity, leads, as we have seen, to the expression μr^{-2} (where r is the distance from the luminous point) for the quantity of light which passes through unit of surface perpendicular to the ray in unit of time, μ being a quantity indicating the rate at which light is emitted by the source. This represents the illumination of the surface on which it falls. The flow through unit of surface whose normal is inclined at an angle θ to the ray is of course $\mu r^{-2} \cos \theta$, again representing the illumination. These are precisely the expressions for the gravitation force exerted by a particle of mass μ on a unit of matter at distance r, and for its resolved part in a given direction. Hence we may employ an expression $V = \Sigma \mu r^{-1}$, which is exactly analogous to the gravitation or electric potential, for the purpose of calculating the effect due to any number of separate sources of light.
>
> And the fundamental proposition in potentials, viz. that, if n be the external normal at any point of a closed

surface, the integral $\int\int(dV/dn)dS$, taken over the whole surface, has the value—$4\pi\mu_0$, where μ_0 is the sum of the values of μ for each source lying within the surface, follows almost intuitively from the mere consideration of what it means as regards light. For every source external to the closed surface sends in light which goes out again. But the light from an internal source goes wholly out; and the amount per second from each unit source is 4π, the total area of the unit sphere surrounding the source.

It is well to observe, however, that the analogy is not quite complete. To make it so, all the sources must lie on the same side of the surface whose illumination we are dealing with. This is due to the fact that, in order that a surface may be illuminated at all, it must be capable of scattering light, *i.e.* it must be to some extent opaque. Hence the illumination depends mainly upon those sources which are on the same side as that from which it is regarded.

Though this process bears some resemblance to the heat analogy employed by Lord Kelvin (Sir W. Thomson) for investigations in statical electricity and to Clerk Maxwell's device of an incompressible fluid without mass, it is by no means identical with them. Each method deals with a substance, real or imaginary, which flows in conical streams from a source so that the same amount of it passes per second through every section of the cone. But in the present process the velocity is constant and the density variable, while in the others the density is virtually constant and the velocity variable. There is a curious reciprocity in formulae such as we have just given. For instance, it is easily seen that the light received from a uniformly illuminated surface is represented by $\int\int r^{-2} \cos\theta \, dS$.

As we have seen that this integral vanishes for a closed surface which has no source inside, its value is the same for all shells of equal uniform brightness whose edges lie on the same cone.

ILLUSTRATION. In a general sense, illustration (or the art of representing pictorially some idea which has been expressed in words) is as old as Art itself. There has never been a time since civilization began when artists were not prompted to pictorial themes from legendary, historical or literary sources. But the art of illustration, as now understood, is a comparatively modern product. The tendency of modern culture has been to make the interests of the different arts overlap. The theory of Wagner, as applied to opera, for making a combined appeal to the artistic emotions, has been also the underlying principle in the development of that great body of artistic production which in painting gives us the picture containing "literary" elements, and, in actual association with literature in its printed form, becomes what we call "illustration." The illustrator's work is the complement of expression in some other medium. A poem can hardly exist which does not awaken in the mind at some moment a suggestion either of picture or music. The sensitive temperament of the artist or the musician is able to realize out of words some parallel idea which can only be conveyed, or can be best conveyed, through his own medium of music or painting. Similarly, music or painting may, and often does, suggest poetry. It is from this inter-relation of the emotions governing the different arts that illustration may be said to spring. The success of illustration lies, then, in the instinctive transference of an idea from one medium to another; the more spontaneous it be and the less laboured in application, the better.

Leaving on one side the illuminated manuscripts of the middle ages (see ILLUMINATED MSS.) we start with the fact that illustration was coincident with the invention of printing. Italian art produced many fine examples, notably the outline illustrations to the *Poliphili Hypneratomachia*, printed by Aldus at Venice in the last year of the 15th century. Other early works exist, the products of unnamed artists of the French, German, Spanish and Italian schools; while of more singular importance, though not then brought into book form, were the illustrations to Dante's *Divine Comedy* made by Botticelli at about the same period. The sudden development of engraving on metal and wood drew many painters of the Renaissance towards illustration as a further opportunity for the exercise of their powers; and the line-work, either original or engraved by others, of Pollajuolo, Mantegna, Michelangelo and Titian has its place in the gradual enlargement of illustrative art. The German school of the 16th century committed its energies even more vigorously to illustration; and many of its artists are now known chiefly through their engravings on wood or copper, a good proportion of which were done to the accompaniment of printed matter. The names of Dürer, Burgmair, Altdorfer and Holbein represent a school whose engraved illustrations possess qualities which have never been rivalled, and remain an invaluable aid to imitators of the present day.

Illustration has generally flourished in any particular age in proportion to the health and vigour of the artistic productions in other kinds. No evident revival in painting has come about, no great school has existed during the last four centuries, which has not set its mark upon the illustration of the period and quickened it into a medium for true artistic expression. The etchers of the Low Countries during the 17th century, with Rembrandt at their head, were to a great extent illustrators in their choice of subjects. In France the period of Watteau and Fragonard gave rise to a school of delicately engraved illustration, exquisite in detail and invention. In England Hogarth came to be the founder of many new conditions, both in painting and illustration, and was followed by men of genius so distinct as Reynolds on the one side and Bewick on the other. With Reynolds one connects the illustrators and engravers for whom now Bartolozzi supplies a surviving name and an embodiment in his graceful but never quite English art. But it is from Thomas Bewick that the wonderfully consistent development of English illustration begins to date. Bewick marks an important period in the technical history of wood-engraving as the practical inventor of the "tint" and "white line" method of wood-cutting; but he also happened to be an artist. His artistic device was to give local colour and texture without shadow, securing thereby a precision of outline which allowed no form to be lost. And though, in consequence, many of his best designs have somewhat the air of a specimen plate, he succeeded in bringing into black-and-white illustration an element of colour which had been wholly absent from it in the work of

Progress in England.

the 15th and 16th century German and Italian schools. Bewick's method started a new school; but the more racy qualities of his woodcuts were entirely dependent on the designer being his own cutter; and the same happy relationship gave distinct characteristics to the nearly contemporary work of William Blake and of Calvert. Blake's wonderful *Illustrations to the Book of Job*, while magnificent in their conventional rendering of light and shade, still retain the colourlessness of the old masters, as do also the more broadly handled designs to his own books of prophecy and verse; but in his woodcuts to Philips's *Pastorals* the modern tendency towards local colour makes itself strongly felt. So wonderfully, indeed, have colour and tone been expressed in these rough wood-blocks, that more vivid impressions of darkness and twilight falling across quiet landscape have never been produced through the same materials. The pastoral designs made by Edward Calvert on similar lines can hardly be over-praised. Technically these engravings are far more able than those from which they drew their inspiration.

With the exception of the two artists named, and in a minor degree of Thomas Stothard and John Flaxman, who also produced original illustrations, the period from the end of the 18th century till about the middle of the 19th was less notable for the work of the designer than of the engraver. The delicate plates to Rogers's *Italy* were done from drawings which Turner had not produced for purposes of illustration; and the admirable lithographs of Samuel Prout and Richard Bonington were merely studies of architecture and landscape made in a material that admitted of indefinite multiplication. It is true that Géricault came over to England about the year 1820 to draw the English race-horse and other studies of country life, which were published in London in 1821, and that other fine work in lithography was done by James Ward, G. Cattermole, and somewhat later by J. F. Lewis. But illustration proper, subject-illustration applied to literature, was mainly in the hands of the wood-engravers; and these, forming a really fine school founded on the lines which Bewick had laid down, had for about thirty years to content themselves with rendering the works of ephemeral artists, among whom Benjamin R. Haydon and John Martin stand out as the chief lights. It must not be forgotten, however, that while the day of a serious English school of illustration had not yet come, Great Britain possessed an indigenous tradition of gross and lively caricature; a tradition of such robust force and vulgarity that, by the side of some choicer specimens of James Gillray and Henry W. Bunbury, the art of Rowlandson appears almost refined. This was the school in which George Cruikshank, John Leech, and the Dickens illustrators had their training, from which they drew more and more away; until, with the help of *Punch*, just before the middle of the 19th century, English caricaturists had learned the secret of how to be apposite and amusing without scurrility and without libel. (See Caricature.)

Under Newspapers will be found some account of the rise of *illustrated journalism*. It was in about the year 1832 that the illustrated weekly paper started on its career in England, and almost by accident determined under what form a great national art was to develop itself. While in France the illustrators were making their triumphs by means of lithography, English illustration was becoming more and more identified with wood-engraving. The demand for a method of illustration, easy to produce and easy to print, for books and magazines of large circulation and moderate price, forced the artist before long into drawing upon the wood itself; and so soon as the artist had asserted his preference for facsimile over "tint," the school which came to be called "of the 'sixties" was in embryo, and waited only for artistic power to give it distinction. The engraver's translation of the artist's painting or wash-drawing into "tint" had largely exalted the individuality of the engraver at the expense of the artist. But from the moment when the designer began to put his own lines upon the wood, new conditions shaped themselves; and though the artist at times might make demands which the engraver could not follow, or the engraver inadequately fulfil the expectation of the artist, the general tendency was to bring designer and engraver into almost ideal relations—an ideal which nothing short of the artist being his own engraver could have equalled. Out of an alliance cemented by their common use and understanding of the material on which they worked came the school of facsimile or partial-facsimile engraving which flourished during the 'sixties, and lasted just so long as its conditions were unimpaired—losing its flavour only at the moment when "improved" mechanical appliances enabled the artist once more to dissociate himself from the conditions which bound the engraver in his craft.

Influence of Wood-engraving.

Before the fortunate circumstances which governed the work of the 'sixties became decisive, illustrations of a transitional character, but tending to the same end, had been produced by John Tenniel, John Gilbert, Birket Foster, Harrison Weir, T. Creswick, W. Mulready and others; but their methods were too vague and diffuse to bear as yet the mark of a school; no single influence gave a unity to their efforts. On some of them Adolf von Menzel's illustrations to Kügler's *Frederick the Great*, published in England in 1844, may have left a mark; Gilbert certainly shows traces of the influence of Delacroix and Bonington in the free, loose method of his draughtsmanship, independent of accurate modelling, and with here and there a paint-like dab of black to relieve a generally colourless effect; while Tenniel, with cold, precise lines of wire-drawn hardness, remained the representative of the past academic style, influencing others by the dignity of his fine technique, but with his own feeling quite untouched by the Pre-Raphaelite and romantic movement which was soon to occupy the world of illustration. In greater or less degree it may be said of the work of all these artists that, as it antedates, so to the end does it stand somewhat removed in character from, the school with which for a time it became contemporary. The year which decisively marked the beginning of new things in illustration was 1857, the year of the Moxon *Tennyson* and of Wilmott's *Poets of the Nineteenth Century*, with illustrations by Rossetti, Millais, Holman Hunt and Ford Madox Brown. In these artists we get the germ of the movement which afterwards came to have so wide a popularity. At the beginning, Pre-Raphaelite in name, poetic and literary in its choice of subjects, the school quickly expanded to an acceptance of those open-air and everyday subjects which one connects with the names of Frederick Walker, Arthur B. Houghton, G. F. Pinwell and M. North. The illustrations of the Pre-Raphaelites were eminently thoughtful, full of symbolism, and with a certain pressure of interest to which the epithet of "intense" came to be applied. As an example of their method of thought-transference from word to form, Madox Brown's drawing for the Dalziel Bible of "Elijah and the Widow's Son" may be taken. The restoration of life to a dead body, of a child to its mother, is there conveyed with many illustrative touches and asides, which become clumsy when stated in words. The hen bearing her chicken between her wings is a perfectly

Pre-Raphaelite movement.

direct and appropriate pictorial symbol, but a far more imaginative stroke is the shadow on the wall of a swallow flying back to the clay bottle where it has made its nest. Here is illustration full of literary symbolism, yet wholly pictorial in its means; and in this it is entirely characteristic of Pre-Raphaelite feeling, with its method of suggesting, through externals, consideration as opposed to mere outlook. Of this phase Rossetti must be accounted the leader, but it was Millais who, by the sheer weight of his personality, carried English illustration along with him from Pre-Raphaelitism to the freer romanticism and naturalistic tendencies of the ’sixties. Rossetti, with his poetic enthusiasm, his strong personal magnetism and dramatic power of composition, may be said to have brought about the awakening; it was Millais who, by his rapid development of style, his original and daring technique, turned it into a movement. When he started, there were many influences behind him and his fellow-workers—among older foreign contemporaries, those of Menzel and Rethel; and behind these again something of the old masters. But through a transitional period, represented by his twelve drawings of “The Parables,” which appeared first in *Good Words*, Millais emerged in to the perfect independence of his illustrations to Trollope’s novels, *Framley Parsonage*, and *The Small House at Allington*, his own master and the master of a new school. Depicting the ugly fashions of his day with grave dignity and distinction, and with a broad power of rendering type in work which had the aspect of genre, he drew the picture of his age in a summary so embracing that his illustrations attain the rank almost of historical art. For art of this sort the symbolism of the Pre-Raphaelites lost its use: the realization in form of a character conveyed by an author’s words, the happy suggestion of a locality helping to fix the writer’s description, the verisimilitudes of ordinary life, even to trivial detail, carried out with real pictorial conviction, were the things most to be aimed at. Pictorial conviction was the great mark of the illustrative school of the ’sixties. The work of its artists has absorbed so completely the interest and reality of the letterpress that the results are a model of what faithful yet imaginative illustration should be. In the illustrated magazines of this period, *Once a Week*, *Good Words*, *Cornhill*, *London Society*, *The Argosy*, *The Leisure Hour*, *Sunday at Home*, *The Quiver* and *The Churchman’s Family Magazine*, as well as others, is to be found the best work of this new school of illustrators; and with the greater number of them it cannot be mistaken that Millais is the prevailing force.

Influence of Millais.

By their side other men were working, more deeply influenced by the old masters, and by the minuteness and hard, definite treatment of form which the Pre-Raphaelite school had inculcated. Foremost of these was Frederick Sandys. His illustrations, scattered through nearly all the magazines which have been named, show always a decorative power of design and are full of fine drawing and fine invention, but remain resolutely cold in handling and lacking in imaginative ardour. The few illustrations done by Burne-Jones at this period show a whole-hearted following of Rossetti, but a somewhat struggling technique; and the same qualities are to be found in the work of Arthur Hughes, whose illustrations in *Good Words for the Young* (1869) have a charm of tender poetic invention showing through the faults and persistent uncertainty of his draughtsmanship. The illustrations of Frederick Shields to Defoe’s *History of the Plague* have a certain affinity to the work of Sandys; but, with less power over form, they show a more dramatic sense of light and shade, and at their best can claim real and original beauty. The formality of feeling and composition, and the strained, stiff quality of line in Lord Leighton’s designs to *Romola* (1863), do a good deal to mar one’s enjoyment of their admirable draughtsmanship. Many fine drawings done at this period by Leighton, Poynter, Henry Armstead and Burne-Jones did not appear until the year 1880 in the “Dalziel Bible Gallery,” when the methods of which they were the outcome had fallen almost out of use.

Deeply influenced by the broad later phases of Millais’s black-and-white work were those artists whose tendency lay in the direction of idyllic naturalism and popular romance, the men to whom more particularly is given the name of the period and school “the ’sixties,” and whose more immediate leader, as far as popular estimation goes, was Frederick Walker. With his, one may roughly group the names of Pinwell, Houghton, North, Charles Keene, Lawless, Matthew J. Mahoney, Morten and, with a certain reservation, W. Small and G. du Maurier. In no very separate category stand two other artists whose contributions to illustration were but incidental, John Pettie and J. M’Neill Whistler. The broad characteristics of this variously related group were a loose, easy line suggestive of movement, a general fondness for white spaces and open-air effects, and in the best of them a thorough sense of the serious beauty of domestic and rural life. They treated the present with a feeling rather idyllic than realistic; when they touched the past it was with a courteous sort of realism, and a wonderful inventiveness of detail which carried with it a charm of conviction. Walker’s method shows a broad and vivid use of black and white, with a fine sense of balance, but very little preoccupation for decorative effect. Pinwell had a more delicate fancy, but less freedom in his technique—less ease, but more originality of composition. In Houghton’s work one sees a swift, masterful technique, full of audacity, noble in its economy of means, sometimes rough and careless. His temperament was dramatic, passionate, satiric and witty. Some of his best work, his “Scenes from American Life,” appeared in the pages of the *Graphic* as late as the years 1873-1874. There are indications in the work of Lawless that he might have come close to Millais in his power of infusing distinction into the barest materials of everyday life, but he died too soon for his work to reach its full accomplishment. North was essentially a landscape illustrator. The delicate sense of beauty in du Maurier’s early work became lost in the formal but graceful conventions of his later *Punch* drawings. It was in the pages of *Punch* that Keene secured his chief triumphs. The two last-named artists outstayed the day which saw the break-up of the school of which these are the leading names. It ran its course through a period when illustrated magazines formed the staple of popular consumption, before the illustrated newspapers, with their hungry rush for the record of latest events, became a weekly feature. Its waning influence may be plainly traced through the early years of the *Graphic*, which started in 1869 with some really fine work, done under transitional conditions before the engraver’s rendering of tone-drawings once more ousted facsimile from its high place in illustration.

“The ’sixties.”

In connexion with this transitional period, drawings for the *Graphic* by Houghton, Pinwell, Sir Hubert von Herkomer, E. J. Gregory, H. Woods, Charles Green, H. Paterson (Mrs Allingham) and William Small deserve honourable mention. Yet it was the last-named who was mainly instrumental in bringing about the change from line-work to pigment, which depressed the artistic value of illustration during the ’seventies and the ’eighties to almost absolute mediocrity. Several artists of great ability practised illustration during this

period: in addition to those *Graphic* artists already mentioned there were Luke Fildes, Frank Holl, S. P. Hall, Paul Renouard and a few others of smaller merit. But the interest was for the time shifting from black-and-white work and turning to colour. Kate Greenaway began to produce her charming idyllic renderings of children in mob-caps and long skirts. Walter Crane on somewhat similar lines designed his illustrated nursery rhymes; while Randolph Caldecott took the field with his fresh and breezy scenes of hunting life and carousal in the times most typical of the English squirearchy. Working with a broad outline, suggestive of the brush by its easy freedom, and adding washes of conventional colour for embellishment, he was one of the first in England to show the beginnings of Japanese influence. Even more dependent upon colour were his illustrated books for children; while in black and white, in his illustrations to *Bracebridge Hall* (1876), for instance, pen and ink began to replace the pencil, and to produce a new and more independent style of draughtsmanship. This style was taken up and followed by many artists of ability, by Harry Furniss, Hugh Thomson and others, till the influence of E. A. Abbey's more mobile and more elaborate penmanship came to produce a still further development in the direction of fineness and illusion, and that of Phil May, with Linley Sambourne for his teacher, to simplify and make broad for those who aimed rather at a journalistic and shorthand method of illustration. (See also Caricature and Cartoon.)

Under the absolutely liberating conditions of "process reproduction" (see Process) the latest developments in illustration on its lighter and more popular side are full of French influences, or ready to follow the wind in any fresh direction, whether to America or Japan; but on the graver side they show a strong leaning towards the older traditions of the 'sixties and of Pre-Raphaelitism. The founding by William Morris of the Kelmscott Press in 1891, through which were produced a series of decorated and illustrated books, aimed frankly at a revival of medieval taste. In Morris's books decorative effect and sense of material claimed mastery over the whole scheme, and subdued the illustrations to a sort of glorious captivity into which no breath of modern spirit could be breathed. The illustrations of Burne-Jones filled with a happy touch of archaism the decorative borders of William Morris; and only a little less happy, apart from their imaginative inferiority, were the serious efforts of Walter Crane and one or two others. Directly under the Morris influence arose the "Birmingham school," with an entire devotion to decorative methods and still archaic effects which tended sometimes to rather inane technical results. Among its leaders may be named Arthur Gaskin, C. M. Gere and E. H. New; while work not dissimilar but more independent in spirit had already been done by Selwyn Image and H. P. Horne in the *Century Guild Hobby-Horse*. But far greater originality and force belonged to the work of a group, known for a time as the neo-Pre-Raphaelites, which joined to an earnest study of the past a scrupulously open mind towards more modern influences. Its earliest expression of existence was the publication of an occasional periodical, the *Dial* (1889-1897), but before long its influence became felt outside its first narrow limits. The technical influence of Abbey, but still more the emotional and intellectual teaching of Rossetti and Millais, together with side-influences from the few great French symbolists, were, apart from their own originality, the forces which gave distinction to the work of C. S. Ricketts, C. H. Shannon, R. Savage and their immediate following. Beauty of line, languorous passion, symbolism full of literary allusions, and a fondness for the life of any age but the present, are the characteristics of the school. Their influence fell very much in the same quarters where Morris found a welcome; but an affinity for the Italian rather than the German masters (shown especially in the "Vale Press" publications), and a studied note of world-weariness, kept them somewhat apart from the sturdy medievalism of Morris, and linked them intellectually with the decadent school initiated by the wayward genius of Aubrey Beardsley. But though broadly men may be classed in groups, no grouping will supply a formula for all the noteworthy work produced when men are drawn this way and that by current influences. Among artists resolutely independent of contemporary coteries may be named W. Strang, whose grave, rugged work shows him a pupil, through Legros, of Dürer and others of the old masters; T. Sturge Moore, an original engraver of designs which have an equal affinity for Blake, Calvert and Hokusai; W. Nicholson, whose style shows a dignified return to the best part of the Rowlandson tradition; and E. J. Sullivan. In the closing years of the 19th century Aubrey Beardsley became the creator of an entirely novel style of decorative illustration. Drawing inspiration from all sources of European and Japanese art, he produced, by the force of a vivid personality and extraordinary technical skill, a result which was highly original and impressive. To a genuine liking for analysis of repulsive and vicious types of humanity he added an exquisite sense of line, balance and mass; and partly by *succès de scandale*, partly by genuine artistic brilliance, he gathered round him a host of imitators, to whom, for the most part, he was able to impart only his more mediocre qualities.

United States.

In America, until a comparatively recent date, illustration bowed the knee to the superior excellence of the engraver over the artist. Not until the brilliant pen-drawing of E. A. Abbey carried the day with the black-and-white artists of England did any work of real moment emanate from the United States, unless that of Elihu Vedder be regarded as an exception. Howard Pyle is a brilliant imitator of Dürer; he has also the ability to adapt himself to draughtsmanship of a more modern tendency. C. S. Reinhart was an artist of directness and force, in a style based upon modern French and German examples; while of greater originality as a whole, though derivative in detail, is the fanciful penmanship of Alfred Brennan. Other artists who stand in the front rank of American illustrators, and whose works appear chiefly in the pages of *Scribner's*, *Harper's* and the *Century Magazine*, are W. T. Smedley, F. S. Church, R. Blum, Wenzell, A. B. Frost, and in particular C. Dana Gibson, the last of whom gained a reputation in England as an American du Maurier.

France.

The record of modern French illustration goes back to the day when political caricature and the Napoleonic legend divided between them the triumphs of early lithography. The illustrators of France at that period were also her greatest artists. Of the historical and romantic school were D. Raffet, Nicholas J. Charlet, Géricault, Delacroix, J. B. Isabey and Achille Devéria, many of whose works appeared in *L'Artiste*, a paper founded in 1831 as the official organ of the romanticists; while the realists were led in the direction of caricature by two artists of such enormous force as Gavarni and Honoré Daumier, whose works, appearing in *La Lithographie Mensuelle*, *Le Charivari* and *La Caricature*, ran the gauntlet of political interference and suppression during a troubled period of French politics—which was the very cause of their prosperity. Behind these men lay the influence of the great Spanish realist Goya. Following upon the harsh satire and venomous realism of this famous school of pictorial invective, the influence of the Barbizon school came as a milder force; but the power of its artists did not show in the direction of original lithography, and far more value attaches to the few woodcuts of J. F.

Millet's studies of peasant life. In these we see clearly the tendency of French illustrative art to keep as far as possible the authentic and sketch-like touch of the artist; and it was no doubt from this tendency that so many of the great French illustrators retained lithography rather than commit themselves to the middleman engraver. Nevertheless, from about the year 1830 many French artists produced illustrations which were interpreted upon the wood for the most part by English engravers. Cunier's editions of *Paul et Virginie* and *La Chaumière Indienne*, illustrated by Huet, Jacque, Isabey, Johannot and Meissonier, were followed by Meissonier's more famous illustrations to *Contes rémois*. After Meissonier came J. B. E. Detaille and Alphonse M. de Neuville and, with a voluminous style of his own, L. A. G. Doré. By the majority of these artists the drawing for the engraver seems to have been done with the pen; and the tendency to penmanship was still more accentuated when from Spain came the influence of M. J. Fortuny's brilliant technique; while after him, again, came Daniel Vierge, to make, as it were, the point of the pen still more pointed. During the middle period of the 19th century the best French illustration was serious in character; but among the later men, when we have recognized the grave beauty of Grasset's *Les Quatre Fils d'Aymon* (in spite of his vicious treatment of the page by flooding washes of colour through the type itself), and the delicate grace of Boutet de Monvel's *Jeanne d'Arc*, also in colours, it is to the illustrators of the comic papers that we have to go for the most typical and most audacious specimens of French art. In the pages of *Gil Blas*, *Le Pierrot*, *L'Écho de Paris*, *Le Figaro Illustré*, *Le Courrier Français*, and similar publications, are to be found, reproduced with a dexterity of process unsurpassed in England, the designs of J. L. Forain, C. L. Léandre, L. A, Willette and T. A. Steinlen, the leaders of a school enterprising in technique, and with a mixture of subtlety and grossness in its humour. Caran d'Ache also became celebrated as a draughtsman of comic drama in outline.

Germany.

Among illustrators of Teutonic race the one artist who seems worthy of comparison with the great Menzel is Hans Tegner, if, indeed, he be not in some respects his technical superior; but apart from these two, the illustrators respectively of Kügler's *Frederick the Great* and Holberg's *Comedies*, there is no German, Danish or Dutch illustrator who can lay claim to first rank. Max Klinger, A. Böcklin, W. Trübner, Franz Stück and Hans Thoma are all symbolists who combine in a singular degree force with brutality; the imaginative quality in their work is for the most part ruined by the hard, braggart way in which it is driven home. The achievements and tendency of the later school of illustration in Germany are best seen in the weekly illustrated journal, *Jugend*, of Munich. Typical of an older German school is the work of Adolf Oberländer, a solid, scientific sort of caricaturist, whose illustrations are at times so monumental that the humour in them seems crushed out of life. Others who command high qualities of technique are W. Dietz, L. von Nagel, Hermann Vogel, H. Lüders and Robert Haug. Behind all these men in greater or less degree lies the influence of Menzel's coldly balanced and dry-lighted realism; but wherever the influence of Menzel ceases, the merit of German illustration for the most part tends to disappear or become mediocre.

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(L. HO.)

Technical Developments.

The history of illustration, apart from the merits of individual artists, during the period since the year 1875, is mainly that of the development of what is called Process (*q.v.*), the term applied to methods of reproducing a drawing or photograph which depend on the use of some mechanical agency in the making of the block, as distinguished from such products of manual skill as steel or wood-engraving, lithography and the like. There is good reason to believe that the art of stereotyping—the multiplication of an already existing block by means of moulds and casts—is as old as the 15th century; and the early processes were, in a measure, a refinement upon this: with the difference that they aimed at the making of a metal block by means of a cast of the lines of the drawing itself, the background of which had been cut away so as to leave the design in a definite relief. Experiments of this nature may be said to have assumed practical shape from the time of the invention of Palmer's process called at first *Glyphography*, about the year 1844; this was afterwards perfected and used to a considerable extent under the name of *Dawson's Typographic Etching*, and its results were in many cases quite admirable, and often appear in books and periodicals of the first part of the period with which we are now concerned. The *Graphic*, for instance, published its first process block in 1876, and the *Illustrated London News* also made similar experiments at about the same time.

From this time begins the gradual application of photography to the uses of illustration, the first successful line blocks made by its help being probably those of Gillot, at Paris, in the early 'eighties. The next stage was to be the invention of some means of reproducing wash drawings. To do this it was necessary for the surface of the block to be so broken up that every tone of the drawing should be represented thereon by a grain holding ink enough to reproduce it. This was finally accomplished by the insertion of a screen, in the camera, between the lens and the plate—the effect of which was to break up the whole surface of the negative into dots, and so secure, when printed on a zinc plate and etched, an approximation to the desired result. Half-tone blocks (as they were called) of this nature (see PROCESS) were used in the *Graphic* from 1884 and the *Illustrated London News* from 1885 onwards, the methods at first in favour being those of Meisenbach and Boussod Valadon and Co.'s phototype. Lemercier and Petit of Paris, Angerer and Göschl of Vienna, and F. Ives of Philadelphia also perfected processes giving a similar result, a block by the latter appearing in the *Century* magazine as early as 1882. Processes of this description had, however, been used for some years before by Henry Blackburn in his *Academy Notes*.

During the decade 1875-1885, however, the main body of illustration was accomplished by wood-engraving, which a few years earlier had achieved such splendid results. Its artistic qualities were now at a rather low ebb, although good facsimile engravings of pen-drawings were not infrequent. The two great illustrated periodicals already referred to during that period relied more upon pictorial than journalistic

work. An increasing tendency towards the illustration of the events of the day was certainly shown, but the whole purpose of the journal was not, as at present, subordinated thereto. The chief illustrated magazines of the time, *Harper's*, the *Century*, the *English Illustrated*, were also content with the older methods, and are filled with wood-engravings, in which, if the value of the simple line forming the chief quality of the earlier work has disappeared, a most astonishing delicacy and success were obtained in the reproduction of tone.

Perhaps the most notable and most characteristic production of the time in England was colour-printing. The *Graphic* and the *Illustrated London News* published full-page supplements of high technical merit printed from wood-blocks in conjunction with metal plates, the latter sometimes having a relief aquatint surface which produced an effect of stipple upon the shading; metal was also used in preference to wood for the printing of certain colours. The children's books illustrated by Randolph Caldecott, Walter Crane and Kate Greenaway at this time are among the finest specimens of colour-printing yet seen outside of Japan; in them the use of flat masses of pleasant colour in connexion with a bold and simple outline was carried to a very high pitch of excellence. These plates were generally printed by Edmund Evans. In 1887 the use of process was becoming still more general; but its future was by no means adequately foreseen, and the blocks of this and the next few years are anything but satisfactory. This, it soon appeared, was due to inefficient printing on the one hand, and, on the other, to a want of recognition by artists of the special qualities of drawing most suitable for photographic reproduction. The publication of Quevedo's *Pablo de Segovia* with illustrations by Daniel Vierge in 1882, although hardly noticed at the time, was to be a revelation of the possibilities of the new development; and a serious study of pen-drawing from this point of view was soon inaugurated by the issue of Joseph Pennell's *Pen Drawing and Pen Draughtsmen* in 1889, followed in by C. G. Harper's *English Pen Artists of To-day* and in 1896 by Walter Crane's *Decorative Illustration of Books*. At this time also the influence of Aubrey Beardsley made itself strongly felt, not merely as a matter of style, but, by the use of simple line or mass of solid black, as an almost perfect type of the work most suitable to the needs of process. Wider experience of printing requirements, and finer workmanship in the actual making of the blocks, in Paris, Vienna, New York and London, soon brought the half-tone process into great vogue. The spread of education has enormously increased the demand for ephemeral literature, more especially that which lends itself to pictorial illustration; and the photograph or drawing in wash reproduced in half-tone has of late to a great extent ousted line work from the better class of both books and periodicals.

Improvements in machinery have made it possible to print illustrations at a very high speed; and the facility with which photographs can now be taken of scenes such as the public delight to see reproduced in pictures has brought about an almost complete change in pictorial journalism. In addition, reference must be made to an extraordinary increase in the numbers and circulation of cheap periodical publications depending to a very large extent for popularity on their illustrations. Several of these, printed on the coarsest paper, from rotary machines, sell to the extent of hundreds of thousands of copies per week. It was inevitable that this cheapening process should not be permitted to develop without opposition, and the *Dial* (1889-1897) must be looked on as a protest by the band of artists who promoted it against the unintelligent book-making now becoming prevalent. Much more effective and far-reaching in the same direction was the influence of William Morris, as shown in the publications of the Kelmscott Press (dating from 1891). In these volumes the aim was to produce illustrations and ornaments which were of their own nature akin to, and thus able to harmonize with the type, and to do this by pure handicraft work. As a result, a distinct improvement is to be found in the mere book-making of Great Britain; and although the main force of the movement soon spent itself in somewhat uninspired imitations, there can be no doubt of the survival of a taste for well-produced volumes, in which the relationship of type, paper, illustration and binding has been a matter of careful and artistic consideration. Under this influence, a notable feature has been the re-issue, in an excellent form, of illustrated editions of the works of most of the famous writers.

In France the general movement has proceeded upon lines on the whole very similar. Process—especially what was called "Gillotage"—was adopted earlier, and used at first with greater liberality than in England, although wood-engraving has persisted effectively even up to our own time. In the various types of periodicals of which the *Revue Illustrée*, *Figaro Illustré* and *Gil Blas Illustré* may be taken as examples, the most noticeable feature is a use of colour-printing, which is far in advance of anything generally attempted in Great Britain. A favourite and effective process is that employed for the reproduction of chalk drawings (as by Steinlen), which consists of the application of a surface-tint of colour from a metal plate to a print from an ordinary process block.

In Germany, *Jugend*, *Simplicissimus*, and other publications devoted to humour and caricature, employ colour-printing to a great extent with success. The organ of the artists of the younger German schools, Pan (1895), makes use of every means of illustration, and has especially cultivated lithography and wood-cuts, using these arts effectively but with some eccentricity. Holland has also employed coloured lithography for a remarkable series of children's books illustrated by van Hoytema and others. The Viennese *Kunst und Kunsthandwerk* is an art publication which is exceptionally well produced and printed.

Illustration in the United States has some few characteristics which differentiate it from that of other countries. The later school of fine wood-engraving is even yet in existence. American artists also introduced an effective use of the process block, namely, the engraving or working over of the whole or certain portions of it by hand. This is generally done by an engraver, but in certain cases it has been the work of the original draughtsman, and its possibilities have been foreseen by him in making his drawing. The only other variant of note is the use of half-tone blocks superimposed for various colours.

(E. F. S.)

ILLUSTRES, the Latin name given to the highest magistrates of the later Roman Empire. The designation was at first informal, and not strictly differentiated from other marks of honour. From the time of Valentinian I. it became an official title of the consuls, the chief praefecti or ministers, and of the

commanders-in-chief of the army. Its usage was eventually extended to lower grades of the imperial service, and to pensionaries from the order of the *spectabiles*. The Illustres were privileged to be tried in criminal cases by none but the emperor or his deputy, and to delegate procuratores to represent them in the courts.

See O. Hirschfeld in *Sitzungsberichte der Berliner Akademie* (1901), p. 594 sqq.; and T. Hodgkin, *Italy and her Invaders* (Oxford, 1892), i. 603-617.

ILLYRIA, a name applied to part of the Balkan Peninsula extending along the eastern shore of the Adriatic from Fiume to Durazzo, and inland as far as the Danube and the Servian Morava. This region comprises the modern provinces or states of Dalmatia, Bosnia and Herzegovina, and Montenegro, with the southern half of Croatia-Slavonia, part of western Servia, the sanjak of Novibazar, and the extreme north of Albania. As the inhabitants of Illyria never attained complete political unity its landward boundaries were never clearly defined. Indeed, the very name seems originally to have been an ethnological rather than a geographical term; the older Greek historians usually wrote of "the Illyrians" (οἱ Ἰλλυρίοι), while the names Illyris (Ἰλλυρίς) or less commonly Illyria (Ἰλλυρία) came subsequently to be used of the indeterminate area inhabited by the Illyrian tribes, *i.e.* a region extending eastward from the Adriatic between Liburnia on the N. and Epirus on the S., and gradually shading off into the territories of kindred peoples towards Thrace. The Latin name Illyricum was not, unless at a very early period, synonymous with Illyria; it also may originally have signified the land inhabited by the Illyrians, but it became a political expression, and was applied to various divisions of the Roman Empire, the boundaries of which were frequently changed and often included an area far larger than Illyria properly so called. Vienna and Athens at different times formed part of Illyricum, but no geographer would ever have included these cities in Illyria.

Ethnology.—Little can be learned from written sources of the origin and character of the Illyrians. The 326
Greek legend that Cadmus and Harmonia settled in Illyria and became the parents of Illyrius, the eponymous ancestor of the whole Illyrian people, has been interpreted as an indication that the Greeks recognized some affinity between themselves and the Illyrians; but this inference is based on insufficient data. Herodotus and other Greek historians represent the Illyrians as a barbarous people, who resembled the ruder tribes of Thrace. Both are described as tattooing their persons and offering human sacrifices to their gods. The women of Illyria seem to have occupied a high position socially and even to have exercised political power. Queens are mentioned among their rulers. Fuller and more trustworthy information can be obtained from archaeological evidence. In Bosnia the lake-dwellings at Butmir, the cemeteries of Jezerine and Glasinac and other sites have yielded numerous stone and horn implements, iron and bronze ornaments, weapons, &c., and objects of more recent date fashioned in silver, tin, amber and even glass. These illustrate various stages in the development of primitive Illyrian civilization, from the neolithic age onward. The Hallstatt and La Tène cultures are especially well represented. (See W. Ridgeway, *The Early Age of Greece*, 1901; R. Munro, *Bosnia-Herzegovina and Dalmatia*, Edinburgh, 1900; and W. Radimský, *Die neolithische Station von Butmir*, Vienna, 1895-1898.) Similar discoveries have been made in Dalmatia, as among the tumuli on the Sabbioncello promontory, and in Croatia-Slavonia. H. Kiepert ("Über den Volkstamm der Leleges," in *Monatsber. Berl. Akad.*, 1861, p. 114) sought to prove that the Illyrians were akin to the Leleges; his theory was supported by E. Schrader, but is not generally accepted. In Dalmatia there appears to have been a large Celtic element, and Celtic place-names are common. The ancient Illyrian languages fall into two groups, the northern, closely connected with Venetic, and the southern, perhaps allied to Messapian and now probably represented by Albanian.

See K. Brugmann, *Kurze vergleichende Grammatik der Indogermanischen Sprachen* (Strassburg, 1904); and his larger *Grundriss der vergleichenden Grammatik* (2nd ed., Strassburg, 1897), with the authorities there quoted, especially P. Kretschmer, *Einleitung in die Geschichte der Griechischen Sprachen* (Göttingen, 1896): see also ALBANIA.

History.—Greek colonization on the Illyrian seaboard probably began late in the 7th century B.C. or early in the 6th century. The most important settlements appear to have been at Epidamnus (Durazzo), Tragurium (Traù), Rhizon (near Cattaro), Salona (near Spalato), Epidaurum (Ragusavecchia), Zara and on the islands of Curzola, Lesina and Lissa. There is a collection of Greek coins from Illyria in the museum at Agram, and the researches of Professor F. Bulié and others at Salona (see SPALATO) have brought to light Greek inscriptions, Greek pottery, &c. dating from 600 B.C. But Greek influence seems never to have penetrated far into the interior, and even on the coast it was rapidly superseded by Latin civilization after the 3rd century B.C. Until then the Illyrian tribes appear to have lived in a state of intermittent warfare with their neighbours and one another. They are said by Herodotus (ix. 43) to have attacked the temple of Delphi. Brasidas with his small army of Spartans was assaulted by them on his march (424 B.C.) across Thessaly and Macedonia to attack the Athenian colonies in Thrace. The earlier history of the Macedonian kings is one constant struggle against the Illyrian tribes. The migrations of the Celts at the beginning of the 4th century disturbed the country between the Danube and the Adriatic. The Scordisci and other Celtic tribes settled there, and forced the Illyrians towards the south. The necessities of defence seem to have united the Illyrians under a chief Bardylis (about 383 B.C.) and his son Clitus. Bardylis nearly succeeded in destroying the rising kingdom of Macedonia; King Amyntas II was defeated, and a few years later Perdiccas was defeated and slain (359). But the great Philip crushed the Illyrians completely, and annexed part of their country. During the next century we hear of them as pirates. Issuing from the secluded harbours of the coast, they ravaged the shores of Italy and Greece, and preyed on the commerce of the Adriatic. The Greeks applied to Rome for help. Teuta, the Illyrian queen, rejected the Roman demands for redress, and murdered the ambassadors; but the two Illyrian Wars (229 and 219 B.C.) ended in the submission of the Illyrians, a considerable part of their territory being annexed by the conquerors. Illyria, however, remained a powerful kingdom with its

capital at Scodra (Scutari in Albania), until 180 B.C., when the Dalmatians declared themselves independent of Gentius or Genthius, the king of Illyria, and founded a republic with its capital at Delminium (see DALMATIA: *History*, on the site of Delminium). In 168 Gentius came into conflict with the Romans, who conquered and annexed his country. Dalmatia was invaded by a Roman army under Gaius Marcius Figulus in 156, but Figulus was driven back to the Roman frontier, and in Dalmatia the Illyrians were not finally subdued until 165 years afterwards. Publius Scipio Nasica, who succeeded Figulus, captured Delminium, and in 119 L. Caecilius Metellus overran the country and received a triumph and the surname *Dalmaticus*. But in 51 a Dalmatian raid on Liburnia led to a renewal of hostilities; the Roman armies were often worsted, and although in 39 Asinius Pollio gained some successes (see Horace, *Odes* ii. 1. 15) these appear to have been exaggerated, and it was not until Octavian took the field in person that the Dalmatians submitted in 33. (For an account of the war see Appian, *Illyrica*, 24-28; Dio Cassius xlix. 38; Livy, *Epit.* 131, 132). They again revolted in 16 and 11, and in A.D. 6-9 joined the rebel Pannonians. Suetonius (*Tiberius*, 16) declares that they were the most formidable enemies with whom the Romans had had to contend since the Punic Wars. In A.D. 9, however, Tiberius entirely subjugated them, for which he was awarded a triumph in 12 (Dio Cass. lv. 23-29, lvi. 11-17; Vell. Pat. ii. 110-115). Thenceforward Dalmatia, Iapydia and Liburnia were united as the province of Illyricum.

Latin civilization spread rapidly, the cultivation of the vine was introduced, gold-mining was carried on in Bosnia, and flourishing commercial cities arose along the coast. Illyria became one of the best recruiting grounds for the Roman legions; and in troubled times many Illyrian soldiers fought their way up from the ranks to the imperial purple. Claudius, Aurelian, Probus, Diocletian and Maximian were all sons of Illyrian peasants. It is probable, however, that most of the highland tribes now represented by the Albanians remained almost unaffected by Roman influence. The importance of Illyricum caused its name to be extended to many neighbouring districts; in the 2nd century A.D. the *Illyricus Limes* included Noricum, Pannonia, Moesia, Dacia and Thrace. In the reorganization of the empire by Diocletian (285) the diocese of Illyricum was created; it comprised Pannonia, Noricum and Dalmatia, while Dacia and Macedonia, together called Eastern Illyricum, were added later. Either Diocletian or after him Constantine made Illyricum one of the four prefectures, each governed by a *praefectus praetorio*, into which the empire was divided. This prefecture included Pannonia, Noricum, Crete and the entire Balkan peninsula except Thrace, which was attached by Constantine to the prefecture of the East. From the partition of the empire in 285 until 379 Illyricum was included in the Western Empire, but thenceforward Eastern Illyricum was annexed to the Eastern Empire; its frontier was almost identical with the line of demarcation between Latin-speaking and Greek-speaking peoples, and roughly corresponded to the boundary which now severs Latin from Greek Christianity in the Balkan peninsula. The whole peninsula except Thrace was still known as Illyricum, but was subdivided into Illyris Barbara or Romana and Illyris Graeca (Eastern Illyricum with Greece and Crete). The Via Egnatia, the great line of road which connected Rome with Constantinople and the East, led across Illyricum from Dyrrachium to Thessalonica.

In the 5th century began a series of invasions which profoundly modified the ethnical character and the civilization of the Illyrians. In 441 and 447 their country was ravaged by the Huns. In 481 Dalmatia was added to the Ostrogothic kingdom, which already included the more northerly parts of Illyricum, *i.e.* 327
Pannonia and Noricum. Dalmatia was partially reconquered by Justinian in 536, but after 565 it was devastated by the Avars, and throughout the century bands of Slavonic invaders had been gradually establishing themselves in Illyria, where, unlike the earlier barbarian conquerors, they formed permanent settlements. Between 600 and 650 the main body of the immigrants occupied Illyria (see SERVIA: *History*; and SLAVS). It consisted of Croats and Serbs, two groups of tribes who spoke a single language and were so closely related that the origin of the distinction between them is obscure. The Croats settled in the western half of Illyria, the Serbs in the eastern; thus the former came gradually under the influence of Italy and Roman Catholicism, the latter under the influence of Byzantium and the Greek Church. Hence the distinction between them became a marked difference of civilization and creed, which has always tended to keep the Illyrian Slavs politically disunited.

The Croats and Serbs rapidly absorbed most of the Latinized Illyrians. But the wealthy and powerful city-states on the coast were strong enough to maintain their independence and their distinctively Italian character. Other Roman provincials took refuge in the mountains of the interior; these Mavrovlachi, as they were called (see DALMATIA: *Population*; and VLACHS), preserved their language and nationality for many centuries. The Illyrian tribes which had withstood the attraction of Roman civilization remained unconquered among the mountains of Albania and were never Slavonized. With these exceptions Illyria became entirely Serbo-Croatian in population, language and culture.

The name of Illyria had by this time disappeared from history. In literature it was preserved, and the scene of Shakespeare's comedy, *Twelfth Night*, is laid in Illyria. Politically the name was revived in 1809, when the name Illyrian Provinces was given to Carniola, Dalmatia, Istria, Fiume, Görz and Gradisca, and Trieste, with parts of Carinthia and Croatia; these territories were ceded by Austria to Italy at the peace of Schönnbrun (14th Oct. 1809). The Illyrian Provinces were occupied by French troops and governed in the interest of Napoleon; the republic of Ragusa was annexed to them in 1811, but about the end of 1813 the French occupation ceased to be effective and the provinces reverted to Austria. The kingdom of Illyria, which was constituted in 1816 out of the crown-lands of Carinthia, Carniola, Istria, Görz and Gradisca, and Trieste, formed until 1849 a kingdom of the Austrian crown. For the political propaganda known as Illyrism, see CROATIA-SLAVONIA: *History*.

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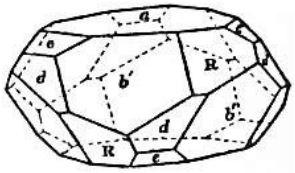
ILMENAU, a town and summer resort of Germany, in the grand-duchy of Saxe-Weimar, at the north foot of the Thuringian Forest, on the river Ilm, 30 m. by rail south of Erfurt. Pop. (1905) 11,222. The town, which stands picturesquely among wooded hills, is much frequented by visitors in the summer. It was a favourite resort of Goethe, who wrote here his *Iphigenie*, and often stayed at Gabelbach in the neighbourhood. It has a grand-ducal palace, a Roman Catholic and two Evangelical churches, a sanatorium for nervous disorders, and several educational establishments. Its chief manufactures are glass and porcelain, toys, gloves and chemicals, and the town has tanneries and saw-mills. Formerly a part of the county of Henneberg, Ilmenau came in 1631 into the possession of electoral Saxony, afterwards passing to Saxe-Weimar.

See R. Springer, *Die klassischen Stätten von Jena und Ilmenau* (Berlin, 1869); Pasig, *Goethe und Ilmenau* (2nd ed., Weimar, 1902); and Fils, *Bad Ilmenau und seine Umgebung* (Hildburghausen, 1886).

