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THE ENCYCLOPÆDIA BRITANNICA

A DICTIONARY OF ARTS, SCIENCES, LITERATURE AND GENERAL INFORMATION

ELEVENTH EDITION

VOLUME V SLICE VI

Celtes, Konrad to Ceramics

Articles in This Slice

CELTES, KONRAD (1459-1508), German humanist and Latin poet, the son of a vintner named Pickel (of which Celtes is the Greek translation), was born at Wipfeld near Schweinfurt. He early ran away from home to avoid being set to his father's trade, and at Heidelberg was lucky enough to find a generous patron in Johann von Dalberg and a teacher in Agricola. After the death of the latter (1485) Celtes led the wandering life of a scholar of the Renaissance, visiting most of the countries of the continent, teaching in various universities, and everywhere establishing learned societies on the model of the academy of Pomponius Laetus at Rome. Among these was the *Sodalitas litteraria Rhenana* or *Celtica* at Mainz (1491). In 1486 he published his first book, *Ars versificandi et carminum*, which created an immense sensation and gained him the honour of being crowned as the first poet laureate of Germany, the ceremony being performed by the emperor Frederick III. at the diet of Nuremberg in 1487. In 1497 he was appointed by the emperor Maximilian I. professor of poetry and rhetoric at Vienna, and in 1502 was made head of the new Collegium Poetarum et Mathematicorum, with the right of conferring the laureateship. He did much to introduce system into the methods of teaching, to purify the Latin of learned intercourse, and to further the study of the classics, especially the Greek. But he was more than a mere classicist of the Renaissance. He was keenly interested in history and topography, especially in that of his native country. It was he who first unearthed (in the convent of St Emmeran at Regensburg) the remarkable Latin poems of the nun Hrosvitha of Gandersheim, of which he published an edition (Nuremberg, 1501), the historical poem *Ligurinus sive de rebus gestis Frederici primi imperatoris libri x.* (Augsburg, 1507), and the celebrated map of the Roman empire known as the *Tabula Peutingeriana* (after Konrad Peutinger, to whom he left it). He projected a great work on Germany; but of this only the *Germania generalis* and an historical work in prose, *De origine, situ, moribus et institutis Nurimbergae libettus*, saw the light. As a writer of Latin verse Celtes far surpassed any of his predecessors. He composed odes, elegies, epigrams, dramatic pieces and an unfinished epic, the *Theodoriceis*. His epigrams, edited by Hartfelder, were published at Berlin in 1881. His editions of the classics are now, of course, out of date. He died at Vienna on the 4th of February 1508.

For a full list of Celtes's works see Engelbert Klüpfel, *De vita et scriptis Conradi Celtis* (2 vols., Freiburg, 1827); also Johann Aschbach, *Die früheren Wanderjahre des Conrad Celtes* (Vienna, 1869); Hartmann, *Konrad Celtes in Nürnberg* (Nuremberg, 1889).

CELTIBERIA, a term used by Greek and Roman writers to denote, sometimes the whole north-east of Spain, and sometimes the north-east part of the central plateau of the peninsula. The latter was probably the correct use. The Celtiberi, in this narrower sense, were not so much one tribe as a group of cantons—Arevaci, Pelendones, Berones and four or five others. They were the most warlike people in Spain, and for a long time offered a stubborn resistance to the Romans. Originally Carthaginian mercenaries, they were induced to serve the Romans in a similar capacity, and Livy (xxiv. 49) distinctly states that they were the first mercenaries in the Roman army. They did not, however, keep faith, and several campaigns were undertaken against them. In 179 B.C. the whole country was subdued by T. Sempronius Gracchus, who by his generous treatment of the vanquished gained their esteem and affection. In 153 they again