ILMENITE, a mineral known also as titanic iron, formerly regarded as an iron and titanium sesquioxide (Fe, Ti)$_2$O$_3$ isomorphous with haematite (Fe$_2$O$_3$), but now generally considered to be an iron titanate FeTiO$_3$ isomorphous with pyrophanite (MnTiO$_3$) and geikielite (MgTiO$_3$). It crystallizes in the parallel-faced hemihedral class of the rhombohedral system, thus having the same degree of symmetry as phenacite and pyrophanite, but differing from that of haematite. The angles between the faces are very nearly the same as between the corresponding faces of haematite; but it is to be noted that the rhombohedral angle (94° 29′) of ilmenite is not intermediate between that of haematite (94° 0′) and of the artificially prepared crystals of titanium sesquioxide (92° 40′), which should be the case if the three substances were isomorphous. Analyses show wide variations in chemical composition, and there is a gradation from normal ilmenite FeTiO$_3$ (with titanium dioxide 52.7, and ferrous oxide 47.3%) to titaniferous haematite and titaniferous magnetite. Frequently also, magnesia and manganous oxide are present in small amounts, the former reaching 16%. The formula (Fe, Mg)TiO$_3$ is then analogous to those of geikielite and pyrophanite. Many analyses show the presence of TiO$_2$ and (Fe, Mg)O in this ratio of 1:1, yet there is often an excess of ferric oxide to be accounted for; this may perhaps be explained by the regular intergrowth on a minute scale of ilmenite with haematite, like the intergrowth of such substances as calcite and sodium nitrate, which are similar crystallographically but not chemically.



In many of its external characters ilmenite is very similar to haematite; the crystals often have the same tabular or lamellar habit; the twin-laws are the same, giving rise to twin-lamellae and planes of parting parallel to the basal plane and the primitive rhombohedron; the colour is iron-black with a submetallic lustre; finally, the conchoidal fracture is the same in both minerals. Ilmenite has a black streak; it is opaque, but in very thin scales sometimes transparent with a clove-brown colour. It is slightly magnetic, but without polarity. The hardness is 5½, and the specific gravity varies with the chemical composition from 4.3 to 5.0.

Owing to the wide variations in composition, which even yet are not properly understood, several varieties of the mineral have been distinguished by special names. Crichtonite occurs as small and brilliant crystals of acute rhombohedral habit on quartz at Le Bourg d'Oisans in Dauphiné; it agrees closely in composition with the formula FeTiO$_3$ and has a specific gravity of 4.7. Manaccanite (or Menaccanite) is a black sandy material, first found in 1791 in a stream at Manaccan near Helston in Cornwall. Iserite, from Iserwiese in the Iser Mountains, Bohemia, is a similar sand, but containing some octahedral crystals, possibly of titaniferous magnetite. Washingtonite is found as large tabular crystals at Washington, Connecticut. Uddevallite is from Uddevalla in Sweden. Picrotitanite or picroilmenite (Gr. πικρός, "bitter") is the name given to varieties containing a considerable amount of magnesia. Other varieties are kibdelophane, hystatite, &c. The name ilmenite, proposed by A. T. Kupffer in 1827, is after the Ilmen Mountains in the southern Urals, whence come the best crystals of the mineral. The largest crystals, sometimes as much as 16 ℔ in weight, are from Kragerö and Arendal in Norway.

Ilmenite occurs, often in association with magnetite, in gneisses and schists, sometimes forming beds of considerable extent, but of little or no economic value. It is a common accessory constituent of igneous rocks of all kinds, more especially basic rocks such as gabbro, diabase and basalt. In these rocks it occurs as platy crystals, and is frequently represented by a white, opaque alteration product known as leucoxene.

(L. J. S.)

ILOILO, a town, port of entry and the capital of the province of Iloilo, Panay, Philippine Islands, at the mouth of Iloilo river, on the S.E. coast. Pop. (1903) 19,054. In 1903, after the census had been taken, the population of the town was more than doubled by the addition of the municipalities of La Paz (pop. 5724), Mandurriao (pop. 4482), Molo (pop. 8551) and Jaro (pop. 10,681); in 1908 Jaro again became a separate town. The town is built on low sandy ground, is irregularly laid out, and its streets are not paved. It has a good government house and a fine church. The harbour, suitable for ships of 15 ft. draught, is well protected by the island of Guimaras, and ocean-going vessels can lie in the channel. The surrounding country, which is traversed by gravel roads leading to the principal towns of the province, is fertile and well cultivated, producing sugar, tobacco and rice in abundance. In commercial importance Iloilo ranks next to Manila among Philippine cities; it has manufactures of piña, jusi, coconut oil, lime, vinegar and various

articles made from palm wood. Much of the town was burned by Filipino insurgents soon after its capture by American troops in February 1899.

ILSENBURG, a village and health resort of Germany, in Prussian Saxony, romantically situated under the north foot of the Harz Mountains, at the entrance to the Ilsethal, 6 m. N.W. from Wernigerode by the railway to Goslar. Pop. (1900) 3868. It has an Evangelical church, a modern château of the princes of Stolberg, with pretty grounds, and a high grade school, and manufactures metal wares, machines and iron screws and bolts.

Owing to its charming surroundings and its central position in the range, Ilsenburg is one of the most frequented tourist resorts in the Harz Mountains, being visited annually by some 6000 persons. The old castle, Schloss Ilsenburg, lying on a high crag above the town, was originally an imperial stronghold and was probably built by the German king Henry I. The emperor Otto III. resided here in 995, Henry II. bestowed it in 1003 upon the bishop of Halberstadt, who converted it into a Benedictine monastery, and the school attached to it enjoyed a great reputation towards the end of the 11th century. After the Reformation the castle passed to the counts of Wernigerode, who restored it and made it their residence until 1710. Higher still, on the edge of the plateau rises the Ilsenstein, a granite peak standing about 500 ft. above the valley, crowned by an iron cross erected by Count Anton von Stolberg-Wernigerode in memory of his friends who fell in the wars of 1813-1815. Around this rock cluster numerous legends.

See Jacobs, *Urkundenbuch des Klosters Ilsenburg* (Halle, 1875); Brandes, *Ilsenburg als Sommeraufenthalt* (Wernigerode, 1885); and H. Herre, *Ilsenburger Annalen* (Leipzig, 1890).

IMAGE (Lat. *imago*, perhaps from the same root as *imitari*, copy, imitate), in general, a copy, representation, exact counterpart of something else. Thus the reflection of a person in a mirror is known as his “image”; in popular usage one person is similarly described as “the very image” of another; so in entomology the term is applied in its Latin form *imago* to an insect which, having passed through its larval stages, has achieved its full typical development. The term is in fact susceptible of two opposite connotations; on the one hand, it implies that the thing to which it is applied is only a copy; on the other that as a copy it is faithful and accurate.

Psychology (*q.v.*) recognizes two uses of the term. The simplest is for the impression made by an observed object on the retina, the eye; in this connexion the term “after-image” (better “after-sensation”) is used for an image which remains when the eye is withdrawn from a brilliantly lighted object; it is called positive when the colour remains the same, negative when the complementary colours are seen. The strict psychological use of the term “image” is by analogy from the physiological for a purely mental idea which is taken as being observed by the eye of the mind. These images are created or produced not by an external stimulus, such as is necessary for a visual image (even the after-image is due to the continued excitement of the same organ), but by a mental act of reproduction. The simplest ideational image, which has been described as the primary memory-image, is “the peculiarly vivid and definite ideal representation of an object which we can maintain or recall by a suitable effort of attention immediately after perceiving it” (Stout). For this no external stimulus is required, and as compared with the after-image it represents the objects in perspective just as they might be seen in perception. This is characteristic of all mental images. The essential requisite for this primary image is that the attention should have been fixed upon the impressions.

The relation between sense-impressions and mental images is a highly complicated one. Difference in intensity is not a wholly satisfactory ground of distinction; abnormal physical conditions apart, an image may have an intensity far greater than that of a sense-given impression. On the other hand, Hume is certainly right in holding that the distinctive character of a percept as compared with an image is in all ordinary cases the force and liveliness with which it strikes the mind—the distinction, therefore, being one of quality, not of degree. A distinction of some importance is found in the “superior steadiness” (Ward) of impressions; while looking at any set of surroundings, images of many different scenes may pass through the mind, each one of which is immediately distinguished from the impression of the actual scene before the eyes. This arises partly, no doubt, from the fact that the perception has clear localization, which the image has not. In many cases indeed an image even of a most familiar scene is exceedingly vague and inaccurate.

In Art the term is used for a representation or likeness of an animate or inanimate object, particularly of the figure of a person in sculpture or painting. The most general application of the word is to such a representation when used as an object of religious worship or adoration, or as a decorative or architectural ornament in places of religious worship. The worship of images, or idolatry, from the point of view of comparative religion, is treated in the article Image-Worship, and the history of the attitude of the Christian church, outside the post-Reformation church of England, towards the use of images as objects of worship and religion in the article Iconoclasts. With regard to the Pre-Reformation period in England, it is of interest to note that by the constitutions of Archbishop Winchelsey, 1305, it was the duty of the parish to provide for the parish church, among other objects, the images of Christ on the Cross, of the saint to whom the church was dedicated, to be placed in the chancel, and of other saints. The injunctions of Edward VI., 1547, ordered

the destruction of all images that had been the objects of superstitious use, and the act of 1549 (3 & 4 Edw. VI. c. 10) declared all such images illegal. This act, repealed in Mary's reign, was revived in 1604 (1 James I. c. 25) and is still in force. The present effect of this unrepealed act, as stated in *Boyd* v. *Philpotts* (L.R. 6 P.C. 449), is that it only referred to the images then subject to abuse, which had been ordered to be removed, and did not refer to the subsequent use or abuse of other images. In Article XXII. of the Articles of Religion it is laid down that "the Romish Doctrine concerning ... Worshipping and Adoration as well of Images as of Reliques ... is a fond thing mainly invented and grounded on no warranty of Scripture, but rather repugnant to the Word of God." The law in regard to images, which in this connexion include pictures and stained-glass windows, but not sculptured effigies on monuments or merely ornamental work, is contained in various judicial decisions, and is not defined by statute. The effect of these decisions is thus summarized in the report of the Royal Commission on Ecclesiastical Discipline, 1906: "Such images are lawful as objects of decoration in a church, but are unlawful if they are made, or are in danger of being made, objects of superstitious reverence, contrary to Article XXII. against the worshipping and adoration of images. In accordance with this view, crosses, if not placed on the Holy Table, and also crucifixes, if part only of a sculptured design or architectural decoration, have been declared lawful. The question whether a crucifix or rood standing alone or combined with figures of the Blessed Virgin and St John can, in any circumstances, be regarded as merely decorative, has given rise to a difference of judicial opinion and appears to be unsettled." Speaking generally, articles of decoration and embellishment not used in the services cannot lawfully be introduced into a church without the consent of the ordinary given by a faculty, the granting of which is subject to the judicial discretion of the chancellor or commissary, sitting as judge of the bishop's court. By section 8 of the Public Worship Regulation Act 1874, complainants may take proceedings if it is considered that "any alteration in, or addition to, the fabric, ornaments or furniture has been made without legal authority, or that any decoration forbidden by law has been introduced into such church ... provided that no proceedings shall be taken ... if such alteration or addition has been completed five years before the commencement of such proceedings." The following are the principal cases on the subject: in *Boyd* v. *Philpotts*, 1874 (L.R., 4 *Ad. & Ec.* 297; 6 P.C. 435), the Exeter reredos case, the privy council, reversing the bishop's judgment, allowed the structure, which contained sculptures in high relief of the Ascension, Transfiguration and Descent of the Holy Ghost at Pentecost, together with a cross and angels; in *R.* v. *the Bishop of London*, 1889 (23 *Q.B.D.* 414, 24 *Q.B.D.* 213), the St Paul's reredos case, the bishop refused further proceedings against the legality of a structure containing sculptured figures of Christ on the Cross and the Virgin and Child. In *Clifton* v. *Ridsdale*, 1876 (1 P. & D., 316), a metal crucifix on the centre of the chancel screen was declared illegal as being in danger of being used superstitiously, and in the same case pictures or rather coloured reliefs representing the "Stations of the Cross" were ordered to be removed on the ground that they had been erected without a faculty, and were also considered unlawful by Lord Penzance as connected with certain superstitious devotion authorized by the Roman church.

IMAGE WORSHIP. It is obvious that two religious votaries kneeling together before a statue may entertain widely different conceptions of what the image is and signifies, although their outward attitude is the same. The one may regard it as a mere image, picture or representation of the higher being, void in itself of value or power. It is to him, like the photograph hung on a wall of one we love, cherished as a picture and no more. But the other may regard it, as a little girl regards her doll, as an animated being, no mere picture, but as tenement and vehicle of the god and fraught with divine influence. The former is the attitude which the Latin Church officially inculcates towards sacred pictures and statues; they are intended to convey to the eyes of the faithful, especially to the illiterate among them, the history of Jesus, of the Virgin and of the saints. The other attitude, however, is that into which simple-minded Latin peasants actually lapse, as it is also that which characterizes other religions ancient or modern which use pictures or sculptures of gods, demons, men, brutes, or of particular parts and organs of the same. With the latter attitude alone does the present article deal, and it may conveniently be called idolatry or image worship. For the history of the use of images in Christian worship see Iconoclasts.

The image or idol differs from the fetish, charm, talisman, phylactery or miraculous relic, only in this, that either in the flat or the round it *resembles* the power adored; it has a prototype capable of being brought before the eye and visualized. This is not necessarily the case with the worshipper of *aniconic* or unshaped gods. The Semite or savage who sets up a sacred stone or Bethel believes indeed that a divine power or influence enters the stone and dwells in it, and he treats the stone as if it were the god, kisses it, anoints it with oil, feeds the god in it by pouring out over it the blood of victims slain. But he is not an idolater, for he has not "made unto himself any graven image, nor the likeness of anything that is in heaven above or in the water beneath or in the water under the earth."

The question arises: must the stage of aniconic gods historically precede and lead up to that of pictures and images? Are the latter a development of the former? In the history of human religions can we trace, as it were, a law of transition from sacred stock and stone up to picture and image? Is it true to say that the latter is characteristic of a later and higher stage of religious development? It was perhaps the facility with which a pillar of stone or wood can be turned into an image by painting or sculpturing on it eyes, ears, mouth, marks of sex and so on, which led anthropologists of an earlier generation to postulate such a law of development; but facts do not bear it out. In the first place, what we are accustomed to call higher religions deliberately attach greater sanctity to aniconic gods than to iconic ones, and that from no artistic incapacity. The Jews were as well able as their neighbours to fashion golden calves, snakes and the minor idols called teraphim, when their legislator, in the words we have just cited, forbade the ancillary use of all plastic and pictorial art for religious purposes. And of our own Christianity, Robertson Smith remarks as follows: "The host in the Mass is artistically as much inferior to the Venus of Milo as a Semitic *Maṣṣēba* was,

but no one will say that medieval Christianity is a lower form of religion than Aphrodite worship."

Here then in the most marked manner the aniconic sacrament has ousted pictures and statues. It is the embodiment and home of divine personality and power, and not they. Equally contradictory of any such law of development is the circumstance that the Greeks of the 5th and 4th centuries B.C., although Pheidias and other artists were embodying their gods and goddesses in the most perfect of images, nevertheless continued to cherish the rude aniconic stocks and stones of their ancestors. If any such law ever operated in human religious development, how can we explain the following facts. In the shadowy age which preceded the Stone age and hardly ended later than 10,000 B.C., the cave-dwellers of the Dordogne could draw elks, bisons, elephants and other animals at rest or in movement, with a freshness and realism which to-day only a Landseer can rival. And yet in the European Stone age which followed, the age in which the great menhirs and cromlechs were erected, in which the domestication of animals began and the first corn was sown, we find in the strata no image of man or beast, big or little.

Whence this seeming blight and decay of art? Salomon Reinach, guided by the analogy of similar practices among the aborigines of Australia, and noticing that these primitive pictures represent none but animals that formed the staple food of the age and place, and that they are usually found in the deepest and darkest recesses of the caves where they could only be drawn and seen by torchlight, has argued that they were not intended for artistic gratification (a late motive in human art), but were magical representations destined to influence and perhaps attract the hunter's quarry. In a word this earliest art was ancillary to the chase. It is a common practice in the magic of all ages and countries to acquire control and influence over men and animals by making images of them. The prototype is believed to suffer whatever is done to the image. Reinach, therefore, supposes that in the Stone age which succeeded, pictorial art was banned because it had got into the hands of magicians and had come to be regarded as inevitably uncanny and malefic. This is certainly the secret of the ordinary Mahommedan prohibition of pictures and statues, which goes even to the length of denying to poor little Arab girls the enjoyment of having dolls. It is felt that if you have got a picture of any one, you have some power of harming him through it; you can bind or loose him, just as you can a Djinn whose name you have somehow learned. It is as dangerous for your enemy to have a picture of you as for him to know your name. The old Hebrew prohibition of graven images was surely based on a like superstition, so far as it was not merely due to the physical impossibility for nomads of heavy statues that do not admit of being carried from camp to camp and from pasture to pasture. Possessing no images of Yahweh the Jews were also not exposed to the same risk as were idolaters of having their gods stolen by their foes and used against them. Lastly, the restriction to aniconic worship saved them from much superstition, for there is nothing which so much stimulates the growth of a mythology as the manufacture of idols. The artist must indeed start with imaginative types, revealed to him in visions or borrowed from current myths. But the tendency of his art is to give rise to new tales of the gods. There is perpetual action and reaction between picture and myth; and a legislator desiring to purify and raise his countrymen's religion must devote no less attention to their plastic art than to their hymnology.

Motives drawn from homoeopathic magic may thus explain the occasional disuse and prohibition of pictorial and plastic art in cult; they may equally explain its genesis and rise in certain ages and countries. 330
Prayer is much more hopeful and efficacious for a worshipper who has means of bringing near to himself, and even coercing the god he worships. An image fashioned like a god, and which has this advantage over a mere stock and stone that it declares itself and reveals at a glance to what god it is sacred, must surely attract and influence the god to choose it as his home and tenement. And having the god thus at hand and imprisoned in matter, the simple-minded worshipper can punish him if his prayers are left unanswered. Dr E. B. Tylor accordingly (in his chapter on "Idolatry" in *Primitive Culture*, ii. 170), reminds us of "the negro who feeds ancestral images and brings them a share of his trade profits, but will beat an idol or fling it into the fire if it cannot give him luck or preserve him from sickness." So Augustus Caesar, having lost some ships in a storm, punished Neptune by forbidding his image to be carried in procession at the Circensian games (Sueton. *Aug.* 16).

In certain cases the wish to carry elsewhere the cult of a favourite or ancestral cult, may have dictated the manufacture of images that declare themselves and reveal at a glance whose they are. Thus a Phoenician colonist might desire to carry abroad the cult of a certain Baal or Astarte who lived in a conical stone or pillar. Pilgrims visiting Paphos, the original home and temple of Astarte, could of course be in no doubt about which of the heavenly powers inhabited the cone of stone in which she was there held to be immanent; nor was any Semite ever ignorant as to which Baal he stood before. It was necessarily the Baal or Lord of the region. But small portrait statues must surely have been made to be carried about or used in private worship. Meanwhile the shapeless cone remained the object of public adoration and pilgrimage.

The Egyptian writer Hermes Trismegistus (*c.* 250), in a work called *Asclepius* (cited by Augustine, *De civit. Dei*, viii. 26), claims that his ancestors discovered the art of making gods, and since they could not create souls, they called up the souls of demons or angels and introduced them into the holy images and divine mysteries, that through these souls the idols might possess powers of doing good and harm. This was the belief of the pagans, and the Christians for centuries shared it with them. Not a few Christian martyrs sought and won the palm by smashing the idols in order to dislodge the indwelling devil; occasionally their zeal was further gratified by beholding it pass away like smoke from its ruined home.

Image worship then is a sort of animism. It is a continuance by adults of their childish games with dolls. In the Roman religion, on a feast of thanksgiving for a great victory, couches were spread in the temples for the gods, whose images were taken down from their pedestals and laid on the couches, and tables set before them loaded with delicate viands. This was called a *Lectisternium*. So Marco Polo (i. chap. 53) relates how the Tatars had each a figure of Natigay, the god of the earth, who watched over their children, cattle and crops. The image was made of felt and cloth, and similar images of his wife and children were set on his left hand and in front of him. "And when they eat, they take the fat of the meat and grease the god's mouth withal, as well as the mouths of his wife and children." The old Greek statues moved of themselves, shook their spears, kneeled down, spoke, walked, wept, laughed, winked, and even bled and sweated,—a mighty

portent. Images of Christ, of the Virgin and saints have achieved many a similar miraculous portent. A figure of Christ has been known even to give its shoes to a poor man, and a Virgin to drop a ring off her finger to a suppliant. In Umbrian villages on Easter Sunday the images of Jesus and His Mother are carried in rival processions from their respective chapels, and are made to bow when they meet face to face. The spectators applaud or hiss according as they make their bow well or ill. In antiquity it was a common ceremony to arrange a holy marriage between male and female images, and such unions acted on the earth as a fertility charm. Much of a priest's time was given up to the toilet of the god or goddess. Thus Isis was dressed and coiffed every day by her special attendants according to Apuleius (*Met.* xi. 9). Like the statue of St Agatha of Catania to-day, her image was loaded with jewels, and an inscription of Cadiz (*C.I.L.* ii. 3386) contains an inventory of the jewels with which Isis had been endowed by Spanish devotees.

Idolatrous cults repose so largely on make-believe and credulity that the priests who administered them, perhaps oftener than we know, fell into the kind of imposture and trickery of which the legend of Bel and the dragon represents a classical example. "Thinkest thou not," said King Astyages, "that Bel is a living god? Or seest thou not how much he eateth and drinketh every day? Then Daniel laughed, and said, O King, be not deceived: for this is but clay within, and brass without, and did never eat or drink anything." In the sequel Daniel proves to the king that the priests with their wives and children came in through privy doors and consumed the viands set before the god; and the king, angered at their trickery, slew them all and gave Bel over to Daniel for destruction.

The invectives against idolatry of the early Jewish and Christian apologists, of Philo, Minucius Felix, Tertullian, Arnobius, Lactantius and others, are very good reading and throw much light on the question how an ancient pagan conceived of his idols. One capital argument of the Christians was the absurdity of a man making an idol and then being afraid of or adoring the work of his own hands. Lactantius preserves the answer of the pagans so attacked (*De origine Erroris*, ii. 2): We do not, they said, fear the images themselves, but those beings after whose likeness they were fashioned and by whose names they were consecrated. Few such rites of consecration remain, but they must have been similar to those used in India to-day. There the Brahmin invites the god to dwell within the image, specially made hollow to contain him, "performing the ceremony of *adhivāsa* or inhabitation, after which he puts in the eyes and the *prāna*, *i.e.* breath, life or soul."[1] Similarly Augustine (*De civ. Dei*, viii. 23) relates how, according to Hermes, the spirits entered by invitation (*spiritus invitatos*), so that the images became bodies of the gods (*corpora deorum*). Thus the invisible spirits by a certain art are so joined unto the visible objects of corporeal matter that the latter become as it were animated bodies, images dedicated to those spirits and controlled by them (see Consecration). Such statues were animated with sense and full of spirit, they foresaw the future, and foretold it by lot, through their priests, in dreams and in other ways.

See E. B. Tylor, *Primitive Culture*, ed. 1903 (list of authorities and sources vol., p. 171); L. R. Farnell, *The Evolution of Religion* (London, 1905); Jacob Grimm, *Teutonic Mythology*, translation by J. S. Stallybrass.

(F. C. C.)

1 Tylor, *Prim. Culture*, ii. 178.

IMAGINATION, in general, the power or process of producing mental pictures or ideas. The term is technically used in psychology for the process of reviving in the mind percepts of objects formerly given in sense perception. Since this use of the term conflicts with that of ordinary language, some psychologists have preferred to describe this process as "imaging" or "imagery" or to speak of it as "reproductive" as opposed to "productive" or "constructive" imagination (see Image and Psychology). The common use of the term is for the process of forming in the mind new images which have not been previously experienced, or at least only partially or in different combinations. Thus the image of a centaur is the result of combining the common percepts of man and horse: fairy tales and fiction generally are the result of this process of combination. Imagination in this sense, not being limited to the acquisition of exact knowledge by the requirements of practical necessity, is up to a certain point free from objective restraints. In various spheres, however, even imagination is in practice limited: thus a man whose imaginations do violence to the elementary laws of thought, or to the necessary principles of practical possibility, or to the reasonable probabilities of a given case is regarded as insane. The same limitations beset imagination in the field of scientific hypothesis. Progress in scientific research is due largely to provisional explanations which are constructed by imagination, but such hypotheses must be framed in relation to previously ascertained facts and in accordance with the principles of the particular science. In spite, however, of these broad practical considerations, imagination differs fundamentally from belief in that the latter involves "objective control of subjective activity" (Stout). The play of imagination, apart from the obvious limitations (*e.g.* of avoiding explicit self-contradiction), is conditioned only by the general trend of the mind at a given moment. Belief, on the other hand, is immediately related to practical activity: it is perfectly possible to *imagine* myself a millionaire, but unless I *believe* it I do not, therefore, act as such. Belief always endeavours to conform to objective conditions; though it is from one point of view subjective it is also objectively conditioned, whereas imagination as such is specifically free. The dividing line between imagination and belief varies widely in different stages of mental development. Thus a savage who is ill frames an ideal reconstruction of the causes of his illness, and attributes it to the hostile magic of an enemy. In ignorance of pathology he is satisfied with this explanation, and actually *believes* in it, whereas such a hypothesis in the mind of civilized man would be treated as a pure effort of imagination, or even as a hallucination. It follows that the distinction between imagination and belief depends in practice on knowledge, social environment, training and the like.

Although, however, the absence of objective restraint, *i.e.* a certain unreality, is characteristic of imagination, none the less it has great practical importance as a purely ideational activity. Its very freedom from objective limitation makes it a source of pleasure and pain. A person of vivid imagination suffers acutely from the imagination of perils besetting a friend. In fact in some cases the ideal construction is so "real" that specific physical manifestations occur, as though imagination had passed into belief or the events imagined were actually in progress.

IMĀM, an Arabic word, meaning "leader" or "guide" in the sense of a "pattern whose example is followed, whether for good or bad." Thus it is applied to the Koran, to a builder's level and plumb-line, to a road, to a school-boy's daily task, to a written record. It is used in several of these, senses in the Koran, but specifically several times of leaders and (ii. 118) of Abraham, "Lo, I make thee a pattern for mankind." *Imām* thus became the name of the head of the Moslem community, whose leadership and patternhood, as in the case of Mahomet himself, is to be regarded as of the widest description. His duty is to be the lieutenant, the Caliph (*q.v.*) of the Prophet, to guard the faith and maintain the government of the state. Round the origin and basis of his office all controversies as to the Moslem state centre. The Sunnites hold that it is for men to appoint and that the basis is obedience to the general usage of the Moslem peoples from the earliest times. The necessity for leaders has always been recognized, and a leader has always been appointed. The basis is thus agreement in the technical sense (see Mahommedan Law), not Koran nor tradition from Mahomet nor analogy. The Shī'ites in general hold that the appointment lies with God, through the Prophet or otherwise, and that He always has appointed. The Khārijites theoretically recognize no absolute need of an Imām; he is convenient and allowable. The Motazilites held that reason, not agreement, dictated the appointment. Another distinction between the Sunnites and the Shī'ites is that the Sunnites regard the Imām as liable to err, and to be obeyed even though he personally sins, provided he maintains the ordinances of Islām. Effective leadership is the essential point. But the Shī'ites believe that the divinely appointed Imām is also divinely illumined and preserved (*ma'ṣūm*) from sin. The above is called the greater Imāmate. The lesser Imāmate is the leadership in the Friday prayers. This was originally performed by the Imām in the first sense, who not only led in prayers but delivered a sermon (*khuṭba*); but with the growth of the Moslem empire and the retirement of the caliph from public life, it was necessarily given over to a deputy—part of a gradual process of putting the Imāmate or caliphate into commission. These deputy Imāms are, in Turkey, ministers of the state, each in charge of his own parish; they issue passports, &c., and perform the rites of circumcision, marriage and burial. In Persia among Shī'ites their position is more purely spiritual, and they are independent of the state. A few of their leaders are called *Mujtahids*, *i.e.* capable of giving an independent opinion on questions of religion and canon law. A third use of the term Imām is as an honorary title. It is thus applied to leading theologians, *e.g.* to Abū Ḥanīfa, ash-Shāfi'ī, Malik ibn Anas, Aḥmad ibn Ḥanbal (these are called "the four Imāms"), Ghazāli.

See McG. de Slane's transl. of Ibn Khaldūn's *Prolégomènes*, i. 384 seq., 402 seq., 426 seq., 445; iii. 35, 58 seq.; Ostrorog's transl. of Māwardī's *Ahkām* i. 89 seq.; Haarbrücker's transl. of Shahrastānī by index; Juynboll's *De Mohammedanische Wet*, 316 seq.; Sell's *Faith of Islam*, 95 seq.; Macdonald's *Development of Muslim Theology*, 56 seq.

(D. B. Ma.)

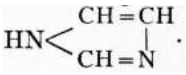
IMBECILE (through the French from Lat. *imbecillus* or *imbecillis*, weak, feeble; of unknown origin), weak or feeble, particularly in mind. The term "imbecility" is used conventionally of a condition of mental degeneration less profound than "idiotcy" (see Insanity).

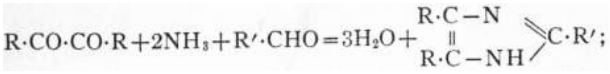
IMBREX (Latin for "tile"), in architecture the term given to the covering tile of the ancient roof: the plain tile is turned up on each side and the imbrex covers the joint. In the simpler type of roof the imbrex is semicircular, but in some of the Greek temples it has vertical sides and an angular top. In the temple of Apollo at Bassae, where the tiles were in Parian marble, the imbrex on one side of the tile and the tile were worked in one piece out of the solid marble.

IMBROS, a Turkish island in the Aegean, at the southern end of the Thracian Chersonese peninsula. It forms with Samothrace, about 17 m. distant, a caza (or canton) in the sanjak of Lemnos and province of the Archipelago Isles. Herodotus (v. 26) mentions it as an abode of the historic Pelasgians (*q.v.*). It was, like Samothrace, a seat of the worship of the Cabeiri (*q.v.*). The island is now the seat of a Greek bishopric.

There is communication with the mainland by occasional vessels. The island is of great fertility—wheat, oats, barley, olives, sesame and valonia being the principal products, in addition to a variety of fruits. Pop. about 92,000, nearly all Turks.

IMERETIA, or Imeritia a district in Russian Transcaucasia, extends from the left bank of the river Tskheniz-Tskhali to the Suram range, which separates it from Georgia on the east, and is bounded on the south by Akhaltsikh, and thus corresponds roughly to the eastern part of the modern government of Kutais. Anciently a part of Colchis, and included in Lazia during the Roman empire, Imeretia was nominally under the dominion of the Greek emperors. In the early part of the 6th century it became the theatre of wars between the Byzantine emperor Justinian and Chosroes, or Khosrau, king of Persia. Between 750 and 985 it was ruled by a dynasty (Apkhaz) of native princes, but was devastated by hostile incursions, reviving only after it became united to Georgia. It flourished until the reign of Queen Thamar, but after her death (1212) the country became impoverished through strife and internal dissensions. It was reunited with Georgia from 1318 to 1346, and again in 1424. But the union only lasted forty-five years; from 1469 until 1810 it was governed by a Bagratid dynasty, closely akin to that which ruled over Georgia. In 1621 it made the earliest appeal to Russia for aid; in 1650 it acknowledged Russian suzerainty and in 1769 a Russian force expelled the Turks. In 1803 the monarch declared himself a vassal of Russia, and in 1810 the little kingdom was definitively annexed to that empire. (See Georgia.)

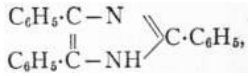
IMIDAZOLES, or Glyoxalines, organic chemical compounds containing the ring system  . Imidazole itself was first prepared by H. Debus (*Ann.* 1858, 107, p. 254) by the action of ammonia on glyoxal, $2C_2H_2O_2 + 2NH_3 = C_3H_4N_2 + H_2CO_2 + 2H_2O$. The compounds of this series may be prepared by the condensation of ortho-diketones with ammonia and aldehydes

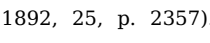
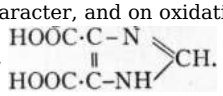


from thioimidazolones by oxidation with dilute nitric acid (W. Marckwald, *Ber.*, 1892, 25, p. 2361); by distillation of hydrobenzamide and similarly constituted bodies; and by the action of phosphorus pentachloride on symmetrical dimethyloxamide, a methylchlorglyoxaline being formed (O. Wallach, *Ann.*, 1877, 184, p. 500).

The glyoxalines are basic in character, and the imide hydrogen is replaceable by metals and alkyl groups. They are stable towards reducing agents, and acidyl groups are only introduced with difficulty.

Imidazole (glyoxaline), $C_3H_4N_2$, crystallizes in thick prisms which melt at 88-89° C. and boil at 253° C., and are readily soluble in alcohol and in water. It is unaffected by chromic acid, but potassium permanganate oxidizes it to formic acid. It forms salts with acids.

Lophine (triphenylglyoxaline),  , is formed by the dry distillation of hydrobenzamide, or by saturating an alcoholic solution of benzil and benzaldehyde (at a temperature of 40° C.) with ammonia. It crystallizes in needles which melt at 275° C. It is a weak base. When heated to 300° C. with hydriodic acid and hydrochloric acid, in the presence of some red phosphorus, it yields benzoic acid.

The keto-glyoxalines are known as imidazolones and are prepared by the action of acids on acetalyl thioureas (W. Marckwald, Ber., 1892, 25, p. 2357). *Benzimidazole*,  , is the simplest representative of the benzoglyoxalines and is prepared by the condensation of formic acid with ortho-phenylene diamine. It forms rhombic crystals which melt at 170° C. It is basic in character, and on oxidation with potassium permanganate yields a small amount of glyoxaline dicarboxylic acid,  (E. Bamberger, *Ann.*, 1893, 273, p. 338).

IMITATION (Lat. *imitatio*, from *imitari*, to imitate), the reproduction or repetition of an action or thought as observed in another person or in oneself, or the construction of one object in the likeness of another. By some writers (*e.g.* Preyer and Lloyd Morgan) the term “imitation” is limited to cases in which one person copies the action or thought of another; others have preferred a wider use of the term (*i.e.* including “self-imitation”), and have attempted to classify imitative action into various groupings, *e.g.* as cases of

"conscious imitation," "imitative suggestion," "plastic imitation" (as when the members of a crowd subconsciously reproduce one another's modes of thought and action), and the like. The main distinction is that which takes into account the question of attention (*q.v.*). In *conscious* imitation, the attention is fixed on the act and its reproduction: in *unconscious* imitation the reproduction is entirely mechanical and the agent does not "attend" to the action or thought which he is copying: in *subconscious* imitation the action is not deliberate, though the necessary train of thought would immediately follow if the attention were turned upon it under normal conditions. Imitation plays an extremely important part in human and animal development, and a clear understanding of its character is important both for the study of primitive peoples, and also in the theories of education, art and sociology. The child's early development is in large measure imitative: thus the first articulate sounds and the first movements are mainly reproductions of the words and actions of parents, and even in the later stages that teacher is likely to achieve the best results who himself gives examples of how a word should be pronounced or an action done. The impulse to imitate is, however, not confined to children: there is among the majority of adults a tendency to assimilate themselves either to their society or to those whom they especially admire or respect: this tendency to shun the eccentric is rooted deeply in human psychology. Moreover, even among highly developed persons the imitative impulse frequently overrides the reason, as when an audience, a crowd, or even practically a whole community is carried away by a panic for which no adequate ground has been given, or when a cough or a yawn is imitated by a company of people. Such cases may be compared with those of persons in mesmeric trances who mechanically copy a series of movements made by the mesmerist. The universality of the imitative impulse has led many psychologists to regard it as an instinct (so William James, *Principles of Psychology*, ii. 408; cf. Instinct), and in that large class of imitative actions which have no obvious ulterior purpose the impulse certainly appears to be instinctive in character. On the other hand where the imitator recognizes the particular effect of a process and imitates with the deliberate intention of producing the same effect, his action can scarcely be classed as instinctive. A considerable number of psychologists have distinguished imitative from instinctive actions (*e.g.* Baldwin, and Sully). According to Darwin the imitative impulse begins in infants at the age of four months. It is to be noted, however, that the child imitates, not every action indiscriminately, but especially those towards which it has a congenital tendency. The same is true of animals: though different kinds of animals may live in close proximity, the young of each kind imitate primarily the actions of their own parents.

Among primitive man imitation plays a very important part. The savage believes that he can bring about events by imitating them. He makes, for instance, an image of his enemy and pierces it with darts or burns it, believing that by so doing he will cause his enemy's death: similarly sailors would whistle, or farmers would pour water on the ground, in the hope of producing wind or rain. This form of imitation is known as sympathetic magic (see Magic). The sociological importance of imitation is elaborately investigated by Gabriel Tarde (*Les Lois de l'imitation*, 2nd ed., 1895), who bases all social evolution on the imitative impulse. He distinguishes "custom imitations," *i.e.* imitations of ancient or even forgotten actions, and "mode imitations," *i.e.* imitations of current fashions. New discoveries are, in his scheme, the product of the conflict of imitations. This theory, though of great value, seems to neglect original natural similarities which, by the law of causation, produce similar consequences, where imitation is geographically or chronologically impossible.

The term "imitation" has also the following special uses:—

1. *In Art-theory.*—According to Plato all artistic production is a form of imitation (μίμησις). That which really exists is the idea or type created by God; of this type all concrete objects are representations, while the painter, the tragedian, the musician are merely imitators, thrice removed from the truth (*Rep.* x. 596 seq.). Such persons are represented by Plato as a menace to the moral fibre of the community (*Rep.* iii.), as performing no useful function, drawing men away from reality and pandering to the irrational side of the soul. All art should aim at moral improvement. Plato clearly intends by "imitation" more than is connotated by the modern word: though in general he associates with it all that is bad and second-rate, he in some passages admits the value of the imitation of that which is good, and thus assigns to it a certain symbolic significance. Aristotle, likewise regarding art as imitation, emphasizes its purely artistic value as purging the emotions (κάθαρσις), and producing beautiful things as such (see Aesthetics and Fine Arts).

2. *In Biology*, the term is sometimes applied to the assimilation by one species of certain external characteristics (especially colour) which enable them to escape the notice of other species which would otherwise prey upon them. It is a form of protective resemblance and is generally known as mimicry (*q.v.*; see also Colours of Animals).

3. *In Music*, the term "imitation" is applied in contrapuntal composition to the repetition of a passage in one or more of the other voices or parts of a composition. When the repetition is note for note with all the intervals the same, the imitation is called "strict" and becomes a canon (*q.v.*); if not it is called "free," the latter being much the more common. There are many varieties of imitation, known as imitation "by inversion," "by inversion and reversion," "by augmentation," "by diminution" (see *Grove's Dictionary of Music, s. v.*, and textbooks of musical theory).

IMITATION OF CHRIST, THE (*Imitatio Christi*), the title of a famous medieval Christian devotional work, much used still by both Catholics and Protestants and usually ascribed to Thomas à Kempis. The "Contestation" over the author of the *Imitation of Christ* is probably the most considerable and famous controversy that has ever been carried on concerning a purely literary question. It has been going on almost without flagging for three centuries, and nearly 200 combatants have entered the lists. In the present

article nothing is said on the history of the controversy, but an attempt is made to summarize the results that may be looked on as definitely acquired.

Until quite recently there were three candidates in the field—Thomas à Kempis (1380-1471), a canon regular of Mount St Agnes in Zwolle, in the diocese of Utrecht, of the Windesheim Congregation of Augustinian Canons; John Gerson (1363-1429), chancellor of the University of Paris; and an abbot, John Gersen, said to have been abbot of a Benedictine monastery at Vercelli in the 12th century. Towards the end of the 15th century the *Imitation* circulated under the names of the first two; but Gerson is an impossible author, and his claims have never found defenders except in France, where they are no longer urged. The Benedictine abbot Gersen is an absolutely mythical personage, a mere "double" of the chancellor. Consequently at the present day the question is narrowed to the issue: Thomas à Kempis, or an unknown author.

The following is a statement of the facts that may be received as certain:—

1. The earliest-known dated MS. of the *Imitation* is of 1424—it contains only Bk. I.; the earliest MSS. of the whole work of certain date are of 1427. Probably some of the undated MSS. are older; but it is the verdict of the most competent modern expert opinion that there is no palaeographical reason for suspecting that any known MS. is earlier than the first quarter of the 15th century.

2. A Latin letter of a Dutch canon regular, named Johann van Schoonhoven, exhibits such a close connexion with Bk. I. that plagiarism on the one side or the other is the only possible explanation. It is capable of demonstration that the author of the *Imitation* was the borrower, and that the opposite hypothesis is inadmissible. Now, this letter can be shown to have been written after 1382. Therefore Bk. I. was beyond controversy written between the years 1382 and 1424.

3. It is not here assumed that the four treatises formed a single work, or even that they are all by the same author; and the date of the other three books cannot be fixed with the same certainty. But, on the one hand, before the beginning of the 15th century there is no trace whatever of their existence—a strong argument that they did not yet exist; and on the other hand, after 1424 nearly each year produces its quota of MSS. and other signs of the existence of these books become frequent. Moreover, as a matter of fact, the four treatises did commonly circulate together. The presumption is strong that Bks. II., III., IV., like Bk. I., were composed shortly before they were put into circulation.

It may then be taken as proved that the *Imitation* was composed between 1380 and 1425, and probably towards the end rather than the beginning of that period. Having ascertained the date, we must consider the birthplace.

4. A number of idioms and turns of expression throughout the book show that its author belonged to some branch of the Teutonic race. Further than this the argument does not lead; for when the dialects of the early 15th century are considered it cannot be said that the expressions in question are Netherlandic rather than German—as a matter of fact, they have all been paralleled out of High German dialects.

5. Of the 400 MSS. of the *Imitation* 340 come from the Teutonic countries—another argument in favour of its Teutonic origin. Again, 100 of them, including the earliest, come from the Netherlands. This number is quite disproportionate to the relative size of the Netherlands, and so points to Holland as the country in which the *Imitation* was first most widely circulated and presumably composed.

6. There is a considerable body of early evidence, traceable before 1450, that the author was a canon regular.

7. Several of the MSS. were written in houses belonging to the Windesheim Congregation of canons regular, or, in close touch with it. Moreover there is a specially intimate literary and spiritual relationship between the *Imitation* and writings that emanated from what has been called the "Windesheim Circle."

To sum up: the indirect evidence points clearly to the conclusion that the *Imitation* was written by a Teutonic canon regular, probably a Dutch canon regular of the Windesheim Congregation, in the first quarter of the 15th century. These data are satisfied by Thomas à Kempis.

We pass to the direct evidence, neglecting that of witnesses who had no special sources of information.

8. There can be no question that in the Windesheim Congregation itself there was already, during Thomas à Kempis's lifetime, a fixed tradition that he was the author of the *Imitation*. The most important witness to this tradition is Johann Busch. It is true that the crucial words are missing in one copy of his "Chronicle"; but it is clear there were two redactions of the work, and there are no grounds whatever for doubting that the second with its various enlargements came from the hands of Busch himself—a copy of it containing the passage exists written in 1464, while both Busch and Thomas à Kempis were still alive. Busch passed a great part of his life in Windesheim, only a few miles from Mount St Agnes where Thomas lived. It would be hard to find a more authentic witness. Another witness is Hermann Rhyd, a German member of the Windesheim Congregation, who also had personally known Thomas. Besides, two or three MSS. originating in the Windesheim Congregation state or imply the same tradition.

9. More than this: the tradition existed in Thomas à Kempis's own monastery shortly after his death. For John Mauburne became a canon in Mount St Agnes within a few years of Thomas's death, and he states more than once that Thomas wrote the *Imitation*.

10. The earliest biographer of Thomas à Kempis was an anonymous contemporary: the *Life* was printed in 1494, but it exists in a MS. of 1488. The biographer says he got his information from the brethren at Mount St Agnes, and he states in passing that Bk. III. was written by Thomas. Moreover, he appends a list of Thomas's writings, 38 in number, and 5-8 are the four books of the *Imitation*.

It is needless to point out that such a list must be of vastly greater authority than those given by St Jerome or Gennadius in their *De Viris Illustribus*, and its rejection must, in consistency, involve methods of criticism

that would work havoc in the history of early literature of what king soever. The domestic tradition in the Windesheim Congregation, and in Mount St Agnes itself, has a weight that cannot be legitimately avoided or evaded. Indeed the external authority for Thomas's authorship is stronger than that for the authorship of most really anonymous books—such, that is, as neither themselves claim to be by a given author, nor have been claimed by any one as his own. A large proportion of ancient writings, both ecclesiastical and secular, are unquestioningly assigned to writers on far less evidence than that for Thomas's authorship of the *Imitation*.

Internal arguments have been urged against Thomas's authorship. It has been said that his certainly authentic writings are so inferior that the *Imitation* could not have been written by the same author. But only if they were of the most certain and peremptory nature could such internal arguments be allowed to weigh against the clear array of facts that make up the external argument in favour of à Kempis. And it cannot be said that the internal difficulties are such as this. Let it be granted that Thomas was a prolific writer and that his writings vary very much in quality; let it be granted also that the *Imitation* surpasses all the rest, and that some are on a level very far below it; still, when at their best, some of the other works are not unworthy of the author of the *Imitation*.

In conclusion, it is the belief of the present writer that the "Contestation" is over, and that Thomas à Kempis's claims to the authorship of the *Imitation* have been solidly established.

The best account in English of the Controversy is that given by F. R. Cruise in his *Thomas à Kempis* (1887). Works produced before 1880 are in general, with the exception of those of Eusebius Amort, superannuated, and deal in large measure with points no longer of any living interest. A pamphlet by Cruise, *Who was the Author of the Imitation?* (1898) contains sufficient information on the subject for all ordinary needs; it has been translated into French and German, and may be regarded as the standard handbook.

It has been said that the *Imitation of Christ* has had a wider religious influence than any book except the Bible, and if the statement be limited to Christendom, it is probably true. The *Imitation* has been translated into over fifty languages, and is said to have run through more than 6000 editions. The other statement, often made, that it sums up all that is best of earlier Western mysticism—that in it "was gathered and concentered all that was elevating, passionate, profoundly pious in all the older mystics" (Milman) is an exaggeration that is but partially true, for it depreciates unduly the elder mystics and fails to do justice to the originality of the *Imitation*. For its spiritual teaching is something quite different from the mysticism of Augustine in the *Confessions*, or of Bernard in the *Sermons on the Song of Songs*; it is different from the scholastic mysticism of the St Victors or Bonaventure; above all, it is different from the obscure mysticism, saturated with the pseudo-Dionysian Neoplatonism of the German school of Eckhart, Suso, Tauler and Ruysbroek. Again, it is quite different from the later school of St Teresa and St John of the Cross, and from the introspective methods of what may be called the modern school of spirituality. The *Imitation* stands apart, unique, as the principal and most representative utterance of a special phase of religious thought—non-scholastic, non-platonic, positive and merely religious in its scope—herein reflecting faithfully the spirit of the movement initiated by Gerhard Groot (*q.v.*), and carried forward by the circles in which Thomas à Kempis lived. In contrast with more mystical writings it is of limpid clearness, every sentence being easily understandable by all whose spiritual sense is in any degree awakened. No doubt it owes its universal power to this simplicity, to its freedom from intellectualism and its direct appeal to the religious sense and to the extraordinary religious genius of its author. Professor Harnack in his book *What is Christianity?* counts the *Imitation* as one of the chief spiritual forces in Catholicism: it "kindles independent religious life, and a fire which burns with a flame of its own" (p. 266).

The best Latin edition of the *Imitation* is that of Hirsche (1874), which follows closely the autograph of 1441 and reproduces the rhythmical character of the book. Of English translations the most interesting is that by John Wesley, under the title *The Christian's Pattern* (1735).

(E. C. B.)

IMMACULATE CONCEPTION, THE. This dogma of the Roman Catholic Church was defined, as "of faith" by Pope Pius IX. on the 8th of December 1854 in the following terms: "The doctrine which holds that the Blessed Virgin Mary, from the first instant of her conception, was, by a most singular grace and privilege of Almighty God, in view of the merits of Jesus Christ, the Redeemer of the human race, preserved from all stain of Original Sin, is a doctrine revealed, by God, and therefore to be firmly and steadfastly believed by all the faithful."[1] These words presuppose the distinction between original, or racial, and actual, or personally incurred sin. There is no dispute that the Church has always held the Blessed Virgin to be sinless, in the sense of actual or personal sin. The question of the Immaculate Conception regards original or racial sin only. It is admitted that the doctrine as defined by Pius IX. was not explicitly mooted before the 12th century. But it is claimed that it is implicitly contained in the teaching of the Fathers. Their expressions on the subject of the sinlessness of Mary are, it is pointed out, so ample and so absolute that they must be taken to include original sin as well as actual. Thus we have in the first five centuries such epithets applied to her as "in every respect holy," "in all things unstained," "super-innocent" and "singularly holy"; she is compared to Eve before the fall, as ancestress of a redeemed people; she is "the earth before it was accursed."[2] The well-known words of St Augustine (d. 430) may be cited: "As regards the mother of God," he says, "I will not allow any question whatever of sin."[3] It is true that he is here speaking directly of actual or personal sin. But his argument is that all men are sinners; that they are so through original depravity; that this original depravity may be overcome by the grace of God, and he adds that he does not know but that Mary may have had sufficient grace to overcome sin "of every sort" (*omni ex parte*).

It seems to have been St Bernard who, in the 12th century, explicitly raised the question of the

Immaculate Conception. A feast of the Conception of the Blessed Virgin had already begun to be celebrated in some churches of the West. St Bernard blames the canons of the metropolitan church of Lyons for instituting such a festival without the permission of the Holy See. In doing so, he takes occasion to repudiate altogether the view that the Conception of Mary was sinless. It is doubtful, however, whether he was using the term "Conception" in the same sense in which it is used in the definition of Pius IX. In speaking of conception one of three things may be meant: (1) the mother's co-operation; (2) the formation of the body, or (3) the completion of the human being by the infusion of the rational or spiritual soul. In early times conception was very commonly used in the first sense—"active" conception as it was called. But it is in the second, or rather the third, sense that the word is employed in modern usage, and in the definition of Pope Pius IX. But St Bernard would seem to have been speaking of conception in the first sense, for in his argument he says, "How can there be absence of sin where there is concupiscence (*libido*)?" and stronger expressions follow, showing that he is speaking of the mother and not of the child.[4]

St Thomas Aquinas, the greatest of the medieval scholastics, refused to admit the Immaculate Conception, on the ground that, unless the Blessed Virgin had at one time or other been one of the sinful, she could not justly be said to have been redeemed by Christ.[5] St Bonaventura (d. 1274), second only to St Thomas in his influence on the Christian schools of his age, hesitated to accept it for a similar reason.[6] The celebrated John Duns Scotus (d. 1308), a Franciscan like St Bonaventura, argued, on the contrary, that from a rational point of view it was certainly as little derogatory to the merits of Christ to assert that Mary was by him preserved from all taint of sin, as to say that she first contracted it and then was delivered.[7] His arguments, combined with a better acquaintance with the language of the early Fathers, gradually prevailed in the schools of the Western Church. In 1387 the university of Paris strongly condemned the opposite view. In 1483 Pope Sixtus IV., who had already (1476) emphatically approved of the feast of the Conception, condemned those who ventured to assert that the doctrine of the Immaculate Conception was heretical, and forbade either side to claim a decisive victory until further action on the part of the Holy See. The council of Trent, after declaring that in its decrees on the subject of original sin it did not include "the blessed and immaculate Virgin Mary, Mother of God," renewed this prohibition.[8] Pope Paul V. (d. 1651) ordered that no one, under severe penalties, should dare to assent in public "acts" or disputations that the Blessed Virgin was conceived in original sin. Pope Gregory XV., shortly afterwards, extended this prohibition to private discussions, allowing, however, the Dominicans to argue on the subjects among themselves. Clement XI., in 1708, extended the feast of the Conception to the whole Church as a holy day of obligation. Long before the middle of the 19th century the doctrine was universally taught in the Roman Catholic Church. During the reign of Gregory XVI. the bishops in various countries began to press for a definition. Pius IX., at the beginning of his pontificate, and again after 1851, appointed commissions to investigate the whole subject, and he was advised that the doctrine was one which could be defined and that the time for a definition was opportune. On the 8th of December 1854 in a great assembly of bishops, in the basilica of St Peter's at Rome, he promulgated the Bull *Ineffabilis Deus*, in which the history of the doctrine is summarily traced, and which contains the definition as given above.

The festival of the Conception of the Blessed Virgin, as distinct from her Nativity, was certainly celebrated in the Greek Church in the 7th century, as we learn from one of the canons of St Andrew of Crete (or of Jerusalem) who died about A.D. 700.[9] There is some evidence that it was kept in Spain in the time of St Ildefonsus of Toledo (d. 667) and in southern Italy before A.D. 1000. In England it was known in the 12th century; a council of the province of Canterbury, in 1328, ascribes its introduction to St Anselm. It spread to France and Germany in the same century. It was extended to the whole church, as stated above, in 1708. It is kept, in the Western Church, on the 8th of December; the Greeks have always kept it one day later.

The chief répertoire of Patristic passages, both on the doctrine and on the festival, is Father Charles Passaglia's great collection, entitled *De immaculato Deiparae semper Virginis conceptu Caroli Passaglia sac. S.J. commentarius* (3 vols., Romae, 1854-1855).

A useful statement of the doctrine with numerous references to the Fathers and scholastics is found in Hürter's *Theologia Dogmatica* (5th ed.), tom. i. tract. vii. cap. 6, p. 438.

The state of Catholic belief in the middle of the 19th century is well brought out in *La Croyance générale el constante de l'Église touchant l'immaculée conception de la bienheureuse Vierge Marie*, published in 1855 by Thomas M. J. Gousset (1792-1866), professor of moral theology at the grand seminary of Besançon, and successively archbishop of Besançon and cardinal archbishop of Reims.

For English readers the doctrine, and the history of its definition, is clearly stated by Archbishop Ullathorne in *The Immaculate Conception of the Mother of God* (2nd ed., London, 1904). Dr F. G. Lee, in *The Sinless Conception of the Mother of God; a Theological Essay* (London, 1891) argued that the doctrine of the Immaculate Conception is a legitimate development of early church teaching.

(†J. C. H.)

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1 From the Bull *Ineffabilis Deus.*

2 See Passaglia's work, referred to below.

3 *De natura et gratia*, cap. xxxvi.

4 S. Bernardi Epist. clxxiv. 7.

5 *Summa theologia*, part iii., quaest. 27, art. 3.

6 *In librum III. sententiarum distinct.* 3 quaest. i. art. 2.

7 *In librum III. sententiarum dist.* 3 quaest. i. n. 4; *Cfr. Distinct.* 18 n. 15. Also the *Summa theologia* of Scotus (compiled by a disciple), part iii., quaest. 27, art. 2.

8 Sess. v. *De peccato originale*.

9 *P. G.*, tom. cxvii. p. 1305.

IMMANENCE (from Lat. *in-manere* to dwell in, remain), in philosophy and theology a term applied in contradistinction to "transcendence," to the fact or condition of being entirely within something. Its most important use is for the theological conception of God as existing in and throughout the created world, as opposed, for example, to Deism (*q.v.*), which conceives Him as separate from and above the universe. This conception has been expressed in a great variety of forms (see THEISM, PANTHEISM). It should be observed that the immanence doctrine need not preclude the belief in the transcendence of God: thus God may be regarded as above the world (transcendent) and at the same time as present in and pervading it (immanent). The immanence doctrine has arisen from two main causes, the one metaphysical, the other religious. Metaphysical speculation on the relation of matter and mind has naturally led to a conviction of an underlying unity of all existence, and so to a metaphysical identification of God and the universe: when this identification proceeds to the length of expressing the universe as merely a mode or form of deity the result is pantheism (cf. the Eleatics): when it regards the deity as simply the sum of the forces of nature (cf. John Toland) the result is naturalism. In either case, but especially in the former, it frequently becomes pure mysticism (*q.v.*). Religious thinkers are faced by the problem of the Creator and the created, and the necessity for formulating a close relationship between God and man, the Infinite and Perfect with the finite and imperfect. The conception of God as wholly external to man, a purely mechanical theory of the creation, is throughout Christendom regarded as false to the teaching of the New Testament as also to Christian experience. The contrary view has gained ground in some quarters (cf. the so-called "New Theology" of Rev. R. J. Campbell) so far as to postulate a divine element in human beings, so definitely bridging over the gap between finite and infinite which was to some extent admitted by the bulk of early Christian teachers. In support of such a view are adduced not only the metaphysical difficulty of postulating any relationship between the infinite and the purely finite, but also the ethical problems of the nature of human goodness —*i.e.* how a merely human being could appreciate the nature of or display divine goodness—and the epistemological problem of explaining how finite mind can cognize the infinite. The development of the immanence theory of God has coincided with the deeper recognition of the essentially spiritual nature of deity as contrasted with the older semi-pagan conception found very largely in the Old Testament of God as primarily a mighty ruler, obedience to whom is comparable with that of a subject to an absolute monarch: the idea of the dignity of man in virtue of his immediate relation with God may be traced in great measure to the humanist movement of the 14th and 15th centuries (cf. the Inner Light doctrine of Johann Tauler). In later times the conception of conscience as an inward monitor is symptomatic of the same movement of thought. In pure metaphysics the term "immanence-philosophy" is given to a doctrine held largely by German philosophers (Rehmke, Leclair, Schuppe and others) according to which all reality is reduced to elements immanent in consciousness. This doctrine is derived from Berkeley and Hume on the one hand and from Kantianism on the other, and embodies the principle that nothing can exist for the mind save itself. The natural consequence of this theory is that the individual consciousness alone exists (solipsism): this position is, however, open to the obvious criticism that in some cases individual consciousnesses agree in their content. Schuppe, therefore, postulates a general consciousness (*Bewusstsein überhaupt*).

IMMANUEL BEN SOLOMON (*c.* 1265-*c.* 1330), Hebrew poet, was born in Rome. He was a contemporary and friend of Dante, and his verse shows the influence of the "divine poet." Immanuel's early studies included science, mathematics and philosophy; and his commentaries on Proverbs, Psalms, Job and other Biblical books are good examples of the current symbolical methods which Dante so supremely used. Immanuel's fame chiefly rests on his poems, especially the collection (in the manner of Harizi, *q.v.*) entitled *Mehabberoth*, a series of 27 good-natured satires on Jewish life. Religious and secular topics are indiscriminately interwoven, and severe pietists were offended by Immanuel's erotic style. Most popular is an additional section numbered 28 (often printed by itself) called *Hell and Paradise* (*ha-Tophet veha-Eden*). The poet is conducted by a certain Daniel (doubtfully identified with Dante) through the realms of torture and bliss, and Immanuel's pictures and comments are at once vivid and witty.

See J. Chotzner, *Hebrew Humour* (Lond., 1905), pp. 82-102.

(I. A.)

IMMERMANN, KARL LEBERECHT (1796-1840), German dramatist and novelist, was born on the 24th of April 1796 at Magdeburg, the son of a government official. In 1813 he went to study law at Halle, where he remained, after the suppression of the university by Napoleon in the same year, until King Frederick William's "Summons to my people" on March 17th. He responded with alacrity, but was prevented by illness from taking part in the earlier campaign; he fought, however, in 1815 at Ligny and Waterloo, and marched into Paris with Blücher. At the conclusion of the war he resumed his studies at Halle, and after being *Referendar* in Magdeburg, was appointed in 1819 *Assessor* at Münster in Westphalia. Here he made the acquaintance of Elise von Lützow, Countess von Ahlefeldt, wife of the leader of the famous "free corps" (see Lützow). This lady first inspired his pen, and their relationship is reflected in several dramas written about

this time. In 1823 Immermann was appointed judge at Magdeburg, and in 1827 was transferred to Düsseldorf as *Landgerichtsrat* or district judge. Thither the countess, whose marriage had in the meantime been dissolved, followed him, and, though refusing his hand, shared his home until his marriage in 1839 with a grand-daughter of August Hermann Niemeyer (1754-1828), chancellor and *rector perpetuus* of Halle university. In 1834 Immermann undertook the management of the Düsseldorf theatre, and, although his resources were small, succeeded for two years in raising it to a high level of excellence. The theatre, however, was insufficiently endowed to allow of him carrying on the work, and in 1836 he returned to his official duties and literary pursuits. He died at Düsseldorf on the 25th of August 1840.

Immermann had considerable aptitude for the drama, but it was long before he found a congenial field for his talents. His early plays are imitations, partly of Kotzebue's, partly of the Romantic dramas of Tieck and Müllner, and are now forgotten. In 1826, however, appeared *Cardenio und Celinde*, a love tragedy of more promise; this, as well as the earlier productions, awakened the ill-will of Platen, who made Immermann the subject of his wittiest satire, *Der romantische Oedipus*. Between 1827 and 1832 Immermann redeemed his good name by a series of historical tragedies, *Das Trauerspiel in Tirol* (1827), *Kaiser Friedrich II.* (1828) and a trilogy from Russian history, Alexis (1832). His masterpiece is the poetic mystery, *Merlin* (1831), a noble poem, which, like its model, *Faust*, deals with the deeper problems of modern spiritual life. Immermann's important dramaturgic experiments in Düsseldorf are described in detail in *Düsseldörfer Anfänge* (1840). More significant is his position as a novelist. Here he clearly stands on the boundary line between Romanticism and modern literature; his *Epigonen* (1836) might be described as one of the last Romantic imitations of Goethe's *Wilhelm Meister*, while the satire and realism of his second novel, *Münchhausen* (1838), form a complete break with the older literature. As a prose-writer Immermann is perhaps best remembered to-day by the admirable story of village life, *Der Oberhof*, which is embedded in the formless mass of *Münchhausen*. His last work was an unfinished epic, *Tristan und Isolde* (1840).

Immermann's *Gesammelte Schriften* were published in 14 vols. in 1835-1843; a new edition, with biography and introduction by R. Boxberger, in 20 vols. (Berlin, 1883); selected works, edited by M. Koch (4 vols., 1887-1888) and F. Muncker (6 vols., 1897). See G. zu Putlitz, *Karl Immermann, sein Leben und seine Werke* (2 vols., 1870); F. Freiligrath, *Karl Immermann, Blätter der Erinnerung an ihn* (1842); W. Müller, *K. Immermann und sein Kreis* (1860); R. Fellner, *Geschichte einer deutschen Musterbühne* (1888); *K. Immermann: eine Gedächtnisschrift* (1896).

IMMERSION (Lat. *immersio*, dipping), the act of being plunged into a fluid, or being overwhelmed by anything; in astronomy, the disappearance of a heavenly body in the shadow of another, especially of a satellite in the shadow of its primary.

IMMIGRATION (from Lat. *in*, into, and *migrare*, to depart), the movement of population, other than that of casual visitors or travellers, *into* one country *from* another (see Migration).

IMMORTALITY (Lat. *in-*, not, *mortalis*, mortal, from *mors*, death), the condition or quality of being exempt from death or annihilation. This condition has been predicated of man, both body and soul, in many senses; and the term is used by analogy of those whose deeds or writings have made a lasting impression on the memory of man. The belief in human immortality in some form is almost universal; even in early animistic cults the germ of the idea is present, and in all the higher religions it is an important feature. This article is confined to summarizing the philosophical or scientific arguments for, and objections to, the doctrine of the persistence of the human soul after death. For the Christian doctrine, see Eschatology; and for other religions see the separate articles.

In the Orphic mysteries "the soul was regarded as a part of the divine, a *particula aurae divinae*, for which the body in its limited and perishable condition was no fit organ, but a grave or prison (τὸ σῶμα σῆμα). The existence of the soul in the body was its punishment for sins in a previous condition; and the doom of its sins in the body was its descent into other bodies, and the postponement of its deliverance" (Salmond's *Christian Doctrine of Immortality*, p. 109). This deliverance was what the mysteries promised. A remarkable passage in Pindar (*Thren.* 2) is thus rendered by J. W. Donaldson (*Pindar's Epinician or Triumphal Odes*, p. 372). "By a happy lot, all persons travel to an end free of toil. And the body, indeed, is subject to the powerful influence of death; but a shadow of vitality is still left alive, and this alone is of divine origin; while our limbs are in activity it sleeps; but, when we sleep, it discloses to the mind in many dreams the future judgment with regard to happiness and misery."

The belief of Socrates is uncertain. In the *Apology* he is represented as sure that "no evil can happen to a good man, either in life or after death," but as not knowing whether "death be a state of nothingness and utter unconsciousness, or a change or migration of the soul from this world to the next" (i. 40, 41). In the

Phaedo a confident expectation is ascribed to him. He is not the body to be buried; he will not remain with his friends after he has drunk the poison, but he will go away to the happiness of the blessed. The silence of the *Memorabilia* of Xenophon must be admitted as an argument to the contrary; but the probability seems to be that Plato did not in the *Phaedo* altogether misrepresent the Master. In Plato's thought the belief held a prominent position. "It is noteworthy," says Professor D. G. Ritchie, "that, in the various dialogues in which Plato speaks of immortality, the arguments seem to be of different kinds, and most of them quite unconnected with one another." In the *Phaedrus* (245 C) the argument is, that the soul is self-moving, and, therefore, immortal; and this argument is repeated in the *Laws* (x. 894, 895). It is an argument that Plato probably inherited from Alcmaeon, the physician of Croton (Arist. *De An.* i. 2, § 17 405 A 29), whose views were closely connected with those of the Pythagoreans. In the *Phaedo* the main argument up to which all the others lead is that the soul participates in the idea of life. Recollection (*anamnesis*) alone would prove pre-existence, but not existence after death. In the tenth book of the *Republic* we find the curious argument that the soul does not perish like the body, because its characteristic evil, sin or wickedness does not kill it as the diseases of the body wear out the bodily life. In the *Timaeus* (41 A) the immortality even of the gods is made dependent on the will of the Supreme Creator; souls are not in their own nature indestructible, but persist because of His goodness. In the *Laws* (xii. 959 A) the notion of a future life seems to be treated as a salutary doctrine which is to be believed because the legislator enacts it (Plato, p. 146). The estimate to be formed of this reasoning has been well stated by Dr A. M. Fairbairn, "Plato's arguments for immortality, isolated, modernized, may be feeble, even valueless, but allowed to stand where and as he himself puts them, they have an altogether different worth. The ratiocinative parts of the *Phaedo* thrown into syllogisms may be easily demolished by a hostile logician; but in the dialogue as a whole there is a subtle spirit and cumulative force which logic can neither seize nor answer" (*Studies in the Philosophy of Religion*, p. 226, 1876).

Aristotle held that the νοῦς or active intelligence alone is immortal. The Stoics were not agreed upon the question. Cleanthes is said to have held that all survive to the great conflagration which closes the cycle, Chrysippus that only the wise will. Marcus Aurelius teaches that even if the spirit survive for a time it is at last "absorbed in the generative principle of the universe." Epicureanism thought that "the wise man fears not death, before which most men tremble; for, if we are, it is not; if it is, we are not." Death is extinction. Augustine adopts a Platonic thought when he teaches that the immortality of the soul follows from its participation in the eternal truths. The Apologists themselves welcomed, and commended to others, the Christian revelation as affording a certainty of immortality such as reason could not give. The Aristotelian school in Islam did not speak with one voice upon the question; Avicenna declared the soul immortal, but Averroes assumes only the eternity of the universal intellect. Albertus Magnus argued that the soul is immortal, as *ex se ipsa causa*, and as independent of the body; Pietro Pomponazzi maintained that the soul's immortality could be neither proved nor disproved by any natural reasons. Spinoza, while consistently with his pantheism denying personal immortality, affirms that "the human mind cannot be absolutely destroyed with the body, but there remains of it something which is eternal" (*Eth.* v. prop, xxiii.). The reason he gives is that, as this something "appertains to the essence of the mind," it is "conceived by a certain eternal necessity through the very essence of God." 337

Leibnitz, in accord with the distinctive principle of his philosophy, affirmed the absolute independence of mind and body as distinct monads, the parallelism of their functions in life being due to the pre-established harmony. For the soul, by its nature as a single monad indestructible and, therefore, immortal, death meant only the loss of the monads constituting the body and its return to the pre-existent state. The argument of Ernst Platner (*Philos. Aphor.* i. 1174, 1178) is similar. "If the human soul is a force in the narrower sense, a substance, and not a combination of substances, then, as in the nature of things there is no transition from existence to non-existence, we cannot naturally conceive the end of its existence, any more than we can anticipate a gradual annihilation of its existence." He adds a reason that recalls one of Plato's, "As manifestly as the human soul is by means of the senses linked to the present life, so manifestly it attaches itself by reason, and the conceptions, conclusions, anticipations and efforts to which reason leads it, to God and eternity."

Against the first kind of argument, as formulated by Moses Mendelssohn, Kant advances the objection that, although we may deny the soul extensive quantity, division into parts, yet we cannot refuse to it intensive quantity, degrees of reality; and consequently its existence may be terminated not by decomposition, but by gradual diminution of its powers (or to use the term he coined for the purpose, by *elanguescence*). This denial of any reasonable ground for belief in immortality in the *Critique of Pure Reason* (*Transcendental Dialectic*, bk. ii. ch. i.) is, however, not his last word on the subject. In the *Critique of the Practical Reason* (*Dialectic*, ch. i. sec. iv) the immortality of the soul is shown to be a postulate. *Holiness*, "the perfect accordance of the will with the moral law," demands an *endless progress*; and "this endless progress is only possible on the supposition of an *endless* duration of the *existence* and *personality* of the same rational being (which is called the immortality of the soul)." Not demonstrable as a theoretical proposition, the immortality of the soul "is an inseparable result of an unconditional a priori practical law." The moral interest, which is so decisive on this question in the case of Kant, dominates Bishop Butler also. A future life for him is important, because our happiness in it may depend on our present conduct; and therefore our action here should take into account the reward or punishment that it may bring on us hereafter. As he maintains that probability may and ought to be our guide in life, he is content with proving in the first chapter of the *Analogy* that "a future life is probable from similar changes (as death) already undergone in ourselves and in others, and from our present powers, which are likely to *continue* unless death destroy them." While we may fear this, "there is no proof that it will, either from the nature of death," of the effect of which on our powers we are altogether ignorant, "or from the analogy of nature, which shows only that the *sensible proof* of our powers (not the powers themselves) may be destroyed." The imagination that death will destroy these powers is unfounded, because (1) "this supposes we are compounded, and so discerptible, but the contrary is probable" on *metaphysical* grounds (the indivisibility of the subject in which consciousness as indivisible inheres, and its distinction from the body) and also *experimental* (the persistence of the living being in spite of changes in the body or even losses of parts of

the body); (2) this also assumes that “our present living powers of reflection” must be affected in the same way by death “as those of sensation,” but this is disproved by their relative independence even in this life; (3) “even the suspension of our present powers of reflection” is not involved in “the idea of death, which is simply dissolution of the body,” and which may even “be like birth, a continuation and perfecting of our powers.” “Even if suspension were involved, we cannot infer destruction from it” (analysis of chapter i. in Angus’s edition). He recognizes that “reason did, as it well might, conclude that it should finally, and upon the whole, be well with the righteous and ill with the wicked,” but only “revelation teaches us that the next state of things after the present is appointed for the execution of this justice” (ch. ii. note 10). He does not use this general anticipation of future judgment, as he might have done, as a positive argument for immortality.

Adam Ferguson (*Institutes of Moral Philosophy*, p. 119, new ed., 1800) argues that “the desire for immortality is an instinct, and can reasonably be regarded as an indication of that which the author of this desire wills to do.” From the standpoint of modern science John Fiske confirms the validity of such an argument; for what he affirms in regard to belief in the divine is equally applicable to this belief in a future life. “If the relation thus established in the morning twilight of man’s existence between the human soul and a world invisible and immaterial is a relation of which only the subjective term is real and the objective term is non-existent; then I say it is something utterly without precedent in the whole history of creation” (*Through Nature to God*, 1899, p. 188, 189). Whatever may have been Hegel’s own belief in regard to personal immortality, the logical issue of his absolute idealism has been well stated by W. Windelband (*History of Philosophy*, p. 633). “It became clear that in the system of perpetual Becoming and of the dialectical passing over of all forms into one another, the finite personality could scarcely raise a plausible claim to the character of a substance and to immortality in the religious sense.” F. D. Schleiermacher applies the phrase “the immortality of religion” to the religious emotion of oneness, amid finitude, with the infinite and, amid time, with the eternal; denies any necessary connexion between the belief in the continuance of personal existence and the consciousness of God; and rests his faith on immortality altogether on Christ’s promise of living fellowship with His followers, as presupposing their as well as His personal immortality. A. Schopenhauer assigns immortality to the universal will to live; and Feuerbach declares spirit, consciousness eternal, but not any individual subject. R. H. Lotze for the decision of the question lays down the broad principle, “All that has once come to be will eternally continue so soon as for the organic unity of the world it has an unchangeable value, but it will obviously again cease to be, when that is not the case” (*Gr. der Psy.* p. 74).

Objections to the belief in immortality have been advanced from the standpoints of materialism, naturalism, pessimism and pantheism. *Materialism* argues that, as life depends on a material organism, thought is a function of the brain, and the soul is but the sum of mental states, to which, according to the theory of psychophysical parallelism, physical changes always correspond; therefore, the dissolution of the body carries with it necessarily the cessation of consciousness. That, as now constituted, mind does depend on brain, life on body, must be conceded, but that this dependence is so absolute that the function must cease with the organ has not been scientifically demonstrated; the connexion of the soul with the body is as yet too obscure to justify any such dogmatism. But against this inference the following considerations may be advanced: (1) Man does distinguish himself from his body; (2) he is conscious of his personal identity, through all the changes of his body; (3) in the exercise of his will he knows himself not controlled by but controlling his body; (4) his consciousness warrants his denying the absolute identification of himself and his body. It may further be added that materialism can be shown to be an inadequate philosophy in its attempts to account even for the physical universe, for this is inexplicable without the assumption of mind distinct from, and directive of, matter. The theory of psychophysical parallelism has been subjected to a rigorous examination in James Ward’s *Naturalism and Agnosticism*, part iii., in which the argument that mind cannot be derived from matter is convincingly presented. Sir Oliver Lodge in his reply to E. Haeckel’s *Riddle of the Universe* maintains that “life may be something not only ultra-terrestrial, but even immaterial, something outside our present categories of matter and energy; as real as they are, but different, and utilizing them for its own purpose” (*Life and Matter*, 1906, p. 198). He rejects the attempt to explain human personality as “generated by the material molecular aggregate of its own unaided latent power,” and affirms that the “universe where the human spirit is more at home than it is among these temporary collocations of matter” is “a universe capable of infinite development, of noble contemplation, and of lofty joy, long after this planet—nay the whole solar system—shall have fulfilled its present spire of destiny, and retired cold and lifeless upon its endless way” (pp. 199-200).

In his lecture on *Human Immortality* (3rd ed., 1906), Professor William James deals with “two supposed objections to the doctrine.” The first is “the law that thought is a function of the brain.” Accepting the law he distinguishes *productive* from *permissive* or *transmissive* function (p. 32), and, rejecting the view that brain produces thought, he recognizes that in our present condition brain transmits thought, thought needs brain for its organ of expression; but this does not exclude the possibility of a condition in which thought will be no longer so dependent on brain. He quotes (p. 57) with approval Kant’s words, “The death of the body may indeed be the end of the sensational use of our mind, but only the beginning of the intellectual use. The body would thus be not the cause of our thinking, but merely a condition restrictive thereof, and, although essential to our sensuous and animal consciousness, it may be regarded as an impeder of our pure spiritual life” (*Kritik der reinen Vernunft*, 2nd ed., p. 809).

Further arguments in the same direction are derived from the modern school of psychical research (see especially F. W. H. Myers’ *Human Personality*, 1903).

Another objection is advanced from the standpoint of *naturalism*, which, whether it issues in materialism or not, seeks to explain man as but a product of the process of nature. The universe is so immeasurably vast in extension and duration, and man is so small, his home but a speck in space, and his history a span in time that it seems an arrogant assumption for him to claim exemption from the universal law of evolution and dissolution. This view ignores that man has ideals of absolute value, truth, beauty, goodness, that he consciously communes with the God who is in all, and through all, and over all, that it is his mind which

recognizes the vastness of the universe and thinks its universal law, and that the mind which perceives and conceives cannot be less, but must be greater than the object of its knowledge and thought.

Pessimism suggests a third objection. The present life is so little worth living that its continuance is not to be desired. James Thomson ("B.V.") speaks "of the restful rapture of the inviolate grave," and sings the praises of *death* and of *oblivion*. We cannot admit that the history of mankind justifies his conclusion; for the great majority of men life is a good, and its continuance an object of hope.

For pantheism personal immortality appears a lesser good than reabsorption in the universal life; but against this objection we may confidently maintain that worthier of God and more blessed for man is the hope of a conscious communion in an eternal life of the Father of all with His whole family.

Lastly positivism teaches a corporate instead of an individual immortality; man should desire to live on as a beneficent influence in the race. This conception is expressed in George Eliot's lines:

"O, may I join the choir invisible
Of those immortal dead who live again
In minds made better by their presence: live
In pulses stirred to generosity,
In deeds of daring rectitude, in scorn
For miserable aims that end with self,
In thoughts sublime that pierce the night like stars,
And with their mild persistence urge man's search
To vaster issues."

But these possibilities are not mutually exclusive alternatives. A man may live on in the world by his teaching and example as a power for good, a factor of human progress, and he may also be continuing and completing his course under conditions still more favourable to all most worthy in him. Consciously to participate as a person in the progress of the race is surely a worthier hope than unconsciously to contribute to it as an influence; ultimately to share the triumph as well as the struggle is a more inspiring anticipation.

In stating constructively the doctrine of immortality we must assign altogether secondary importance to the metaphysical arguments from the nature of the soul. It is sufficient to show, as has already been done, that the soul is not so absolutely dependent on the body, that the dissolution of the one must necessarily involve the cessation of the other. Such arguments as the indivisibility of the soul and its persistence can at most indicate the *possibility* of immortality.

The *juridical argument* has some force; the present life does not show that harmony of condition and character which our sense of justice leads us to expect; the wicked prosper and the righteous suffer; there is ground for the expectation that in the future life the anomalies of this life will be corrected. Although this argument has the support of such great names as Butler and Kant, yet it will repel many minds as an appeal to the motive of self-interest.

The *ethical argument* has greater value. Man's life here is incomplete, and the more lofty his aims, the more worthy his labours, the more incomplete will it appear to be. The man who lives for fame, wealth, power, may be satisfied in this life; but he who lives for the ideals of truth, beauty, goodness, lives not for time but for eternity, for his ideals cannot be realized, and so his life fulfilled on this side of the grave. Unless these ideals are mocking visions, man has a right to expect the continuance of his life for its completion. This is the line of argument developed by Professor Hugo Münsterberg in his lecture on *The Eternal Life* (1905), although he states it in the terms peculiar to his psychology, in which personality is conceived as primarily will. "No endless duration is our goal, but complete repose in the perfect satisfaction which the will finds when it has reached the significance, the influence, and the value at which it is aiming" (p. 83).

More general in its appeal still is the argument from the *affections*, which has been beautifully developed in Tennyson's *In Memoriam*. The heart protests against the severance of death, and claims the continuance of love's communion after death; and as man feels that love is what is most godlike in his nature, love's claim has supreme authority.

There is a *religious argument* for immortality. The saints of the Hebrew nation were sure that as God had entered into fellowship with them, death could not sever them from his presence. This is the argument in Psalms xvi. and xvii., if, as is probable, the closing verses do express the hope of a glorious and blessed immortality. This too is the proof Jesus himself offers when he declares God to be the God of the living and not of the dead (Matt. xxii. 32). God's companions cannot become death's victims.

Josiah Royce in his lecture on *The Conception of Immortality* (1900) combines this argument of the soul's union with God with the argument of the incompleteness of man's life here:—

> "Just because God is One, all our lives have various and unique places in the harmony of the divine life. And just because God attains and wins and finds this uniqueness, all our lives win in our union with Him the individuality which is essential to their true meaning. And just because individuals whose lives have uniqueness of meaning are here only objects of pursuit, the attainment of this very individuality, since it is indeed real, occurs not in our present form of consciousness, but in a life that now we see not, yet in a life whose genuine meaning is continuous with our own human life, however far from our present flickering form of disappointed human consciousness that life of the final individuality may be. Of this our true individual life, our present life is a glimpse, a fragment, a hint, and in its best moments a visible beginning. That this individual life of all of us is not something limited in its temporal expression to the life that now we experience, follows from the very fact that here nothing final or individual is found expressed" (pp. 144-146).

R. W. Emerson declares that "the impulse to seek proof of immortality is itself the strongest proof of all."

We expect immortality not merely because we desire it; but because the desire itself arises from all that is best and truest and worthiest in ourselves. The desire is reasonable, moral, social, religious; it has the same worth as the loftiest ideals, and worthiest aspirations of the soul of man. The loss of the belief casts a dark shadow over the present life. “No sooner do we try to get rid of the idea of Immortality—than Pessimism raises its head.... Human griefs seem little worth assuaging; human happiness too paltry (at the best) to be worth increasing. The whole moral world is reduced to a point. Good and evil, right and wrong, become infinitesimal, ephemeral matters. The affections die away—die of their own conscious feebleness and uselessness. A moral paralysis creeps over us” (*Natural Religion*, Postscript). The belief exercises a potent moral influence. “The day,” says Ernest Renan, “in which the belief in an after-life shall vanish from the earth will witness a terrific moral and spiritual decadence. Some of us perhaps might do without it, provided only that others held it fast. But there is no lever capable of raising an entire people if once they have lost their faith in the immortality of the soul” (quoted by A. W. Momerie, *Immortality*, p. 9). To this belief, many and good as are the arguments which can be advanced for it, a confident certainty is given by Christian faith in the Risen Lord, and the life and immortality which he has brought to light in his Gospel.

In addition to the works referred to above, see R. K. Gaye, *The Platonic Conception of Immortality and its Connexion with the Theory of Ideas* (1904); R. H. Charles, *A Critical History of the Doctrine of a Future Life in Israel, in Judaism and in Christianity* (1899); E. Pétavel, *The Problem of Immortality* (Eng. trans. by F. A. Freer, 1892); J. Fiske, *The Destiny of Man, viewed in the Light of his Origin* (1884); G. A. Gordon, *Immortality and the New Theodicy* (1897); Henry Buckle, *The After Life* (1907).

(A. E. G.*)

IMMUNITY (from Lat. *immunis*, not subject to a *munus* or public service), a general term for exemption from liability, principally used in the legal sense discussed below, but also in recent times in pathology (for which see Bacteriology). In international law the term (“not serving,” “not subject”) implies exemption from the jurisdiction of the state which otherwise exercises jurisdiction where the immunity arises. It is thus applied to the exceptional position granted to sovereigns and chiefs of states generally, and their direct representatives in the states to which they are accredited.

Under Exterritoriality is treated the inviolability of embassies and legations and the application of the material side of the doctrine of immunity. As a right appertaining to the persons of those who enjoy it, the doctrine has grown out of the necessity for sovereigns of respecting each other’s persons in their common interest. To be able to negotiate without danger of arrest or interference of any kind with their persons was the only condition upon which sovereigns would have been able to meet and discuss their joint interests. With the development of states as independent entities and of intercourse between them and their “nationals,” the work of diplomatic missions increased to such an extent that instead of having merely occasional ambassadors as at the beginning, states found it expedient to have resident representatives with a permanent residence. Hence the sovereign’s inviolability becomes vested in the person of the sovereign’s delegate, and with it as a necessary corollary the exterritoriality of his residence. Out of the further expansion of the work of diplomatic missions came duplication of the *personnel* and classes of diplomatic secretaries, who as forming part of the embassy or legation also had to be covered by the diplomatic immunity.

In no branch of international intercourse have states shown so laudable a respect for tradition as in the case of this immunity, and this in spite of the hardship which frequently arises for private citizens through unavoidable dealings with members of embassies and legations. The Institute of International Law (see Peace) at their Cambridge session in 1895 drew up the following rules,[1] which may be taken to be the only precise statement of theory on the subject, for the guidance of foreign offices in dealing with it:—

Art. 1.—Public ministers are inviolable. They also enjoy “exterritoriality,” in the sense and to the extent hereinafter mentioned and a certain number of immunities.

Art. 2.—The privilege of inviolability extends: (1) To all classes of public ministers who regularly represent their sovereign or their country; (2) To all persons forming part of the official staff of a diplomatic mission; (3) To all persons forming part of its non-official staff, under reserve, that if they belong to the country where the mission resides they only enjoy it within the official residence.

Art. 3.—The government to which the minister is accredited must abstain from all offence, insult or violence against the persons entitled to the privilege, must set an example in the respect which is due to them and protect them by specially rigorous penalties from all offence, insult or violence on the part of the inhabitants of the country, so that they may devote themselves to their duties in perfect freedom.

Art. 4.—Immunity applies to everything necessary for the fulfilment by ministers of their duties, especially to personal effects, papers, archives and correspondence.

Art. 5.—It lasts during the whole time which the minister or diplomatic official spends, in his official capacity, in the country to which he has been sent.

It continues even in time of war between the two powers during the period necessary to enable the minister to leave the country with his staff and effects.

Art. 6.—Inviolability cannot be claimed: (1) In case of legitimate defence on the part of private persons against acts committed by the persons who enjoy the privilege; (2) In case of risks incurred by any of the persons in question voluntarily or needlessly; (3) In case of improper acts committed by them, provoking on the part of the state to which the minister is accredited measures of defence or precaution; but, except in a case of extreme urgency, this state should confine itself to reporting the facts to the minister’s government,

requesting the punishment or the recall of the guilty agent and, if necessary, to surrounding the official residence to prevent unlawful communications or manifestations.

Immunity with Respect to Taxes.

Art. 11.—A public minister in a foreign country, functionaries officially attached to his mission and the members of their families residing with them, are exempt from paying: (1) Personal direct taxes and sumptuary taxes; (2) General taxes on property, whether on capital or income; (3) War contributions; (4) Customs duties in respect of articles for their personal use.

Each government shall indicate the grounds (*justifications*) to which these exemptions from taxation shall be subordinated.

Immunity from Jurisdiction.

Art. 12.—A public minister in a foreign country, functionaries officially attached to his mission and the members of their families residing with them, are exempt from all jurisdiction, civil or criminal, of the state to which they are accredited; in principle, they are only subject to the civil and criminal jurisdiction of their own country. A claimant may apply to the courts of the capital of the country of the minister, subject to the right of the minister to prove that he has a different domicile in his country.

Art. 13.—With respect to crimes, persons indicated in the preceding article remain subject to the penal laws of their own country, as if they had committed the acts in their own country.

Art. 14.—The immunity attaches to the function in respect of acts connected with the function. As regards acts done not in connexion with the function, immunity can only be claimed so long as the function lasts.

Art. 15.—Persons of the nationality of the country to the government of which they are accredited cannot claim the privilege of immunity.

Art. 16.—Immunity from jurisdiction cannot be invoked: (1) In case of proceedings taken by reason of engagements entered into by the exempt person, not in his official or private capacity, but in the exercise of a profession carried on by him in the country concurrently with his diplomatic functions; (2) In respect of real actions, including possessory actions, relating to anything movable or immovable in the country.

It exists even in case of a breach of the law which may endanger public order or safety, or of crime against the safety of the state, without prejudice to such steps as the territorial government may take for its own protection.

Art. 17.—Persons entitled to immunity from jurisdiction may refuse to appear as witnesses before a territorial court on condition that, if required by diplomatic intervention, they shall give their testimony in the official residence to a magistrate of the country appointed for the purpose.

Further questions connected with Immunity and Exterritoriality (*q.v.*) arise out of the different industrial enterprises undertaken by states, such as posts, telegraphs, telephones, railways, steamships, &c., which require regulation to prevent conflicts of interest between the state owners and the private interests involved in these enterprises.

(T. Ba.)

1 The rules were drawn up in French. The author of this article is responsible for the translation of them.

IMOLA (anc. *Forum Cornelii*), a town and episcopal see of Emilia, Italy, in the province of Bologna, from which it is 21 m. S.E. by rail, 140 ft. above sea-level. Pop. (1901) 12,058 (town); 33,144 (commune). The cathedral of S. Cassiano has been modernized; it possesses interesting reliquaries, and contains the tomb of 340
Petrus Chrysologus, archbishop of Ravenna (d. 451), a native of Imola. S. Domenico has a fine Gothic portal and S. Maria in Regola an old campanile. The town also contains some fine palaces. The communal library has some MSS., including a psalter with miniatures, that once belonged to Sir Thomas More. The citadel is square with round towers at the angles; it dates from 1304, and is now used as a prison. Imola has a large lunatic asylum with over 1200 inmates. Innocenzo Francucci (Innocenzo da Imola), a painter of the Bolognese school (1494-1549), was a native of Imola, and two of his works are preserved in the Palazzo del Comune. The Madonna del Piratello, 2 m. outside the town to the N.W., is in the early Renaissance style (1488); the campanile was probably built from Bramante's plans in 1506.

The ancient Forum Cornelii, a station on the Via Aemilia, is said by Prudentius, writing in the 5th century A.D., to have been founded by Sulla; but the fact that it belonged to the *Tribus Pollia* shows that it already possessed Roman citizenship before the Social war. In later times we hear little of it; Martial published his third book of epigrams while he was there. In the Lombard period the name Imolas begins to appear. In 1480, after a chequered history, the town came into the possession of Girolamo Riario, lord of Forli, as the dowry of his wife Caterina Sforza, and was incorporated with the States of the Church by Caesar Borgia in 1500.

IMP (O. Eng. *impa*, a graft, shoot; the verb *impian* is cognate with Ger. *impfen*, to graft, inoculate, and the Fr. *enter*; the ultimate origin is probably the Gr. ἐμφύειν, to implant, cf. ἔμφυτος, engrafted), originally a slip or shoot of a plant or tree used for grafting. This use is seen in Chaucer (*Prologue to the Monk's Tale*, 68) "Of fieble trees ther comen wrecched ympes." The verb "to imp" in the sense of "to graft" was especially used of the grafting of feathers on to the wing of a falcon or hawk to replace broken or damaged plumage, and is frequently used metaphorically. Like "scion," "imp" was till the 17th century used of a member of a family, especially of high rank, hence often used as equivalent to "child." The *New English Dictionary* quotes an epitaph (1584) in the Beauchamp chapel at Warwick, "Heere resteth the body of the noble Impe Robert of Dudley ... sonne of Robert Erle of Leycester." The current use of the word for a small devil or mischievous sprite is due to the expressions "imp of Satan, or of the devil or of hell," in the sense of "child of evil." It was thus particularly applied to the demons supposed to be the "familiar" spirits of witches.

IMPATIENS, in botany, a genus of annual or biennial herbs, sometimes becoming shrubby, chiefly natives of the mountains of tropical Asia and Africa, but also found widely distributed in the north temperate zone and in South Africa. The flowers, which are purple, yellow, pink or white and often showy, are spurred and irregular in form and borne in the leaf-axils. The name is derived from the fact that the seed-pod when ripe discharges the seeds by the elastic separation and coiling of the valves. *Impatiens Noli-me-tangere,* touch-me-not, an annual succulent herb with yellow flowers, is probably wild in moist mountainous districts in north Wales, Lancashire and Westmorland. *I. Roylei,* a tall hardy succulent annual with rose-purple flowers, a Himalayan species, is common in England as a self-sown garden plant or garden escape. *I. Balsamina,* the common balsam of gardens, a well-known annual, is a native of India; it is one of the showiest of summer and autumn flowers and of comparatively easy cultivation. *I. Sultani,* a handsome plant, with scarlet flowers, a native of Zanzibar, is easily grown in a greenhouse throughout the summer, but requires warmth in winter.

IMPEACHMENT (O. Fr. *empechement, empeschement,* from *empecher* or *empescher,* to hinder, Late Lat. *impedicare,* to entangle, *pedica,* fetter, *pes*, foot), the English form of judicial parliamentary procedure against criminals, in which the House of Commons are the prosecutors and the House of Lords the judges. It differs from bills of attainder (*q.v.*) in being strictly judicial. When the House of Commons has accepted a motion for impeachment, the mover is ordered to proceed to the bar of the House of Lords, and there impeach the accused "in the name of the House of Commons, and of all the Commons of the United Kingdom." The charges are formulated in articles, to each of which the accused may deliver a written answer. The prosecution must confine itself to the charges contained in the articles, though further articles may be adhibited from time to time. The Commons appoint managers to conduct the prosecution, but the whole House in committee attends the trial. The defendant may appear by counsel. The president of the House of Lords is the lord high steward, in the case of peers impeached for high treason; in other cases the lord chancellor. The hearing takes place as in an ordinary trial, the defence being allowed to call witnesses if necessary, and the prosecution having a right of reply. At the end of the case the president "puts to each peer, beginning with the junior baron, the questions upon the first article, whether the accused be guilty of the crimes charged therein. Each peer in succession rises in his place when the question is put, and standing uncovered, and laying his right hand upon his breast, answers, 'Guilty' or 'Not guilty,' as the case may be, 'upon my honour.' Each article is proceeded with separately in the same manner, the lord high steward giving his own opinion the last" (May's *Parliamentary Practice,* c. xxiii.). Should the accused be found guilty, judgment follows if the Commons move for it, but not otherwise. The Commons thus retain the power of pardon in their own hands, and this right they have in several cases expressly claimed by resolution, declaring that it is not parliamentary for their lordships to give judgment "until the same be first demanded by this House." Spiritual peers occupy an anomalous position in the trial of peers, as not being themselves ennobled in blood; on the impeachment of Danby it was declared by the Lords that Spiritual peers have the right to stay and sit during proceedings for impeachment, but it is customary for them to withdraw before judgment is given, entering a protest "saving to themselves and their successors all such rights in judicature as they have by law, and by right ought to have." An impeachment, unlike other parliamentary proceedings, is not interrupted by prorogation, nor even by dissolution. Proceedings in the House of Commons preliminary to an impeachment are subject to the ordinary rules, and in the Warren Hastings case an act was passed to prevent the preliminary proceedings from discontinuance by prorogation and dissolution. A royal pardon cannot be pleaded in bar of an impeachment, though it is within the royal prerogative to pardon after the lords have pronounced judgment. The point was raised in the case of the earl of Danby in 1679, and the rule was finally settled by the Act of Settlement. Persons found guilty on impeachment may be reprieved or pardoned like other convicts. Impeachment will lie against all kinds of crimes and misdemeanours, and against offenders of all ranks. In the case of Simon de Beresford, tried before the House of Lords in 1330, the House declared "that the judgment be not drawn into example or consequence in time to come, whereby the said peers may be charged hereafter to judge others than their peers," from which Blackstone and others have inferred that "a commoner cannot be impeached before the Lords for any capital offence, but only for high misdemeanours." In the case of Edward Fitzharris in 1681, the House of Commons in answer to a resolution of the Lords suspending the impeachment, declared it to be their undoubted right "to impeach any peer or commoner for treason or any other crime or

misdemeanour." And the House of Lords has in practice recognized the right of the Commons to impeach whomsoever they will. The procedure has, however, been reserved for great political offenders whom the ordinary powers of the law might fail to reach. It has now fallen into desuetude. The last impeachments were those of Warren Hastings (1788-1795) and Lord Melville (1806), but an unsuccessful attempt was made by Thomas C. Anstey to impeach Lord Palmerston in 1848. The earliest recorded instances of impeachment are those of Lord Latimer in 1376 and of Pole, earl of Suffolk, in 1386. From the time of Edward IV. to Elizabeth it fell into disuse, "partly," says Hallam, "from the loss of that control which the Commons had obtained under Richard II. and the Lancastrian kings, and partly from the preference the Tudor princes had given to bills of attainder or pains and penalties when they wished to turn the arm of parliament against an obnoxious subject." Revived in the reign of James I., it became an instrument of parliamentary resistance to the crown, and it was not unfrequently resorted to in the first three reigns after the Revolution.