revolted, and were not finally overcome until the capture of Numantia (133). The twenty years' war waged round this city, and its siege and destruction by Scipio the Younger (133 B.C.) form only the most famous episode in the long struggle, which has left its mark in entrenchments near Numantia excavated in 1906-1907 by German archaeologists. After the fall of Numantia, and still more after the death of Sertorius (72 B.C.), the Celtiberians became gradually romanized, and town life grew up among their valleys; Clunia, for instance, became a Roman municipality, and ruins of its walls, gates and theatre testify to its civilization; while Bilbilis (Bambola), another municipality, was the birthplace of the eminently Roman poet Martial. The Celtiberians may have been so called because they were thought to be the descendants of Celtic immigrants from Gaul into Iberia (Spain), or because they were regarded (cf. Lucan iv. 9) as a mixed race of Celts and Spaniards (Iberians); in either case the name represents a geographer's theory rather than an ascertained fact. That a strong Celtic element existed in Spain is proved both by numerous traditions and by the more trustworthy evidence of place-names. The Celtic place-names of Spain, however, are not confined to Celtiberia or even to the north and east; they occur even in the south and west.

A long description of the manners and customs of the Celtiberi is given by Diodorus Siculus (v. 33, 34). Their country was rough and unfruitful as a whole (barley, however, was cultivated), being chiefly used for the pasture of sheep. Its inhabitants either led a nomadic life or occupied small villages; large towns were few. Their infantry and cavalry were both excellent. In battle, they adopted the wedge-shaped formation of the column. They carried double-edged swords and short daggers for use hand to hand, the steel of which was hardened by being buried underground; their defensive armour was a light Gallic shield or a round wicker buckler, and greaves of felt round their legs. They wore brazen helmets with purple crests, and rough-haired black cloaks, in which they slept on the bare ground. Like the Cantabri, they washed themselves with urine instead of water. They were said to offer sacrifice to a nameless god (Strabo iii. p. 164) at the time of the full moon when all the household danced together before the doors of the houses. Although cruel to their enemies, they were hospitable to strangers. They ate meat of all kinds, and drank a kind of mead. E. Hübner's article in Pauly-Wissowa's *Realencyclopadie*, iii. (1886-1893), collects all the ancient references, which are almost all brief. Strabo's notice (bk. iii.), based perhaps on Poseidonius, is fullest.

(F. J. H.)

CEMENT (from Lat. *caementum*, rough pieces of stone, a shortened form of *caedimentum*, from *caedere*, to cut), apparently first used of a mixture of broken stone, tiles, &c., with some binding material, and hence of any material capable of adhering to, and uniting into a coherent mass, fragments of a substance not in itself adhesive. The term is often applied to adhesive mixtures employed to unite objects or parts of objects (see below), but in engineering, when used without qualification, it means Portland cement, its modifications and congeners; these are all hydraulic cements, *i.e.* when set they resist the action of water, and can, under favourable conditions, be allowed to set under water.

Hydraulic Cements.—It was well known to builders in the earliest historic times that certain limes would, when set, resist the action of water, *i.e.* were hydraulic; it was also known that this property could be conferred on ordinary lime by admixture of silicious materials such as pozzuolana or tufa. We have here the two classes into which hydraulic cements are divided.

When pure chalk or limestone is "burned," *i.e.* heated in a kiln until its carbonic acid has been driven off, it yields pure lime. This slakes violently with water, giving slaked lime, which can be made into a smooth paste with water and mixed with sand to form common mortar. The setting of the mortar is due to the drying of the lime (a purely physical phenomenon, no chemical action occurring between the lime and the sand). The function of the sand is simply that of a diluent to prevent undue shrinkage and cracking in drying. Subsequent hardening of the mortar is caused by the gradual absorption of carbonic acid from the air by the lime, a skin of carbonate of lime being formed; but the action is superficial. Mortar made from pure or "fat" lime cannot withstand the action of water, and is only used for work done above water-level. If, however, such "fat" lime is mixed in the presence of water, not with sand but with silica in an active form, *i.e.* amorphous and (generally) hydrated, or with a silicate containing silica in an active condition, it will unite with the silica and form a silicate of lime capable of resisting the action of water. The mixture of the lime and active silica or silicate is a pozzuolanic cement. The simplest of all pozzuolanic cements would be a mixture of pure lime and hydrated silica, but though the latter is prepared artificially for various purposes, it is too expensive to be used as a cement material. A similar obstacle lies in the way of using a certain native form of active silica, viz. kieselguhr, for it is too valuable as

Pozzuolanic cement.

an absorbent of nitroglycerine, for the manufacture of dynamite, to be available for making pozzuolanic cement. There are, however, many silicious substances occurring abundantly in nature which can thus be used. They are mostly of volcanic origin, and include pumice, tufa, santorin earth, trass and pozzuolana itself. The following analyses show their general composition:—

	Neapolitan Pozzuolana (per cent)	Roman Pozzuolana (per cent)	Trass (per cent)
Soluble silica (SiO_2)	27.80	32.64	19.32
Insoluble silicious residue	35.38	25.94	50.40
Alumina (Al_2O_3)	} 19.80	} 22.74	13.86
Ferric oxide (Fe_2O_3)			3.10
Lime (CaO)	5.68	4.06	..
Magnesia (MgO)	0.35	1.37	0.13
Sulphuric anhydride (SO_3)	Trace	Trace	..
Combined water (H_2O)	} 4.27	} 8.92	7.57
Carbonic anhydride (CO_2)			..
Moisture	..	..	5.04
Alkalis and loss	6.72	4.33	0.58
	100.00	100.00	100.0

An artificial product which serves perfectly as a pozzuolana is granulated blast-furnace slag. The slag, which must contain a high percentage of lime, is granulated by being run while fused into abundance of water. This granulated slag differs from the same slag allowed to cool slowly, in that a portion of the energy which it possesses while fused is retained after it has solidified. It bears to ordinary slowly-cooled slag a similar relation to that borne by plastic sulphur to ordinary crystalline sulphur. This potential energy becomes kinetic when the slag is brought into contact with lime in the presence of water, and causes the formation of a true hydraulic silicate of lime. The following analysis shows the composition of a typical slag:—

	Per Cent.
Insoluble residue	1.04
Silica (SiO_2)	31.50
Alumina (Al_2O_3)	18.56
Manganous oxide (MnO)	0.44
Lime (CaO)	42.22
Magnesia (MgO)	3.18
Soda (Na_2O)	0.70
Sulphuric anhydride (SO_3)	0.45
Sulphur (S)	2.21
	———
	100.30
Deduct oxygen equivalent to sulphur	1.10
	———
	99.20

Granulated slag of this character is ground with slaked lime until both materials are in a state of fine division and intimately mixed. The usual proportions are three of slag to one of slaked lime by weight. The product termed slag cement sets slowly, but ultimately attains a strength scarcely inferior to that of Portland cement. Although it is cheap and suitable for many purposes, its use is not large and tends to decrease. Pozzuolanic cements are little used in England. Generally speaking, they are only of local importance, their cheapness depending largely on the nearness and abundance of some suitable volcanic deposit of the trass or tufa class. They are not usually manufactured by the careful grinding together of the pozzuolana and the lime, but are mixed roughly, a great excess of pozzuolana being employed. This excess does no harm, for that part which fails to unite with the lime serves as a diluent, much as does sand in mortar. In fact, ordinary pozzuolanic cement made on the spot where it is to be used may be regarded as a better kind of common mortar having hydraulic qualities. Good hydraulic mortars may be made from lime mixed with furnace ashes or burnt clay as the pozzuolanic constituent.

Portland Cement

Cements of the Portland type differ in kind from those of the pozzuolanic class; they are not mechanical mixtures of lime and active silica ready to unite under suitable conditions, but consist of definite chemical compounds of lime and silica and lime and alumina, which, when mixed with water, combine therewith, forming crystalline substances of great mechanical strength, and capable of adhering firmly to clean inert material, such as stone and sand. They are made by heating to a

high temperature an intimate mixture of a calcareous substance and an argillaceous substance. The commonest of such substances in England are chalk and clay, but where local conditions demand it, limestone, marl, shale, slag or any similar material may be used, provided that the correct proportions of lime, silica and alumina are maintained. The earliest forms of cements of the Portland class were the hydraulic limes. These are still largely used, and are prepared by burning limestones containing clayey matter. Some of these naturally possess a composition differing but little from that of the mixture of raw materials artificially prepared for the manufacture of Portland cement itself. Although hydraulic limes have been in use from the most ancient times, their true nature and the reason of their resistance to water have only become known since 1791. Next in antiquity to hydraulic lime is Roman cement, prepared by heating an indurated marl occurring naturally in nodules. Its name must not be taken to imply that it was used by the ancients; in point of fact the manufacture of this substance dates back only to 1796.