In the United States the procedure of impeachment both in the national and in almost all of the state governments is very similar to that described above. The national constitution prescribes that the House of Representatives "shall have the sole power of impeachment" and that "the Senate shall have the sole power to try all impeachments." The House appoints managers to conduct the prosecution at the bar of the Senate, and the vote of the Senate is taken by putting the question separately to each member, who, during the trial, must be on oath or affirmation. In ordinary cases the president or president *pro tempore* of the Senate presides, but when the president of the United States is on trial the presiding officer must be the chief justice of the United States Supreme Court. A two-thirds vote is necessary for conviction. The president, vice-president or any civil officer of the United States may be impeached for "treason, bribery or other high crimes and misdemeanours," and if convicted, is removed from office and may be disqualified for holding any office under the government in future. The officer after removal is also "liable and subject to indictment, trial, judgment and punishment, according to law." The term "civil officers of the United States" has been construed as being inapplicable to members of the Senate and the House of Representatives. The president's pardoning power does not extend to officers convicted, on impeachment, of offences against the United States. Since the organization of the Federal government there have been only eight impeachment trials before the United States Senate, and of these only two—the trials of Judge John Pickering, a Federal District judge for the District of New Hampshire, in 1803, on a charge of making decisions contrary to law and of drunkenness and profanity on the bench, and of Judge W. H. Humphreys, Judge of the Federal District Court of Tennessee, in 1863, on a charge of making a secession speech and of accepting a judicial position under the Confederate Government—resulted in convictions. The two most famous cases are those of Justice Samuel Chase of the United States Supreme Court in 1805, and of President Andrew Johnson, the only chief of the executive who has been impeached, in 1868. There is a conflict of opinion with regard to the power of the House to impeach a Federal officer who has resigned his office, and also with regard to the kind of offences for which an officer can be impeached, some authorities maintaining that only indictable offences warrant impeachment, and others that impeachment is warranted by any act highly prejudicial to the public welfare or subversive of any essential principle of government. The latter view was adopted by the House of Representatives when it impeached President Johnson.

IMPERIAL CHAMBER (*Reichskammergericht*), the supreme judicial court of the Holy Roman Empire, during the period between 1495 and the dissolution of the Empire in 1806. From the early middle ages there had been a supreme court of justice for the Empire—the *Hofgericht* (or *curia imperatoris*, as it were), in which the emperor himself presided. By his side sat a body of assessors (*Urtheilsfinder*), who must be at least seven in number, and who might, in solemn cases, be far more numerous,[1] the assessors who acted varying from time to time and from case to case. The Hofgericht was connected with the person of the emperor; it ceased to act when he was abroad; it died with his death. Upon him it depended for its efficiency; and when, in the 15th century, the emperor ceased to command respect, his court lost the confidence of his subjects. The dreary reign of Frederick III. administered its deathblow and after 1450 it ceased to sit. Its place was taken by the *Kammergericht*, which appeared side by side with the Hofgericht from 1415, and after 1450 replaced it altogether. The king (or his deputy) still presided in the Kammergericht and it was still his personal court; but the members of the court were now officials—the *consiliarii* of the imperial *aula* (or *Kammer*, whence the name of the court). It was generally the legal members of the council who sat in the Kammergericht (see under Aulic Council); and as they were generally doctors of civil law, the court which they composed tended to act according to that law, and thus contributed to the "Reception" of Roman law into Germany towards the end of the 15th century. The old Hofgericht had been filled, as it were, by amateurs (provided they knew some law, and were peers of the person under trial), and it had acted by old customary law; the Kammergericht, on the contrary, was composed of lawyers, and it acted by the written law of Rome. Even the Kammergericht, however, fell into disuse in the later years of the reign of Frederick III.; and the creation of a new and efficient court became a matter of pressing necessity, and was one of the most urgent of the reforms which were mooted in the reign of Maximilian I.

This new court was eventually created in 1495; and it bore the name of *Reichskammergericht*, or Imperial Chamber. It was distinguished from the old Kammergericht by the essential fact that it was not the personal court of the emperor, but the official court of the Empire (or *Reich*—whence its name). This change was a natural result of the peculiar character of the movement of reform which was at this time attempted by the electors, under the guidance of Bertold, elector of Mainz. Their aim was to substitute for the old and personal council and court appointed and controlled by the emperor a new and official council, and a new and official court, appointed and controlled by the diet (or rather, in the ultimate resort, by the electors).

The members of the Imperial Chamber, which was created by the diet in 1495 in order to serve as such a court,[2] were therefore the agents of the Empire, and not of the emperor. The emperor appointed the president; the Empire nominated the assessors, or judges.[3] There were originally sixteen assessors (afterwards, as a rule, eighteen): half of these were to be doctors of Roman law, while half were to be knights; but after 1555 it became necessary that the latter should be learned in Roman law, even if they had not actually taken their doctorate.

Thus the Empire at last was possessed of a court, a court resting on the enactment of the diet, and not on the emperor's will; a court paid by the Empire, and not by the emperor; a court resident in a fixed place (until 1693, Spires, and afterwards, from 1693 to 1806, Wetzlar), and not attached to the emperor's person. The original intention of the court was that it should repress private war (*Fehde*), and maintain the public peace (*Landfriede*). The great result which in the issue it served to achieve was the final "Reception" of Roman law as the common law of Germany. That the Imperial Chamber should itself administer Roman law was an inevitable result of its composition; and it was equally inevitable that the composition and procedure of the supreme imperial court should be imitated in the various states which composed the Empire, and that Roman law should thus become the local, as it was already the central, law of the land.

The province of the Imperial Chamber, as it came to be gradually defined by statute and use, extended to breaches of the public peace, cases of arbitrary distraint or imprisonment, pleas which concerned the treasury, violations of the emperor's decrees or the laws passed by the diet, disputes about property between immediate tenants of the Empire or the subjects of different rulers, and finally suits against immediate tenants of the Empire (with the exception of criminal charges and matters relating to imperial fiefs, which went to the Aulic Council). It had also cognizance in cases of refusal to do justice; and it acted 342
as a court of appeal from territorial courts in civil and, to a small extent, in criminal cases, though it lost its competence as a court of appeal in all territories which enjoyed a *privilegium de non appellando* (such as, *e.g.* the territories of the electors). The business of the court was, however, badly done; the delay was interminable, thanks, in large measure, to the want of funds, which prevented the maintenance of the proper number of judges. In all its business it suffered from the competition of the Aulic Council (*q.v.*); for that body, having lost all executive competence after the 16th century, had also devoted itself exclusively to judicial work. Composed of the personal advisers of the emperor, the Aulic Council did justice on his behalf (the erection of a court to do justice for the Empire having left the emperor still possessed of the right to do justice for himself through his *consiliarii*); and it may thus be said to be the descendant of the old Kammergericht. The competition between the Aulic Council and the Imperial Chamber was finally regulated by the treaty of Westphalia, which laid it down that the court which first dealt with a case should alone have competence to pursue it.

See R. Schröder, *Lehrbuch der deutschen Rechtsgeschichte* (Leipzig, 1904); J. N. Harpprecht, *Staatsarchiv des Reichskammergerichts* (1757-1785); and G. Stobbe, *Reichshofgericht und Reichskammergericht* (Leipzig, 1878).

(E. Br.)

1 For instance, all the members of the diet might serve as Urtheilsfinder in a case like the condemnation of Henry the Lion, duke of Saxony, in the 12th century.

2 The attempt to create a new and official council ultimately failed.

3 More exactly, the emperor nominates, according to the regular usage of later times, a certain number of members, partly as emperor, and partly as the sovereign of his hereditary estates; while the rest, who form the majority, are nominated partly by the electors and partly by the six ancient circles.

IMPERIAL CITIES OR TOWNS, the usual English translation of *Reichsstädte*, an expression of frequent occurrence in German history. These were cities and towns subject to no authority except that of the emperor, or German king, in other words they were immediate; the earliest of them stood on the demesne land of their sovereign, and they often grew up around his palaces. A distinction was thus made between a *Reichsstadt* and a *Landstadt*, the latter being dependent upon some prince, not upon the emperor direct. The term *Freie Reichsstadt*, which is sometimes used in the same sense as *Reichsstadt*, is rightly only applicable to seven cities, Basel, Strassburg, Spires, Worms, Mainz, Cologne and Regensburg. Having freed themselves from the domination of their ecclesiastical lords these called themselves *Freistädte* and in practice their position was indistinguishable from that of the *Reichsstädte*.

In the middle ages many other places won the coveted position of a *Reichsstadt*. Some gained it by gift and others by purchase; some won it by force of arms, others usurped it during times of anarchy, while a number secured it through the extinction of dominant families, like the Hohenstaufen. There were many more free towns in southern than in northern Germany, but their number was continually fluctuating, for their liberties were lost much more quickly than they were gained. Mainz was conquered and subjected to the archbishop in 1462. Some free towns fell into the hands of various princes of the Empire and others placed themselves voluntarily under such protection. Some, like Donauwörth in 1607, were deprived of their privileges by the emperor on account of real, or supposed, offences, while others were separated from the Empire by conquest. In 1648 Besançon passed into the possession of Spain, Basel had already thrown in its lot with the Swiss confederation, while Strassburg, Colmar, Hagenau and others were seized by Louis XIV.

Meanwhile the free towns had been winning valuable privileges in addition to those which they already possessed, and the wealthier among them, like Lübeck and Augsburg, were practically *imperia in imperio*, waging war and making peace, and ruling their people without any outside interference. But they had also

learned that union is strength. They formed alliances among themselves, both for offence and for defence, and these *Städtebünde* had an important influence on the course of German history in the 14th and 15th centuries. These leagues were frequently at war with the ecclesiastical and secular potentates of their district and in general they were quite able to hold their own in these quarrels. The right of the free towns to be represented in the imperial diet was formally recognized in 1489, and about the same time they divided themselves into two groups, or benches, the Rhenish and the Swabian. By the peace of Westphalia in 1648 they were formally constituted as the third college of the diet. A list drawn up in 1422 mentions 75 free cities, another drawn up in 1521 mentions 84, but at the time of the French Revolution the number had decreased to 51. At this time the Rhenish free cities were: Cologne, Aix-la-Chapelle, Lübeck, Worms, Spires, Frankfort-on-the-Main, Goslar, Bremen, Hamburg, Mühlhausen, Nordhausen, Dortmund, Friedberg and Wetzlar. The Swabian free cities were: Regensburg, Augsburg, Nuremberg, Ulm, Esslingen, Reutlingen, Nördlingen, Rothenburg-on-the-Tauber, Schwäbisch-Hall, Rottweil, Ueberlingen, Heilbronn, Memmingen, Gmünd, Dinkelsbühl, Lindau, Biberach, Ravensburg, Schweinfurt, Kempten, Windsheim, Kaufbeuern, Weil, Wangen, Isny, Pfullendorf, Offenburg, Leutkirch, Wimpfen, Weissenburg, Giengen, Gengenbach, Zell, Buchorn, Aalen, Buchau and Bopfingen. But a large proportion of them had as little claim to their exceptional positions as the pocket boroughs of Great Britain and Ireland had before the passing of the Reform Bill of 1832.

By the peace of Lunéville in 1801 Cologne, Aix-la-Chapelle, Worms and Spires were taken by France, and by the decision of the imperial deputation of 1803 six cities only: Hamburg, Lübeck, Bremen, Augsburg, Frankfort-on-Main and Nuremberg, were allowed to keep their *Reichsfreiheit*, or in other words to hold directly of the Empire. This number was soon further reduced. On the dissolution of the Empire in 1806 Augsburg and Nuremburg passed under the sovereignty of Bavaria, and Frankfort was made the seat of a duchy for Karl Theodor von Dalberg, elector and archbishop of Mainz, who was appointed prince primate of the Confederation of the Rhine. When the German Confederation was established in 1815 Hamburg, Lübeck, Bremen and Frankfort were recognized as free cities, and the first three hold that position in the modern German empire; but Frankfort, in consequence of the part it took in the war of 1866, lost its independence and was annexed by Prussia.

In the earlier years of their existence the free cities were under the jurisdiction of an imperial officer, who was called the *Reichsvogt* or imperial advocate, or sometimes the *Reichsschultheiss* or imperial procurator. As time went on many of the cities purchased the right of filling these offices with their own nominees; and in several instances the imperial authority fell practically into desuetude except when it was stirred into action by peculiar circumstances. The internal constitution of the free cities was organized after no common model, although several of them had a constitution drawn up in imitation of that of Cologne, which was one of the first to assert its independence.

For the history of the free cities, see J. J. Moser, *Reichsstädtisches Handbuch* (Tübingen, 1732); D. Hänlein, *Anmerkungen über die Geschichte der Reichsstädte* (Ulm, 1775); A. Wendt, *Beschreibung der kaiserlichen freien Reichsstädte* (Leipzig, 1804); G. W. Hugo, *Die Mediatisirung der deutschen Reichsstädte* (Carlsruhe, 1838); G. Waitz, *Deutsche Verfassungsgeschichte* (Kiel, 1844 fol.); G. L. von Maurer, *Geschichte der Städteverfassung in Deutschland* (Erlangen, 1869-1871); W. Arnold, *Verfassungsgeschichte der deutschen Freistädte* (Gotha, 1854); P. Brülcke, *Die Entwickelung der Reichsstandschaft der Städte* (Hamburg, 1881); A. M. Ehrentraut, *Untersuchungen über die Frage der Frei- und Reichsstädte* (Leipzig, 1902); and S. Rietschel, *Untersuchungen zur Geschichte der deutschen Stadtverfassung* (Leipzig, 1905). See also the article COMMUNE.

(A. W. H.*)

IMPEY, SIR ELIJAH (1732-1809), chief justice of Bengal, was born on the 13th of June 1732, and educated at Westminster with Warren Hastings, who was his intimate friend throughout life. In 1773 he was appointed the first chief justice of the new supreme court at Calcutta, and in 1775 presided at the trial of Nuncomar (*q.v.*) for forgery, with which his name has been chiefly connected in history. His impeachment was unsuccessfully attempted in the House of Commons in 1787, and he is accused by Macaulay of conspiring with Hastings to commit a judicial murder; but the whole question of the trial of Nuncomar has been examined in detail by Sir James Fitzjames Stephen, who states that “no man ever had, or could have, a fairer trial than Nuncomar, and Impey in particular behaved with absolute fairness and as much indulgence as was compatible with his duty.”

See E. B. Impey, *Sir Elijah Impey* (1846); and Sir James Stephen, *The Story of Nuncomar and the Impeachment of Sir Elijah Impey* (1885).

IMPHAL, the capital of the state of Manipur (*q.v.*) in eastern Bengal and Assam, on the north-east frontier of India, situated at the confluence of three rivers. Pop. (1901) 67,903. It is really only a collection of villages buried amid trees, with a clearing containing the palace of the raja, the cantonments, and the houses of the few European residents.

IMPLEMENT (Lat. *implementum*, a filling up, from *implere*, to fill), in ordinary usage, a tool, especially in the plural for the set of tools necessary for a particular trade or for completing a particular piece of work (see TOOLS). It is also the most general term applied to the weapons and tools that remain of those used by primitive man. The Late Lat. *implementum*, more usually in the plural, *implementa*, was used for all the objects necessary to stock or "fill up" a house, farm, &c.; it was thus applied to furniture of a house, the vestments and sacred vessels of a church, and to articles of clothing, &c. The transition to the necessary outfit of a trade, &c., is easy. In its original Latin sense of "filling up," the term survives in Scots law, meaning full performance or "fulfilment" of a contract, agreement, &c.; "to implement" is thus also used in Scots law for to carry out, perform.

IMPLUVIUM, the Latin term for the sunk part of the floor in the atrium of a Greek or Roman house, which was contrived to receive the water passing through the compluvium (*q.v.*) of the roof. The impluvium was generally in marble and sunk about a foot below the floor of the atrium.

IMPOSITION (from Lat. *imponere*, to place or lay upon), in ecclesiastical usage, the "laying on" of hands by a bishop at the services of confirmation and ordination as a sign that some special spiritual gift is conferred, or that the recipient is set apart for some special service or work. The word is also used of the levying of a burdensome or unfair tax or duty, and of a penalty, and hence is applied to a punishment task given to a schoolboy. From "impose" in the sense of "to pass off" on some one, imposition means also a trick or deception. In the printing trade the term is used of the arrangement of pages of type in the "forme," being one of the stages between composing and printing.

IMPOST (through the O. Fr. from Lat. *impositum*, a thing laid upon another; the modern French is *impôt*), a tax or tribute, and particularly a duty levied on imported or exported merchandise (see TAXATION, CUSTOMS DUTIES, EXCISE, &c.). In architecture, "impost" (in German *Kaempfer*) is a term applied in Italian to the doorpost, but in English restricted to the upper member of the same, from which the arch springs. This may either be in the same plane as the arch mould or projecting and forming a plain band or elaborately moulded, in which case the mouldings are known as impost mouldings. Sometimes the complete entablature of a smaller order is employed, as in the case of the Venetian or Palladian window, where the central opening has an arch resting on the entablature of the pilasters which flank the smaller window on each side. In Romanesque and Gothic work the capitals with their abaci take the place of the impost mouldings.

IMPOTENCE (Lat. *impotentia*, want of power), the term used in law for the inability of a husband or wife to have marital intercourse. In English matrimonial law if impotence exists in either of the parties to a marriage at the time of its solemnization the marriage is voidable *ab initio*. A suit for nullity on the ground of impotence can only be brought by the party who suffers the injury. Third persons—however great their interest—cannot sue for a decree on this ground, nor can a marriage be impeached after the death of one of the parties. The old rule of the ecclesiastical courts was to require a triennial cohabitation between the parties prior to the institution of the suit, but this has been practically abrogated (*G.* v. *G.*, 1871, L.R. 2 P.C.D. 287). In suits for nullity on the ground of impotence, medical evidence as to the condition of the parties is necessary and a commission of two medical inspectors is usually appointed by the registrar of the court for the purpose of examining the parties; such cases are heard *in camera*. In the United States impotence is a ground for nullity in most states. In Germany it is recognized as a ground for annulment, but not so in France.

IMPRESSIONISM. The word "Impressionist" has come to have a more general application in England than in France, where it took currency as the nickname of a definite group of painters exhibiting together, and was adopted by themselves during the conflict of opinion which the novelty of their art excited. The word therefore belongs to the class of nicknames or battle-names, like "Romanticist," "Naturalist," "Realist," which preceded it, words into which the acuteness of controversy infuses more of theoretical

purport than the work of the artists denoted suggests to later times. The painters included in such a "school" differ so much among themselves, and so little from their predecessors compared with the points of likeness, that we may well see in these recurring effervescences of official and popular distaste rather the shock of individual force in the artist measured against contemporary mediocrity than the disturbance of a new doctrine. The "Olympia" of Manet, hooted at the Salon of 1865 as subversive of all tradition, decency and beauty, strikes the visitor to the Luxembourg rather as the reversion to a theme of Titian by an artist of ruder vision than as the demonstration of a revolutionary in painting. Later developments of the school do appear to us revolutionary. With this warning in a matter still too near us for final judgment, we may give some account of the Impressionists proper, and then turn to the wider significance sometimes given to the name.

The words *Impressioniste*, *Impressionisme*, are said to have arisen from a phrase in the preface to Manet's catalogue of his pictures exhibited in 1867 during the Exposition Universelle, from which he was excluded. "It is the effect," he wrote, "of sincerity to give to a painter's works a character that makes them resemble a protest, whereas the painter has only thought of rendering his impression." An alternative origin is a catalogue in which Claude Monet entitled a picture of sunrise at sea "Une Impression." The word was probably much used in the discussions of the group, and was caught up by the critics as characteristic.[1] At the earlier date the only meaning of the word was a claim for individual liberty of subject and treatment. So far as subject went, most, though not all of Manet's pictures were modern and actual of his Paris, for his power lay in the representation of the thing before his eye, and not in fanciful invention. His simplicity in this respect brought him into collision with popular prejudice when, in the "Déjeuner sur l'herbe" (1863), he painted a modern *fête champêtre*. The actual characters of his painting at this period, so fancifully reproached and praised, may be grouped under two heads. (1) The expression of the object by a few carefully chosen values in flattish patches. Those patches are placed side by side with little attenuation of their sharp collision. This simplification of colour and tone recalls by its broad effects of light and silhouette on the one hand Velasquez, on the other the extreme simplification made by the Japanese for the purposes of colour-printing. Manet, like the other painters of his group, was influenced by these newly-discovered works of art. The image, thus treated, has remarkable hardiness and vigour, and also great decorative breadth. Its vivacity and intensity of aspect is gained by the sacrifice of many minor gradations, and by the judgment with which the leading values have been determined. This matching of values produces, technically, a "solid" painting, without glazing or elaborate transparency in shadows. (2) During this period Manet makes constant progress towards a fair, clear colour. In his early work the patches of blond colour are relieved against black shadows; later these shadows clear up, and in place of an indeterminate brown sauce we find shadows that are colours. A typical picture of this period is the "Musique aux Tuileries," refused by the Salon of 1863. In this we have an actual out-of-doors scene rendered with a frankness and sharp taste of contemporary life surprising to contemporaries, with an elision of detail in the treatment of a crowd and a seizing on the chief colour note and patch that characterize each figure equally surprising, an effort finally to render the total high-pitched gaiety of the spectacle as a banquet of sunlight and colour rather than a collection of separate dramatic groups.

For life of Édouard Manet (1832-1883) see Edmond Bazire, *Manet* (Paris, 1884). An idea of the state of popular feeling may be gained by reading Zola's eloquent defence in *Mon Salon*, which appeared in *L'Événement* (1866) and *Édouard Manet* (1867), both reprinted in *Mes Haines* (Paris, 1880). The same author has embodied many of the impressionist ideals in Claude Lantier, the fictitious hero of *L'Œuvre*. Other writers belonging to Manet's group are Théodore Duret, author of *Les Peintres français en 1867* and *Critique d'avant-garde*, articles and catalogue-prefaces reprinted 1885. See also, for Manet and others, J. K. Huysman's *L'Art moderne* (1883) and *Certains*. Summaries of the literature of the whole period will be found in R. Muther, *The History of Modern Painting* (tr. London, 1896), not always trustworthy in detail, and Miss R. G. Kingsley, *A History of French Art* (1899). For an interesting critical account see W. C. Brownell, *French Art* (1892).

The second period, to which the name is sometimes limited, is complicated by the emergence of new figures, and it is difficult as yet, and perhaps will always remain difficult, to say how much of originality belongs to each artist in the group. The main features are an intenser study of illumination, a greater variety of illuminations, and a revolution in *facture* with a view to pressing closer to a high pitch of light. Manet plays his part in this development, but we shall not be wrong probably in giving to Claude Monet (b. 1840) the chief rôle as the instinctive artist of the period, and to Camille Pissarro (b. 1830) a very large part as a painter, curious in theory and experiment. Monet at the early date of 1866 had painted a picture as daring in its naïve brutality of out-of-door illumination as the "Déjeuner sur l'herbe." But this picture has the breadth of patch, solidity and suavity of paste of Manet's practice. During the siege of Paris (1870-71) Monet and Pissarro were in London, and there the study of Turner's pictures enlarged their ideas of the pitch in lighting and range of effect possible in painting, and also suggested a new handling of colour, by small broken touches in place of the large flowing touches characteristic of Manet. This method of painting occupied much of the discussion of the group that centred round Manet at the Café Guerbois, in the Batignolles quarter (hence called *L'École de Balignolles*). The ideas were: (1) Abolition of conventional brown tonality. But all browns, in the fervour of this revolt, went the way of conventional brown, and all ready-made mixtures like the umbers, ochres, siennas were banished from the palette. Black itself was condemned. (2) The idea of the spectrum, as exhibiting the series of "primary" or "pure" colours, directed the reformed palette. Six colours, besides white, were admitted to represent the chief hues of the spectrum. (3) These colours were laid on the canvas with as little previous mixture on the palette as possible to maintain a maximum of luminosity, and were fused by touch on the canvas as little as possible, for the same reason. Hence the "broken" character of the touch in this painting, and the subordination of delicacies of form and suave continuity of texture to the one aim of glittering light-and-colour notation. Justification of these procedures was sought in occasional features of the practice of E. Delacroix, of Watteau, of J. B. Chardin, in the hatchings of pastel, the stipple of water-colour. With the ferment of theory went a *parti pris* for translating all effects into the upper registers of tone (cf. Ruskin's chapter on Turner's practice in *Modern Painters*), and for emphasizing the colour of shadows at the expense of their tone. The

characteristic work of this period is landscape, as the subject of illumination strictly observed and followed through the round of the day and of the seasons. Other pictorial motives were subordinated to this research of effect, and Monet, with a haystack, group of poplars, or church front, has demonstrated the variety of lighting that the day and the season bring to a single scene. Besides Pissarro, Alfred Sisley (1840-1899) is a member of the group, and Manet continues his progress, influenced by the new ideas in pictures like “Le Linge” and “Chez le Père Lathuille.”

Edmond Degas (b. 1834), a severe and learned draughtsman, is associated with this landscape group by his curiosity in the expression of momentary action and the effects of artificial illumination, and by his experiments in broken colour, more particularly in pastel. The novelty of his matter, taken from unexplored corners of modern life, still more the daring and irony of his observation and points of view, and the strangeness of his composition, strongly influenced by Japanese art, enriched the associations now gathering about the word “impressionist.” Another name, that of Auguste Renoir (b. 1841), completes the leading figures of the group. Any “school” programme would be strained to breaking-point to admit this painter, unless on the very general grounds of love of bright colour, sunlit places and independence of vision. He has no science of drawing or of tone, but wins a precarious charm of colour and expression.

The landscape, out-of-doors line, which unites in this period with Manet’s line, may be represented by these names: J. B. Corot, J. B. Jongkind, Boudin, Monet. Monet’s real teacher was Eugène Boudin (1824-1898), (See Gustave Cahen’s *Eugène Boudin*, Paris, 1900). They, and others of the group, worked together in a painters’ colony at Saint Simeon, near Honfleur. It is usual to date the origin of *plein-air* painting, *i.e.* painting out-of-doors, in an out-of-doors key of tone, from a picture Manet painted in the garden of de Nittis, just before the outbreak of war in 1870. This dates only Manet’s change to the lighter key and looser handling. It was Monet who carried the practice to a logical extreme, working on his canvas only during the effect and in its presence. The method of Degas is altogether different, viz., a combination in the studio from innumerable notes and observations. It will be evident from what has been said above that impressionistic painting is an artistic ferment, corresponding to the scientific research into the principles of light and colour, just as earlier movements in painting coincided with the scientific study of perspective and anatomy. Chevreul’s famous book, already referred to, *De la loi du contraste simultané des couleurs* (1838), established certain laws of interaction for colours adjacent to one another. He still, however, referred the sensations of colour to the three impossible “primaries” of Brewster—red, blue and yellow. The Young-Helmholtz theory affected the palette of the Impressionists, and the work of Ogden Rood, *Colour* (Internat. Scientific Series, 1879-1881), published in English, French and German, furnished the theorists with formulae measuring the degradation of pitch suffered by pigments in mixture.

The Impressionist group (with the exception of Manet, who still fought for his place in the Salon) exhibited together for the first time as L’Exposition des Impressionistes at Nadar’s, Boulevard des Capucines, in 1874. They were then taken up by the dealer Durand-Ruel, and the succeeding exhibitions in 1876, 1877, 1879, 1880, 1881, 1882 and 1886 were held by him in various galleries. The full history of these exhibitions, with the names of the painters, will be found in two works: Félix-Fénéon, *Les Impressionistes en 1886* (Paris, 1886), and G. Geffroy, *La Vie artistique* (“Histoire de l’impressionisme,” in vol. for 1894). See also G. Lecomte, *L’Art impressionists d’après la collection privée de M. Durand-Ruel* (Paris, 1892); Duranty, *La Peinture nouvelle* (1876). Besides the names already cited, some others may be added: Madame Berthe Morisot, sister-in-law of Manet; Paul Cézanne, belonging to the Manet-Pissarro group; and, later, Gauguin. J. F. Raffaëlli applied a “characteristic” drawing, to use his word, to scenes in the dismal suburbs of Paris; Forain, the satiric draughtsman, was a disciple of Degas, as also Zandomeneghi. Miss Mary Cassatt was his pupil. Caillebotte, who bequeathed the collection of Impressionist paintings now in the Luxembourg, was also an exhibitor; and Boudin, who linked the movement to the earlier schools.

The first exhibitions of the Impressionists in London were in 1882 and 1883, but their fortunes there cannot be pursued in the present article, nor the history of the movement beyond its originators. This excludes notable figures, of which M. Besnard may be chosen as a type.

In Manet’s painting, even in the final steps he took towards “la peinture claire,” there is nothing of the “decomposition of tones” that logically followed from the theories of his followers. He recognized the existence in certain illuminations of the violet shadow, and he adopted in open-air work a looser and more broken touch. The nature of his subjects encouraged such a handling, for the painter who attempts to note from nature the colour values of an elusive effect must treat form in a summary fashion, still more so when the material is in constant movement like water. Moreover, in the river-side subjects near Paris there was a great deal that was only pictorially tolerable when its tone was subtracted from the details of its form. Monet’s painting carries the shorthand of form and broken colour to extremity; the flowing touch of Manet is chopped up into harsher, smaller notes of tone, and the pitch pushed up till all values approach the iridescent end of the register. It was in 1886 that the *doctrinaire* ferment came to a head, and what was supposed to be a scientific method of colour was formulated. This was *pointillisme*, the resolution of the colours of nature back into six bands of the rainbow or spectrum, and their representation on the canvas by *dots* of unmixed pigment. These dots, at a sufficient distance, combine their hues in the eye with the effect of a mixture of coloured *lights*, not of pigments, so that the result is an increase instead of a loss of luminosity. There are several fallacies, however, theoretical and practical, in this “spectral palette” and pointillist method. If we depart from the three primaries of the Helmholtz hypothesis, there is no reason why we should stop at six hues instead of six hundred. But pigments follow the spectrum series so imperfectly that the three primaries, even if we could exactly locate them, limit the palette considerably in its upper range. The sacrifice of black is quite illogical, and the lower ranges suffer accordingly. Moreover, it is doubtful whether many painters have followed the laws of mixture of lights in their dotting, *e.g.* dotting green and red together to produce yellow. It may be added that dotting with oil pigment is in practice too coarse and inaccurate a method. This innovation of *pointillisme* is generally ascribed to George Seurat (d. 1890), whose picture, “La Grande Jatte,” was exhibited at the Rue Laffitte in 1886. Pissarro experimented in the new method, but abandoned it, and other names among the *Pointillistes* are Paul Signac, Vincent van Gogh, and van Rysselberghe. The theory opened the way for endless casuistries, and its extravagances died out in the later exhibition of the *Indépendants* or were domesticated in the Salon by painters like M. Henri

Martin.

> The first modern painter to concern himself scientifically with the reactions of complementary colours appears to have been Delacroix (J. Leonardo, it should be remembered, left some notes on the subject). It is claimed for Delacroix that as early as 1825 he observed and made use of these reactions, anticipating the complete exposition of Chevreul. He certainly studied the treatise, and his biographers describe a dial-face he constructed for reference. He had quantities of little wafers of each colour, with which he tried colour effects, a curious anticipation of pointillist technique. The pointillists claim him as their grandfather. See Paul Signac, "D'Eugène Delacroix au Néo-Impressionnisme" (*Revue Blanche*, 1898). For a fuller discussion of the spectral palette see the *Saturday Review*, 2nd, 9th and 23rd February and 23rd March 1901.

In England the ideas connected with the word Impressionism have been refracted through the circumstances of the British schools. The questions of pitch of light and iridescent colour had already arisen over the work of Turner, of the Pre-Raphaelites, and also of G. F. Watts, but less isolated and narrowed, because the art of none of these limited itself to the pursuit of light. *Pointillisme*, after a fashion, existed in British water-colour practice. But the Pre-Raphaelite school had accustomed the English eye to extreme definition in painting and to elaboration of detail, and it happened that the painting of James M'Neill Whistler (Grosvenor Gallery, 1878) brought the battle-name Impressionism into England and gave it a different colour. Whistler's method of painting was in no way revolutionary, and he preferred to transpose values into a lower key rather than compete with natural pitch, but his vision, like that of Manet under the same influences, Spanish and Japanese, simplified tone and subordinated detail. These characteristics raised the whole question of *the science and art of aspect in modern painting*, and the field of controversy was extended backwards to Velasquez as the chief master of the moderns. "Impressionism" at first had meant individualism of vision, later the notation of fugitive aspects of light and of movement; now it came to mean breadth in pictorial vision, all the simplifications that arise from the modern analysis of aspect, and especially the effect produced upon the parts of a picture-field by attending to *the impression of the whole*. Ancient painting analyses aspect into three separate acts as form, tone and colour. All forms are made out with equal clearness by a conventional outline; over this system of outlines a second system of light and shade is passed, and over this again a system of colours. Tone is conceived as a difference of black or white added to the tints, and the colours are the definite local tints of the objects (a blue, a red, a yellow, and so forth). In fully developed modern painting, instead of an object analysed into sharp outlines covered with a uniform colour darkened or lightened in places, we find an object analysed into a number of surfaces or planes set at different angles. On each of these facets the character of the object and of the illumination, with accidents of reflection, produces a patch called by modern painters a "value," because it is colour of a particular value or tone. (With each difference of tone, "value" implies a difference of hue also, so that when we speak of a different tone of the same colour we are using the word "same" in a loose or approximate sense.) These planes or facets define themselves one against another with greater or less sharpness. Modern technique follows this modern analysis of vision, and in one act instead of three renders by a "touch" of paint the shape and value of these facets, and instead of imposing a uniform ideal outline at all their junctions, allows these patches to define themselves against one another with variable sharpness.

Blurred definition, then, as it exists in our natural view of things, is admitted into painting; a blurring that may arise from distance, from vapour or smoke, from brilliant light, from obscurity, or simply from the nearness in value of adjacent objects. Similarly, much detail that in primitive art is elaborated is absorbed by rendering the aspect instead of the facts known to make up that aspect. Thus hair and fur, the texture of stuffs, the blades of grass at a little distance, become patches of tone showing only their larger constructive markings. But the blurring of definitions and the elimination of detail that we find in modern pictorial art are not all of this ready-made character. We have so far only the scientific analysis of a field of view. If the painter were a scientific reporter he would have to pursue the systems of planes, with their shapes and values, to infinity. Impressionism is the art that surveys the field and determines which of the shapes and tones are of chief importance to the *interested* eye, enforces these, and sacrifices the rest. Construction, the logic of the object rendered, determines partly this action of the eye, and also decoration, the effects of rhythm in line and harmony in fields of colour. These motives belong to all art, but the specially impressionist motive is the act of *attention* as it affects the aspect of the field. We are familiar, in the ordinary use of the eye, with two features of its structure that limit clearness of vision. There is, first, the spot of clear vision on the retina, outside of which all falls away into blur; there is, secondly, the action of *focus*. As the former limits clear definition to one spot in the field extended vertically and laterally, so focus limits clear definition to one plane in the third dimension, viz. depth. If three objects, A, B and C, stand at different depths before the eye, we can at will fix A, whereupon B and C must fall out of focus, or B, whereupon A and C must be blurred, or C, sacrificing the clearness of A and B. All this apparatus makes it impossible to see everything at once with equal clearness, enables us, and forces us for the uses of real life, to frame and limit our picture, according to the immediate interest of the eye, whatever it may be. The painter instinctively uses these means to arrive at the emphasis and neglect that his choice requires. If he is engaged on a face he will now screw his attention to a part and now relax it, distributing the attention over the whole so as to restore the bigger relations of aspect. Sir Joshua Reynolds describes this process as seeing the whole "with the dilated eye"; the commoner precept of the studios is "to look with the eyes half closed"; a third way is to throw the whole voluntarily out of focus. In any case the result is that minor planes are swamped in bigger, that smaller patches of colour are swept up into broader, that markings are blurred. The final result of these tentative reviews records, in what is blurred and what is clear, the attention that has been distributed to different parts, and to parts measured against the whole. The Impressionist painter does not allot so much detail to a face in a full-length portrait as to a head alone, nor to twenty figures on a canvas as to one. Again, he indicates by his treatment of planes and definitions whether the main subject of his picture is in the foreground or the distance. He persuades the eye to slip over hosts of near objects so that, as in life, it may hit a distant target, or concentrate its attack on what is near, while the distance falls away into a dim curtain. All those devices by which attention is directed and distributed, and the importance in space of an object established, affect impressionistic composition.

It is an inevitable misunderstanding of painting which plays the game of art so closely up to the real aspects of nature that its aim is that of mere exact copying. Painting like Manet's, accused of being realistic in this sense, sufficiently disproves the accusation when examined. Never did painting show a *parti pris* more pronounced, even more violent. The elisions and assertions by which Manet selects what he finds significant and beautiful in the complete natural image are startling to the stupid realist, and the Impressionist may best be described as the painter who out of the completed contents of vision constructs an image moulded upon his own interest in the thing seen and not on that of any imaginary schoolmaster. Accepting the most complex terms of nature with their special emotions, he uses the same freedom of sacrifice as the man who at the other end of the scale expresses his interest in things by a few scratches of outline. The perpetual enemy of both is the eclectic, who works for possible interests not his own.

Some of the points touched on above will be found amplified in articles by the writer in *The Albemarle* (September 1892), the *Fortnightly Review* (June 1894), and *The Artist* (March-July 1896). An admirable exposition of Impressionism in this sense is R. A. M. Stevenson's *The Art of Velasquez* (1895). Mr Stevenson was trained in the school of Carolus Duran, where impressionist painting was reduced to a system. Mr Sargent's painting is a brilliant example of the system.

(D. S. M.)

1 Mr H. P. Hain Friswell has pointed out that the word "impression" occurs frequently in Chevreul's book on colour; but it is also current among the critics. See Ruskin's chapter on Turner's composition—"impression on the mind."

IMPRESSMENT, the name given in English to the exercise of the authority of the state to "press"[1] or compel the service of the subject for the defence of the realm. Every sovereign state must claim and at times exercise this power. The "drafting" of men for service in the American Civil War was a form of impressment. All the monarchical, or republican, governments of Europe have employed the press at one time or another. All forms of conscription, including the English ballot for the militia, are but regulations of this sovereign right. In England impressment may be looked upon as an erratic, and often oppressive, way of enforcing the common obligation to serve in "the host" or in the *posse comitatus* (power of the county). In Scotland, where the feudal organization was very complete in the Lowlands, and the tribal organization no less complete in the Highlands, and where the state was weak, impressment was originally little known. After the union of the two parliaments in 1707, no distinction was made between the two divisions of Great Britain. In England the kings of the Plantagenet dynasty caused Welshmen to be pressed by the Lords Marchers, and Irish kerns to be pressed by the Lords Deputy, for their wars in France. Complaints were made by parliament of the oppressive use of this power as early as the reign of Edward III., but it continued to be exercised. Readers of Shakespeare will remember Sir John Falstaff's commission to press soldiers, and the manner, justified no doubt by many and familiar examples of the way in which the duty was performed. A small sum called imprest-money, or coat and conduct money, was given to the men when pressed to enable them to reach the appointed rendezvous. Soldiers were secured in this way by Queen Elizabeth, by King Charles I., and by the parliament itself in the Civil War. The famous New Model Army of Cromwell was largely raised by impressment. Parliament ordered the county committees to select recruits of "years meet for their employment and well clothed." After the Revolution of 1688 parliament occasionally made use of this resource. In 1779 a general press of all rogues and vagabonds in London to be drafted into the regiments was ordered. It is said that all who were not too lame to run away or too destitute to bribe the parish constable were swept into the net. As they were encouraged to desert by the undisguised connivance of the officers and men who were disgusted with their company, no further attempt to use the press for the army was made.

A distinction between the liability of sailors and of other men dates from the 16th century. From an act of Philip and Mary (1556) it appears that the watermen of the Thames claimed exemption from the press as a privileged body. They were declared liable, and the liability was clearly meant to extend to service as a soldier on shore. In the fifth year of Queen Elizabeth (1563) an act was passed to define the liability of the sailors. It is known as "an Act touching politick considerations for the maintenance of the Navy." By its term all fishermen and mariners were protected from being compelled "to serve as any soldiers upon the Land or upon the Sea, otherwise than as a mariner, except it shall be to serve under any Captain of some ship or vessel, for landing to do some special exploit which mariners have been used to do." The operation of the act was limited to ten years, but it was renewed repeatedly, and was at last indefinitely prolonged in the sixteenth year of the reign of Charles I. (1631). By the Vagrancy Act of the close of Queen Elizabeth's reign (1597), disorderly serving-men and other disreputable characters, of whom a formidable list is given, were declared to be liable to be impressed for service in the fleet. The "Takers," as they were called in early times, the Press Gang of later days, were ordered to present their commission to two justices of the peace, who were bound to pick out "such sufficient number of able men, as in the said commission shall be contained, to serve Her Majesty as aforesaid." The justices of the peace in the coast districts, who were often themselves concerned in the shipping trade, were not always zealous in enforcing the press. The pressed sailors often deserted with the "imprest money" given them. Loud complaints were made by the naval officers of the bad quality of the men sent up to serve in the king's ships. On the other hand, the Press Gangs were accused of extorting money, and of making illegal arrests. In the reign of Queen Anne (1703) an act was passed "for the increase of Seamen and the better encouragement of navigation, and the protection of the Coal Trade." The act which gave parish authorities power to apprentice boys to the sea exempted the apprentices from the press for three years, and until the age of eighteen. It especially reaffirmed the part of the Vagrancy Act of Elizabeth's reign which left rogues and vagabonds subject to be pressed for the sea service. By the act for the "Increase of Mariners and Seamen to navigate Merchant Ships and other trading

ships or vessels," passed in the reign of George II. (1740), all men over fifty-five were exempted from the press together with lads under eighteen, foreigners serving in British ships (always numerous in war time), and landsmen who had gone to sea during their first two years. The act for "the better supplying of the cities of London and Westminster with fish" gave exemption to all masters of fishing-boats, to four apprentices and one mariner to each boat, and all landsmen for two years, except in case of actual invasion. By the act for the encouragement of insurance passed in 1774, the fire insurance companies in London were entitled to secure exemption for thirty watermen each in their employment. Masters and mates of merchant vessels, and a proportion of men per ship in the colliers trading from the north to London, were also exempt.

Subject to such limitations as these, all seafaring men, and watermen on rivers, were liable to be pressed between the ages of eighteen and fifty-five, and might be pressed repeatedly for so long as their liability lasted. The rogue and vagabond element were at the mercy of the justices of the peace. The frightful epidemics of fever which desolated the navy till late in the 18th century were largely due to the infection brought by the prisoners drafted from the ill-kept jails of the time. As service in the fleet was most unpopular with the sailors, the press could often only be enforced by making a parade of strength and employing troops. The men had many friends who were always willing to conceal them, and they themselves became expert in avoiding capture. There was, however, one way of procuring them which gave them no chance of evasion. The merchant ships were stopped at sea and the sailors taken out. This was done to a great extent, more especially in the case of homeward-bound vessels. On one occasion, in 1802, an East Indiaman on her way home was deprived of so many of her crew by a man of war in the Bay of Biscay that she was unable to resist a small French privateer, and was carried off as a prize with a valuable cargo. The press and the jails failed to supply the number of men required. In 1795 it was found necessary to impose on the counties the obligation to provide "a quota" of men, at their own expense. The local authorities provided the recruits by offering high bounties, often to debtors confined in the prisons. These desperate men were a very bad element in the navy. In 1797 they combined with the United Irishmen, of whom large numbers had been drafted into the fleet as vagabonds, to give a very dangerous political character to the mutinies at the Nore and on the south of Ireland. After the conclusion of the great Napoleonic wars in 1815 the power of the press was not again exercised. In 1835 an act was passed during Sir James Graham's tenure of office as first lord of the admiralty, by which men who had once been pressed and had served for a period of five years were to be exempt from impressment in future. Sir James, however, emphatically reaffirmed the right of the crown to enforce the service of the subject, and therefore to impress the seamen. The introduction of engagements for a term of five years in 1853, and then of long service, has produced so large a body of voluntary recruits, and service in the navy is so popular, that the question has no longer any interest save an historical one. If compulsory service in the fleet should again become necessary it will not be in the form of the old system of impressment, which left the sailor subject to compulsory service from the age of eighteen to fifty-five, and flooded the navy with the scum of the jails and the workhouse.

AUTHORITIES.—Grose's *Military Antiquities*, for the general subject of impressment, vol. ii. p. 73 et seq. S. R. Gardiner gives many details in his history of James I. and Charles I., and in *The Civil War*. The acts relating to the navy are quoted in *A Collection of the Statutes relating to the Admiralty*, &c., published in 1810. Some curious information is in the papers relating to the Brest Blockade edited by John Leyland for the Navy Record Society. Sir James Graham's speech is in Hansard for 1835.

(D. H.)

1 It is now accepted generally that "to press" is a corruption of "prest," as "impress" is of "imprest," but the word was quite early connected with "press," to squeeze, crush, hence to compel or force. The "prest" was a sum of money advanced (O. Fr. *prester*, modern *prêter*, to lend, Lat. *praestare*, to stand before, provide, become surety for, &c.) to a person to enable him to perform some undertaking, hence used of earnest money given to soldiers on enlistment, or as the "coat and conduct" money alluded to in this article. The methods of compulsion used to get men for military service naturally connected the word with "to press" (Lat. *pressare*, frequentative of *premere*) to force, and all reference to the money advanced was lost (see *Skeat, Etym. Dict.*, 1898, and the quotation from H. Wedgwood, *Dict. of Eng. Etym.*).

IMPROMPTU (from *in promptu*, on the spur of the moment), a short literary composition which has not been, or is not supposed to have been, prepared beforehand, but owes its merit to the ready skill which produces it without premeditation. The word seems to have been introduced from the French language in the middle of the 17th century. Without question, the poets have, from earliest ages, made impromptus, and the very art of poetry, in its lyric form, is of the nature of a modified improvisation. It is supposed that many of the epigrams of the Greeks, and still more probably those of the Roman satirists, particularly Martial, were delivered on the moment, and gained a great part, at least, of their success from the evidence which they gave of rapidity of invention. But it must have been difficult then, as it has been since, to be convinced of the value of that evidence. Who is to be sure that, like Mascarille in *Les Précieuses ridicules*, the impromptu-writer has not employed his leisure in sharpening his arrows? James Smith received the highest praise for his compliment to Miss Tree, the cantatrice:—

> On this tree when a nightingale settles and sings,
> The Tree will return him as good as he brings.

This was extremely neat, but who is to say that James Smith had not polished it as he dressed for dinner? One writer owed all his fame, and a seat among the Forty Immortals of the French Academy, to the reputation of his impromptus. This was the Marquis François Joseph de St Aulaire (1643-1742). The piece

which threw open the doors of the Academy to him in 1706 was composed at Sceaux, where he was staying with the duchess of Maine, who was guessing secrets, and who called him Apollo. St Aulaire instantly responded:—

La divinité qui s'amuse
A me demander mon secret,
Si j'étais Apollon, ne serait pas ma muse,
Elle serait Thétis—et le jour finirait.

This is undoubtedly as neat as it is impertinent, and if the duchess had given him no ground for preparation, this is typical of the impromptu at its best. Voltaire was celebrated for the savage wit of his impromptus, and was himself the subject of a famous one by Young. Less well known but more certainly extemporaneous is the couplet by the last-mentioned poet, who being asked to put something amusing in an album, and being obliged to borrow from Lord Chesterfield a pencil for the purpose, wrote:—

Accept a miracle instead of wit,—
See two dull lines with Stanhope's pencil writ.

The word "impromptu" is sometimes used to designate a short dramatic sketch, the type of which is Molière's famous *Impromptu du Versailles* (1663), a miniature comedy in prose.

IMPROVISATORE, a word used to describe a poet who recites verses which he composes on the spur of the moment, without previous preparation. The term is purely Italian, although in that language it would be more correctly spelt *improvvisatore*. It became recognized as an English word in the middle of the eighteenth century, and is so used by Smollett in his *Travels* (1766); he defines an improvisatore as "an individual who has the surprising talent of reciting verses extempore, on any subject you propose." In speaking of a woman, the female form *improvisatrice* is sometimes used in English.