With the growth of engineering in the early part of the 19th century arose a great demand for hydraulic cement. The supply of materials containing naturally suitable proportions of calcium carbonate and clay being limited, attempts were made to produce artificial mixtures which would serve a similar end. Among those who experimented in this direction was Joseph Aspdin, of Leeds, who added clay to finely ground limestone, calcined the mixture, and ground the product, which he called Portland cement. The only connexion between Portland cement and the place Portland is that the cement when set somewhat resembles Portland stone in colour. True, it is possible to manufacture Portland cement from Portland stone (after adding a suitable quantity of clay), but this is merely because Portland stone is substantially carbonate of lime; any other limestone would serve equally well. Although Portland cement is later in date than either Roman cement or hydraulic lime, yet on account of its greater industrial importance, and of the fact that, being an artificial product, it is of approximately uniform composition and properties, it may conveniently be treated of first. The greater part of the Portland cement made in England is manufactured on the Thames and Medway. The materials are chalk and Medway mud; in a few works the latter is replaced by gault.

The composition of typical samples of chalk and clay is shown in the following analyses:—

Chalk.	
	Per cent.
Silica (SiO_2)	0.92
Alumina + ferric oxide (Al_2O_2 + Fe_2O_3)	0.24
Lime (CaO)	55.00
Magnesia (MgO)	0.36
Carbonic anhydride (CO_2)	43.40
	———
	99.92

Clay.				
	Per cent.			
Insoluble silicious matter	26.67	Consisting of		
Silica (SiO_2)	31.24	Quartz (SiO_2)	19.33	
Alumina (Al_2O_3)	16.60	Silica (SiO_2)	5.19	
Ferric Oxide (Fe_2O_3)	8.66	Alumina (Al_2O_3)	1.47	Feldspar 7.34%
Lime (CaO)	0.25	Magnesia (MgO)	0.03	
Magnesia (MgO)	1.91	Soda (Na_20)	0.65	
Soda (Na_2O)	1.00		———	
Potash (K_2O)	0.45		26.67	
Sodium Chloride (NaCl)	1.86			
Combined water, organic matter, and loss	11.36			
	———			
	100.00			

Mixing.

These materials are mixed in the proportion of about 3:1 by weight so that the dried mixture contains approximately 75% of calcium carbonate, the balance being clay. The mixing may be effected in several ways. The method once exclusively used consists in mixing the raw materials with a large quantity of water in a wash mill, a machine having radial horizontal arms driven from a central vertical spindle and carrying harrows which stir up and intermix any soft material placed in the pit in which the apparatus revolves. The raw materials in the correct proportion are fed into this mill together with a large quantity of water. The thin watery “slip” or slurry flows into large settling tanks (“backs”) where the solids in suspension are deposited; the water is drawn off, leaving behind an intimate mixture of chalk and clay in the form of a wet paste. This is dug out, and after being dried on floors heated by flues is ready for burning. This process is now almost obsolete. According to present practice the raw materials are mixed in a wash mill with so much water

that the resulting slurry contains 40 to 50% of water. The slurry, which is wet enough to flow, is ground between millstones so as to complete the process of comminution begun in the wash mill. Thorough grinding and mixing are of the utmost importance, as otherwise the cement ultimately produced will be unsound and of inferior quality. The drying of the slurry is generally effected by the waste heat of the kilns, so that while one charge is burning another is drying ready for the next loading of the kilns. The kilns commonly employed are “chamber kilns,”

Loading the kiln.