Improvisation is a gift which properly belongs to those languages in which a great variety of grammatical inflections, wedded to simplicity of rhythm and abundance of rhyme, enable a poet to slur over difficulties in such a way as to satisfy the ear of his audience. In ancient times the greater part of the popular poetry with which the leisure of listeners was beguiled was of this rhapsodical nature. But in modern Europe it was the troubadours, owing to the extreme flexibility of the languages of Provence, who distinguished themselves above all others as improvisatores. It is difficult to believe, however, that the elaborate compositions of these poets, which have come down to us, in which every exquisite artifice of versification is taken advantage of, can have been poured forth without premeditation. These poets, we must rather suppose, took a pride in the ostentation of a prodigious memory, most carefully trained, and poured forth in public what they had laboriously learned by heart in private. The Italians, however, in the 16th century, cultivated what seems to have been a genuine improvisation, in which the bards rhapsodized, not as they themselves pleased, but on subjects which were unexpected by them, and which were chosen on the spot by their patrons. Of these, the most extraordinary is said to have been Silvio Antoniano (1540-1603), who from the age of ten was able to pour out melodious verse on any subject which was suggested to him. He was brought to Rome, where successive popes so delighted in his talent that in 1598 he was made a cardinal. In the 17th century the celebrated Metastasio first attracted attention by his skill as an improvisatore. But he was excelled by Bernardino Perfetti (1681-1747), who was perhaps the most extraordinary genius of this class who has ever lived. He was seized, in his moments of composition, with a transport which transfigured his whole person, and under this excitement he poured forth verses in a miraculous flow. It was his custom to be attended by a guitarist, who played a recitative accompaniment. In this way Perfetti made a triumphal procession through the cities of Italy, ending up with the Capitol of Rome, where Pope Benedict XIII. crowned him with laurel, and created him a Roman citizen. One of the most remarkable improvisatores of modern times appeared in Sweden, in the person of Karl Mikael Bellman (1740-1795), who used to take up a position in the public gardens and parks of Stockholm, accompanying himself on a guitar, and treating metre and rhythm with a virtuosity and originality which place him among the leading poets of Swedish literature. In England, somewhat later, Theodore Hook (1788-1841) developed a surprising talent for this kind, but his verses were rarely of the serious or sentimental character of which we have hitherto spoken. Hook's animal spirits were unfortunately mingled with vulgarity, and his clever *jeux d'esprit* had little but their smartness to recommend them. A similar talent, exercised in a somewhat more literary direction, made Joseph Méry (1798-1865) a delightful companion in the Parisian society of his day. It is rare indeed that the productions of the improvisatore, taken down in shorthand, and read in the cold light of criticism, are found to justify the impression which the author produced on his original audience. Imperfections of every kind become patent when we read these transcripts, and the reader cannot avoid perceiving weaknesses of style and grammar. The eye and voice of the improvisatore so hypnotize his auditors as to make them incapable of forming a sober judgment on matters of mere literature.

IN-ANTIS, the architectural term given to those temples the entrance part of which consisted of two

columns placed between the antae or pilasters (see TEMPLE).

INAUDI, JACQUES (1867-), Italian calculating prodigy, was born at Onorato, Piedmont, on the 15th of October 1867. When between seven and eight years old, at which time he was employed in herding sheep, he already exhibited an extraordinary aptitude for mental calculation. His powers attracted the notice of various showmen, and he commenced to give exhibitions. He was carefully examined by leading French scientists, including Charcot, from the physiological, psychological and mathematical point of view. The secret of his arithmetical powers appeared to reside in his extraordinary memory, improved by continuous practice. It appeared to depend upon hearing rather than sight, more remarkable results being achieved when figures were read out than when they were written.

INCANTATION, the use of words, spoken, sung or chanted, usually as a set formula, for the purpose of obtaining a result by their supposed magical power. The word is derived from the Latin *incantare*, to chant a magical formula; cf. the use of *carmen*, for such a formula of words. The Latin use is very early; thus it appears in a fragment of the XII. Tables quoted in Pliny (*N.H.* xxviii. 2, 4, 17), "Qui malum carmen incantasset." From the O. Fr. derivative of *incantare*, *enchanter*, comes "enchant," "enchantment," &c., properly of the exercise of magical powers, hence to charm, to fascinate, words which also by origin are of magical significance. The early magi of Assyria and Babylonia were adepts at this art, as is evident from the examples of Akkadian spells that have been discovered. Daniel (v. 11) is spoken of as "master of the enchanters" of Babylon. In Egypt and in India many formulas of religious magic were in use, witness especially the Vedic *mantras*, which are closely akin to the Maori *karakias* and the North American *matamanik*. Among the holy men presented by the king of Korea to the mikado of Japan in A.D. 577 was a reciter of *mantras*, who would find himself at home with the *majinahi* or incantation practised by the ancient Japanese for dissipating evil influences. One of the most common, widespread and persistent uses of incantation was in healing wounds, instances of which are found in the *Odyssey* and the *Kalevala*, and in the traditional folk-lore of almost every European country. Similar songs were sung to win back a faithless lover (cf. the second *Idyll* of Theocritus).

See further MAGIC.

INCE, WILLIAM, English 18th century furniture designer and cabinetmaker. He was one of the most successful imitators of Chippendale, although his work was in many respects lighter. He helped, indeed, to build the bridge between the massive and often florid style of Chippendale and the more boudoir-like forms of Hepplewhite. Although many of his designs were poor and extravagant, his best work was very good indeed. His chairs are sometimes mistaken for those of Chippendale, to which, however, they are much inferior. He greatly affected the Chinese and Gothic tastes of the second half of the 18th century. He was for many years in partnership in Broad Street, Golden Square, London, with Thomas Mayhew (*q.v.*), in collaboration with whom he published a folio volume of ninety-five plates, with letterpress in English and French under the title of *The Universal System of Household Furniture* (undated, but probably about 1762).

INCE-IN-MAKERFIELD, an urban district in the Ince parliamentary division of Lancashire, England, adjoining the borough of Wigan. Pop. (1901) 21,262. The Leeds and Liverpool Canal intersects the township. There are large collieries, ironworks, forges, railway wagon works, and cotton mills. There is preserved here the Old Hall, a beautiful example of half-timbered architecture.

INCENDIARISM (Lat. *incendere*, to set on fire, burn), in law, the wilful or malicious burning of the house or property of another, and punishable as arson (*q.v.*). It may be noted that in North Carolina it is provided in case of fires that there is to be a preliminary investigation by local authorities: all towns and cities have to make an annual inspection of buildings and a quarterly inspection within fire limits and report to the state insurance commissioner; all expenses so incurred are met by a tax of $\frac{1}{5}$% on the gross receipts of the

insurance companies (L. 1903, ch. 719).

INCENSE,[1] the perfume (fumigation) arising from certain resins and gum-resins, barks, woods, dried flowers, fruits and seeds, when burnt, and also the substances so burnt. In its literal meaning the word "incense" is one with the word "perfume," the aroma given off with the smoke (*per fumum*[2]) of any odoriferous substance when burnt. But, in use, while the meaning of the word "perfume" has been extended so as to include everything sweet in smell, from smoking incense to the invisible fresh fragrance of fruits and exquisite scent of flowers, that of the word "incense," in all the languages of modern Europe in which it occurs, has, by an opposite process of limitation, been gradually restricted almost exclusively to frankincense (see Frankincense). Frankincense has always been obtainable in Europe in greater quantity than any other of the aromatics imported from the East; it has therefore gradually come to be the only incense used in the religious rites and domestic fumigations of many countries of the West, and at last to be properly regarded as the only "true" or "genuine" (*i.e.* "franc") incense (see Littré's *Fr. Dict.* and Skeat's *Etym. Dict. of Engl. Lang.*).[3]

The following is probably an exhaustive list of the substances available for incense or perfume mentioned in the Hebrew Scriptures:—Algum or almug wood (almug in 1 Kings x. 11, 12; algum in 2 Chron. ii. 8, and ix. 10, 11), generally identified with sandalwood (*Santalum album*), a native of Malabar and Malaya; aloes, or lign aloes (Heb. *ahālim*, *ahālōth*), produced by the *Aloexylon Agallochum* (Loureiro), a native of Cochin-China, and *Aquilaria Agallocha* (Roxburgh), a native of India beyond the Ganges; balm (Heb. *tsorī*), the oleo-resin of *Balsamodendron opobalsamum* and *B. gileadense*; bdellium (Heb. *bdōlah*), the resin produced by *Balsamodendron roxburghii*, *B. Mukul* and *B. pubescens*, all natives of Upper India (Lassen, however, identifies *bdōlah* with musk); calamus (Heb. *kaneh*; sweet calamus, *keneh bosem*, Ex. xxx. 23; Ezek. xxvii. 19; sweet cane, *kaneh hattob*, Jer. vi. 20; Isa. xliii. 24), identified by Royle with the *Andropogon Calamus aromaticus* or roosa grass of India; cassia (Heb. *kiddah*) the *Cinnamomum Cassia* of China; cinnamon (Heb. *kinnamon*), the *Cinnamomum zeylanicum* of the Somali country, but cultivated largely in Ceylon, where also it runs wild, and in Java; costus (Heb. *ketzioth*), the root of the *Aucklandia Costus* (Falconer), native of Kashmir; frankincense (Heb. *lebōnah*), the gum-resin of *Bosiwellia Frereana* and *B. Bhau-Dajiana* of the Somali country, and of *B. Carterii* of the Somali country and the opposite coast of Arabia (see "The Genus Boswellia" by Sir George Birdwood, *Transactions of the Linnean Society*, xxi. 1871); galbanum (Heb. *helbenah*), yielded by *Opoidia galbanifera* (Royle) of Khorassan, and *Galbanum officinale* (Don) of Syria and other *Ferulas*; ladanum (Heb. *lōt*, translated "myrrh" in Gen. xxxvii. 25, xliii. 11), the resinous exudation of *Cistus creticus*, *C. ladaniferus* and other species of "rock rose" or "rose of Sharon"; myrrh (Heb. *mōr*), the gum-resin of the *Balsamodendron Myrrha* of the Somali country and opposite shore of Arabia; onycha (Heb. *sheḥeleth*), the celebrated odoriferous shell of the ancients, the operculum or "nail" of a species of *Strombus* or "wing shell," formerly well known in Europe under the name of *Blatta byzantina*; it is still imported into Bombay to burn with frankincense and other incense to bring out their odours more strongly; saffron (Heb. *karkōm*), the stigmata of *Crocus sativus*, a native originally of Kashmir; spikenard (Heb. *nerd*), the root of the *Nardostachys Jatamansi* of Nepal and Bhutan; stacte (Heb. *nataf*), generally referred to the *Styrax officinalis* of the Levant, but Hanbury has shown that no stacte or storax is now derived from *S. officinalis*, and that all that is found in modern commerce is the product of the *Liquidambar orientalis* of Cyprus and Anatolia.

Besides these aromatic substances named in the Bible, the following must also be enumerated on account of their common use as incense in the East; benzoin or gum benjamin, first mentioned among Western writers by Ibn Batuta (1325-1349) under the name of *lubân d' Javi* (*i.e.* olibanum of Java), corrupted in the parlance of Europe into benjamin and benzoin; camphor, produced by *Cinnamomum Camphora*, the "camphor laurel" of China and Japan, and by *Dryobalanops aromatica*, a native of the Indian Archipelago, and widely used as incense throughout the East, particularly in China; elemi, the resin of an unknown tree of the Philippine Islands, the elemi of old writers being the resin of *Boswellia Frereana*; gum-dragon or dragon's blood, obtained from *Calamus Draco*, one of the ratan palms of the Indian Archipelago, *Dracaena Draco*, a liliaceous plant of the Canary Island, and *Pterocarpus Draco*, a leguminous tree of the island of Socotra; rose-malloes, a corruption of the Javanese *rasamala*, or liquid storax, the resinous exudation of *Liquidambar Altingia*, a native of the Indian Archipelago (an American *Liquidambar* also produces a rose-malloes-like exudation); star anise, the starlike fruit of the *Illicum anisatum* of Yunan and south-western China, burnt as incense in the temples of Japan; sweet flag, the root of *Acorus Calamus*, the bach of the Hindus, much used for incense in India. An aromatic earth, found on the coast of Cutch, is used as incense in the temples of western India. The animal excreta, musk and civet, also enter into the composition of modern European pastils and *clous fumants*. Balsam of Tolu, produced by *Myroxylon toluiferum*, a native of Venezuela and New Granada; balsam of Peru, derived from *Myroxylon Pereirae*, a native of San Salvador in Central America; Mexican and Brazilian elemi, produced by various species of *Icica* or "incense trees," and the liquid exudation of an American species of *Liquidambar*, are all used as incense in America. Hanbury quotes a faculty granted by Pope Pius V. (August 2, 1571) to the bishops of the West Indies permitting the substitution of balsam of Peru for the balsam of the East in the preparation of the chrism to be used by the Catholic Church in America. The *Sangre del drago* of the Mexicans is a resin resembling dragon's blood obtained from a euphorbiaceous tree, *Croton Draco*.

Probably nowhere can the actual historical progress from the primitive use of animal sacrifices to the later refinement of burning incense be more clearly traced than in the pages of the Old Testament, where no mention of the latter rite occurs before the period of the Mosaic legislation; but in the monuments of ancient Egypt the authentic traces of the use of incense that still exist carry us back to a much earlier date. From Meroe to Memphis the commonest subject carved or painted in the interiors of the temples is that of some contemporary Phrah or Pharaoh worshipping the presiding deity with oblations of gold and silver vessels, rich vestments, gems, the firstlings of the flock and herd, cakes, fruits, flowers, wine, anointing oil

and incense. Generally he holds in one hand the censer, and with the other casts the pastils or osselets of incense into it: sometimes he offers incense in one hand and makes the libation of wine with the other. One of the best known of these representations is that carved on the memorial stone placed by Tethmosis (Thothmes) IV. (1533 B.C.) on the breast of the Sphinx at Gizeh.[4] The tablet represents Tethmosis before his guardian deity, the sun-god Rê, pouring a libation of wine on one side and offering incense on the other. The ancient Egyptians used various substances as incense. They worshipped Rê at sunrise with resin, at mid-day with myrrh and at sunset with an elaborate confection called *kuphi*, compounded of no fewer than sixteen ingredients, among which were honey, wine, raisins, resin, myrrh and sweet calamus. While it was being mixed, holy writings were read to those engaged in the operation. According to Plutarch, apart from its mystic virtues arising from the magical combination of 4 × 4, its sweet odour had a benign physiological effect on those who offered it.[5] The censer used was a hemispherical cup or bowl of bronze, supported by a long handle, fashioned at one end like an open hand, in which the bowl was, as it were, held, while the other end within which the pastils of incense were kept was shaped into the hawk's head crowned with a disk, as the symbol of Rê.[6] In embalming their dead the Egyptians filled the cavity of the belly with every sort of spicery except frankincense (Herod, ii. 86), for it was regarded as specially consecrated to the worship of the gods. In the burnt-offerings of male kine to Isis, the carcase of the steer, after evisceration, was filled with fine bread, honey, raisins, figs, frankincense, myrrh and other aromatics, and thus stuffed was roasted, being basted all the while by pouring over it large quantities of sweet oil, and then eaten with great festivity.

How important the consumption of frankincense in the worship of the gods became in Egypt is shown by two of its monuments, both of the greatest interest and value for the light they throw on the early history of the commerce of the Indian Ocean. One is an inscription in the rocky valley of Hammamat, through which the desert road from the Red Sea to the valley of Egypt opens on the green fields and palm groves of the river Nile near Coptos. It was cut on the rocks by an Egyptian nobleman named Hannu, who states that he was sent by Pharaoh Sankhkere, Menthotp IV., with a force gathered out of the Thebaid, from Coptos to the Red Sea, there to take command of a naval expedition to the Holy Land of Punt (Puoni), "to bring back odoriferous gums." Punt is identified with the Somali country, now known to be the native country of the trees that yield the bulk of the frankincense of commerce. The other bears the record of a second expedition to the same land of Punt, undertaken by command of Queen Hatshepsut, 1600 B.C. It is preserved in the vividly chiselled and richly coloured decorations portraying the history of the reign of this famous Pharaoh on the walls of the "Stage Temple" at Thebes. The temple is now in ruins, but the entire series of gorgeous pictures recording the expedition to "the balsam land of Punt," from its leaving to its returning to Thebes, still remains intact and undefaced.[7] These are the only authenticated instances of the export of incense trees from the Somali country until Colonel Playfair, then political agent at Aden, in 1862-1864, collected and sent to Bombay the specimens from which Sir George Birdwood prepared his descriptions of them for the Linnean Society in 1868. King Antigonus is said to have had a branch of the true frankincense tree sent to him.

Homer tells us that the Egyptians of his time were emphatically a nation of druggists (*Od.* iv. 229, 230). This characteristic, in which, as in many others, they so remarkably resemble the Hindus, the Egyptians have maintained to the present day; and, although they have changed their religion, the use of incense among them continues to be as familiar and formal as ever. The *kohl* or black powder with which the modern, like the ancient, Egyptian ladies paint their languishing eyelids, is nothing but the smeeth of charred frankincense, or other odoriferous resin brought with frankincense, and phials of water, from the well of Zem-zem, by the pilgrims returning from Mecca. They also melt frankincense as a depilatory, and smear their hands with a paste into the composition of which frankincense enters, for the purpose of communicating to them an attractive perfume. Herodotus (iv. 75) describes a similar artifice as practised by the women of Scythia (compare also Judith x. 3, 4). In cold weather the Egyptians warm their rooms by placing in them a brazier, "chafing-dish," or "standing-dish," filled with charcoal, whereon incense is burnt; and in hot weather they refresh them by occasionally swinging a hand censer by a chain through them—frankincense, benzoin and aloe wood being chiefly used for the purpose.[8]

In the authorized version of the Bible, the word "incense" translates two wholly distinct Hebrew words. In various passages in the latter portion of Isaiah (xl.-lxvi.), in Jeremiah and in Chronicles, it represents the Hebrew *lebōnah*, more usually rendered "frankincense"; elsewhere the original word is *ketoreth* (Ex. xxx. 8, 9; Lev. x. 1; Num. vii. 14, &c.), a derivative of the verb *kitter* (Pi.) or *hiktir* (Hiph.), which verb is used, not only in Ex. xxx. 7, but also in Lev. i. 9, iii. 11, ix. 13, and many other passages, to denote the process by which the "savour of satisfaction" in any burnt-offering, whether of flesh or of incense, is produced. Sometimes in the authorized version (as in 1 Kings iii. 3; 1 Sam. ii. 28) it is made to mean explicitly the burning of incense with only doubtful propriety. The expression "incense (*ketoreth*) of rains" in Ps. lxvi. 15 and the allusion in Ps. cxli. 2 ought both to be understood, most probably, of ordinary burnt-offerings.[9] The "incense" (*ketoreth*), or "incense of sweet scents" (*ketoreth sammim*), called, in Ex. xxx. 35, "a confection after the art of the apothecary," or rather "a perfume after the art of the perfumer," which was to be regarded as most holy, and the imitation of which was prohibited under the severest penalties, was compounded of four "sweet scents" (*sammim*),[10] namely stacte (*nataph*), onycha (*sheheleth*), galbanum (*helbenah*) and "pure" or "fine" frankincense (*lebōnah zaccah*), pounded together in equal proportions, with (perhaps) an admixture of salt (*memullah*).[11] It was then to be "put before the testimony" in the "tent of meeting." It was burnt on the altar of incense by the priest every morning when the lamps were trimmed in the Holy Place, and every evening when they were lighted or "set up" (Ex. xxx. 7, 8). A handful of it was also burnt once a year in the Holy of Holies by the high priest on a pan of burning coals taken from the altar of burnt-offering (Lev. xvi. 12, 13). Pure frankincense (*lebōnah*) formed part of the meat-offering (Lev. ii. 16, vi. 15), and was also presented along with the shew bread (Lev. xxiv. 7) every Sabbath day (probably on two golden saucers; see Jos. *Ant.* iii. 10, 7). The religious significance of the use of incense, or at least of its use in the Holy of Holies, is distinctly set forth in Lev. xvi. 12, 13.

The Jews were also in the habit of using odoriferous substances in connexion with the funeral obsequies of

distinguished persons (see 2 Chron. xvi. 14, xxi. 19; Jer. xxxiv. 5). In Amos vi. 10 “he that burneth him” probably means “he that burns perfumes in his honour.” References to the domestic use of incense occur in Cant. iii. 6; Prov. xxvii. 9; cf. vii. 17.

The “marbles” of Nineveh furnish frequent examples of the offering of incense to the sun-god and his consort (2 Kings xxiii. 5). The kings of Assyria united in themselves the royal and priestly offices, and on the monuments they erected they are generally represented as offering incense and pouring out wine to the Tree of Life. They probably carried the incense in the sacred bag so frequently seen in their hands and in those also of the common priests. According to Herodotus (i. 183), frankincense to the amount of 1000 talents’ weight was offered every year, during the feast of Bel, on the great altar of his temple in Babylon.

The monuments of Persepolis and the coins of the Sassanians show that the religious use of incense was as common in ancient Persia as in Babylonia and Assyria. Five times a day the priests of the Persians (Zoroastrians) burnt incense on their sacred fire altars. In the Avesta (*Vendidad*, Fargard xix. 24, 40), the incense they used is named *vohu gaono*. It has been identified with benzoin, but was probably frankincense. Herodotus (iii. 97) states that the Arabs brought every year to Darius as tribute 1000 talents of frankincense. The Parsees still preserve in western India the pure tradition of the ritual of incense as followed by their race from probably the most ancient times.

The *Ramayana* and *Mahabharata* afford evidence of the employment of incense by the Hindus, in the worship of the gods and the burning of the dead, from the remotest antiquity. Its use was obviously continued by the Buddhists during the prevalence of their religion in India, for it is still used by them in Nepal, Tibet, Ceylon, Burma, China and Japan. These countries all received Buddhism from India, and a large proportion of the porcelain and earthenware articles imported from China and Japan into Europe consists of innumerable forms of censers. The Jains all over India burn sticks of incense before their Jina. The commonest incense in ancient India was probably frankincense. The Indian frankincense tree, *Boswellia thurifera*, Colebrooke (which certainly includes *B. glabra*, Roxburgh), is a doubtful native of India. It is found chiefly where the Buddhist religion prevailed in ancient times, in Bihar and along the foot of the Himalayas and in western India, where it particularly flourishes in the neighbourhood of the Buddhist caves at Ajanta. It is quite possible therefore that, in the course of their widely extended commerce during the one thousand years of their ascendancy, the Buddhists imported the true frankincense trees from Africa and Arabia into India, and that the accepted Indian species are merely varieties of them. Now, however, the incense in commonest use in India is benzoin. But the consumption of all manner of odoriferous resins, gum resins, roots, woods, dried leaves, flowers, fruits and seeds in India, in social as well as religious observances, is enormous. The grateful perfumed powder *abir* or *randa* is composed either of rice, flour, mango bark or deodar wood, camphor and aniseed, or of sandalwood or wood aloes, and zerumbet, zedoary, rose flowers, camphor and civet. The incense sticks and pastils known all over India under the names of *ud-buti* (“benzoin-light”) or *aggar-ki-buti* (“wood aloes light”) are composed of benzoin, wood aloes, sandalwood, rock lichen, patchouli, rose-malloes, *talispat* (the leaf of *Flacourtia Cataphracta* of Roxburgh), mastic and sugar-candy or gum. The *abir* and *aggir butis* made at the Mahommedan city of Bijapur in the Mahratta country are celebrated all over western India. The Indian Mussulmans indeed were rapidly degenerating into a mere sect of Hindus before the Wahabi revival, and the more recent political propaganda in support of the false caliphate of the sultans of Turkey; and we therefore find the religious use of incense among them more general than among the Mahommedans of any other country. They use it at the ceremonies of circumcision, *bismillah* (teaching the child “the name of God”), virginity and marriage. At marriage they burn benzoin with *nim* seeds (*Melia Azadirachta*, Roxburgh) to keep off evil spirits, and prepare the bride-cakes by putting a quantity of benzoin between layers of wheaten dough, closed all round, and frying them in clarified butter. For days the bride is fed on little else. In their funeral ceremonies, the moment the spirit has fled incense is burnt before the corpse until it is carried out to be buried. The begging fakirs also go about with a lighted stick of incense in one hand, and holding out with the other an incense- 351
holder (literally, “incense chariot”), into which the coins of the pious are thrown. Large “incense trees” resembling our Christmas trees, formed of incense-sticks and pastils and osselets, and alight all over, are borne by the Shiah Mussulmans in the solennial procession of the Mohurrum, in commemoration of the martyrdom of the sons of Ali. The worship of the *tulsi* plant, or holy basil (*Ocymum sanctum*, Don), by the Hindus is popularly explained by its consecration to Vishnu and Krishna. It grows on the four-horned altar before the house, or in a pot placed in one of the front windows, and is worshipped every morning by all the female members of every Hindu household. It is possible that its adoration has survived from the times when the Hindus buried their dead in their houses, beneath the family hearth. When they came into a hot climate the fire of the sacrifices and domestic cookery was removed out of the house; but the dead were probably still for a while buried in or near it, and the *tulsi* was planted over their graves, at once for the salubrious fragrance it diffuses and to represent the burning of incense on the altar of the family Lar. The rich land round about the holy city of Pandharpur, sacred to Vithoba the national Mahratta form of (Krishna)-Vishnu, is wholly restricted to the cultivation of the tulsi plant.

As to the θύεα mentioned in Homer (*Il.* ix. 499, and elsewhere) and in Hesiod (*Works and Days*, 338), there is some uncertainty whether they were incense offerings at all, and if so, whether they were ever offered alone, and not always in conjunction with animal sacrifices. That the domestic use, however, of the fragrant wood θύον (the *Arbor vitae* or *Cailitris quadrivalvis* of botanists, the source of the resin sandarach) was known in the Homeric age, is shown by the case of Calypso (*Od.* v. 60), and the very similarity of the word θύον to θύος may be taken as almost conclusively proving that by that time the same wood was also employed for religious purposes. It is not probable that the sweet-smelling gums and resins of the countries of the Indian Ocean began to be introduced into Greece before the 8th or 7th century B.C., and doubtless λίβανος or λιβανωτός first became an article of extensive commerce only after the Mediterranean trade with the East had been opened up by the Egyptian king Psammetichus (*c.* 664-610 B.C.). The new Oriental word is frequently employed by Herodotus; and there are abundant references to the use of the thing among the writers of the golden age of Attic literature (see, for example, Aristophanes, *Plut.* 1114; *Frogs*, 871, 888; *Clouds*, 426; *Wasps*, 96, 861). Frankincense, however, though the most common, never became

the only kind of incense offered to the gods among the Greeks. Thus the Orphic hymns are careful to specify, in connexion with the several deities celebrated, a great variety of substances appropriate to the service of each; in the case of many of these the selection seems to have been determined not at all by their fragrance but by some occult considerations which it is now difficult to divine.

Among the Romans the use of religious fumigations long preceded the introduction of foreign substances for the purpose (see, for example, Ovid, *Fast.* i. 337 seq., "Et non exiguo laurus adusta sono"). Latterly the use of frankincense ("mascula thura," Virg. *Ecl.* viii. 65) became very prevalent, not only in religious ceremonials, but also on various state occasions, such as in triumphs (Ovid, *Trist*, iv. 2, 4), and also in connexion with certain occurrences of domestic life. In private it was daily offered by the devout to the *Lar familiaris* (Plaut. *Aulul.* prol. 23); and in public sacrifices it was not only sprinkled on the head of the victim by the pontifex before its slaughter, and afterwards mingled with its blood, but was also thrown upon the flames over which it was roasted.

No perfectly satisfactory traces can be found of the use of incense in the ritual of the Christian Church during the first four centuries.[12] It obviously was not contemplated by the author of the epistle to the Hebrews; its use was foreign to the synagogue services on which, and not on those of the temple, the worship of the primitive Christians is well known to have been originally modelled; and its associations with heathen solemnities, and with the evil repute of those who were known as "thurificati," would still further militate against its employment. Various authors of the ante-Nicene period have expressed themselves as distinctly unfavourable to its religious, though not of course to its domestic, use. Thus Tertullian, while (*De Cor. Mil.* 10) ready to acknowledge its utility in counteracting unpleasant smells ("si me odor alicujus loci offenderit, Arabiae aliquid incendo"), is careful to say that he scorns to offer it as an accompaniment to his heartfelt prayers (*Apol.* 30; cf. 42). Athenagoras also (*Legat.* 13) gives distinct expression to his sense of the needlessness of any such ritual ("the Creator and Father of the universe does not require blood, nor smoke, nor even the sweet smell of flowers and incense"); and Arnobius (*Adv. Gent.* vii. 26) seeks to justify the Christian neglect of it by the fact, for which he vouches, that among the Romans themselves incense was unknown in the time of Numa, while the Etruscans had always continued to be strangers to it. Cyril of Jerusalem, Augustine and the Apostolic Constitutions make no reference to any such feature either in the public or private worship of the Christians of that time. The earliest mention, it would seem, occurs in the Apostolic Canons (can. 3), where the θυμίαμα is spoken of as one of the requisites of the eucharistic service. It is easy to perceive how it should inevitably have come in along with the whole circle of ideas involved in such words as "temple," "altar," "priest," which about this time came to be so generally applied in ecclesiastical connexions. Evagrius (vi. 21) mentions the gift of a θυμιατήριον by the contemporary Chosroes of Persia to the church of Jerusalem; and all the Oriental liturgies of this period provide special prayers for the thurification of the eucharistic elements. The oldest *Ordo Romanus*, which perhaps takes us back to within a century of Gregory the Great, enjoins that in pontifical masses a sub-deacon, with a golden censer, shall go before the bishop as he leaves the secretarium for the choir, and two, with censers, before the deacon gospeller as he proceeds with the gospel to the ambo. And less than two centuries afterwards we read an order in one of the capitularies of Hincmar of Reims, to the effect that every priest ought to be provided with a censer and incense. That in this portion of their ritual, however, the Christians of that period were not universally conscious of its direct descent from Mosaic institutions may be inferred perhaps from the "benediction of the incense" used in the days of Charlemagne, which runs as follows: "May the Lord bless this incense to the extinction of every noxious smell, and kindle it to the odour of its sweetness." Even Thomas Aquinas (p. iii. qu. 83, art. 5) gives prominence to this idea.

The character and order of these historical notices of incense would certainly, were there nothing else to be considered, justify the conclusion hitherto generally adopted, that its use was wholly unknown in the worship of the Christian Church before the 5th century. On the other hand, we know that in the first Christian services held in the catacombs under the city of Rome, incense was burnt as a sanitary fumigation at least. Tertullian also distinctly alludes to the use of aromatics in Christian burial: "the Sabaeans will testify that more of their merchandise, and that more costly, is lavished on the burial of Christians, than in burning incense to the gods." And the whole argument from analogy is in favour of the presumption of the ceremonial use of incense by the Christians from the first. It is natural that little should be said of so obvious a practice until the fuller development of ritual in a later age. The slighting references to it by the Christian fathers are no more an argument against its existence in the primitive church than the similar denunciations by the Jewish prophets of burnt-offerings and sacrifices are any proof that there were no such rites as the offering of incense, and of the blood of bulls and fat of rams, in the worship of the temple at Jerusalem. There could be no real offence to Christians in the burning of incense. Malachi (i. 11) had already foretold the time when among the Gentiles, in every place, incense should be offered to God. Gold, with myrrh and frankincense were offered by the Persian Magi to the infant Jesus at his birth; and in Revelation viii. 3, 4, the image of the offering of incense with the prayers of the saints, before the throne of God, is not without its significance. If also the passage in Ambrose of Milan (on Luke i. 11), where he speaks of "us" as "adolentes altaria" is to be translated "incensing the altars," and taken literally, it is a testimony to the use of incense by the Christian Church in, at least, the 4th century. But the earliest express mention of the censing of the altar by Christian priests is in "the works," first quoted in the 6th century, attributed to "Dionysius the Areopagite," the contemporary of St Paul (Acts xvii. 34).

The Missal of the Roman Church now enjoins incensation before the introit, at the gospel and again at the offertory, and at the elevation, in every high mass; the use of incense also occurs at the exposition of the sacrament, at consecrations of churches and the like, in processions, in the office for the burial of the dead and at the exhibition of relics. On high festivals the altar is censed at vespers and lauds.

In the Church of England the use of incense was gradually abandoned after the reign of Edward VI., until the ritualistic revival of the present day. Its use, however, has never been abolished by law. A "Form for the Consecration of a Censer" occurs in Sancroft's *Form of Dedication and Consecration of a Church or Chapel* (1685). In various works of reference (as, for example, in *Notes and Queries*, 3rd ser. vol. viii. p. 11) numerous sporadic cases are mentioned in which incense appears to have been burnt in churches; the

evidence, however, does not go so far as to show that it was used during divine service, least of all that it was used during the communion office. At the coronation of George III., one of the king's grooms appeared "in a scarlet dress, holding a perfuming pan, burning perfumes, as at previous coronations."

In 1899, on the appeal of the Rev. H. Westall, St Cuthbert's, London, and the Rev. E. Ram, St John's, Norwich, against the use of incense in the Church of England, the archbishops of Canterbury (Dr Temple) and York (Dr Maclagan) supported the appeal. Their decision was reviewed by Chancellor L. T. Dibdin in the 10th edition of the *Encyclopaedia Britannica*, and the exposition given by Sir Lewis Dibdin of the whole question of the use of incense in the Church of England may here be interpolated.

(G. B.)

Incense in the Church of England.—Mr Scudamore (*Notitia Eucharistica*, 2nd ed. pp. 141-142) thus describes the method and extent of the employment of incense at the mass prior to the Reformation:—

> "According to the use of Sarum (and Bangor) the priest, after being himself censed by the deacon, censed the altar before the Introit began. The York rubric directed him to do it immediately alter the first saying of the Introit, which in England was thrice said. The Hereford missal gives no direction for censing the altar at that time. The middle of the altar was censed, according to Sarum, Bangor and Hereford, before the reading of the Gospel. According to Sarum and Bangor, the thurible, as well as the lights, attended the Gospel to the lectern. Perhaps the York rubric implies that this was done when it orders (which the others do not) the thurible to be carried round the choir with the Gospel while the Creed was being sung. In the Sarum and Bangor, the priest censed the oblations after offering them; then the space between himself and the altar. He was then, at Sarum, censed by the deacon, and an acolyte censed the choir; at Bangor the *Sinistrum Cornu* of the altar and the relics were censed instead. York and Hereford ordered no censing at the offertory. There is reason to think that, notwithstanding the order for the use of incense at every celebration, it was in practice burnt only on high festivals, and then only in rich churches, down to the period of the Reformation. In most parishes its costliness alone would preclude its daily use, while the want of an assistant minister would be a very common reason for omitting the rite almost everywhere. Incense was not burnt in private masses, so that the clergy were accustomed to celebrations without it, and would naturally forego it on any plausible ground."

The ritual of the mass remained unchanged until the death of Henry VIII. (Jan. 28, 1547). In March 1548 the *Order of the Communion* was published and commanded to be used by royal proclamation in the name of Edward VI. It was the precursor of the Prayer Book, and supplemented the accustomed Latin service by additions in English to provide for the communion of the people in both kinds. But it was expressly stated in a rubric that the old service of the mass was to proceed without variation of any rite or ceremony until after the priest had received the sacrament, that is, until long after the last of the three occasions for the use of incense explained above. But on Whitsunday 1549 the first Prayer Book of Edward VI. came into use under an Act of Parliament (2 and 3 Ed. VI. ch. 1, the first Act of Uniformity) which required its exclusive use in public worship so as to supersede all other forms of service. Another Act, 3 and 4 Ed. VI. ch. 10, required the old service books to be delivered up to be destroyed. The first Prayer Book does not contain any direction to use or any mention of incense. It has been and still is a keenly controverted question whether incense did or did not continue to be in ceremonial use under the first Prayer Book or during the rest of Edward VI.'s reign. No evidence has hitherto been discovered which justifies us in answering this question in the affirmative. The second Prayer Book of Edward VI. (1552), published under the authority of the second Act of Uniformity (5 and 6 Ed. VI. ch. 1), contains no reference to incense. Edward VI. died on the 6th July 1553. Queen Mary by statute (1 Mary, sess. 2, ch. 2) abolished the Prayer Book, repealed the Acts of Uniformity and restored "divine service and administration of sacraments as were most commonly used in England in the last year of Henry VIII." The ceremonial use of incense thus became again an undoubted part of the communion service in the Church of England. A proclamation issued (December 6, 1553) directed the churchwardens to obtain the proper ornaments for the churches; and the bishops (at any rate Bishop Bonner, see *Visitation Articles 1554*, Cardwell's *Doc. Ann.* i. 149-153) in their visitations inquired whether censers had been furnished for use. Mary died on the 17th of November 1558. On the 24th of June 1559 the second Prayer Book of Edward VI. (with a few alterations having no reference to incense) was again established, under the authority of the third Act of Uniformity (1 Eliz. ch. 2), as the exclusive service book for public service. There is no evidence of the ceremonial use of incense under Elizabeth's Prayer Book, or under the present Prayer Book of 1662 (established by the fourth Act of Uniformity, 13 and 14 Charles II. ch. 4) until the middle of the 19th century; and there is no doubt that as a ceremony of divine worship, whether at the Holy Communion or at other services, it was entirely disused. There are, however, a good many instances recorded of what has been called a fumigatory use of frankincense in churches, by which it was sought to purify the air, in times of public sickness, or to dispel the foulness caused by large congregations, or poisonous gases arising from ill-constructed vaults under the church floor. It seems also to have been used for the purpose of creating an agreeable perfume on great occasions, *e.g.* the great ecclesiastical feasts. But this use of incense must be carefully distinguished from its ceremonial use. It was utilitarian and not symbolical, and from the nature of the purpose in view must have taken place before, rather than during, service. Of the same character is the use of incense carried in a perfuming pan before the sovereign at his coronation in the procession from Westminster Hall to the Abbey. This observance was maintained from James II.'s coronation to that of George III. In the general revival of church ceremonial which accompanied and followed the Oxford Movement incense was not forgotten, and its ceremonial use in the pre-Reformation method has been adopted in a few extreme churches since 1850. Its use has been condemned as an illegal ceremony by the ecclesiastical courts. In 1868 Sir Robert Phillimore (Dean of the Arches) pronounced the ceremonial use of incense to be illegal in the suit of *Martin* v. *Mackonochie* (2 A. and E.L.R. 116). The case was carried to the Privy Council on appeal, but there was no appeal on the question of incense. Again, in 1870, the ceremonial use of incense was condemned by Sir Robert Phillimore in the suit of *Sumner* v. *Wix* (3 A. and E. L.R. 58).

Notwithstanding these decisions, it was insisted by those who defended the revival of the ceremonial use of incense that it was a legal custom of the Church of England. The question was once more elaborately argued in May 1899 before an informal tribunal consisting of the archbishop of Canterbury (Dr. Temple)

and the archbishop of York (Dr. Maclagan), at Lambeth Palace. On the 31st of July 1899 the archbishops decided that the liturgical use of incense was illegal. The Lambeth "opinion," as it was called, failed to convince the clergy against whom it was directed any better than the judgments of the ecclesiastical courts, but at first a considerable degree of obedience to the archbishops' view was shown. Various expedients were adopted, as, *e.g.*, the use of incense just before the beginning of service, by which it was sought to retain incense without infringing the law as laid down by the archbishops. There remained, nevertheless, a tendency on the part of the clergy who used incense, or desired to do so, to revert to the position they occupied before the Lambeth hearing—that is, to insist on the ceremonial use of incense as a part of the Catholic practice of the Church of England which it is the duty of the clergy to maintain, notwithstanding the decisions of ecclesiastical judges or the opinions or archbishops to the contrary.

(L. T. D.)

Manufacture.—For the manufacture of the incense now used in the Christian churches of Europe there is no fixed rule. The books of ritual are agreed that Ex. xxx. 34 should be taken as a guide as much as possible. It is recommended that frankincense should enter as largely as possible into its composition, and that if inferior materials be employed at all they should not be allowed to preponderate. In Rome olibanum alone is employed; in other places benzoin, storax, lign, aloes, cascarilla bark, cinnamon, cloves and musk are all said to be occasionally used. In the Russian Church, benzoin is chiefly employed. The Armenian liturgy, in its benediction of the incense, speaks of "this perfume prepared from myrrh and cinnamon."

The preparation of pastils of incense has probably come down in a continuous tradition from ancient Egypt, Babylonia and Phoenicia. Cyprus was for centuries famous for their manufacture, and they were still known in the middle ages by the names of pastils or osselets of Cyprus.

Maimonides, in his *More Nevochim*, states that the use of incense in the worship of the Jews originated as a corrective of the disagreeable odours arising from the slaughter and burning of the animals offered in sacrifice. There can be no doubt that its use throughout the East is based on sanitary considerations; and in Europe even, in the time when the dead were buried in the churches, it was recognized that the burning of incense served essentially to preserve their salubrity. But evidently the idea that the odour of a burnt-offering (cf. the κνίσης ἡδὺς ἀυτμή of *Odyss.* xii. 369) is grateful to the deity, being indeed the most essential part of the sacrifice, or at least the vehicle by which alone it can successfully be conveyed to its destination, is also a very early one, if not absolutely primitive; and survivals of it are possibly to be met with even among the most highly cultured peoples where the purely symbolical nature of all religious ritual is most clearly understood and maintained. Some such idea plainly underlies the familiar phrase "a sweet savour," more literally "a savour of satisfaction," whereby an acceptable offering by fire is so often denoted in the Bible (Gen. viii. 21; Lev. i. 9, *et passim*; cf. Eph. v. 2). It is easy to imagine how, as men grew in sensuous appreciation of pleasant perfumes, and in empirical knowledge of the sources from which these could be derived, this advance would naturally express itself, not only in their domestic habits, but also in the details of their religious ceremonial, so that the custom of adding some kind of incense to their animal sacrifices, and at length that of offering it pure and simple, would inevitably arise. Ultimately, with the development of the spiritual discernment of men, the "offering of incense" became a mere symbolical phrase for prayer (see Rev. v. 8, viii. 3, 4). Clement of Alexandria expresses this in his well-known words: "The true altar of incense is the just soul, and the perfume from it is holy prayer." (So also Origen, *Cont. Cels.* viii. 17, 20.) The ancients were familiar with the sanitary efficacy of fumigations. The energy with which Ulysses, after the slaughter of the suitors, calls to Euryclea for "fire and sulphur" to purge (literally "fumigate") the dining-hall from the pollution of their blood (*Od.* xxii. 481, 482) would startle those who imagine that sanitation is a peculiarly modern science. There is not the slightest doubt that the censing of things and persons was first practised as an act of purification, and thus became symbolical of consecration, and finally of the sanctification of the soul. The Egyptians understood the use of incense as symbolical of the purification of the soul by prayer. Catholic writers generally treat it as typifying contrition, the preaching of the Gospel, the prayers of the faithful and the virtues of the saints.

(G. B.)

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1 *Incensum* (or *incensum thuris*) from *incendere*; Ital. and Port. *incenso*; Span. *incienso*; Fr. *encens*. The substantive occurs in an inscription of the Arvalian brotherhood (Marini, *Gli Atti e Monumenti de' fratelli Arvali*, p. 639), but is frequent only in ecclesiastical Latin. Compare the classical *suffimentum* and *suffitus* from *suffio*. For "incense" Ulfila (Luke i. 10, 11) has retained the Greek θυμίαμα (thymiama); all the Teutonic names (Ger. *Weihrauch*; Old Saxon *Wîrôc*; Icel. *Reykelsi*; Dan. *Rögelse*) seem to belong to the Christian period (Grimm, *Deutsche Mythologie*, i. 50).

2 The etymological affinities of θύω, θύος, *thus*, *fuffio*, *funus*, and the Sans. *dhuma* are well known. See Max Müller, *Chips*, i. 99.

3 Classical Latin has but one word (*thus* or *tus*) for all sorts of incense. *Libanus*, for frankincense, occurs only in the Vulgate. Even the "ground frankincense" or "ground pine" (*Ajuga chamaepitys*) was known to the Romans as *Tus terrae* (Pliny), although they called some plant, from its smelling like frankincense, *Libanotis*, and a kind of Thasian wine, also from its fragrance, *Libanios*. The Latino-barbaric word *Olibanum* (quasi *Oleum Libani*), the common name for frankincense in modern commerce, is used in a bull of Pope Benedict IX. (1033). It may here be remarked that the name "European frankincense" is applied to *Pinus Taeda*, and to the resinous exudation ("Burgundy pitch") of the Norwegian spruce firs (*Abies excelsa*). The "incense tree" of America is the *Icica guianensis*, and the "incense wood" of the same continent *I. heptaphylla*.

4 Brugsch, *Egypt under the Pharaohs*, i. 77-81, 414-419.

5 Plutarch, *De Iside et Osiride*, c. 52. In Parthey's edition (Berlin, 1850) other recipes for the manufacture of *kuphi*, by Galen and Dioscorides, are given; also some results of the editor's own experiments.

6 Wilkinson, *Ancient Egyptians*, i. 493; ii. 49, 398-400, 414-416.

7 Brugsch, *Egypt under the Pharaohs*, i. 303-312.

8 See Lane, *Mod. Egyptians*, pp. 34, 41, 139, 187, 438 (ed. 1860).

9 See Wellhausen, *Gesch. Israels*, i. 70 sqq., who from philological and other data infers the late date of the introduction of incense into the Jewish ritual.

10 According to Philo (*Opera*, i. 504, ed. Mangey), they symbolized respectively water, earth, air and fire.

11 Other accounts of its composition, drawn from Rabbinical sources, will be found in various works on Jewish antiquities; see, for example, Reland, *Antiq. Sacr. vet. Hebr.* pp. 39-41 (1712).

12 This guarded statement still holds good. Compare Duchesne, *Christian Worship* (Eng. trans., 1904), ch. ii., "The Mass in the East," v. "The Books of the Latin Rite," and xii. "The Dedication of Churches."

INCEST (Lat. *incestus*, unchaste), sexual intercourse between persons so related by kindred or affinity that legal marriage cannot take place between them (see MARRIAGE, especially the section *Canon Law*). In England incest formerly was not generally treated as a crime, although, along with other offences against morals, it was made punishable by death in 1650. Since the Restoration it had, to use Blackstone's phrase, been left to the "feeble coercion of the spiritual courts," but bills to make it a criminal offence have at various times been unsuccessfully introduced in Parliament. In 1908 however, an act (The Punishment of Incest Act 1908) was passed, under which sexual intercourse of a male with his grand-daughter, daughter, sister or mother is made punishable with penal servitude for not less than 3 or more than 7 years, or with imprisonment for not more than two years with or without hard labour. It is immaterial that the sexual intercourse was had with the consent of the female; indeed, by s. 2 a female who consents is on conviction liable to the same punishment as the male. The act also makes an attempt to commit the offence of incest a misdemeanour, punishable by imprisonment for not more than two years with or without hard labour. The terms "brother" and "sister" include half-brother and half-sister, whether the relationship is or is not traced through lawful wedlock. All proceedings under the act are held *in camera* (s. 5). The act does not apply to Scotland, incest being punishable in Scots law. Under the Matrimonial Causes Act 1857, s. 27, incestuous adultery is *per se* sufficient ground to entitle a wife to divorce her husband. The Deceased Wife's Sister's Marriage Act 1907, s. 3, retained wives' sisters in the class of persons with whom adultery is incestuous. In the law of Scotland, it was, until the Criminal Procedure (Scotland) Act 1887, a crime nominally punishable with death, but the penalty usually inflicted was penal servitude for life. This sentence was actually pronounced on a man in 1855. In the United States incest is not an indictable offence at common law, but, generally speaking, it has been made punishable by fine and imprisonment by state legislation. It is also a punishable offence in some European countries, notably Germany, Austria and Italy.

INCH (O. Eng. *ynce* from Lat. *uncia*, a twelfth part; cf. "ounce," and see As), the twelfth part of a linear foot. As a measure of rainfall an "inch of rain" is equivalent to a fall of a gallon of water spread over a surface of about 2 sq. ft., or 100 tons to an acre.

INCHBALD, MRS ELIZABETH (1753-1821), English novelist, playwright and actress, was born on the 15th of October 1753 at Standingfield, Suffolk, the daughter of John Simpson, a farmer. Her father died when she was eight years old. She and her sisters never enjoyed the advantages of school or of any regular supervision in their studies, but they seem to have acquired refined and literary tastes at an early age. Ambitious to become an actress, a career for which an impediment in her speech hardly seemed to qualify her, she applied in vain for an engagement; and finally, in 1772, she abruptly left home to seek her fortune in London. Here she married Joseph Inchbald (d. 1779), an actor, and on the 4th of September made her début in Bristol as Cordelia, to his Lear. For several years she continued to act with him in the provinces. Her rôles included Anne Boleyn, Jane Shore, Calista, Calpurnia, Lady Anne in *Richard III.*, Lady Percy, Lady Elizabeth Grey, Fanny in *The Clandestine Marriage*, Desdemona, Aspasia in *Tamerlane*, Juliet and Imogen; but notwithstanding her great beauty and her natural aptitude for acting, her inability to acquire rapid and easy utterance prevented her from attaining to more than very moderate success. After the death of her husband she continued for some time on the stage; making her first London appearance at Covent Garden as Bellario in *Philaster* on the 3rd of October 1780. Her success, however, as an author led her to retire in 1789. She died at Kensington House on the 1st of August 1821.

Mrs. Inchbald wrote or adapted nineteen plays, and some of them, especially *Wives as They Were and Maids as They Are* (1797), were for a time very successful. Among the others may be mentioned *I'll tell you What* (translated into German, Leipzig, 1798); *Such Things Are* (1788); *The Married Man*; *The Wedding Day*; *The Midnight Hour*; *Everyone has his Fault*; and *Lover's Vows*. She also edited a collection of the *British Theatre*, with biographical and critical remarks (25 vols., 1806-1809); a *Collection of Farces* (7 vols., 1809); and *The Modern Theatre* (10 vols., 1809). Her fame, however, rests chiefly on her two novels: *A Simple Story* (1791), and *Nature and Art* (1796). These works possess many minor faults and inaccuracies, but on the whole their style is easy, natural and graceful; and if they are tainted in some degree by a morbid and exaggerated sentiment, and display none of that faculty of creation possessed by the best writers of

fiction, the pathetic situations, and the deep and pure feeling pervading them, secured for them a wide popularity.

Mrs Inchbald destroyed an autobiography for which she had been offered £1000 by Phillips the publisher; but her *Memoirs*, compiled by J. Boaden, chiefly from her private journal, appeared in 1833 in two volumes. An interesting account of Mrs Inchbald is contained in *Records of a Girlhood*, by Frances Ann Kemble (1878). Her portrait was painted by Sir Thomas Lawrence.

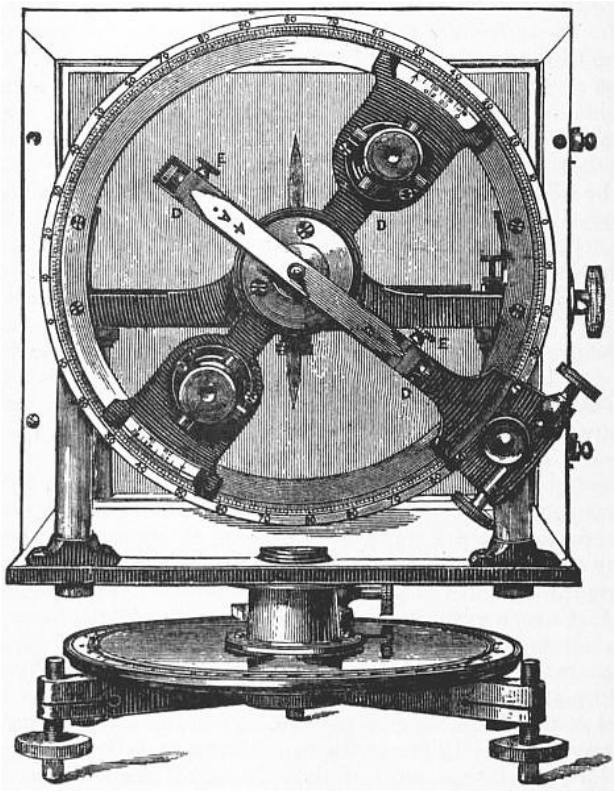
INCHIQUIN, MURROUGH O'BRIEN, 1st Earl of (*c.* 1614-1674), Irish soldier and statesman, was the son of Dermod O'Brien, 5th Baron Inchiquin (d. 1624). He belonged to a great family which traced its descent to Brian Boroimhe, king of Ireland, and members of which were always to the forefront in Irish public life. The first baron of Inchiquin was another Murrough O'Brien (d. 1551) who, after having made his submission to Henry VIII., was created baron of Inchiquin and earl of Thomond in 1543. When Murrough died in November 1551 by a curious arrangement his earldom passed to his nephew Donogh, son of Conor O'Brien (d. 1539), the last independent prince of Thomond (see Thomond, Earls of), leaving only his barony to be inherited by his son Dermod (d. 1557), the ancestor of the later barons of Inchiquin.

Murrough O'Brien, who became 6th baron of Inchiquin in 1624, gained some military experience in Italy, and then in 1640 was appointed vice-president of Munster. He took an active and leading part in suppressing the great Irish rebellion which broke out in the following year, and during the Civil War the English parliament made him president of Munster. Early in 1648, however, he declared, for his former master Charles I., and for about two years he sought to uphold the royalist cause in Ireland. In 1654 Charles II. made him an earl. His later years were partly spent in France and in Spain, but he had returned to Ireland when he died on the 9th of September 1674.

His son William, the 2nd earl (*c.* 1638-1692), served under his father in France and Spain, and for six years was governor of Tangier. He was a partisan of William III. in Ireland, and in 1690 he became governor of Jamaica where he died in January 1692. In 1800 his descendant Murrough, the 5th earl (d. 1808), was created marquess of Thomond, but on the death of James, the 3rd marquess, in July 1855 both the marquessate and the earldom became extinct. The barony of Inchiquin, however, passed to a kinsman, Sir Lucius O'Brien, Bart. (1800-1872), a descendant of the first baron and a brother of William Smith O'Brien (*q.v.*).

INCLEDON, CHARLES BENJAMIN (1763-1826), English singer, son of a doctor in Cornwall, began as a choir-boy at Exeter, but then went into the navy. His fine tenor voice, however, attracted general attention, and in 1783 he determined to seek his fortune on the stage. After various provincial appearances he made a great success in 1790 at Covent Garden, and thenceforth was the principal English tenor of his day. He sang both in opera and in oratorio, but his chief popularity lay in his delivery of ballads, such as "Sally in our Alley," "Black-eyed Susan," "The Arethusa," and anything of a bold and manly type. He toured in America in 1817; and on retiring in 1822 from the operatic stage, he travelled through the provinces with an entertainment called "The Wandering Melodist." He died of paralysis at Worcester on the 11th of February 1826.

INCLINOMETER (Dip Circle). Two distinct classes of instruments are used for measuring the dip (see Magnetism, Terrestrial) or inclination of the earth's magnetic field to the horizontal, namely (1) dip circles, and (2) induction inclinometers or earth inductors.



Dip Circles.—In the case of the dip circle the direction of the earth's magnetic field is obtained by observing the position of the axis of a magnetized needle so supported as to be free to turn about a horizontal axis passing through its centre of gravity. The needles now used consist of flat lozenge-shaped pieces of steel about 9 cm. long and 0.1 cm. thick, and weigh about 4.1 grams. The axle, which is made of hard steel, projects on either side of the needle and has a diameter of about 0.05 cm. Needles considerably larger than the above have been used, but experience showed that the values for the dip observed with needles 23 cm. long, was about 1' less than with the 9 cm. needles, and A. Schuster (*Phil. Mag.*, 1891 [5], 31, p. 275) has shown that the difference is due to the appreciable bending of the longer needles owing to their weight.

When in use the dip needle is supported on two agate knife-edges, so that its axle is on the axis of a vertical divided circle, on which the positions of the ends of the needle are either directly observed by means of two reading lenses, in which case the circle is generally divided into thirds of a degree so that it can by estimation be read to about two minutes, or a cross arm carries two small microscopes and two verniers, the cross wires of each microscope being adjusted so as to bisect the image of the corresponding end of the needle. Two **V**-shaped lifters actuated by a handle serve to raise the needle from the agates, and when lowered assure the axle being at the centre of the vertical circle. The supports for the needle, and a box to protect the needle from draughts, as well as the vertical circle, can be rotated about a vertical axis, and their azimuth read off on a horizontal divided circle. There are also two adjustable stops which can be set in any position, and allow the upper part of the instrument to be rotated through exactly 180° without the necessity of reading the horizontal circle.

When making a determination of the dip with the dip circle, a number of separate readings have to be made in order to eliminate various instrumental defects. Thus, that side of the needle on which the number is engraved being called the face of the needle, and that side of the protecting box next the vertical circle the face of the instrument, both ends of the needle are observed in the following relative positions, the instrument being in every case so adjusted in azimuth that the axle of the needle points magnetic east and west:—

i. Face of instrument east and face of needle next to face of instrument;

ii. Face of instrument west and face of needle next to face of instrument;

iii. Face of instrument west and face of needle away from face of instrument;

iv. Face of instrument east and face of needle away from face of instrument.

Next the direction of magnetization of the needle is reversed by stroking it a number of times with two strong permanent magnets, when the other end of the needle dips and the above four sets of readings are repeated. The object in reading both ends of the needle is to avoid error if the prolongation of the axle of the needle does not pass through the centre of the vertical circle, as also to avoid error due to the eccentricity of the arm which carries the reading microscopes and verniers. The reversal of the instrument between (i.) and (ii.) and between (iii.) and (iv.) is to eliminate errors due to (*a*) the line joining the zeros of the vertical circle not being exactly horizontal, and (*b*) the agate knife-edges which support the needle not being exactly horizontal. The reversal of the needle between (ii.) and (iii.) is to eliminate errors due to (*a*) the magnetic axis of the needle not coinciding with the line joining the two points of the needle, and (*b*) to the centre of gravity of the needle being displaced from the centre of the axle in a direction at right angles to the length of the needle. The reversal of the poles of the needle is to counteract any error produced by the centre of

gravity of the needle being displaced from the centre of the axle in a direction parallel to the length of the needle.

For use at sea the dip circle was modified, by Robert Were Fox (*Annals of Electricity*, 1839, 3, p. 288), who used a needle having pointed axles, the points resting in jewelled holes carried by two uprights, so that the movement of the ship does not cause the axle of the needle to change its position with reference to the vertical divided circle. To counteract the tendency of the axle to stick in the bearings, the instrument is fitted with a knob on the top of the box protecting the needle, and when a reading is being taken this knob is rubbed with an ivory or horn disk, the surface of which is corrugated. In this way a tremor is caused which is found to assist the needle in overcoming the effects of friction, so that it takes up its true position. In the Creak modification of the Fox dip circle, the upper halves of the jewels which form the bearings are cut away so that the needle can be easily removed, and thus the reversals necessary when making a complete observation can be performed (see also Magneto-Meter).

Induction Inclinometers.—The principle on which induction inclinometers depend is that if a coil of insulated wire is spun about a diameter there will be an alternating current induced in the coil, unless the axis about which it turns is parallel to the lines of force of the earth's field. Hence if the axis about which such a coil spins is adjusted till a sensitive galvanometer connected to the coil through a commutator, by which the alternating current is converted into a direct current, is undeflected, then the axis must be parallel to the lines of force of the earth's field, and hence the inclination of the axis to the horizontal is the dip. The introduction and perfection of this type of inclinometer is almost entirely due to H. Wild. His form of instrument for field observations[1] consists of a coil 10 cm. in diameter, containing about 1000 turns of silk-covered copper wire, the resistance being about 40 ohms, which is pivoted inside a metal ring. This ring can itself rotate about a horizontal axle in its own plane, this axle being at right angles to that about which the coil can rotate. Attached to the axle of the ring is a divided circle, by means of which and two reading microscopes the inclination of the axis of rotation of the coil to the horizontal can be read. The bearings which support the horizontal axle of the ring are mounted on a horizontal annulus which can be rotated in a groove attached to the base of the instrument, as so to allow the azimuth of the axle of the ring, and hence also that of the plane in which the axis of the coil can move, to be adjusted. The coil is rotated by means of a flexible shaft worked by a small cranked handle and a train of gear wheels. The terminals of the coil are taken to a two-part commutator of the ordinary pattern on which rest two copper brushes which are connected by flexible leads to a sensitive galvanometer. The inclination of the axis of the coil can be roughly adjusted by hand by rotating the supporting ring. The final adjustment is made by means of a micrometer screw attached to an arm which is clamped on the axle of the ring.

When making a measurement the azimuth circle is first set horizontal, a striding level placed on the trunnions which carry the ring being used to indicate when the adjustment is complete. The striding level is then placed on the axle which carries the coil, and when the bubble is at the centre of the scale the microscopes are adjusted to the zeros of the vertical circle. A box containing a long compass needle and having two feet with inverted V's is placed to rest on the axle of the coil, and the instrument is turned in azimuth till the compass needle points to a lubber line on the box. By this means the axis of the coil is brought into the magnetic meridian. The commutator being connected to a sensitive galvanometer, the coil is rotated, and the ring adjusted till the galvanometer is undeflected. The reading on the vertical circle then gives the dip. By a system of reversals slight faults in the adjustment of the instrument can be eliminated as in the case of the dip circle. With such an instrument it is claimed that readings of dip can be made accurate to ±0.1 minutes of arc.

The form of Wild inductor for use in a fixed observatory differs from the above in that the coil consists of a drum-wound armature, but without iron, of which the length is about three times the diameter. This armature has its axle mounted in a frame attached to the sloping side of a stone pillar, so that the axis of rotation is approximately parallel to the lines of force of the earth's field. By means of two micrometer screws the inclination of the axis to the magnetic meridian and to the horizontal can be adjusted. The armature is fitted with a commutator and a system of gear wheels by means of which it can be rapidly rotated. The upper end of the axle carries a plane mirror, the normal to which is adjusted parallel to the axis of rotation of the armature. A theodolite is placed on the top of the pillar and the telescope is turned so that the image of the cross-wires, seen by reflection in the mirror, coincides with the wires themselves. In this way the axis of the theodolite telescope is placed parallel to the axis of the armature, and hence the dip can be read off on the altitude circle of the theodolite.

Authorities.—In addition to the references already given the following papers may be consulted: (1) *Admiralty Manual of Scientific Inquiry*, which contains directions for making observations with a dip circle; (2) Stewart and Gee, *Elementary Practical Physics*, which contains a full description of the dip circle and instructions for making a set of observations; (3) L. A. Bauer, *Terrestrial Magnetism* (1901), 6, p. 31, a memoir which contains the results of a comparison of the values for the dip obtained with a number of different circles; (4) E. Leyst, *Repertorium für Meteorologie der kaiserl. Akad. der Wiss.* (St Petersburg, 1887), 10, No. 5, containing a discussion of the errors of dip circles; (5) H. Wild, *Bull. de l'Acad. Imp. des Sci. de St Pétersbourg* (March 1895), a paper which considers the accuracy obtainable with the earth inductor.

(W. Wn.)

1 *Repertorium für Meteorologie der kaiserl. Akad. der Wissensch.* (St Petersburg, 1892), 16, No. 2, or *Meteorolog. Zeits.* (1895), 12, p. 41.

INCLOSURE, or ENCLOSURE, in law, the fencing in of waste or common lands by the lord of the manor for the purpose of cultivation. For the history of the inclosure of such lands, and the legislation, dating from 1235, which deals with it, see COMMONS.

IN COENA DOMINI, a papal bull, so called from its opening words, formerly issued annually on Holy Thursday (in Holy Week), or later on Easter Monday. Its first publication was in 1363. It was a statement of ecclesiastical censure against heresies, schisms, sacrilege, infringement of papal and ecclesiastical privileges, attacks on person and property, piracy, forgery and other crimes. For two or three hundred years it was varied from time to time, receiving its final form from Pope Urban VIII. in 1627. Owing to the opposition of the sovereigns of Europe both Protestant and Catholic, who regarded the bull as an infringement of their rights, its publication was discontinued by Pope Clement XIV. in 1770.

INCOME TAX, in the United Kingdom a general tax on income derived from every source. Although a graduated tax on income from certain fixed sources was levied in 1435 and again in 1450, it may be said that the income tax in its present form dates in England from its introduction by W. Pitt in 1798 "granting to His Majesty an aid and contribution for the prosecution of the war." This act of 1798 merely increased the duties of certain assessed taxes, which were regulated by the amount of income of the person assessed, provided his income amounted to £60 or upwards. These duties were repealed by an act of 1799 (39 Geo. III. c. 13), which imposed a duty of 10% on all incomes from whatever sources derived, incomes under £60 a year being exempt, and reduced rates charged on incomes between that amount and £200 a year. The produce of this tax was £6,046,624 for the first year, as compared with £1,855,996, the produce of the earlier tax. This income tax was repealed after the peace of Amiens, but the renewal of the war in 1803 caused its revival. At the same time was introduced the principle of "collection at the source" (*i.e.* collection before the income reaches the person to whom it belongs), which is still retained in the English Revenue system, and which, it has been said, is mainly responsible for the present development of income tax and the ease with which it is collected. The act of 1803 (43 Geo. III. c. 122) distributed the various descriptions of income under different schedules, known as A, B, C, D and E. A rate of 5% was imposed on all incomes of £150 a year and over, with graduation on incomes between £60 and £150. This income tax of 5% collected at the source yielded almost as much as the previous tax of 10% collected direct from each taxpayer. The tax was continued from year to year with the principle unchanged but with variations in the rate until the close of the war in 1815, when it was repealed. It was, during its first imposition, regarded as essentially a war tax, and in later days, when it was reimposed, it was always considered as an emergency tax, to be levied only to relieve considerable financial strain, but it has now taken its place as a permanent source of national income, and is the most productive single tax in the British financial system. The income tax was revived in 1842 by Sir R. Peel, not as a war tax, but to enable him to effect important financial reforms (see TAXATION). Variations both in the rate levied and the amount of income exempted have taken place from time to time, the most important, probably, being found in the Finance Acts of 1894, 1897, 1898, 1907 and 1909-1910.

It will be useful to review the income tax as it existed before the important changes introduced in 1909. It was, speaking broadly, a tax levied on all incomes derived from sources within the United Kingdom, or received by residents in the United Kingdom from other sources. Incomes under £160 were exempt; an abatement allowed of £160 on those between £160 and £400; of £150 on those between £400 and £500; of £120 on those between £500 and £600, and of £70 on those between £600 and £700. An abatement was also allowed on account of any premiums paid for life insurance, provided they did not exceed one-sixth of the total income. The limit of total exemption was fixed in 1894, when it was raised from £150; and the scale of abatements was revised in 1898 by admitting incomes between £500 and £700; the Finance Act 1907 distinguished between "earned" and "unearned" income, granting relief to the former over the latter by 3d. in the pound, where the income from all sources did not exceed £2000. The tax was assessed as mentioned above, under five different schedules, known as A, B, C, D and E. Under schedule A was charged the income derived from landed property, including houses, the annual value or rent being the basis of the assessment. The owner is the person taxed, whether he is or is not in occupation. In England the tax under this schedule is obtained from the occupier, who, if he is not the owner, recovers from the latter by deducting the tax from the rent. In Scotland this tax is usually paid by the owner as a matter of convenience, but in Ireland it is by law chargeable to him. All real property is subject to the tax, with certain exceptions:—(*a*) crown property, such as public offices, prisons, &c.; (*b*) certain properties belonging to charitable and educational bodies, as hospitals, public schools, colleges, almshouses, &c.; (*c*) public parks or recreation grounds; (*d*) certain realities of companies such as mines, quarries, canals, &c., from which no profit is derived beyond the general profit of the concern to which they belong. Under schedule B were charged the profits arising from the occupation of land, the amount of such profits being assumed to be one-third of the annual value of the land as fixed for the purposes of schedule A. This applies principally to farmers who might, if they chose, be assessed on schedule D on their actual profits. Schedule C included income derived from interest, &c., payable out of the public funds of the United Kingdom or any other country. Schedule D, the most important branch of the income tax and the most difficult to assess, included profits arising from trade, from professional or other employment, and from foreign property, the assessment in most cases being made on an average of the receipts for three years. Schedule E covered the salaries and pensions of persons in the employment of the state or of public bodies, and of the officials of public companies, &c. The method of

assessment and collection of the tax is uniformly the same. Under schedules A, B and D it is in the hands of local authorities known as the General or District Commissioners of Taxes. They are appointed by the Land Tax Commissioners out of their own body, and, as regards assessment, are not in any way controlled by the executive government. They appoint a clerk, who is their principal officer and legal adviser, assessors for each parish and collectors. There is an appeal from their decisions to the High Court of Justice on points of law, but not on questions of fact. Assessments under schedules A and B are usually made every five years, and under schedule D every year. The interests of the revenue are looked after by officers of the Board of Inland Revenue, styled surveyors of taxes, who are stationed in different parts of the country. They are in constant communication with the Board, and with the public on all matters relating to the assessment and collection of the tax; they attend the meetings of the local commissioners, examine the assessments and the taxpayers' returns, and watch the progress of the collection. There are also certain officers, known as special commissioners, who are appointed by the crown, and receive fixed salaries from public funds. For the purpose of schedule D, any taxpayer may elect to be assessed by them instead of by the local commissioners; and those who object to their affairs being disclosed to persons in their own neighbourhood may thus have their assessments made without any risk of publicity. The special commissioners also assess the profits of railway companies under schedule D, and profits arising from foreign or colonial sources under schedules C and D. The greater part of the incomes under schedule E is assessed by the commissioners for public offices, appointed by the several departments of the government.

Previously to 1909 the rate of income tax has been as high as 16d. (in 1855-1857), and as low as 2d. (in 1874-1876). Each penny of the tax was estimated to produce in 1906-1907 a revenue of £2,666,867.[1]

It had long been felt that there were certain inequalities in the income tax which could be adjusted without any considerable difficulty, and from time to time committees have met and reported upon the subject. Select committees reported in 1851-1852 and in 1861, and a Departmental Committee in 1905. In 1906 a select committee was appointed to inquire into and report upon the practicability of graduating the income tax, and of differentiating, for the purpose of the tax, between permanent and precarious incomes. The summary of the conclusions contained in their *Report* (365 of 1906) was:—

1. Graduation of the income tax by an extension of the existing system of abatements is practicable. But it could not be applied to all incomes from the highest to the lowest, with satisfactory results. The limits of prudent extension would be reached when a large increase in the rate of tax to be collected at the source was necessitated, and the total amount which was collected in excess of what was ultimately retained became so large as to cause serious inconvenience to trade and commerce and to individual taxpayers. Those limits would not be exceeded by raising the amount of income on which an abatement would be allowed to £1000 or even more.

2. Graduation by a super-tax is practicable. If it be desired to levy a much higher rate of tax upon large incomes (say of £5000 and upwards) than has hitherto been charged, a super-tax based on personal declaration would be a practicable method.

3. Abandonment of the system of "collection at the source" and adoption of the principle of direct personal assessment of the whole of each person's income would be inexpedient.

4. Differentiation between earned and unearned incomes is practicable, especially if it be limited to earned incomes not exceeding £3000 a year, and effect be given to it by charging a lower rate of tax upon them.

5. A compulsory personal declaration from each individual of total net income in respect of which tax is payable is expedient, and would do much to prevent the evasion and avoidance of income tax which at present prevail.

Acting upon the report of this committee the Finance Bill of 1909 was framed to give effect to the principles of graduation and differentiation. The rate upon the earned portion of incomes of persons whose total income did not exceed £3000 was left unchanged, viz. 9d. in the pound up to £2000, and 1s. in the pound between £2000 and £3000. But the rate of 1s. in the pound on all unearned incomes and on the earned portion of incomes over £2000 from all sources was raised to 1s. 2d. In addition to the ordinary tax of 1s. 2d. in the pound, a super-tax of 6d. in the pound was levied on all incomes exceeding £5000 a year, the super-tax being paid upon the amount by which the incomes exceed £3000 a year. A special abatement of £10 a child for every child under the age of sixteen was allowed upon all incomes under £500 a year. No abatements or exemptions were allowed to persons not resident in the United Kingdom, except in the case of crown servants and persons residing abroad on account of their health. Certain abatements for improvements were also allowed to the owners of land or houses.

The estimated increased yield of the income tax for 1909-1910 on these lines was £2,500,000, which excluded the abatements allowed for improvements. The super-tax was estimated to yield a sum of £500,000, which would be increased ultimately to £2,500,000, when all returns and assessments were made.

The following accounts show the operation of the same system of taxation in other countries:—[2]

Austria.—The income tax dates from 1849, but the existing tax, which is arranged on a progressive system, came into force on the 1st of January 1898. The tax is levied on net income, deductions from the gross income being allowed for upkeep of business, houses and lands, for premiums paid for insurance against injuries, for interest on business and private debts, and for payment of taxes other than income tax. Incomes under £50 a year are exempt, the rate of taxation at the first stage (£52) being 0.6 of the income; at the twelfth stage (£100) the rate is 1%, at the twenty-seventh stage (£300) it rises to 2%, at the forty-third stage (£1000) it is 3%, and at the fifty-sixth (£2500) it is 3½%; an income of £4000 pays 4%; from £4000 up to £8333 per annum progression rises at £166 a step, and for every step £8, 6s. 8d. taxation is assessed. Incomes between £8333 and £8750 pay £387, 10s.; incomes over £8750 are taxed £20, 6s. 8d. at each successive stage of £417, 10s. Certain persons are exempt from the tax, viz.:—(*a*) the emperor; (*b*) members of the imperial family, as far as regards such sums as they receive as allowances; (*c*) the diplomatic corps, the consular corps who are not Austrian citizens, and the official staffs and foreign servants of the embassies, legations and consulates; (*d*) such people as are exempted by treaty or by the law of nations; (*e*)

people in possession of pensions from the Order of Maria Theresa, and those who receive pensions on account of wounds or the pension attached to the medal for bravery, are exempted as far as the pensions are concerned; (*f*) officers, chaplains and men of the army and navy have no tax levied on their pay; (*g*) all other military persons, and such people as are included in the scheme of mobilization are exempted from any tax on their pay. Special allowances are made for incomes derived from labour, either physical or mental, as well as for a family with several children. There are also special exemptions in certain cases where the annual income does not exceed £4167, 10s., viz.—(*a*) special charges for educating children who may be blind, deaf, dumb or crippled; (*b*) expense in maintaining poor relations; (*c*) perpetual illness; (*d*) debts; (*e*) special misfortunes caused by fire or floods; (*f*) being called out for military service. The tax is assessed usually on a direct return from the individual taxpayer, except in the cases of fixed salaries and wages, on which the tax is collected from the employer, who either deducts it from the salary of the employee or pays it out of his own pocket. The tax, which is assessed on the income of the previous year, is paid direct to the collector's office in two instalments—one on the 1st of June and the other on the 1st of December.

Belgium.—No income tax proper exists in Belgium, but there is a state tax of 2% on the dividends of joint stock companies.

Denmark.—Income tax is levied under a law of the 15th of May 1903. Incomes under 2000 kroner pay a tax of 1.3%; under 3000 kroner, 1.4%; under 4000 kroner, 1.5%; under 6000 kroner, 1.6%; under 8000 kroner, 1.7%; under 10,000 kroner, 1.8%; under 15,000 kroner, 1.9%; under 20,000 kroner, 2.0% and for every additional 10,000 kroner up to 100,000 kroner 1%, incomes of 100,000 kroner and upwards paying 2.5%. Exempt from the duty are—the king, members of the royal family and the civil list; the legations, staffs and consular officers of foreign powers (not being Danish subjects); foreigners temporarily resident in the country; mortgage societies, credit institutions, savings and loan banks. The increase in capital resulting from an increase in value of properties is not deemed income—on the other hand no deduction in income is made if such properties decrease in value—nor are daily payments and travelling expenses received for the transaction of business on public service, if the person has thereby been obliged to reside outside his own parish. Certain deductions can be made in calculating income—such as working expenses, office expenses, pensions and other burthens, amounts paid for direct taxation, dues to commune and church, tithe, tenant and farming charges, heirs' allowances and similar burthens; interest on mortgages and other debts, and what has been spent for necessary maintenance or insurance of the property of the taxpayer. There are also certain exemptions with respect to companies not having an establishment in the country.

France.—There is no income tax in France corresponding exactly to that levied in the United Kingdom. There are certain direct taxes, such as the taxes on buildings, *personnelle mobilière*, and doors and windows (*impôts de répartition*)—the tax levied on income from land and from all trades and professions (*impôts de quotité*) which bear a certain resemblance to portions of the British income tax (see FRANCE: *Finance*). From time to time a graduated income tax has been under discussion in the French Chambers, the proposal being to substitute such a tax for the existing (*personnelle mobilière*) and doors and windows taxes, but no agreement on the matter has been reached.

German Empire.—In Prussia the income tax is levied under a law of the 24th of June 1891. All persons with incomes of over £150 per annum are required to send in an annual declaration of their full income, divided according to four main sources—(*a*) capital; (*b*) landed property; (*c*) trade and industry; (*d*) employment bringing gain, this latter including the salary or wages of workmen, servants and industrial assistants, military persons and officials; also the receipts of authors, artists, scientists, teachers and tutors. Liability for income tax, however, begins with an income of £45, and rises by a regular system of progression, the rate being about 3% of the income. Thus an income of more than £45, but under £52, 10s. pays a tax of 6s. and so on up to £475, an income over that sum but under £525 paying a tax of 15s. Incomes over £525 rise by steps of £50 up to £1525, for every step £1, 10s. being paid. Incomes between £1526 and £1600 rise by steps of £75, £3 being paid for every step. Between £1601 and £3900, the steps are £100, and the tax £4 a step; from £3901 to £5000 the steps are the same (£100), but the tax is £5 a step. There is also a supplementary tax on property of about $\frac{1}{20}$th% of the assessed value. This supplementary tax is not levied on those whose taxable property does not exceed a total value of £300, nor on those whose annual income does not exceed £45, if the total value of their taxable property does not exceed £1000, nor on women who have members of their own family under age to maintain, nor on orphans under age, nor on persons incapable of earning incomes if their taxable property does not exceed £1000 nor their income £60. There are a number of exemptions from the income tax, some of the more important being—(*a*) the military incomes of non-commissioned officers and privates, also of all persons on the active list of the army or navy as long as they belong to a unit in war formation; (*b*) extraordinary receipts from inheritances, presents, insurances, from the sale of real estate not undertaken for purposes of industry or speculation, and similar profits (all of which are reckoned as increases of capital); (*c*) expenses incurred for the purpose of acquiring, assuring and maintaining income; (*d*) interest on debts; (*e*) the regular annual depreciation arising from wear of buildings, machines, tools, &c., in so far as they are not included under working expenses; (*f*) the contributions which taxpayers are compelled by law or agreement to pay to invalid, accident, old age insurance, widow, orphan and pension funds; (*g*) insurance premiums. Moreover, persons liable to taxation with an income of not more than £150 may deduct from that income £2, 10s. for every member of their family under fourteen years of age, and abatement is also allowed to persons with incomes up to £475 whose solvency has been unfavourably affected by adverse economic circumstances. The income tax is both levied at the source (as in the case of companies) and assessed on a direct return by the taxpayer of his income from all sources. Salaries are not taxed before payment. Fixed receipts are assessed according to their amount for the taxation year in which the assessment is made, and variable incomes on an average of the three years immediately preceding the assessment. The income tax and the supplementary tax are collected in the first half of the second month of each quarter by the communities (*Gemeinden*) who bear the whole cost.

In Saxony a graduated tax is in force on all incomes of £20 per annum and upwards. All corporate bodies and individuals who derive their income or any portion of it from Saxony are liable to the extent of that income, except those serving religious, charitable or public purposes. Incomes between £20 and £5000 are divided into 118 classes, in which the rate rises progressively. From £500 to £5000 the classes rise by £50, and above £5000 by £100. The rate of income tax begins at ¼%, *i.e.* 1s. on an income of £20. An abatement

is allowed to those whose incomes do not exceed £155 of £2, 10s. for each child between the ages of six and fourteen years, provided such abatements do not reduce the income by more than one class. In the case of persons with incomes not exceeding £290 abatement (not exceeding three classes) is allowed—(*a*) when the support of children or indigent relations involves a burden of such a nature as to affect the general standard of living; (*b*) on account of long-continued illness, involving heavy expense; and, on restoration to health, temporary decrease of wage-earning power; (*c*) in the case of accidents which have had the same effect.

In Bavaria the existing system of income tax came into force on the 1st of January 1900. The rate on earned income varies according to a scale laid down in article 5 of the law, beginning at .1% for incomes up to £37, 10s. (1s.), being .66% (£2, 5s.) for incomes between £230 and £250; 1.03% (£4) for incomes between £350 and £375; 1.30% (£6, 16s.) for incomes between £475 and £500 and 1.38% (£10) for incomes between £650 and £700. Incomes exceeding £700 and not exceeding £1100 pay £1 on every £50; those between £1100 and £1700, £1, 10s., on every £50, between £1700 and £2050, £2 on every £50; between £2050 and £2500, £2, 10s. on every £50 and beyond £2500, 3% on every £50. Exemptions from earned income tax are similar to those already mentioned in the case of Prussia. Special abatement in the case of incomes not exceeding £250 from all sources is given in consideration of education of children, protracted illness, maintenance of poor relations, serious accidents, &c. The tax on unearned income is at the rate of 1½% on incomes from £3, 10s. to £5; from £6 to £20, 2%; from £21 to £35, 2½%; from £36 to £59, 3%; from £51 to £150, 3½%; from £151 to £5000, 3¾%, and over £5000, 4%. There is a differentiation in assessment on fluctuating and fixed incomes. Fluctuating incomes (*e.g.* those derived from literary, scientific or artistic work) are assessed at the average receipts of the two past years. Fixed income is returned at the actual amount at the time of assessment, and the assessment for earned income, both fixed and fluctuating, takes place every four years. Income tax is not levied at the source, but on a direct return by the taxpayer. In the case of unearned income, where a person's yearly unearned income does not exceed £100 and he has no other or only an insignificant additional income, he is required to pay only half the assessed tax. Also in the case where a total income, earned and unearned, does not exceed £250 it may, by claiming abatement on such grounds as the education of children, maintenance of indigent relations, &c., be assessed at the lowest rate but one, or be entirely exempt.

In Württemberg the General Income Tax Act came into force on the 1st of April 1905. Article 18 provides a graduated scale of rates on incomes from £25 upwards. Abatements are allowed for the education and support of children, support of indigent relatives, active service in the army and navy, protracted illness and severe accidents or reverses. There is a supplementary tax of 2% on unearned income from certain kinds of property, such as interest or other income derived from invested capital, dividends, &c., from joint-stock companies and annuities of all kinds. The income tax is not levied at the source, but on a direct return by the ratepayers; assessments are made on the current year, except in the case of fluctuating incomes, when they are made on the income of the preceding year.

Hungary.—There is no income tax in Hungary at all corresponding to that of the United Kingdom, although proposals for such a tax have from time to time been made.

Italy.—Graduated income tax in Italy dates from 1864. Incomes are classified according to their characters, and the rate of the tax varies accordingly. In class A^1 are placed incomes derived from interests on capital, and perpetual revenues owned by the state, interests and premiums on communal and provincial loans, dividends of shares issued by companies guaranteed or subsidized by the state lottery prizes. These incomes are assessed at their integral value and pay the full tax of 20%. In class A^2 are placed incomes derived from capital alone and all perpetual revenues. The assessments on these are reduced to 30/40ths of the actual income and taxed at a rate of 15%. In class B are incomes derived from the co-operation of labour and capital, *i.e.* those produced by industries and commerce. The assessments of these are reduced to 20/40ths and taxed at 10%. In class C are placed incomes derived from labour alone (private employment) and those represented by temporary revenues or life annuities. Assessments on these are reduced to 18/40ths and taxed at a rate of 9%. In class D are placed incomes from salaries, pensions and all personal allowances made by the state, the provinces and communes. Assessments on these are reduced to 15/40ths and taxed at 7½%. Certain abatements are allowed on small incomes in classes B, C and D. Incomes are assessed (1) on the average of the two preceding years in the case of private industries, professions or companies in which liability is unlimited; (*b*) on the income of the current year in the case of incomes from dividends, salaries, pensions and fixed allowances, as well as in the case of incomes of communes, provinces and corporations; (*c*) on the basis of the account closed before the previous July of the current year in the case of incomes of limited liability companies, banks and savings banks.

Netherlands.—In the Netherlands there is a property tax imposed upon income derived from capital, as well as a tax on income earned by labour.

Norway.—In Norway under the state income tax incomes under 1000 kroner are exempt, those between 1000 and 4000 kroner pay 2% on that part liable to taxation; those between 4000 and 7000 kroner pay 3%; those between 7000 and 10,000 kroner pay 4%, and those above 10,000 kroner 5%. Persons liable to taxation are divided into (*a*) those who have no one to support, as companies and the like; (*b*) those who have from one to three persons to support; (*c*) those who have from four to six persons to support; (*d*) those who have seven or more persons to support. Those who are counted as dependent upon the taxpayer are his children, own or adopted, his parents, brothers and sisters, and other relations and connexions by marriage who might have a reasonable claim to his support. A certain part of the income liable to taxation is abated by a graduated scale according to the class into which the ratepayer falls.

Spain.—In Spain the income tax is divided into (*a*) that derived from personal exertion and (*b*) that derived from property. Directors, managers and representatives of banks, companies and societies pay 10%; those employed in banks, &c., commercial houses, and those in private employment, as well as actors, bullfighters, professional pelota-players, acrobats, conjurers, &c., pay 5%. Those employed by the day or those whose salary is under £45 are exempt, as are also masters in primary schools. Income derived from property is taxed according to the source from which the income is derived, *e.g.* income from shares in public works is rated at 20%, income from shares in ordinary companies, railways, tramways or canals at 3%, from dividends on bank shares at 5%, from mining shares at only 2%. There is also an industry tax, *i.e.* on the exercise of industrial, commercial and professional enterprises, which tax is divided into five different

tariffs, of which I. applies to commerce (vendors), II. also to commerce (middlemen), III. to industry (machinery), IV. to professions and V. to licences (retail and itinerant vendors). Tariff I. is differentiated according to the importance of the business and of the locality in which it is carried on, the rate being fixed by a consideration of the two combined. Tariff II. is differentiated according to the character of the enterprise, its importance and the importance of the locality. Tariff III. is differentiated according to either motive power, output, method, product or locality; Tariff IV. according to the character of the profession and the importance of the locality; Tariff V. is also differentiated according to the locality and the importance of the business.

Switzerland.—The system of income tax varies in the different cantons. Broadly speaking, these may be divided into four different kinds: (1) a graduated property tax, in which the rate applicable to each class of fortune is definitely fixed; (2) a proportional tax, under which property and income are chargeable, each at a fixed rate, while the total amount of the tax is liable to a proportionate increase according to scale if it exceeds certain specified amounts; (3) a system by which property and income are divided into three classes, the rate of the tax being increased by a graduated rise, according to the class to which the property or income belongs, and (4) a uniform rate of tax, with progression in the amount of income liable to taxation.

United States.—One of the means adopted by the Federal Government for meeting its expenses during the Civil War was the levying of an income tax. By the Act of Congress of the 5th of August 1861 a tax of 3% was imposed on all incomes, with an exemption of $800, and was made payable on or before the 30th of June 1862. No tax, however, was assessed under the law. In March 1862 a new income tax bill was introduced into the House of Representatives. This act, which was signed on the 1st of July 1862, imposed a tax of 3% on all incomes not over $10,000, and 5% on all incomes above that sum, with an exemption of $600. It was also provided that dividends of banks, insurance companies and railways should be assessed directly; but the bond-holder was allowed to deduct the dividend so assessed from his taxable income. In the case of government salaries, the tax was deducted before the salaries were paid. The income tax was first levied in 1863. The rate was changed by act of Congress in 1865, 1867 and 1870, and a joint resolution in 1864 imposed a special additional tax of 5% for that year. The tax was finally abolished in 1872. The total amount produced by the tax from the beginning was $376,150,209. The constitutionality of the act was subsequently brought into question, but was upheld by a unanimous decision of the Supreme Court in 1880, which held that the tax was not a direct tax but an excise tax, and that Congress had a right to impose it so long as it was made uniform throughout the United States. On the 27th of August 1894 an income tax act was passed as part of the Wilson Bill. By this act it was provided that a tax of 2% on all incomes should be levied from the 1st of January 1895 to the 1st of January 1900, with an exemption of $4000. The legality of the tax was assailed, chiefly on the ground that it was a direct tax, and not apportioned among the several states in proportion to their population. On the 20th of May 1895 the Supreme Court, by a vote of five to four, declared the tax to be unconstitutional. Accordingly, before any federal income tax could be imposed, there was needed an amendment of the constitution, and a movement in this direction gradually began. In the first year of the presidency of Mr W. H. Taft both Houses of Congress passed by the necessary two-thirds majority a resolution to submit the proposal to the 46 states, the wording of the amendment being “That Congress shall have power to lay and collect taxes on incomes from whatever source derived, without apportionment among the several States, and without regard to any census enumeration.”

Cape Colony.—Cape Colony was the only South African colony which, prior to the Union in 1910, had a system of income tax, which was first imposed by an act of the 31st of May 1904. Incomes not exceeding £1000 per annum were exempt from taxation; incomes exceeding £1000 but not exceeding £2000 were taxed 6d. in the pound on the excess beyond £1000; those between £2000 and £5000 were exempt for the first £1000, paid 6d. in the pound on the next £1000 and 9d. in the pound on the remainder; those exceeding £5000 paid 6d. in the pound on the second £1000, 9d. in the pound on the next £3000 and 1s. in the pound on the remainder.

New South Wales.—Income tax in New South Wales first came into operation on the 1st of January 1896. It is complementary with a land tax, assessed on the unimproved value of freehold lands (with certain exemptions and deductions). Incomes of £200 per annum and under are exempt, and all other incomes (except those of companies) are entitled to a reduction of £200 in their assessments. The rate of tax is 6d. in the pound. There are certain incomes, revenues and funds which are exempt from taxation, such as those of municipal corporations or other local authorities, of mutual life insurance societies and of other companies or societies not carrying on business for purposes of profit or gain, and of educational, ecclesiastical and charitable institutions of a public character, &c.

New Zealand.—In New Zealand the income tax is also complementary with a land tax. Incomes up to £300 per annum are exempt; incomes up to £1000 per annum are taxed 6d. in the pound, with an exemption of £300 and life insurance premiums up to £50; incomes over £1300 pay 1s. in the pound, which is also the tax on the income of trading companies, to whom no exemption is allowed. The income of friendly societies, savings banks, co-operative dairy companies, public societies not carrying on business for profit, &c., are exempt from income tax.

Queensland.—In Queensland income tax is levied on (*a*) income derived from property such as rents, interest, income from companies, royalties, &c., and (*b*) on income derived from personal exertion. On income derived from property all incomes not exceeding £100 are exempt; incomes between £100 and £120 pay £1 tax; those over £120 but under £300 have £100 exempt and pay 1s. in each and every pound over £100, while incomes over £300 pay 1s. in each and every pound. Incomes from personal exertion pay 10s. between £100 and £125; £1 between £126 and £150; between £151 and £300 have £100 exempt and pay 6d. in each and every pound over £100: between £301 and £500 6d. in every pound; between £501 and £1000 6d. in every pound of the first £500 and 7d. in every pound over £500, between £1001 and £1500 7d. in every pound of the first £1000, and 8d. in every pound over £1000; incomes over £1500 pay 8d. in every pound; 1s. in every pound is charged on the incomes of all companies and of all absentees.

South Australia.—The income tax dates from 1884 and is levied on all incomes arising, accruing in or derived from South Australia, except municipal corporations, district councils, societies, &c., not carrying on business for the purpose ot gain, and all friendly societies. Where the income is derived from personal exertion the rate of tax is 4½d. in the pound up to £800, and 7d. in the pound over £800. For income derived

from property the rate is 9d. in the pound up to £800, and 1s. 1½d. in the pound over £800. There is an exemption of £150 on incomes up to £400, but no exemption over that limit.

Tasmania.—In Tasmania there is (*a*) an income tax proper, and (*b*) a non-inquisitorial ability tax, one complementary to the other. The income tax proper is levied on all income of any company, at the rate of 1s. for every pound of the taxable amount; on all income of any person, at the rate of 1s. for every pound of the taxable amount derived from property, and on every dividend at the same rate. Personal incomes of £400 and over are assessed at the full amount, but an abatement of £10 for every £50 of income is allowed on incomes below £400 down to incomes of £150, which thus have £50 deducted; incomes between £120 and £150 have £60 deducted; incomes between £110 and £120, £70, and incomes between £100 and £110, £80. The ability tax is paid by (*a*) occupiers and sub-occupiers of property and (*b*) by lodgers. The amount of tax paid by occupiers or sub-occupiers is calculated upon the assessed annual value of the property occupied, and that of lodgers from the assessed annual value of their board and lodging. A detailed account of both taxes will be found in House of Commons Papers, No. 282 of 1905.

Victoria.—In Victoria the rate of income tax is fixed annually by act. The rate charged on income derived from property is exactly double that charged on income derived from personal exertion, the rate for which for 1905 was: on the first £500 or fractional part thereof, 3d. in the pound; on the second £500 or fractional part thereof, 4d. in the pound; on the third £500 or fractional part thereof, 5d. in the pound; on all incomes in excess of £1500, 6d. in the pound. All companies, except life insurance companies, were charged 7d. in the pound on their incomes; life insurance companies were charged 8d. in the pound.

BIBLIOGRAPHY.—The Annual Reports of the Commissioners of Inland Revenue, the Reports of Committees and other references mentioned in the article, as well as Dowell's *History of Taxation in England* (1884); Dowell's *Acts relating to the Income Tax* (6th ed., 1908), and Robinson's *Law relating to Income Tax* (2nd ed., 1908).

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1 Full statistics of the yield of income tax and other information pertaining thereto will be found in the *Reports of the Commissioners of His Majesty's Inland Revenue* (published annually); those issued in 1870 and in 1885 are especially interesting.

2 In Appendix No. 4 to the *Report from the Select Committee on Income Tax* (1906), will be found a valuable list (prepared in the Library of the London School of Economics) of references to the graduation of the income tax and the distribution of incomes both in the United Kingdom and in other countries.

INCORPORATION (from Lat. *incorporare*, to form into a body), in law, the embodying or formation of a legal corporation, brought about either by a general rule contained in such laws, *e.g.* as the Companies acts, and applicable wherever its conditions are satisfied; or by a special act of sovereign power, *e.g.* an incorporating statute or charter. The word is used also in the sense of uniting, *e.g.* a will may incorporate by reference other papers, which may be then taken as part of the will, as much as if they were set out at length in it.

INCUBATION and **INCUBATORS**. The subject of "incubation" (Lat. *incubare*, to brood; *in-cumbere*, to lie on), a term which, while strictly signifying the action of a hen in sitting on her eggs to hatch them, is also used in pathology for the development within the body of the germs of disease, is especially associated with the artificial means, or "incubators," devised for hatching eggs, or for analogous purposes of an artificial foster-mother nature, or for use in bacteriological laboratories.

Life is dependent, alike for its awakening and its maintenance, upon the influence of certain physical and chemical factors, among which heat and moisture may be regarded as the chief. It is therefore obvious that any method of incubation must provide for a due degree of temperature and moisture. And this degree must be one within limits, for while all organisms are plastic and can attune themselves to a greater or less range of variation in their physical environment, there is a given degree at which the processes of life in each species proceed most favourably. It is this particular degree, which differs for different species, which must be attained, if artificial incubation is to be successfully conducted. In other words, the degree of temperature and moisture within the incubation drawer must remain uniform throughout the period of incubation if the best results are to be reached. It is not easy to attain these conditions, for there are many disturbing factors. We may therefore next consider the more important of them.

The chief causes which operate to make the temperature within the incubator drawer variable are the changes of the temperature of the outer air, fluctuations in the pressure of the gas when that is used as the source of heat, or the gradual diminution of the oxidizing power of the flame and wick when an oil lamp is substituted for gas. Also, the necessary opening of the incubator drawer, either for airing or for sprinkling the eggs with water when that is necessary, tends to reduce the temperature. But there is another equally important though less obvious source of disturbance, and this resides within the organism undergoing incubation. In the case of the chick, at about the ninth or tenth days of incubation important changes are occurring. Between this period and the fourteenth day the chick becomes relatively large and bulky, and the temporary respiratory organ, the allantois, together with its veins, increases greatly in size and extent. As a consequence, the respiratory processes are enabled to proceed with greater activity, and the chemical

processes of oxidation thus enhanced necessarily largely increase the amount of heat which the chick itself produces. Thus an incubator, to be successful, must be capable of automatically adjusting itself to this heightened temperature.

The drawer of an incubator is a confined space and is usually packed as closely as possible with the contained eggs. The eggs are living structures and consequently need air. This necessitates some method of direct ventilation, and this in its turn necessarily increases the evaporation of water vapour from the surface of the egg. Unless, therefore, this evaporation is checked, the eggs will be too dry at the period—from the tenth day onwards—when moisture is more than ever an important factor. There is, according to some poultry authorities, reason to believe that the sitting hen secretes some oily substance which, becoming diffused over the surface of the egg, prevents or retards evaporation from within; presumably, this oil is permeable to oxygen. In nature, with the sitting hen, and in the “Mamal” artificial incubating establishments of the Egyptians, direct air currents do not exist, owing to the large size of the chambers, and consequently incubation can be successfully achieved without any special provision for the supply of moisture.

Artificial incubation has been known to the Egyptians and the Chinese from almost time immemorial. In Egypt, at Berme on the Delta, the trade of artificial hatching is traditionally transmitted from father to son, and is consequently confined to particular families. The secrets of the process are guarded with a religious zeal, and the individuals who practise it are held under plighted word not to divulge them. It is highly probable that the process of artificial incubation as practised by the Egyptians is not so simple as it is believed to be. But as far as the structures and processes involved have been ascertained by travellers, it appears that the “Mamal” is a brick building, consisting of four large ovens, each of such a size that several men could be contained within it. These ovens are in pairs, in each pair one oven being above the other, on each side of a long passage, into which they open by a circular aperture, just large enough for a man to obtain access to each. The eggs are placed in the middle of the floor of the oven, and in the gutters round the sides the fire is lighted. The material for this latter, according to one account, consists of camels’ dung and chopped hay, and according to another of horses’ dung. The attainment of the right degree of heat is apparently reached wholly by the skill of the persons employed. When this has been attained, they plug the entrance hole with coarse tow. On the tenth to twelfth days they cease to light the fires.

Each “Mamal” may contain from 40,000 to 80,000 eggs. There are 386 “Mamals” in the country, which are only worked for six months of the year, and produce in that time eight broods. Many more than two-thirds of the eggs put in are successfully hatched. It is estimated that 90,000,000 eggs are annually hatched by the Bermeans.

A method of incubating that appears to have been altogether overlooked in England—or at least never to have been practised—is that carried on by the *Couveurs* or professional hatchers in France. They make use of hen-turkeys for the purpose, and each bird can be made to sit continuously for from three to six months. The *modus operandi* is as follows: a dark room which is kept at a constant temperature throughout the year contains a number of boxes, just large enough to accommodate a turkey. The bottom of the box is filled with some vegetable material, bracken, hay, heather, straw or cocoa-fibres. Each box is covered in with lattice-work wire, so arranged that the freedom of the sitting bird is limited and its escape prevented. Dummy eggs, made by emptying addled ones and filling with plaster of Paris, are then placed in the nest and a bird put in. At first it endeavours to escape, but after an interval of a few days it becomes quiet, and the dummy eggs being then removed, fresh ones are inserted. As soon as the chickens are hatched, they are withdrawn and fresh eggs substituted. The hen turkeys are also used successfully as foster-mothers. Each bird can adequately cover about two dozen eggs.

Incubation as an industry in Europe and America is of recent development. The growing scarcity of game birds of all kinds, coincident with the increase of population, and the introduction of the breech-loading gun, together with the marked revival of interest in fancy poultry about the year 1870, led, however, to the production of a great variety of appliances designed to render artificial incubation successful.

Previously to this, several interesting attempts had been made. As long ago as 1824, Walthew constructed an incubator designed to be used by farmers’ wives with the aid of no more than ordinary household conditions. It consisted of a double-walled metal box, with several pipes opening into the walled space round the sides, bottom and top of the incubator. These pipes were connected with an ordinary kitchen boiler. Walthew, however, constructed a fire grate, with a special boiler adapted to the requirements of the incubator. Into the walled space of the incubator, steam from the kitchen boiler passed; the excess steam escaped from an aperture in the roof, and the condensed steam through one in the floor. Ventilating holes and also plugs, into which thermometers were placed, pierced the door of the incubator.

In 1827, J. H. Barlow successfully reared hens and other birds by means of steam at Drayton Green, Ealing. He constructed very large rooms and rearing houses, expending many thousands of pounds upon the work. He reared some 64,000 game birds annually. The celebrated physician Harvey, and the famous anatomist Hunter were much interested in his results.

To John Champion, Berwick-on-Tweed, in 1870, belongs, however, the credit of instituting a system which, when extended, may become the system of the future, and will rival the ancient “Mamals” in the success of the incubation and in the largeness of the numbers of eggs incubated. He used a large room through which passed two heated flues, the eggs being placed upon a table in the centre. The flues opened out into an adjoining space. The temperature of the room was adjusted by personal supervision of the fire. This system, more elaborated and refined, is now in use in some parts of America.

Bird Incubators.

Owing to the great variety in the details of construction, it is difficult to arrange a classification of

incubators which shall include them all. They may, however, be classified in one of two ways. We may either consider the method by which they are heated or the method by which their temperature is regulated.

In the former case we may divide them into “hot-air” incubators and into “hot-water” or “tank” incubators. In the latter ease we may classify them according as their thermostat or temperature-regulator is actuated by a liquid expanding with rising temperature, or by solids, usually metals.

In America incubators of the hot-air type with solid and metallic thermostats are most used, while in Europe the “tank” type, with a thermostat of expansible liquid, prevails.

For the purpose of more adequately considering the various forms which have been in use, or are still used, we shall here divide them into the “hot-air” and “hot-water” (or “tank”) classes.

In the hot-air types the incubator chamber is heated by columns of hot air, while in the tank system this chamber is heated by a tank of warmed water.

(*a*) *Hot-Water Incubators.*—In 1866 Colonel Stuart Wortley described in *The Field* an incubator constructed upon a novel principle, but which appears never to have been adopted by breeders. The descriptive article is illustrated with a sketch. Essentially the incubator consists of four pipes which extend across the egg chamber some little distance above the eggs. The pipes pass through holes in the side of the incubator, which are furnished with pads, so as to render their passage air-tight. Externally they are connected with a boiler. This is provided with a dome through which steam escapes, and also with a glass gauge to show the height of the water within the boiler. The water in the boiler is kept at the boiling point, and the temperature of the incubator is regulated by adjustment of the length of the hot-water pipes within the egg chamber. To raise the temperature, a greater length of the pipes is pushed into the chamber, and to reduce it, more of their length is pulled outwards. It is claimed for this instrument that since the temperature of boiling water at any particular locality remains practically constant, the disadvantages due to fluctuations in the activity of a lamp flame or the size of a gas flame are obviated. But it has the serious disadvantage that there is no automatic adjustment to compensate for fluctuations of atmospheric temperature. And experiments by C. Hearson have shown that even if the temperature of the tank or source of heat be constant, that of the incubator drawer will nevertheless vary with fluctuations of external temperature. Probably if the mechanical difficulties of providing a self-regulator were overcome, it would prove an efficient and reliable incubator. The difficulties do not seem to be insuperable, and it appears possible that a thermostatic bar could be so arranged as to automatically increase or decrease the length of hot-water pipes within the incubator, and therefore the incubator temperature.

Another early form of incubator is Brindley’s, which was first in use about 1845, and in his hands it appeared occasionally to act successfully, but it never became generally used. The egg chamber was lined with felt, and was placed beneath a heated air chamber, the floor and roof of which were composed of glass. The air chamber was heated by a number of hot-water pipes which were connected with a copper boiler. This latter was heated by means of a lamp so constructed as to burn steadily. The temperature of the air chamber was regulated within certain limits by means of a balanced valve, which could be so adjusted that it would open at any desired temperature. 361

In Colonel Stuart Wortley’s incubator the hot-water tubes passed directly into the egg chamber, and in Brindley’s into a chamber above it. But in other forms of incubators in which the principle of an external boiler connected with water tubes is adopted, the latter pass not into the egg chamber nor into an air chamber, but open into and from a tank of water. The floor of this tank forms the roof of the egg chamber, so that the eggs are heated from above. This device of warming the eggs from above was adopted in imitation of the processes that presumably occur with the sitting hen; for it is generally assumed that the surface of the eggs in contact with the hen is warmer than that in contact with the damp soil or with the material of the nest.

One of the earliest of this form of incubator is that invented by F. Schröder, manager of the now extinct British National Poultry Company. In this incubator the form is circular, and there are four egg drawers, so that each one occupied the quadrant of a circle, and the inner corner of each drawer meets in the middle of the incubator. From the centre of the incubator a vertical chimney passes upwards and opens out from the inner corners of the four egg drawers. This chimney acts as a ventilator to the incubating chambers. These latter are open above, but their floors are made of perforated zinc, and when in use they are partially filled with chaff or similar material. Under them is a tank containing cold water and common to all four drawers; the slight vapour rising from the surface of the water diffuses through the egg drawers and thus insures a sufficient degree of humidity to the air within. Above the egg drawers is a circular tank containing warm water. The floor of this tank constitutes the roof of the egg drawers, while the roof forms the floor of a circular chamber above it, the side wall of which is composed of perforated zinc. This upper chamber is used to dry the chicks when they are just hatched and to rear them until they are strong enough for removal. It is partially filled with sand, which serves the double purpose of retaining the heat in the warm-water tank beneath and of forming a bed for the chicks. The water in the warm-water tank is heated by means of a boiler which is external to the incubator, and in communication with the tank by means of an inlet and an outlet pipe. There is no valve to regulate the temperature, and the latter is measured by means of a thermometer, the bulb of which is situated not in the incubator drawers, but in the warm-water tank. This is a wrong position for the thermometer, since it is now known that the temperature of the water tank may be different by several degrees to that of the egg drawer; for with a fall of external temperature that of the latter necessarily tends to fall more rapidly than the former. But, none the less, in skilful hands this incubator gave good results.

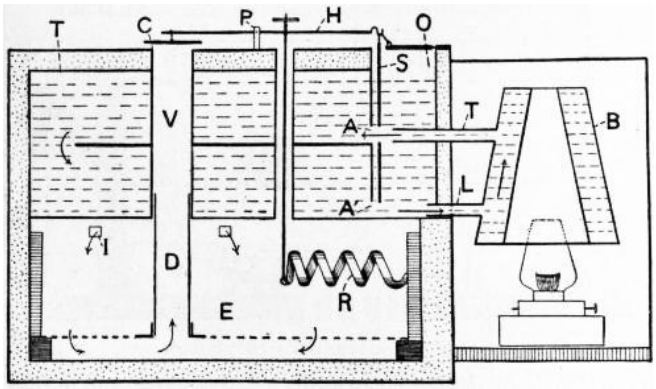


FIG. 1.—Christy's Improved Incubator.

T. Christy's incubator, which we shall describe next, has passed through several forms. We shall consider the most recent one (1894). The incubator (fig. 1) is double walled, and the space between the two walls is packed with a non-conducting material. In the upper part of the incubator there is a water tank (T) divided by a horizontal partition into two chambers, communicating with each other at the left-hand side. Below the tank is the incubation drawer (E), which contains the eggs and also a temperature regulator or thermostat (R). The tank is traversed by a ventilating shaft (V), and inserted into this is a smaller sliding tube passing up to it from a hole in the bottom of the incubator drawer. The floor of the incubator drawer is perforated, and beneath it is an enclosed air space which opens into the sliding air shaft just described. Fresh air is let into the incubator drawer from a few apertures (I) at its top. The ventilating shaft (V) is closed externally by a cap (C), which can be raised from or lowered down upon its orifice by the horizontal arm (H) working upon pivot joints at (P). This arm is operated by the thermostat (R), through the agency of a vertical rod. The water in the tank is heated by an external boiler (B) through two pipes, one of which (T) serves as an inlet, and the other (L) as an outlet channel from the tank. These two pipes do not open directly into the tank, but into an outer vessel (O) communicating with it. Communication between this vessel and the tank may be made or broken by means of a sliding valve (S), which is pierced by an aperture that corresponds in position with the upper of the two in the wall of the tank when the valve is up. When this valve is in its upper position, the tank (T) communicates with the outer vessel (O) by two apertures (A and A′), the top one being the inlet and the lower one the outlet. These coincide in position with the tubes from the boiler. This latter (B) is a conical vessel containing two spaces. The heated water is contained in the outer of these spaces, while the central space is an air shaft heated by a lamp flame. This particular form of the boiler results in the water at its top part being more heated than that in its lower. As a consequence of this, a continual circulation of water through the tank ensues. The more heated water, being specifically lighter, passes into the outer vessel, where it remains among the higher strata, and therefore enters the tank through the upper aperture. In passing along the upper division of the tank it becomes slightly cooled and sinks therefore into the lower compartment, passes along it, and out through the aperture A′. Hence it passes into the lower portion of the boiler, where it becomes warmed and specifically lighter; in consequence it becomes pushed upwards in the boiler by the cooler and heavier water coming in behind and below it.

Should the temperature in the incubator drawer rise, the bimetallic thermostat (R) opens out its coil and pulls down the vertical rod. This simultaneously effects two things: it raises the cap (C) over the ventilating shaft and allows of a more rapid flow of fresh air through the incubator drawer, and it also lowers the slide-valve (S) so that the tank becomes cut off from communication with the outer vessel (O) and therefore with the boiler. The temperature thereupon begins to fall and the thermostat, coiling closer, raises the vertical rod, closes the ventilating shaft, and once more places the tank in communication with the boiler.

The structure of the thermostat is given below.

The Chantry Incubator (Sheffield) is also an incubator with a hot-water tank, the circulation of which is maintained by an outside boiler. Its temperature is regulated by a metal regulator.

In Schröder's and Christy's incubators the hot-water pipes from the boiler simply entered the warm-water tank but did not traverse it. In the two incubators to be next described the hot-water pipes are made to pass through the water in the tank, and are so arranged as to minimize the possibility that the outside of the tank may become colder than the centre. Both of them are also fitted with an ingenious though slightly complex valve for maintaining an approximately constant temperature.

Halsted's incubator was the earliest of this type. Since his original form was constructed he has designed an improved one, and it is this latter which will be described.

The egg drawer (E, fig. 2) lies beneath the warm-water tank (T), and above this is a nursery (N). The egg drawer is ventilated by two tubular shafts (V), of which only one is represented in the illustration; the tubes are about 2½ in. in diameter, and each one is fitted at its upper end, where it opens into the nursery, with a swing-valve (V′) which turns upon a horizontal axis (A), in its turn connected, by means of cranks (C) and shafts (S), with the heat regulating apparatus (R). A space of about 2 in. between the top of the incubating drawer and the warm-water tank is necessary for the insertion of this apparatus. The water in the tank (T) is heated by means of the boiler (B); the tank and boiler are connected by the two pipes (I) and (O), of which one is the inlet and the other the outlet channel. The boiler consists of an inner (I′) and an outer (O) division in communication with each other below. The latter is cylindrical in form, while the outer wall of the former is

cylindrical and its inner wall conical. The conical wall of the inner boiler is the surface which is heated by the lamp (L). The arrangement of the inlet and outlet tubes is important. In the illustration, for the sake of clearness, they are represented as one above the other. In reality they lie in the same plane, and the fork (F) of the inlet pipe similarly lies in the horizontal plane and not vertically as represented. The inlet pipe not only differs from the outlet pipe in the possession of a forked end, but it is carried to the farther end (not shown in the diagram) of the water tank, while the outlet pipe opens from about the middle of the tank. The inlet pipe is connected with the inner portion of the boiler and the outlet one with the outer portion. The result of this adjustment of the parts is that the warmer water of the inner boiler, being specifically lighter than the cooler water of the outer boiler, rises up and passes through the inlet pipe (I) and is discharged into the tank through the two divergent orifices of the fork (F). Here the water strikes the side wall of the farther end of the tank and is reflected back along the back and front walls towards the nearer side. Hence it is again reflected, but in the opposite direction, and now forms a central current, which is directed towards the centrally situated orifice of the outlet tube (O). Through this it passes to the outer boiler, and sinking towards the bottom, reaches the base of the inner boiler. Here it becomes heated and lighter and consequently rises to the top, and once more passes through the inlet pipe to the water tank. The warm water thus travels round the outer walls of the tank and the cooled water is conducted away along the middle portion. A more equable distribution of temperature over the roof of the incubating chamber is thus ensured than would be the case if the heated water were discharged either into the centre or at any other single point only of the tank.

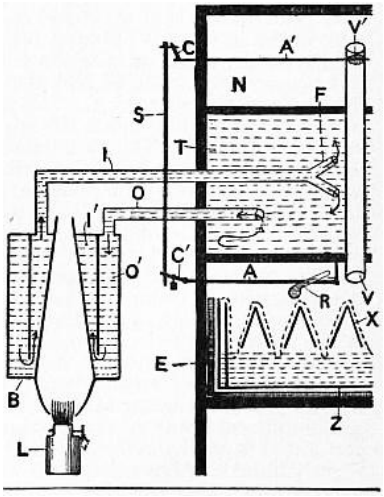


FIG 2.—Halsted's Incubator.

To a very large extent, the efficiency of this apparatus depends upon the approximately perfect performance of the lamp. A good, steadily burning one should be employed, and only the best oil used; for, should the wick become fouled the flame cannot freely burn. For this reason it is better to use gas, whenever obtainable.

The maintenance of an approximately uniform temperature is obtained by allowing the heated air of the egg-drawer to escape through the two ventilating shafts (V). The swing-valves of these are opened or closed by means of the regulator (R). This latter consists of a glass bowl prolonged into a tube, about 8 in. long and three-eighths of an inch in diameter. The glass tube swings upon an axis (A) which is situated as near as possible to the bowl of the regulator. The axis is connected with a crank (C′) which is disposed so as to act as a lever upon the vertical shaft (S), which in its turn is connected with the upper crank (C); this works the axis (A′) of the swing-valves, and so can open or close the apertures of the ventilating pipes. The bowl of the regulator is filled with mercury to such an extent that at the temperature of 100° F., and when the tube is slightly inclined upwards from the horizontal it just flows slightly into the tube from the bowl. On the lever-crank (C′) a weight is slung by a sliding adjustment, and is so placed that when the temperature of the egg-drawer is 103° it just balances the tube of the regulator when it is slightly inclined upwards. Should the temperature of the drawer now rise higher the mercury flows towards the distant end of the tube and, causing it to fall down, brings about a rotation of the regulator axis and as a consequence the opening of the ventilating valves. A transverse stay prevents the limb of the regulator from quite reaching the horizontal when it falls. As the temperature cools down the mercury contracts and retraces to the nearer end of the tube and to the bowl, and consequently results in the upward inclination of the limb; the valves are thus closed again.

The egg-drawer (E) is specially constructed so as to imitate as nearly as possible the natural conditions that exist under a sitting hen. The drawer is of wood and contains a zinc tray (Z) into which cold water is placed. Fitting into the zinc tray is another zinc compartment, the floor of which is made of a number of zinc strips (X) transversely arranged and placed in relation to each other like the limbs of an inverted Λ. The limbs are so disposed that those of one series do not touch the adjacent ones, and in fact a space is left between them. Thus a number of parallel troughs are formed, each of which opens below into the moist air chamber of the cold water tray beneath. In practice these troughs are covered with flannel which is allowed to dip into the water of the tray. Thus the eggs lie in a series of damp troughs and their lower surfaces are therefore damper and colder than their upper ones. This incubator, if carefully worked and the necessary practical details observed, has the reputation of being an efficient machine.

Somewhat similar to the Halsted incubator, but differing from it in the nature of the boiler and in the temperature regulator, is the Graves incubator, made in Boston, U.S.A. The incubator itself (fig. 3) consists of an incubating or egg-drawer (E) heated from above by a warm-water tank (T). Below the egg-drawer is a tank containing cold water, the vapour of which passes through the perforated floor of the former and keeps the air of the egg-chamber slightly humid. Above the warm-water tank is an air chamber (AC) to serve as a non-conducting medium and to prevent therefore undue loss of heat. Above this is a nursery or drying chamber (N), closed in, with a movable lid.

The warm-water tank is heated by means of a simple boiler (B) from which an inlet tube (I) carries heated water to the tank; the tube traverses the length of the tank and discharges at its farther end (not shown in the diagram). From the nearer end of the tank an outlet tube (O) passes out and opens into the boiler at a slightly higher level than the inlet one. The boiler is heated by an evenly burning lamp below, of special construction. The rectangular tube through which the wick passes is bevelled at its outer end, and upon this bevelled edge a metal flap (F) is allowed to rest more or less closely, according as the flame is to be smaller or larger respectively. The wick is, of course, bevelled to correspond to the form of its tube. The metal flap is raised or depressed by means of levers connected with the heat-regulator. When it is depressed upon the wick the flame is lessened; and it becomes proportionately bigger as the flap is raised more and more.

The heat-regulator consists of a glass tube (T) which runs the whole width of the incubation chamber and lies in contact with the

floor of the warm-water tank; it is filled with alcohol. Externally to the incubator this tube is connected with a **U**-shaped one containing mercury. The free limb of the **U**-tube contains a piston (P) which rests upon the surface of the mercury in that limb. From the piston a piston rod (PR) passes vertically upwards and is connected with a lever (L) which operates, through the agency of a second lever (L′) the movements of the ventilating valve (V) inserted over the orifice of the ventilating shaft (A) which opens from the roof of the incubator drawer. The lever (L) is further connected with a spiral spring (S) which works the metal flap of the lamp already described. The height of the piston in the **U** tube can be so adjusted, by varying the quantity of mercury in the tube, that when the temperature of the incubation drawer is 103° F., the ventilating valves are closed and the wick is burning to its full extent. Should the temperature rise, the alcohol in the glass tube (T) expands and causes the mercury in the free limb of the **U** tube to rise. This carries with it the piston, and this movement brings about the opening of the ventilating valves, and at the same time, through the agency of the lever (L) and the spiral spring (S) the metal flap is brought down upon the wick, cutting off more or less of the flame. Should the temperature then fall to 103° or lower, the contraction of the alcohol reverses these movements, the valve closes, and the wick once more burns to its full extent.

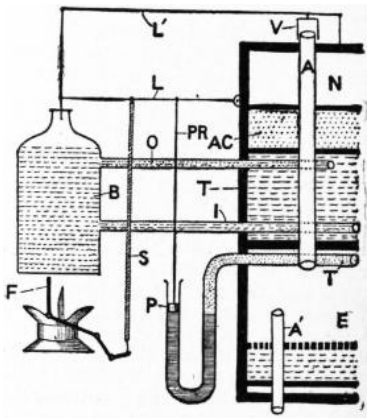


FIG. 3.—Graves’s Incubator.

In practice, the boiler and the temperature regulator are duplicated, there being a set on both sides of the incubator. Any slight irregularity on the one side may be thus compensated for by the other side.

Graves’s incubator has the reputation of being a good machine.

Among the most recent type of incubators made in England is that of Charles Hearson. This differs from any of those described in the simplicity and ingenuity of the heat regulator, and in that the tubes which traverse the water tank are hot-air flues, carrying the air heated by the flame and not warm water. Consequently a further simplification is introduced inasmuch as no boiler is required.

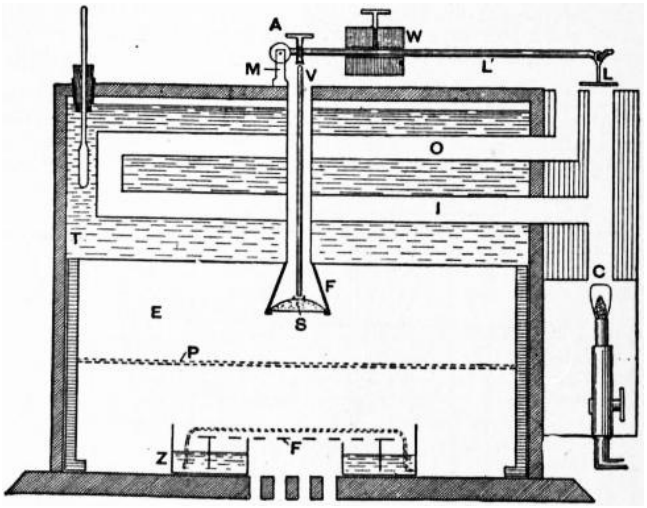


FIG. 4.—Hearson’s Incubator.

The essential features of this incubator are shown in fig. 4. The internal parts of the incubator are insulated by a double wall, the interspace being packed by a non-conducting material, which is not shown in the figure. The incubation or egg-drawer (E) is heated by the warm-water tank (T). Beneath the egg-drawer is a zinc tray (Z), so constructed that in the central part the floor is raised up into a short cylinder. Around the raised cylinder is a wide trough containing water and into this dips a canvas cloth which is stretched out over a perforated zinc support (F). By this means an extended moistened surface is produced which allows of a rapid evaporation. The floor of the incubator, which is raised by short feet from the table on which it stands, is perforated in the central portion by a number of holes, and which are so situated that they lie beneath the raised cylinder of the cold-water tray (Z). The incubation-drawer is thus supplied continuously by a slow current of moistened air because the air in the upper part of the drawer, *i.e.* in contact with the floor of the warm-water tank, is the warmest and lightest. It therefore tends to diffuse or pass through the narrow slits between the drawer and the walls of the incubator, and also through the aperture in the front wall of the egg-drawer, through which a thermometer is laced. To replace the air thus lost, fresh air passes in through the holes in the bottom of the incubator, and on its way must pass through the pores of the damp canvas which dips into the water in the zinc tray (Z).

The warm-water tank is heated by an inlet (I) and outlet (O) flue which are, however, continuous. The inlet flue opens out from a vertical chimney (C), the air in which is heated either by a gas flame or that of an oil lamp. The outlet or return flue passes back through the width of the tank and opens independently to the exterior. The vertical chimney (C) is capped by a lid (L) capable of being raised or lowered upon its orifice by the lever (L′). When the cap is resting upon the chimney all the heated air from within the latter passes through the flues and heats the water in the tank. If the cap is widely raised, practically all the heated air passes directly upwards through the chimney and none goes through the flues. If the cap be but slightly raised, part of the heated air goes through the flues and part directly escapes through the aperture of the chimney. The movement of the lever (L′) which raises the cap (L) is determined by the thermostatic capsule (S), situated within the egg-drawer.

The principle upon which this capsule is designed is that the boiling point of a liquid depends not only

upon temperature but also upon pressure. A given liquid at ordinary atmospheric pressure will boil at a certain degree of temperature, which varies for different substances. But if the pressure be increased the boiling point of the liquid is raised to a higher degree of temperature. A liquid when it boils passes into a gaseous condition and in this state will occupy a very much larger volume—some two or three hundred times—than in the liquid condition. If, therefore, a hermetically sealed capsule with flexible sides be filled with some liquid which boils at a given temperature, the sides of the capsule will distend when the temperature of the air round the capsule has been raised to the boiling point of the liquid within it. The distension of this capsule can be used to raise the lever (L′). The thermostatic capsule is placed on a fixed cradle (F) and is filled with a mixture of ether and alcohol, the proportions being such that the boiling point of the mixed liquid is 100° F. Between the capsule and the lever (L′) is a vertical rod (V), articulating with the lever as close as possible to its fulcrum (M). The articulation with the lever is by means of a screw, so that the necessary nice adjustment between the height of the rod (V), the thickness of the capsule and the position of rest of the damper (L) upon the chimney, can be accurately made. The temperature at which it is desired that the liquid in the capsule shall boil can be determined by sliding the weight (W) nearer or farther to the fulcrum of the lever (L′). The farther it is moved outwards, the greater is the pressure upon the thermostatic capsule and consequently the higher will be the boiling point of its contained liquid. By means of the milled-head screw (A), the height of the lever at its outer end can be so adjusted that when the liquid of the capsule is not boiling the damper (L) closes the chimney, but that when it does boil the damper will be raised sufficiently high from it. If the weight is pushed as far as it will go towards the fulcrum end of the lever, the temperature of the egg-drawer will never rise more than 100° F. because at this temperature and under the pressure to which it is then subjected, the liquid in the capsule boils, and consequently brings about the raising of the damper. It matters not, therefore, how high the flame of the gas or lamp be turned, the temperature of the egg-drawer will not increase, because the extra heat of the enlarged flame is passing directly outwards through the chimney, and is not going through the flues in the tank. In order to raise the temperature within the incubation chamber to 102° or 103°, or any other desired degree, the weight (W) must be moved outwards along the lever (L′), about 1 in. for every degree of temperature increase desired. This thermostatic capsule works admirably, and the incubator will work for months at a time and requires no adjustment, however much, within the limits of our climate, the external temperature may vary. The capsule, like all other thermostats in which the expansible substance is a liquid, is, however, dependent upon external pressure for the point at which its contained liquid boils and therefore, for the degree of temperature prevailing within the incubator drawer. It is therefore responsive to variations in atmospheric pressure, and as the barometer may fall 1 or 2 in., this may possibly make a difference of two or three degrees in the fluctuation of temperature within the egg-drawer. It is not, of course, often that such large oscillations of the barometer occur, and as a matter of practical experience, under ordinary conditions, this incubator will work for months together without attention with only half a degree variation round the point at which it was set.

Greenwood's incubator (fig. 5), named the Bedford, resembles Pearson's in that hot-air flues (F and F′) and not hot-water pipes, traverse the water tank (T). And the method of regulation of the temperature is much the same, *i.e.* a thermostat (V) operating upon a lever which raises a cap (C) from off the aperture of the main flue (F) and thus allows all the heat of the flame to pass directly outwards, without passing through the series of flues (F) which horizontally traverse the water-tank. Fresh air enters through a wide circular aperture (A) which surrounds the main flue, and it thus becomes partially warmed before entering the egg-chamber. The eggs are placed upon a perforated floor (E) lying over water baths (B). The water tank (T) lies in the centre of the incubation chamber and is traversed through its central axis by the main hot-air flue (F). From this, four horizontal flues pass outwards through the water and open into small vertical flues, which in their turn communicate with the exterior.

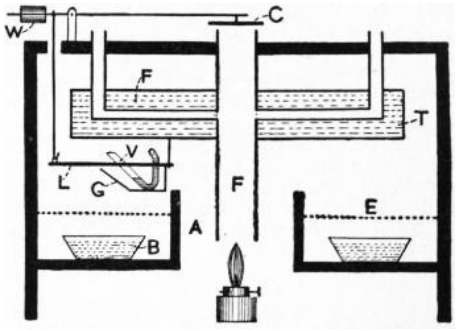


FIG. 5.—The Bedford (Greenwood's) Incubator.

The thermostat (V) consists of a glass tube of peculiar form. This is closed at the end of its short limb and open at its other extremity on the long limb. The bent portion of the tube is filled with mercury and between the mercury column and the closed end is a small quantity of ether. The thermostat is lodged in a box (G), which forms part of the lever (L). At one end this lever is pivoted to a fixed arm, and at the other to the vertical rod which operates the ventilating cap (C). If the temperature should rise, the ether in the thermostat expands and pushes the mercury column up along the inclined long limb. This disturbs the equilibrium of the lever (L), and it descends downwards, pulling with it the vertical rod, and thus raising the cap over the main flue. If the temperature falls the reverse series of changes occur. The temperature at which the cap will be raised can be adjusted within limits by the position of the weight (W) and by the adjustment of the degree of inclination of the thermostat.

The Proctor incubator, made at Otley, is apparently, in its main features, similar to the Greenwood.

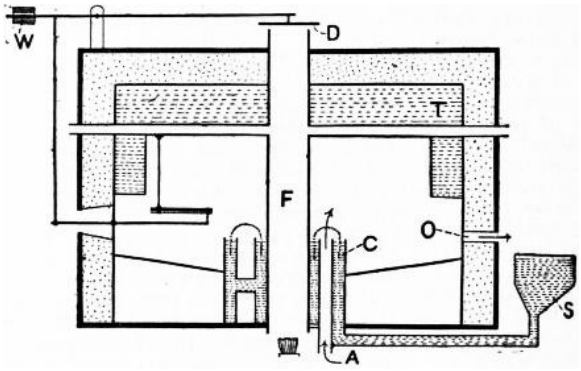


FIG. 6.—The Winchcombe Incubator.

Somewhat similar, in certain features, to the Greenwood is the Winchcombe. Its improved form, in which metal replaces the wood casing, is named the Gladstone. In it there is a combination of the hot-air and the water-tank systems of warming the incubation chamber. The wall of the incubator is double, and the space between the outer and inner wall is packed with a non-conducting material. The incubation chamber is heated above by a water-tank (fig. 6 T) which is traversed by a main vertical flue (F) and four subsidiary horizontal ones which discharge externally. The main flue, however, in passing up to enter the water tank traverses the egg-chamber, and therefore serves to warm it, as in the hot-air type of incubator, by the heat of the flue itself. Around the lower half of the flue is a water vessel consisting of two concentric containers (C), holding water. In the space between these concentric containers, fresh air passes in through the aperture (A), and before it reaches the egg-chamber it passes through coarse canvas which dips into the water in the containers, and is therefore kept permanently moist. The containers are filled from a water tank (S) outside the incubator. Air passes out from the egg-chamber through the aperture (O). The temperature is regulated by a bimetallic thermostat (see below), which operates two levers, that by their arrangement can raise or depress the cap (D) over the main flue (F). The temperature at which this occurs will be determined, within limits, by the position of the adjustable weight (W).

Tomlinson's incubator, designed in 1880, is novel in principle. It possesses a very large water tank, holding 15 gallons for every hundred eggs. Through this tank there pass two hot-air horizontal flues, lying in the same plane. The novelty of the construction lies in the great volume of water used and in the disposition of the flues towards the top of the tank. It is said that very little circulation of water takes place beneath the flues, because warmed water rises instead of falling. The great body of water below the flues will therefore only take up heat relatively slowly, and will, on account of its bulk and its physical properties, but slowly lose it. Should the flame fall in power, or even go out for ten or twelve hours, it is claimed that no serious loss of efficiency of the apparatus will result.

Regulation of the temperature is by means of an air tube, the air in which expanding bulges out an india-rubber diaphragm and this moves a lever. The lever operates a valve which allows more or less of the heated air to escape from the egg-drawer.

(*b*) *Hot-air Incubators.*—W. H. Hillier's Incubator (fig. 7) is circular in form and is constructed of a double-walled metal case. The space between the two walls is packed with a non-conducting material. The incubation or egg-chamber (C) is warmed by a circular heating box (H), and the air in this is heated by a lamp. The roof of this box forms part of the floor of the incubation chamber and from it a main flue (F) and four smaller ones (F′) pass upwards through the roof of the incubator and discharge to the exterior. Fresh air passes in to the incubator through two tubular channels (A and A′) on either side of the heating box and escapes through a hole in the roof, which serves at the same time as a passage for one of the rods (D) in connexion with the temperature regulating apparatus.

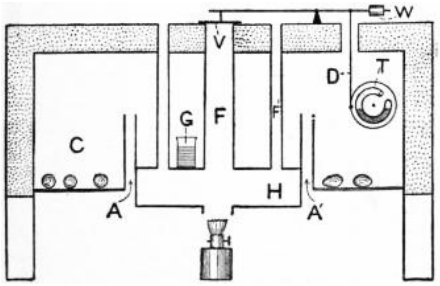


FIG. 7.—Hillier's Incubator.

This apparatus (T) consists of a glass tube of ½ in. bore, and which is bent into the form of a circle of 5 in. diameter. The tube is fastened to a wooden disk, which rotates upon a pivot and in so doing operates a vertical rod (D), which in its turn works the cap (V) which covers the orifice of the main flue. The tube is partly filled with mercury and is closed at one end. At this end there is contained some spirit. As the temperature rises, this expands and pushes the mercury column farther along the tube. The equilibrium of the position of rest is thus disturbed, and the wooden disk consequently rotates, carrying with it the vertical arm, the downward movement of which raises the cap (V) of the flue. The temperature at which it is desired that this valve shall uncover the flue, can be adjusted within the necessary limits by sliding the weight (W) along the horizontal arm and by the amount of mercury present in the bent tube. The air of the incubation chamber is rendered sufficiently moist by the evaporation of water in the vessel (G).

In the Cornell incubator (New York) more personal attention is required than in other forms, since the ventilation of the egg-chamber is not wholly automatic but is regulated according to the results of observation. The great difficulty in ventilation is the proper combination of fresh air and moisture. The Cornell Incubator Company has endeavoured to obviate this difficulty by carrying out a series of observations on the rate at which evaporation occurs in incubating eggs under natural conditions. The rate of evaporation is measured by the size of the air-space within the egg-shell at successive days. This they have ascertained, and with their incubators they furnish a book of instructions in which diagrams showing the size of the air space on the 1st, 5th, 10th, 14th and 18th days are given. Examination of the eggs should therefore be made every two or three days, and the result compared with the diagrams. The incubator is provided with an adjustable ventilator and this should be so arranged that evaporation is neither too great

nor too little. The ventilator should never be wholly closed, and if when closed to its minimum evaporation is still too great, then water should be placed in the moisture pans. In all cases lukewarm water should be placed in these on the 18th day and the ventilating slide opened wide.

It will thus be seen that in this machine there is an attempt to do away with the addition of water to the incubator drawer during the greater part of the period of incubation, and to rely upon the aqueous vapour naturally present in the atmosphere. This attempt is based upon the fact that water vapour is lighter than air, and will therefore rise to the top in any enclosed volume of air. If the direction of the ventilating current is downwards in the incubation chamber, and if it is slow enough, it is thought that the water vapour will be sifted out and tend to accumulate to a sufficient extent in the chamber. In the Cornell incubator consequently the ventilating current passes first upward through an external heater in order to warm it, whence it is then deflected downwards into the egg-chamber and diffuses through its perforated bottom. Then it passes along a space beneath the chamber into a space in the left-hand wall of the incubator and out to the exterior through an adjustable and graduated ventilating slide.

These incubators are hot-air machines, and the hot-air chamber is situated above the egg-drawer and is traversed by several flues opening out from a main one. The temperature regulating apparatus appears to be similar to that of Hearson’s machine and operates by a thermostat, which through the agency of levers opens or closes a valve over the main flue.

The Westmeria incubators (Leighton Buzzard) are of two patterns. One type is built on the hot-air principle and the other on the hot-water system. In both forms the heated air from the heating surfaces is deflected down on the eggs and escapes through the perforated bottom of the egg-drawer. The inlet air is first warmed by contact with the main flue. The thermostat is similar to that in the Hillier machine (fig. 7) and consists of a coil mounted on an axis, round which it can rotate. The coil is filled with mercury and is closed at one end. Between this end and the mercury column is a short column of air. By expansion of the air under a rising temperature, the mercury column is displaced and brings about a rotation of the disk to which the coiled tube containing it is attached. This rotation raises the cap over the main flue.

All the incubators so far described have been constructed with the idea of obtaining as nearly as possible a uniform temperature. But in E. S. Renwick’s incubator (America) no attempt is made to obtain uniformity in temperature. On the other hand, it is designed to give a periodical oscillation from one extreme to the other of a limited range, about 3°, of temperature. This is accomplished by means of a thermostatic bar made of plates of brass and vulcanite fastened together. This is connected with a clockwork and detent arrangement, which simultaneously opens a valve and actuates the lamp flame. The temperature falls to the lower limit of its range before the thermostatic bar is sufficiently bent to set the clockwork arrangement operating in the reverse direction, by which the valve is closed and the lamp flame increased. The temperature then rises to the higher limit, when the bending of the thermostatic bar again releases the detent and the clockwork opens the valve and reduces the flame.

The incubator is said to succeed well. It also possesses a mechanical arrangement by which all the eggs can be periodically turned on rollers at once.

Size.—The incubators which have been described are of relatively small size, and the numbers of eggs which they can incubate are strictly limited. For commercial purposes, however, operations of a much larger magnitude are desirable and necessary. And there can be no doubt that for these purposes the incubators of the future will be of great size and will contain from 15,000 to 30,000 eggs or more at a time. Already, at Aratoma Farm, Stamford, New York State, there is established a large incubation room, containing several thousands of eggs, and in which the heat regulation is controlled in part by the personal efforts of attendants. It constitutes almost a complete return, with added accessories, to the methods of the Egyptians, and to those of John Champion.

Bacteriological Incubators.

These differ from bird Incubators in that the heating surface of the incubation chamber generally surrounds all sides of it and there is, as a rule, no special arrangement for bringing about a more or less humid condition of the contained air. In some forms there is an arrangement to ensure a continuous supply of fresh and moist air, but in the majority the incubation chamber obtains its supply of fresh air vicariously. In some forms the chamber of the incubator is heated by a warm water tank of a simple kind, which extends round all its sides. But in other forms a series of tubes or flues passes through the water in this tank and thus simulates in principle the tube boiler. This latter form utilizes the heat of the flame to a greater degree than the former kind. In yet other forms the incubation chamber is heated by warm air chambers which surround it or flues which traverse it. Most bacteriological incubators are square or rectangular in form, but some bacteriologists prefer cylindrical forms, presumably on account of the ratio of volume to surface in connexion with the water tank.

One of the best known and most generally used of the cylindrical and water-tank kind is that of Dr d’Arsonval. It consists of two copper cylinders (fig. 8 C and C′), each terminating in a cone below. Between the cylinders is a wide interspace, in order that a large volume of water may be contained. This interspace therefore constitutes the water-tank of the incubator. The upper orifice of the inner cylinder is closed by a movable double lid, which contains an interspace filled with water. The outer cylinder has an oblique form at its upper end and is permanently closed. The result attained by this slope of the lid of the outer cylinder is that the water tank, which is fed from the highest point, becomes completely filled. The aperture at the highest point of the outer cylinder is plugged with a caoutchouc plug and through a perforation in this a glass tube (T) is placed. In the side of the outer cylinder below this, there is a wide and rimmed aperture, to which a gas regulator of special construction is fixed.

This regulator was designed by Théophile Schloesing, and consists of a brass box, supplied with a rim (L) which fits on to the corresponding rim (L′) on the aperture of the incubator. Stretching across the orifice thus connecting the brass box of the regulator

with the water-tank of the incubator is a thin india-rubber diaphragm (D). At its outer end a perforated cap (R) screws on to the brass box. Through the perforation the inlet gas tube passes (I); the outlet gas tube (O) leaves the brass box below and passes direct to the gas burners. The inlet gas tube is fitted at its inner end with a sliding flanged collar (F), which is kept pressed against the rubber diaphragm by a spiral spring. Just behind the collar the inlet tube is perforated by a small hole, so that the gas supply is never wholly cut off, even though the rubber diaphragm completely occludes the inner aperture of the pipe.

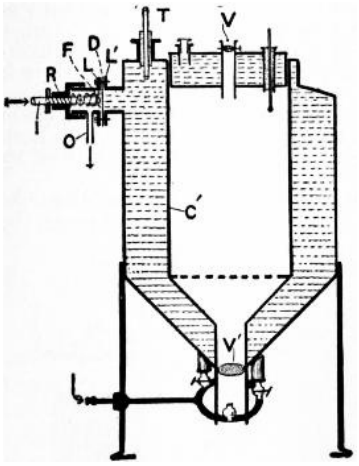


FIG. 8.—D'Arsonval Incubator.

The mode of working of the regulator is as follows: when the water tank of the incubator is filled with distilled or rain water at the temperature required, it presses upon the india-rubber diaphragm with a certain degree of pressure. By screwing the inlet pipe in or out, as required, it can be so adjusted that the diaphragm does not occlude its inner aperture, and consequently the full volume of gas can pass through to the burners below. The temperature of the water in the water-tank therefore begins to rise, and in consequence the volume of the water to increase. This results in the water rising up into the tube (T), and therefore the dynamical pressure which is exercised by the water upon every part of the two cylinders of the incubator and consequently also upon the india-rubber diaphragm of the regulator is increased. As this pressure increases, the diaphragm becomes bulged outwardly and reduces the volume of gas passing through the aperture of the inlet pipe. At a certain point, of course, the diaphragm completely occludes the aperture, and the gas supply is wholly cut off, except for the very small hole, forming a by-pass, in the pipe, behind the collar. This hole is just sufficiently big to allow the minimum amount of gas requisite to keep the flames burning to pass through. The temperature will, therefore, begin to fall, the volume of water to decrease with its resulting descent from the glass tube (T) and consequent decrease in the dynamical pressure of the water upon the diaphragm. The latter therefore retracts away from the aperture of the inlet tube, and more gas consequently passes through; the flames again increase in size and the temperature rises once more. And as soon as the volume of water, owing to the rising temperature, has increased to the extent correlated with the temperature at which the apparatus has been set to work, it will have risen once more in the tube (T), and the gas will be again cut off. The three burners are placed upon a support that can be moved vertically up or down along one of the legs of the incubator. The flames are protected from draughts by mica chimneys. Ventilation is provided by an adjustable valve (V′) in the cylindrical termination of the incubator at its lower end, and by tubular orifices, also fitted with valves (V) in the lid above.

The incubator is very reliable and may be worked within very narrow limits of variation, provided that the gas-supply be regulated by a gas-pressure regulator, that the height of the water in the tube (T) is maintained by daily additions of a few drops of distilled water, and that the incubator itself be protected from draughts.

Another form of d'Arsonval incubator has a glass door in the side of it and a slightly modified form of the heat regulator.

Other cylindrical forms of incubators are made by Lequeux of Paris. In one of these the heat regulator is a bimetallic thermostat, the movements of which are enlarged by a simple series of levers, so that a valve can be automatically adjusted to allow more or less heat from the flame to pass through the heating flue.

In another form there is a movable interior, and an arrangement for keeping the air in the incubation chamber saturated. It is governed by a bimetallic thermostat of the Roux type.

In Dr Hüppe's improved form of his incubator, which is approximately square in form, the double-walled water tank is completely surrounded externally by an air chamber, which is heated by the passage through it of the products of combustion of the two flames. The heated gases escape through an adjustable aperture at the top. In the earlier form the water tank was traversed by a number of hot-air flues, and there was consequently no external hot-air chamber. There is an arrangement of tubes for ventilation, which allow fresh air to enter the lower part of the incubation chamber and to leave it at the top. The incoming air is warmed before it enters. The walls are made of lead-coated steel, and externally the incubator is covered with linoleum. In the more expensive forms the inner chamber is of copper. The temperature may be controlled by any of the simpler mercury thermostats described below.

Dr Babes' incubator is somewhat similar, but the water tank is not surrounded by a hot-air chamber. Instead it is traversed by a number of vertical flues through which the heated gases from the flames pass. Ventilation is provided for and there is an apparatus for controlling the humidity of the air in the incubation chamber. As in Hüppe's incubator, the bottom is conical in form. The walls of the incubator are of lead-coated steel, and externally they are covered with linoleum; there are two doors, an inner one of glass and an outer one of metal. The temperature may be controlled as in Hüppe's incubator.

Hearson has designed several forms of bacteriological (biological) incubators, made by Chas. Hearson & Co., Ltd. Some are heated by a petroleum lamp and others by a gas flame. In the form heated by a lamp, for which, however, gas can be substituted, the incubation chamber is surrounded by a water tank (fig. 9, A) and the lowest part of this is traversed by an in-going (L) and an out-going flue. The mode of regulation of the temperature is by means of a thermostat which operates the movements of a cap (F) over the main flue (V), and it is identical in its chief features with the method employed in the chicken incubator. The thermostat (S) is situated in the upper part of the incubation chamber.

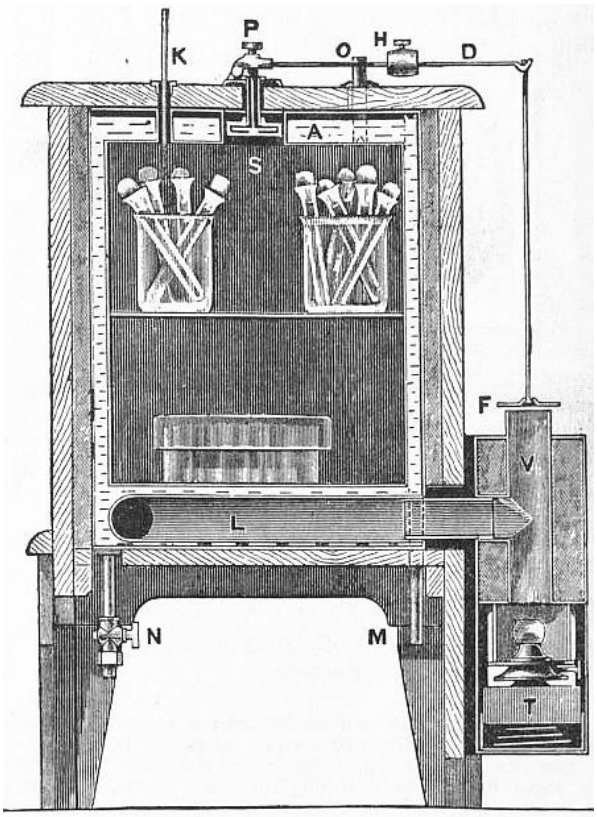


FIG. 9.—Hearson's Bacteriological Incubator. (Heated by a petroleum lamp.)

In the other form (fig. 10) for which gas is used exclusively, there are no flues traversing the water tank. This latter is heated from its conical floor by a burner beneath the incubator. The heat regulation is controlled by a thermostat of the same nature as in the form of incubator just described, but instead of operating by lowering or raising a cap over a main flue, so as to direct the heated gases either through the water tank if the temperature is falling, or through the main flue directly to the exterior if it is rising, it actuates a gas-governor, so that the flame itself is increased or diminished in size according to the needs of the incubator. The gas-governor (fig. 11) is fixed to the roof of the incubator. The horizontal arm (D) is the same that raises the cap (fig. 9, F) over the flue in the other form of incubator, but in this case it simply acts as the bearer of the sliding weight. Beyond its fulcrum (fig. 11, G) it is continued into a detent-like spur (B) which pushes down upon a button attached to a rubber diaphragm, when the thermostat within the incubator is expanded by a rise in temperature. The button thus forced down, more or less completely closes the inlet gas aperture, and so reduces or cuts off the gas supply to the flame. There is a by-pass to prevent the flame from going out completely, and the size of this can be adjusted by the screw (S). Hearson's incubators have the reputation of very accurate performance and practically need no attention for months, or even years.

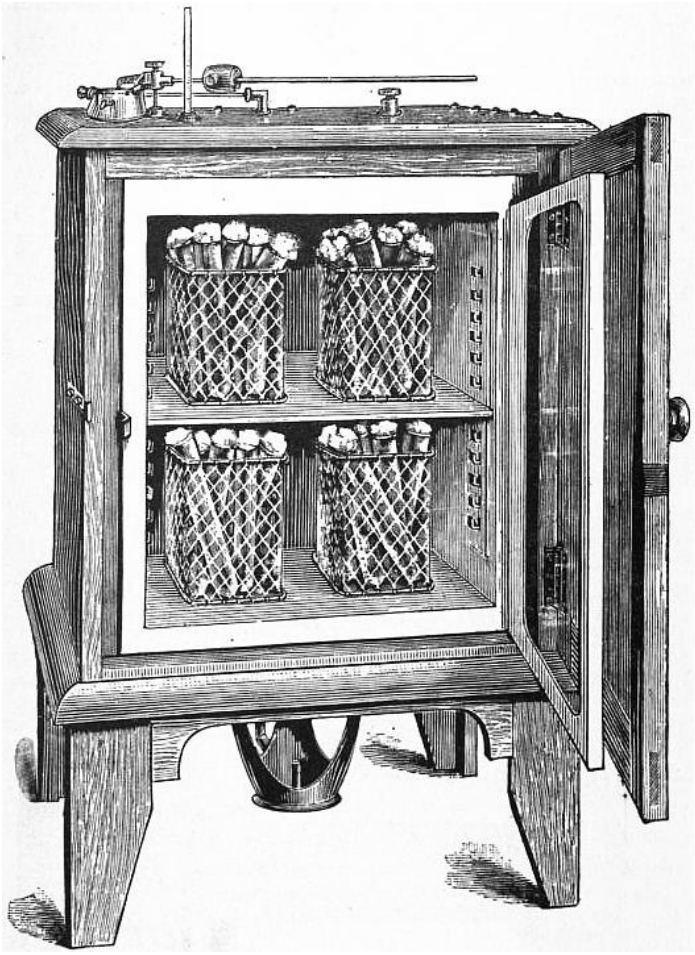


FIG. 10.—Hearson's Bacteriological Incubator (heated by a gas flame).

Schribaux's incubator is a hot-air form. Its walls are of metal, but it is cased externally with wood, which serves as the insulating material. Against the inner metal wall of the incubator, and upon its internal surface, there are disposed a number of vertical tubes, which open through the roof above into a common discharging funnel. Below, at the bottom of the incubator they receive the heated gases of several burners, which as they pass through them radiate their heat evenly throughout the incubation chamber. In each side wall, at the bottom of the chamber, is an adjustable ventilating valve.

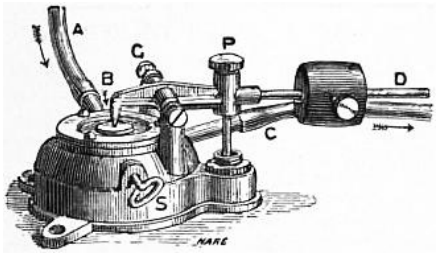


FIG. 11.—Gas-governor.

Inside the incubation chamber, and situated against its left-hand wall, is a **U**-shaped bimetallic thermostat of the Roux design, described below. This very accurately controls the temperature of the incubator.

(*c*) *Cool Incubators.*—In bacteriological laboratories there are two standards of temperature, one chiefly for the culture of non-pathogenic organisms and the other for the pathogenic forms. The first standard of temperature lies between 18° and 20° C., and the second between 35° and 38° C. But in hot countries, and even in temperate regions during the summer, the external temperature is much higher than the former of these two standards, with the result that many cultures, especially the gelatine ones, are spoiled. The difficulty is often partially overcome by running cold water through the incubator.

Hearson, however, has constructed a "cool biological incubator," in which by an ingenious device the expansion or contraction of the thermostatic capsule deflects a horizontal pipe (C) (fig. 12), through which cold water from an ordinary tap is kept running, in one of two directions. If it is deflected so as to open into the tube (D), the cold water passes into the tank (F), where it is warmed by a gas flame, and thence it passes into the water-jacket of the incubator. If it is deflected so as to open into the pipe (E), it then runs through the ice tank (B), containing broken ice, before passing through the water-jacket of the incubator. If it poured into neither of these pipes it then simply passes out through the pipe (H) to the waste pipe (N). By this device the temperature of the incubator can be kept constant at any desired point, even though it may be some 30° to 40° C. below that of the external air.

Dr Roux has also designed an incubator which can be maintained at a constant temperature below that of the surrounding air. This also depends upon the principle of carrying water through an ice-safe, which then traverses a pipe within the incubator chamber before passing into the water-jacket of the machine. The heat-regulating apparatus is a bimetallic thermostat. The incubator is made by Lequeux of Paris.

The most recent forms of all kinds of incubators, made by Hearson of London, Lequeux of Paris and Lautenschläger of Berlin are both heated and regulated by electricity. The heating is accomplished by electric radiators.

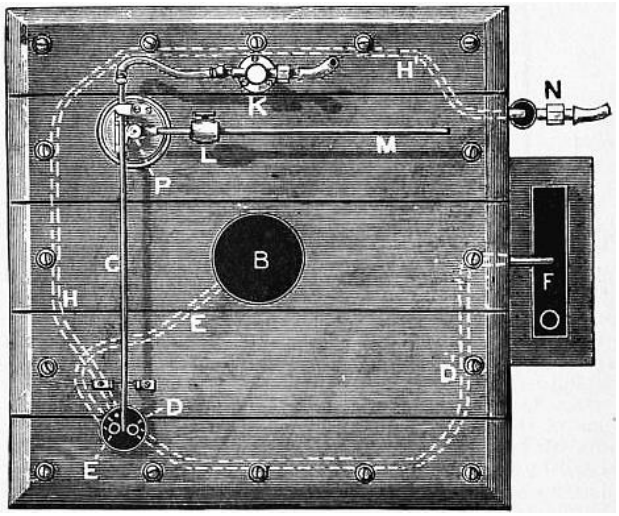


FIG. 12.—Hearson's Cool Biological Incubator.

In Hearson's machines the regulation of the temperature is brought about by the breaking or making of the electric current, through the lifting or depression of a platinum contact, actuated by the expansion or contraction of the thermostatic capsule.

In Roux's apparatus, made by Lequeux, the make and break is attained by the movement of one limb of a bimetallic thermostat, and in some forms a resistance coil and rheostat are placed in the circuit.

At the Pasteur Institute in Paris, and at other large laboratories in France, the bacteriological incubator is raised to the dimensions of a room. In the centre of this room is a large boiler heated by gas-burners, the fumes from which pass through a large flue to the outside. The flame of the burners is regulated by a bimetallic thermostat. The gas by-pass can be regulated by an attendant. The cultures are contained in vessels placed on shelves, which are ranged round the side of the room.

Human Incubators.

The first incubator designed for rearing children who are too weak to survive under normal conditions, or who are prematurely born, is that of Dr Tarnier. It was constructed in 1880 and was first used at the Paris Maternity Hospital. Its form is that of a rectangular box measuring 65 × 30 × 50 centimetres (fig. 13). It is divided into an upper and lower chamber; the former contains the infant, while the latter serves as a heating chamber, and in reality is simply a modified water-tank. The partition (P) which divides the incubator into two chambers does not extend the whole length of it, so that the upper and lower chambers are at one end of the apparatus in communication with each other. It is through this passage that the heated air from the lower chamber passes into the upper one containing the infant. The narrow bottom chamber C serves to prevent loss of heat from the base of the water-bottles. The outside air is admitted into the lower chamber at the opposite end, through an aperture (A), and passing over a series of bottles (B) containing warm water, becomes heated. The air is rendered adequately moist by means of a wetted sponge (S) which is placed at the entrance of the lower chamber into the upper. The warmed and moistened air is determined in its direction by the position of the outlet aperture (O), which is situated above and just behind the head of the infant. It contains a helix valve (H) and the rotation of this is an indication that the air is circulating within the incubator.

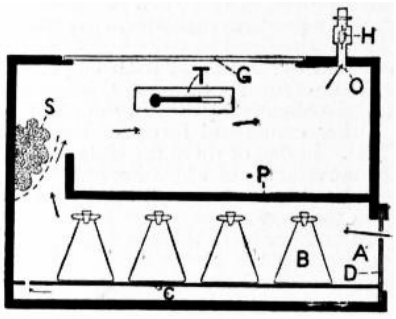


FIG. 13.—Tarnier's Incubator.

The child is kept under observation by means of a sliding glass door (G) situated in the upper or roof wall of the incubator. Immediately beneath this, and attached to one of the side walls, is a thermometer (T) which records the temperature of the air in the infant-chamber. The temperature should be maintained at 31° to 32° C. The precise limit of temperature must of course be determined by the condition of the child; the smaller and weaker it is, the higher the temperature must be.

The warm water vessels contain three-quarters of a pint of water and four of them are sufficient to maintain the required temperature, provided that the external air does not fall below 16° C. The vessels are withdrawn and replaced through an entrance to the lower chamber, and which can be opened or closed by a sliding door (D).

The walls of the incubator, with the exception of the glass sliding door, are made of wood 25 millimetres thick.

The apparatus appears to have been successful, if by success is understood the indiscriminate saving of life apart from all other considerations, since the mortality of infants under 2000 grammes has been reduced by about 30%, and about 45% of children who are prematurely born are saved.

Dr Tarnier's apparatus requires constant attention, and the water in the warm water vessels needs renewing sufficiently often. It is not provided with a temperature regulator and consequently fluctuations of internal temperature, due to external thermal variations, are liable to occur.

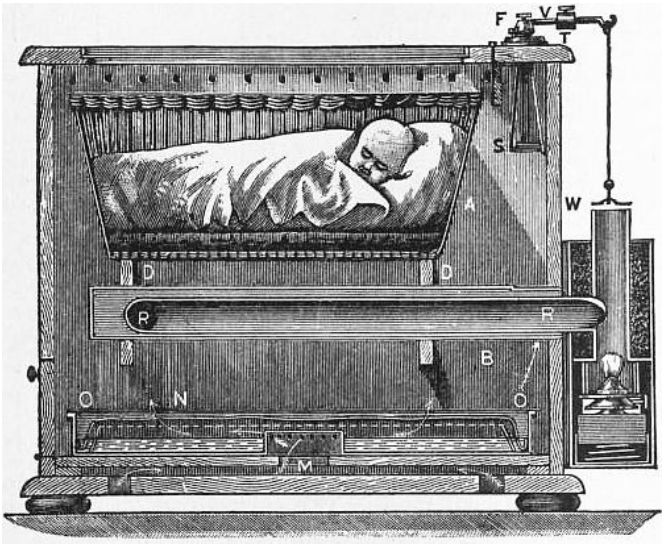


FIG. 14.—Hearson's "Thermostatic Nurse."

In Hearson's Thermostatic Nurse these drawbacks are to a large extent obviated. This "Nurse" consists fundamentally of an application of the arrangements for heating and moistening the air and for regulating the temperature of Hearson's chick incubator to Dr Tarnier's human incubator. As in this latter form, there are two chambers (fig. 14), an upper (A) and a lower (B), connected with each other in the same way as in Tarnier's apparatus. The upper chamber contains the infant, but the lower is not a heating but a moistening chamber. Through apertures (M) in the bottom of the lower chamber, the external air passes through, and as in the chick incubator it then passes through perforations in the inner cylinder of a water tray (O) and thence over the surface of the water in the tray, through a sheet of wet canvas, to the chamber itself. Hence it passes to the infant chamber and ultimately leaves this through a series of perforations round the top. The air in both chambers is heated by a warm-water tank. This tank forms the partition which divides the incubator into upper and lower chambers and is made of metal. Through the water contained in it, an incoming (R) and an outgoing (R) to the left flue, continuous with each other, pass. These two flues are related to each other as in the chick incubator (see above) and the inlet flue is heated in the same way and the outlet flue discharges similarly. The heat-regulating apparatus is identical with that in the chick incubator, and the thermostatic capsule (S) is placed in the upper chamber, near the head of the infant.

The child is placed in a basket which has perforated walls, and is open above. The basket rests upon two shallow supports (D) situated on the upper surface of the water-tank partition. The child is kept under observation through a glass door in the upper or roof-wall of the incubator.

In Great Britain this apparatus is in use at various hospitals and workhouses throughout the country, and provided there is no great fluctuation of barometric pressure, it maintains a uniform temperature.

Thermo-Regulators or Thermostats.

Certain special forms of thermo-regulators, adapted to the requirements of the particular incubators to which they are attached, have already been described. It remains now to describe other forms which are of more general application. Only those kinds will be described which are applicable to incubators. The special forms used for investigations in physical-chemistry are not described. There are various types of thermo-regulators, all of which fall into one of two classes. Either they act through the expansion of a solid, or through that of a liquid. They are so adjusted, that, at a certain temperature, the expansion of the material chosen causes the gas supply to be nearly completely cut off. The gas flame is prevented from being wholly extinguished by means of a small by-pass.

We will first describe those which act through the expansion of a liquid. A very efficient and cheap form is that described by F. J. M. Page in the *Journal of the Chemical Society* for 1876. The regulator consists of a glass bulb (fig. 15 B), continuous above with a tubular limb (L). At the upper part of the limb is a lateral tubular arm (A) which bends downwards and constitutes the outlet pipe. At the upper extremity of the limb there is a short and much wider tube (T), the lower end of which slides upwards or downwards along it. The upper end of this wider tube is closed by a cork and through a perforation in this a very small glass tube (G) passes downwards into the limb of the regulator to a point a short distance below the exit of the outlet tube. The exact height of the lower aperture of the small tube can be varied by sliding the wider tube up or down along the limb. The by-pass (P) consists of a transverse connexion between the inlet and outlet gas pipes, and the amount of gas which travels through the short circuit thus formed is regulated by means of a stopcock. The by-pass, however, can be formed, as suggested by Schäfer (*Practical Histology*, 1877, p. 80), by making an extremely small hole in the small inlet tube, a little way above its lower extremity. But unless this hole be small enough, too much gas will be allowed to pass, and a sufficiently low temperature therefore unattainable. The regulator is filled with mercury until the top of the column reaches within ½ in. of the exit of the outlet tube, the bulb is placed in the incubator chamber, and gas is allowed to pass through it. By pushing down the inner inlet tube (G) until its aperture is immersed beneath the mercury, the gas supply is cut off, with the exception of that passing through the by-pass. The stopcock is now turned until only the smallest flame exists. The inlet pipe is

then raised again above the mercury, and the flame consequently increases in size. The temperature of the incubator gradually rises, and when the desired degree is reached, the inlet tube is pushed down until the end is just beneath the surface of the mercury. The gas supply is thus cut off at the desired temperature. If the temperature of the incubator falls, the mercury contracts, the aperture of the inlet tube is uncovered, the gas supply is renewed and the flame increased. The temperature will then rise until the required point is reached, when the gas supply will again be cut off. A uniform temperature which oscillates within a range of half a degree is thus attained.

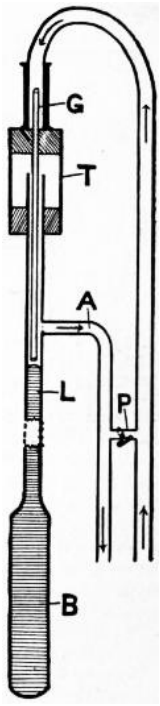


FIG. 15.—Page's Thermostat.

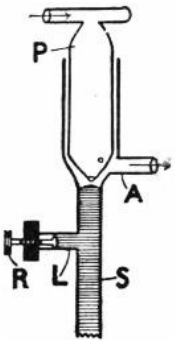


FIG. 16.—Reichert's Thermo-Regulator.

Reichert's Thermo-regulator (fig. 16) is another simple and also an earlier form. The stem (S) of the regulator is enlarged above and receives a hollow **T**-piece (P), the vertical limb of which fits accurately into the enlarged end of the stem, and one end of the cross-limb receives the inlet gas pipe; the other end is closed. The vertical limb of the **T**-piece is narrowed down at its lower extremity and opens by a small aperture. Above this terminal aperture is a lateral one of the smallest size. From the enlarged end of the stem there passes out a lateral arm (A) which is connected with the outlet pipe to the burner, and lower down another arm (L), which is closed at its outer extremity by a screw (R), is also attached. The stem and lower arm are filled with mercury and the bulb of the stem is placed in the incubator chamber, and gas allowed to pass. When the desired temperature is reached, the mercury in the stem is forced upwards until it closes the aperture of the **T**-piece, by screwing in the screw (R) of the lower lateral arm (L).

There are several modifications of Reichert's original form. In one of these the screw arrangement in the lower arm is replaced by a piston rod working in a narrow bore of a vertically bent limb of the arm. In another form, the other end of the cross bar of the **T**-piece is open and leads through a stopcock to a third arm, which opens into the enlarged upper end of the stem opposite to the outlet arm (A); this modification acts as an adjustable by-pass and replaces the minute aperture in the side of the vertical limb of the **T**-piece.

In Babes' modification the gas supply is cut off, not by the occlusion by the rising mercury of the aperture of the **T**-piece, but by a floating beaded wire-valve. The aperture of the vertical limb of the **T**-piece (P) is traversed by a fine wire which is enlarged at both ends into a bead-like knob. The wire fits loosely in the aperture and not only therefore works easily in it, but allows gas to freely pass. When the lower bead-like knob, however, is raised by the expansion of the mercury, the gas supply is cut off by the bead being carried up against the orifice.

Cuccatti's thermo-regulator (fig. 17) is an exceedingly simple and ingenious form. The stem (S) of the regulator is enlarged below into a bulb, while above it divides into a V. The two limbs of the V are of course traversed by a canal and they are connected above by a tubular cross bar (C). In the middle of this there is a stopcock situated between the two points where the bar joins the limbs of the V. One end of the cross-tube serves as an inlet and the other as an outlet for the gas. The stopcock serves as an adjustable by-pass. About an inch below the point where the two limbs of the V join the stem, the bore of the latter is enlarged, and it leads into a lateral arm (A), containing a screw (R), similar to the corresponding arm in Reichert's regulator. When the mercury in the bulb and stem expands, it rises, and reaching the point when the two limbs of the V meet occludes the orifice to both and thus cuts off the gas supply, except that which is passing through the by-pass of the stopcock. The temperature at which this occlusion will take place can be determined by the screw in the lateral arm. The more this is screwed in, the lower will be the temperature at which the gas becomes cut off, and vice versa.

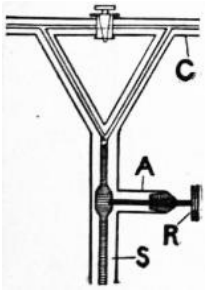


FIG. 17.—Cuccatti's Thermo-Regulator.

Bunsen's, Kemp's and Muenke's regulators are in reality of the nature of air-thermometers, and act by the expansion and contraction of air, which raises or lowers respectively a column of mercury; this in its turn results in the occlusion or opening of the gas aperture. Such forms, however, are subject to the influence of barometric pressure and an alteration of 0.5 in. of the barometer column may result in the variation of the temperature to as much as 2°.

Lothar Meyer's regulator is described in the *Berichte of the German Chemical Society*, 1883, p. 1089. It is essentially a liquid thermometer, the mercury column being raised by the expansion of a liquid of low boiling-point. The liquid replaces the air in Bunsen's and other similar forms. The boiling-point of this liquid must be below the temperature required as constant.

The solid forms of thermostats are constructed upon the same principle as the compensation balance of a watch or the compensation pendulum of a clock. This depends upon the fact that the co-efficient of expansion is different for different metals. It therefore results that if two bars of different metals are fastened together along their lengths (fig. 18, Z and ST) with the same rise of temperature one of these will expand or lengthen more than the other. And since both are fastened together and must therefore accommodate themselves within the same linear area, it follows that the compound rod must bend into a curved form, in order that the bar of greater expansion may occupy the surface of greater length, *i.e.* the convex one. Conversely, when the temperature falls, the greater degree of contraction will be in the same bar, and the surface occupied by it will tend to become the concave one. If, then, one end of

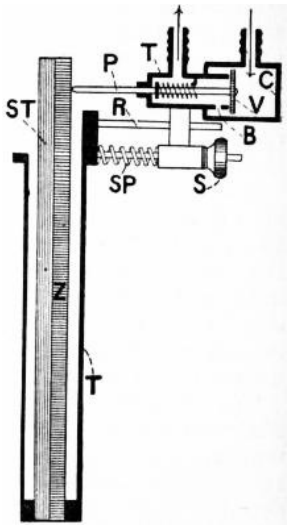


FIG. 18.—Dr Roux's Thermostat (straight bar).

this compound rod be fixed and the other free, the latter end will describe a backward and forward movement through an arc of a circle, which will correspond with the oscillations of temperature. This movement can be utilized by means of simple mechanical arrangements, to open or close the stopcock of a gas supply pipe.

In the construction of this type of thermostat it is obvious that the greater the difference in the co-efficient of expansion of the two metals used, the larger will be the amplitude of the movement obtained. Steel and zinc are two metals which satisfy this condition. The co-efficient of steel is the lowest of all metals and is comparable in its degree with that of glass. Substances which are not metals, such as vulcanite and porcelain, are sometimes used to replace steel, as the substance of low co-efficient of expansion.

The bimetallic thermostat most commonly employed is one of the two forms designed by Dr Roux. In one of these forms the compound bar is straight (fig. 18) and in the other it is **U**-shaped (fig. 19). In the former type the bar itself is enclosed in a tube (T) of metal, the wall of which is perforated. Towards the open end of this tube the gas box or case (C) is fixed. In the **U**-shape form it is attached to the outer surface (zinc) of one limb of the bar. The gas box is capable of adjustment with respect to its distance from the bar, by means of a screw (S) and a spiral spring (SP), which moves the box outwards or inwards along a rod (R). This adjustment enables the degree of temperature at which it is desired that the gas shall be cut off to be fixed accurately, and within a certain more or less extended range. The inlet and the outlet pipe are disconnected from each other in the gas box by means of a piston-like rod (P) and valve (V), which slides backwards and forwards in the tubular part (T) of the box, from which the outlet pipe emerges. When the valve (V) rests upon the edge of this box, the gas is completely cut off from passing through the outlet pipe, with the exception of that which passes through an exceedingly small aperture (B), serving as a by-pass. This is just large enough to allow sufficient gas to pass to maintain a small flame. The piston-like rod and valve, when free, is kept pressed outwards by means of a spiral spring. This ensures that the valve shall follow the movements of the compound bar. When this bar bends towards the gas box owing to a fall of temperature, the valve is pushed back away from the orifice and gas in increasing quantity passes through. The temperature of the incubator begins then to rise, and the zinc bar (Z) expanding more than the steel one (ST), the bar bends outwards and the valve once more cuts off the gas supply.

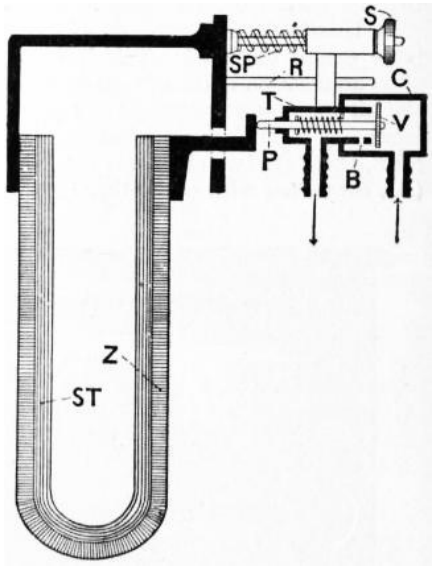


FIG. 19.—Dr Roux's Thermostat (**U**-shaped bar).

(*d*) *Gas-Pressure Regulators.*—The liquid form of thermo-regulators especially work with a greater degree of accuracy if they are combined with some apparatus which controls the variations in gas pressure. There are various forms of these regulators, most of which are figured and sometimes partially described in the catalogues of various makers of scientific instruments. It will suffice if we describe two forms, one of which (that of Buddicom) can be made by a laboratory attendant of average intelligence.

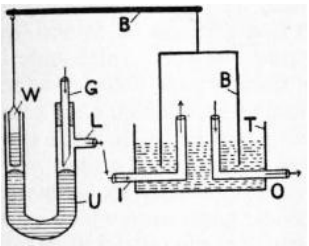


FIG. 20.—Buddicom's Gas Regulator.

In R. A. Buddicom's gas regulator (fig. 20) the inlet (I) and outlet (O) gas pipe open into a metal bell (B), the lower and open end of which is immersed beneath water contained in a metal tray (T). The bell is suspended upon the arm of a balance (B) and the other arm is poised by a weight (W). This weight may be made of any convenient material. In the original apparatus a test-tube partially filled with mercury was used. The weight dips into one limb of a **U**-shaped glass tube (U), which contains mercury. Into the other limb of this tube the gas from the meter enters through a glass tube (G) which is held in position by a well-fitting cork. The internal aperture of the tube (G) is very oblique, and it rests just above the level of the mercury when the instrument is finally adjusted. This adjustment is better made in the morning when the gas pressure in the main is at its lowest. Just above the internal aperture of the tube (G), a lateral tube (L) passes out from the limb of the U and is connected with the inlet pipe (I) of the bell. If the gas pressure rises, the bell (B) is raised and the counter-poising weight (W) is proportionately lowered. This forces the mercury up in the other limb of the **U**-tube and consequently diminishes the size of the oblique orifice in the tube (G). Some of the gas is thus cut off and the pressure maintained constant. Should the pressure fall, the reverse processes occur, and more gas passes through the orifice of G and consequently to the burner by the outlet tube (O).

Moitessier's regulator (fig. 21) is more complex, and needs more skilled work in its construction. It consists of an outer and closed cylinder (O), which is filled about half-way up with a mixture of acid-free glycerine and distilled water in the proportion of two to one respectively. Within the cylinder is a bell (B), the lower and open end of which dips under the glycerine-water mixture. From the top of the bell a vertical rod (R) passes up through an aperture in the cover of the outer cylinder, and supports the

weighted dish (D). The inlet (I) and outlet (O) pipes enter the chamber of the bell above the level of the glycerine-water mixture. The outlet tube is a simple one; but the inlet tube is enlarged into a relatively capacious cylinder (C), and its upper end is fitted with a cover which is perforated by an aperture having a smooth surface and concave form. Into this aperture an accurately fitting ball- or socket-valve (V) fits. The ball-valve is supported by a suspension thread (T) from the roof of the bell (B). The apparatus should be adjusted in the morning when the pressure is low, and the dish (D) should be then so weighted that the full amount of gas passes through. The size of the flame should then be adjusted. Should the pressure increase, the bell (B) is raised and with it the ball-valve (V). The aperture in the cover of the inlet cylinder is consequently reduced and some of the gas cut off. When the pressure falls again, the ball-valve is lowered and more gas passes through. The relative pressure in the inlet and outlet pipes can be read off on the manometer (M) placed on each of these tubes.

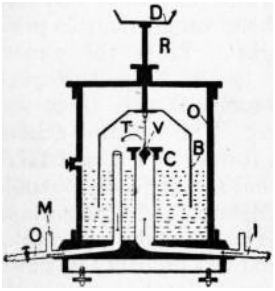


FIG. 21.—Moitessier's Gas Regulator.

Levelling screws allow of the apparatus being horizontally adjusted. The friction engendered by the working of the vertical rod (R) through the aperture in the collar of the cylinder cover is reduced to a minimum by the rod being made to slide upwards or downwards on three vertical knife-edge ridges within the aperture of the collar.

AUTHORITIES.—Charles A. Cyphers, *Incubation and its Natural Laws* (1776); J. H. Barlow, *The Art and Method of Hatching and Rearing all Kinds of Domestic Poultry and Game Birds by Steam* (London, 1827); and *Daily Progress of the Chick in the Egg during Hatching in Steam Apparatus* (London, 1824); Walthew, *Artificial Incubation* (London, 1824); William Bucknell, *The Eccaleobin. A Treatise on Artificial Incubation*, in 2 parts (published by the author, London, 1839); T. Christy, jun., *Hydro-Incubation* (London, 1877); L. Wright, *The Book of Poultry* (2nd ed. London, 1893); A. Forget, *L'Aviculture et l'incubation artificielle* (Paris, 1896); J. H. Sutcliffe, *Incubators and their Management* (Upcott Gill, London, 1896); H. H. Stoddard, *The New Egg Farm* (Orange Judd Co., New York, 1900); Edward Brown, *Poultry Keeping as an Industry* (5th ed., 1904); F. J. M. Page, "A Simple Form of Gas Regulator," *Journ. Chem. Soc.* i. 24 (London, 1876); V. Babes, "Über einige Apparate zur Bacterienuntersuchung," *Centralblatt für Bacteriologie*, iv. (1888); T. Hüppe, *Methoden der Bacterienforschungen* (Berlin, 1889). For further details of bacteriological incubators and accessories see catalogues of Gallenkamp, Baird & Tatlock, Hearson of London, and of the Cambridge Scientific Instrument Company, Cambridge; of P. Lequeux of Paris; and of F. & M. Lautenschläger of Berlin. That of Lequeux and of the Cambridge Company are particularly useful, as in many instances they give a scientific explanation of the principles upon which the construction of the various pieces of apparatus is based.

(G. P. M.)

INCUBUS (a Late Latin form of the classical *incubo*, a night-mare, from *incubare*, to lie upon, weigh down, brood), the name given in the middle ages to a male demon which was supposed to haunt women in their sleep, and to whose visits the birth of witches and demons was attributed. The female counterparts of these demons were called *succubae*. The word is also applied generally to an oppressive thing or person.

INCUMBENT (from Lat. *incumbere*, to lean, lie upon), a general term for the holder (rector, vicar, curate in charge) of an ecclesiastical benefice (see BENEFICE). In Scotland the title is generally confined to clergy of the Episcopal Church. The word in this application is peculiar to English. Du Cange (*Glossarium, s.v.* "Incumbens") says that the *Jurisconsulti* use *incumbere* in the sense of *obtinere*, *possidere*, but the sense may be transferred from the general one of that which rests or is laid on one as a duty which is also found in post-classical Latin; to be "diligently resident" in a parish or benefice, has also been suggested as the source of the meaning.

INCUNABULA, a Latin neuter-plural meaning "swaddling-clothes," a "cradle," "birthplace," and so the beginning of anything, now curiously specialized to denote books printed in the 15th century. Its use in this sense may have originated with the title of the first separately published list of 15th-century books, Cornelius a Beughem's *Incunabula typographiae* (Amsterdam, 1688). The word is generally recognized all over Europe and has produced vernacular forms such as the French incunables, German *Inkunabeln* (*Wiegendrucke*), Italian *incunaboli*, though the anglicized *incunables* is not yet fully accepted. If its original meaning had been regarded the application of the word would have been confined to books printed before a much earlier date, such as 1475, or to the first few printed in any country or town. By the end of the 15th century book-production in the great centres of the trade, such as Venice, Lyons, Paris and Cologne, had already lost much of its primitive character, and in many countries there is no natural halting-place between 1490 and 1520 or later. The attractions of a round date have prevailed, however, over these considerations,

and the year 1500 is taken as a halting-place, or more often a terminus, in all the chief works devoted to the registration and description of early printed books. The most important of these are (i.) Panzer's *Annales typographici ab artis inventae origine ad annum MD.*, printed in five volumes at Nuremberg in 1793 and subsequently in 1803 carried on to 1536 by six additional volumes; (ii.) Ham's *Repertorium bibliographicum in quo libri omnes ab arte typographica inventa usque ad annum MD. typis expressi ordine alphabetico vel simpliciter enumerantur vel adcuratius, recensentur* (Stuttgart, 1826-1838). In Panzer's *Annales* the first principle of division is that of the alphabetical order of the Latin names of towns in which incunabula were printed, the books being arranged under the towns by the years of publication. In Hain's *Repertorium* the books are arranged under their authors' names, and it was only in 1891 that an index of printers was added by Dr Konrad Burger. In 1898 Robert Proctor published an *Index to the Early Printed Books in the British Museum: from the invention of printing to the year MD., with notes of those in the Bodleian Library*. In this work the books were arranged as far as possible chronologically under their printers, the printers chronologically under the towns in which they worked, and the towns and countries chronologically in the order in which printing was introduced into them, the total number of books registered being nearly ten thousand. Between 1898 and 1902 Dr W. Copinger published a *Supplement to Hain's Repertorium*, described as a collection towards a new edition of that work, adding some seven thousand new entries to the sixteen thousand editions enumerated by Hain. From the total of about twenty-three thousand incunabula thus registered considerable deductions must be made for duplicate entries and undated editions which probably belong to the 16th century. On the other hand Dr Copinger's *Supplement* had hardly appeared before additional lists began to be issued registering books unknown both to him and to Hain, and the new *Repertorium*, begun in 1905, under the auspices of the German government, seemed likely to register, on its completion, not fewer than thirty thousand different incunabula as extant either in complete copies or fragments.

In any attempt to estimate the extent to which the incunabula still in existence represent the total output of the 15th-century presses, a sharp distinction must be drawn between the weightier and the more ephemeral literature. Owing to the great religious and intellectual upheaval in the 16th century much of the literature previously current went out of date, while the cumbrous early editions of books still read were superseded by handier ones. Before this happened the heavier works had found their way into countless libraries and here they reposed peacefully, only sharing the fate of the libraries themselves when these were pillaged, or by a happier fortune amalgamated with other collections in a larger library. The considerable number of copies of many books for whose preservation no special reason can be found encourages a belief that the proportion of serious works now completely lost is not very high, except in the case of books of devotion whose honourable destiny was to be worn to pieces by devout fingers. On the other hand, of the lighter literature in book-form, the cheap romances and catchpenny literature of all kinds, the destruction has been very great. Most of the broadsides and single sheets generally which have escaped have done so only by virtue of the 16th-century custom of using waste of this kind as a substitute for wooden boards to stiffen bindings. Excluding these broadsides, &c., the total output of the 15th-century presses in book form is not likely to have exceeded forty thousand editions. As to the size of the editions we know that the earliest printers at Rome favoured 225 copies, those at Venice 300. By the end of the century these numbers had increased, but the soft metal in use then for types probably wore badly enough to keep down the size of editions, and an average of 500 copies, giving a possible total of twenty million books put on the European market during the 15th century is probably as near an estimate as can be made.

Very many incunabula contain no information as to when, where or by whom they were printed, but the individuality of most of the early types as compared with modern ones has enabled typographical detectives (of whom Robert Proctor, who died in 1903, was by far the greatest) to track most of them down. To facilitate this work many volumes of facsimiles have been published, the most important being K. Burger's *Monumenta Germaniae et Italiae Typographica* (1892, &c.), J. W. Holtrop's *Monuments typographiques des Pays-Bas* (1868), O. Thierry-Poux's *Premiers monuments de l'imprimerie en France au XV^e^ siècle* (1890), K. Haebler's *Typographie ibérique du quinzième siècle* (1901) and Gordon Duff's *Early English Printing* (1896), the publications of the Type Facsimile Society (1700, &c.) and the *Woolley Facsimiles*, a collection of five hundred photographs, privately printed.

In his *Index to the Early Printed Books at the British Museum* Proctor enumerated and described all the known types used by each printer, and his descriptions have been usefully extended and made more precise by Dr Haebler in his *Typenrepertorium der Wiegendrucke* (1905, &c.). With the aid of these descriptions and of the facsimiles already mentioned it is usually possible to assign a newly discovered book with some certainty to the press from which it was issued and often to specify within a few weeks, or even days, the date at which it was finished.

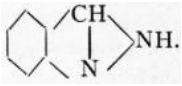
As a result of these researches it is literally true that the output of the 15th-century presses (excluding the ephemeral publications which have very largely disappeared) is better known to students than that of any other period. Of original literature of any importance the half-century 1450-1500 was singularly barren, and the zeal with which 15th-century books have been collected and studied has been criticized as excessive and misplaced. No doubt the minuteness with which it is possible to make an old book yield up its secrets has encouraged students to pursue the game for its own sake without any great consideration of practical utility, but the materials which have thus been made available for the student of European culture are far from insignificant. The competition among the 15th-century printers was very great and they clearly sent to press every book for which they could hope for a sale, undaunted by its bulk. Thus the great medieval encyclopaedia, the *Specula* (*Speculum naturale*, *Speculum historiale*, *Speculum morale*, *Speculum doctrinale*) of Vincent de Beauvais went through two editions at Strassburg and found publishers and translators elsewhere, although it must have represented an outlay from which many modern firms would shrink. It would almost seem, indeed, as if some publishers specially affected very bulky works which, while they remained famous, had grown scarce because the scribes were afraid to attempt them. Hence, more especially in Germany, it was not merely the output of a single generation which came to the press before 1500, but the whole of the medieval literature which remained alive, *i.e.* retained a reputation sufficient to

attract buyers. A study of lists of incunabula enables a student to see just what works this included, and the degree of their popularity. On the other hand in Italy the influence of the classical renaissance is reflected in the enormous output of Latin classics, and the progress of Greek studies can be traced in the displacement of Latin translations by editions of the originals. The part which each country and city played in the struggle between the old ideals and the new can be determined in extraordinary detail by a study of the output of its presses, although some allowance must be made for the extent to which books were transported along the great trade routes. Thus the fact that the Venetian output nearly equalled that of the whole of the rest of Italy was no doubt mainly due to its export trade. Venetian books penetrated everywhere, and the skill of Venetian printers in liturgical books procured them commissions to print whole editions for the English market. From the almost complete absence of scholarly books in the lists of English Incunabula it would be too much to conclude that there was no demand for such books in England. The demand existed and was met by importation, which a statute of Richard III.'s expressly facilitated. But that it was not commercially possible for a scholarly press to be worked in England, and that no man of means was ready to finance one, tells its own tale. The total number of incunabula printed in England was probably upwards of four hundred, of which Caxton produced fully one-fourth. Of the ten thousand different incunabula which the British Museum and Bodleian library possess between them, about 4100 are Italian, 3400 German, 1000 French, 700 from the Netherlands, 400 from Switzerland, 150 from Spain and Portugal, 50 from other parts of the continent of Europe and 200 English, the proportion of these last being about doubled by the special zeal with which they have been collected. The celebration in 1640 of the second centenary (as it was considered) of the invention of printing may be taken as the date from which incunabula began to be collected for their own sake, apart from their literary interest, and the publication of Beughem's *Incunabula typographiae* in 1688 marks the increased attention paid to them. But up to the end of the 17th century Caxtons could still be bought for a few shillings. The third centenary of the invention of printing in 1740 again stimulated enthusiasm, and by the end of the 18th century the really early books were eagerly competed for. Interest in books of the last ten or fifteen years of the century is a much more modern development, but with the considerable literature which has grown up round the subject is not likely to be easily checked.

The chief collections of incunabula are those of the Bibliothèque Nationale at Paris, Royal library, Munich, and British Museum, London, the number of separate editions in each library exceeding nine thousand, with numerous duplicates. The number of separate editions at the Bodleian library is about five thousand. Other important collections are at the University library, Cambridge, and the John Rylands library, Manchester, the latter being based on the famous Althorp library formed by Earl Spencer (see BOOK-COLLECTING).

(A. W. PO.)

INDABA, a Zulu-Bantu word, formed from the inflexional prefix *in* and *daba*, business, news, for an important conference held by the "indunas" or principal men of the Kaffir (Zulu-Xosa) tribes of South Africa. Such "indabas" may include only the "indunas" of a particular tribe, or may be held with the representatives of other tribes or peoples.

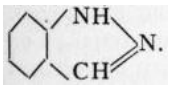
INDAZOLES (BENZOPYRAZOLES), organic substances containing the ring system  . The parent substance indazole, $C_7H_6N_2$, was obtained by E. Fischer (*Ann.* 1883, 221, p. 280) by heating ortho-hydrazine cinnamic acid,

$$C_6H_4\begin{cases}CH=CH\cdot COOH\\NH\cdot NH_2\end{cases}=C_2H_4O_2+C_7H_6N_2.$$

It has also been obtained by heating ortho-diazoaminotoluene with acetic acid and benzene (F. Heusler, *Ber.*, 1891, 24, p. 4161).

$$C_6H_4\begin{cases}CH_3\\N:N\cdot NHC_7H_7\end{cases}=C_7H_7NH_2+C_7H_6N_2.$$

It crystallizes in needles (from hot water), which melt at 146.5° C. and boil at 269°-270° C. It is readily soluble in hot water, alcohol and dilute hydrochloric acid. Nitrous acid converts it into nitrosoindazole; whilst on heating with the alkyl iodides it is converted into alkyl indazoles.

A series of compounds isomeric with these alkyl derivatives is known, and can be considered as derived from the ring system  . These isomers are called *isindazoles*, and may be prepared by the reduction of the nitroso-ortho-alkylamino-acetophenones with zinc dust and water or acetic acid. The

indazoles are weak bases, which crystallize readily. Phenyl indazole, on reduction with sodium and absolute alcohol, gives a dihydro derivative (K. L. Paal, *Ber.*, 1891, 24, p. 963).

For other derivatives, see E. Fischer and J. Tafel, *Ann.* 1885, 227, p. 314.

INDEMNITY (through Fr. *indemnité*, Lat. *indemnis*, free from damage or loss; *in-*, negative, and *damnum*, loss), in law, an undertaking, either express or implied, to compensate another for loss or damage, or for trouble or expense incurred; also the sum so paid (see CONTRACT; and INSURANCE: *Marine*). An act of indemnity is a statute passed for the purpose either of relieving persons from disabilities and penalties to which they have rendered themselves liable or to make legal transactions which, when they took place, were illegal. An act or bill of indemnity used to be passed every session by the English parliament for the relief of those who had unwittingly neglected to qualify themselves in certain respects for the holding of offices, &c., as, for example, justices, without taking the necessary oaths. The Promissory Oaths Act 1868 rendered this unnecessary.

INDENE, C_9H_8, a hydrocarbon found in the fraction of the coal tar distillate boiling between 176° and 182° C., and from which it may be extracted by means of its picrate (G. Kramer, A. Spilker, Ber., 1890, 23, p. 3276). It may also be obtained by distilling the calcium salt of hydrindene carboxylic acid, $C_6H_4(CH_2)_2{\cdot}CH{\cdot}COOH$. It is an oil which boils at 179.5°-180.5°, and has a specific gravity 1.04 (15° C.). Dilute nitric acid oxidizes it to phthalic acid, and sodium reduces it in alcoholic solution to *hydrindene*, C_9H_{10}. A. v. Baeyer and W. H. Perkin (Ber., 1884, 17, p. 125) by the action of sodiomalonic ester on ortho-xylylene bromide obtained a hydrindene dicarboxylic ester,

$$C_6H_4(CH_2Br)_2 + 2CHNa(CO_2C_2H_5)_2 = 2NaBr + CH_2(CO_2C_2H_5)_2 + C_6H_4{:}[CH_2]_2{:}C(CO_2C_2H_5)_2;$$

this ester on hydrolysis yields the corresponding acid, which on heating loses carbon dioxide and gives the monocarboxylic acid of hydrindene. The barium salt of this acid, when heated, yields indene and not hydrindene, hydrogen being liberated (W. H. Perkin, *Jour. Chem. Soc.*, 1894, 65, p. 228). Indene vapour when passed through a red hot tube yields chrysene. It combines with nitrosyl chloride to form indene nitrosate (M. Dennstedt and C. Ahrens, *Ber.*, 1895, 28, p. 1331) and it reacts with benzaldehyde, oxalic ester and formic ester (J. Thiele, *Ber.*, 1900, 33, p. 3395).

On the derivatives of indene see W. v. Miller, *Ber.*, 1890, 23, p. 1883; Th. Zincke, *Ber.*, 1887, 20, p. 2394, 1886, 19, p. 2493; and W. Roser and E. Haselhoff, *Ann.*, 1888, 247, p. 140.

INDENTURE (through O. Fr. *endenture* from a legal Latin term *indentura*, *indentare*, to cut into teeth, to give a jagged edge, in *modum dentium*, like teeth), a law term for a special form of deed executed between two or more parties, and having counterparts or copies equal to the number of parties. These copies were all drawn on one piece of vellum or paper divided by a toothed or "indented" line. The copies when separated along this waved line could then be identified as "tallies" when brought together. Deeds executed by one party only had a smooth or "polled" edge, whence the name "deed poll." By the Real Property Act 1845, § 5, all deeds purporting to be "indentures" have the effect of an "indenture," even though the indented line be absent. The name "chirograph" (Gr. χεὶρ, hand, γράφειν, to write) was also early applied to such a form of deed, and the word itself was often written along the indented line (see further DEED and DIPLOMATIC). The term "indenture" is now used generally of any sealed agreement between two or more parties, and specifically of a contract of apprenticeship, whence the phrase "to take up one's indentures," on completion of the term, and also of a contract by labourers to serve in a foreign country or colony (see COOLIE).

INDEPENDENCE, a city and the county-seat of Jackson county, Missouri, U.S.A., 3 m. S. of the Missouri river and 10 m. E. of Kansas City. Pop. (1890) 6380, (1900) 6974 (937 negroes); (1910) 9859. The city is served by the Missouri Pacific, the Chicago & Alton, and the Kansas City Southern railways, and by an electric line and fine boulevard to Kansas City. It is situated about 1000 ft. above the sea, and is surrounded by a fertile agricultural district. The city has a small public square (surrounding the court-house) and a public library, and is the seat of St Mary's Academy, under the control of the Sisters of Mercy. Among its manufactures are farming implements, flour and lumber. The municipality owns its electric lighting plant. Independence was laid out as a town and chosen as the county-seat in 1827, first chartered as a city in 1849

and made a city of the third-class in 1889. About 1500 Mormons, attracted by the “revelation” that this was to be a Zion, settled in and about Independence in 1831 and 1832. They contemplated building their chief temple about ½ m. W. of the site of the present court house, but in 1833 (partly because they invited free negroes to join them) were expelled by the “gentile” inhabitants of Independence. In 1867 a settlement of about 150 Hedrickites, or members of the “Church of Jesus Christ” (organized in Illinois in 1835), came here and secretly bought up parts of the “Temple Lot.” The heirs of the settlers of 1831-1832 conveyed the lot by deed to the Reorganized Church of Jesus Christ of Latter Day Saints (with headquarters at Lamoni, Iowa), which brought suit against the Hedrickites, but in 1894 the U.S. Circuit Court of Appeals decided the case on the ground of laches in favour of the Hedrickites, who fifteen years afterwards had nearly died out. In 1867-1869 a few families belonging to the Reorganized Church of Jesus Christ of Latter Day Saints (monogamists) settled in Independence, and in 1908 their church here had about 2000 members. Besides a large church building, they have here a printing establishment, from which is issued the weekly *Zion’s Ensign* (founded in 1891), and the “Independence Sanitarium” (completed in 1908). The faithful Mormons still look to Independence as the Zion of the church. In 1907 a number of Mormons from Utah settled here, moving the headquarters of the “Central States’ Mission” from Kansas City to Independence, and founded a periodical called *Liahona, the Elder’s Journal*. From about 1831 to 1844, when its river landing was destroyed by flood, Independence was the headquarters and outfitting point of the extensive caravan trains for the Santa Fé, Oregon and Old Salt Lake trails. During the Civil War about 300 Federals under Lieut.-Colonel D. H. Buel, occupying the town, were captured on the 16th of August 1862 by Colonel Hughes in command of 1500 Confederates, and on the 22nd of October 1864 a part of General Sterling Price’s Confederate army was defeated a few miles E. of Independence by General Alfred Pleasonton.

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