circular structures not unlike an ordinary running lime kiln, but having the top closed and connected at the side with a wide flue in which the slurry is exposed to the hot products of combustion from the kiln. The farther ends of the flues of several such kilns are connected with a chimney shaft. The slurry, in drying on the floor of the flue, forms a fairly tough cake which cracks spontaneously in the process of drying into rough blocks suitable for loading into the kiln. At the bottom of the kiln is a grate of iron bars, and on this wood and coke are piled to start the fire. A layer of dried slurry is loaded on this, then a layer of coke, then a layer of slurry, and so on until the kiln is filled with coke and slurry evenly distributed. Fresh slurry is run on to the drying floors, and the kiln is started. The construction of an ordinary chamber kiln may be gathered from the accompanying diagram (fig. l). The operation of burning is a slow one. An ordinary kiln, which will contain about 50 tons of slurry and 12 tons of coke, will take two days to get fairly alight, and will be another two or three days in burning out. Therefore, allowing adequate time for loading and unloading, each kiln will require about one week for a complete run. The output will be about 30 tons of “clinker” ready to be ground into cement. The grinding of the hard rock-like masses of clinker is effected between millstones, or in modern plants in ball-mills, tube-mills and edge-runners. It is an important part of the manufacture, because the finished cement should be as fine and “floury” as possible. The foregoing description represents the procedure in use in many English factories. There are various modifications in practice according to local conditions: a few of these may be described. In all cases, however, the main operations are the same, viz. intimately mixing the raw materials, drying the mixture, if necessary, and burning it at a clinkering temperature (about 1500° C. =2732° F.). Thus when hard limestone is the form of calcium carbonate locally available, it is ground dry and mixed with the correct proportion of clay also dried and ground. The mixture is slightly damped, moulded into rough bricks, dried and burned. A possible alternative is to burn the limestone first and mix the resulting lime with clay, the mixture being burned as before. By this method grinding the hard limestone is avoided, but there is an extra expenditure of fuel in the double burning.

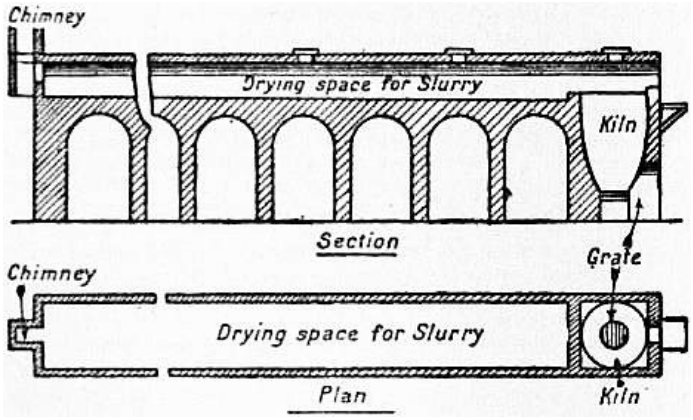


Fig. 1.

Many different forms of kiln are used for burning Portland cement. Besides the chamber kilns which have been described, there are the old-fashioned bottle kilns, which are similar to the chamber kilns, but are bottle-shaped

Other kilns.

and open at the top; they do not dry the slurry for their next charge. Their use is becoming obsolete. There are also stage kilns of the Dietzsch type, which consist of two vertical shafts, one above the other, but not in the same vertical line, connected by a horizontal channel. At this middle portion and in the upper part of the lower shaft the burning proper proceeds; the upper shaft is full of unburnt raw material which is heated by the hot gases coming from the burning

zone, and the lower shaft contains clinker already burned and hot enough to heat the incoming air which supplies that necessary for combustion at the clinkering zone. A pair of Dietzsch kilns, built back to back, are shown in fig. 2. There are other forms of shaft kiln, such as the Schneider, in which there is a burning zone, a heating and cooling zone as in the Dietzsch, but no horizontal stage, the whole shaft being in the same vertical plane. Another form is the Hoffmann or ring kiln, made up of a number of compartments arranged in a ring and connected with a central chimney; in these compartments rough brick-shaped masses of the raw materials are stacked, and between these bricks fuel is sprinkled. At a given moment one of these compartments is burning and at its full temperature; the air for combustion is drawn in through one or more compartments behind it which have just finished burning, and is thereby strongly heated; the products of combustion pass away through one or more compartments in front of it and heat their contents before they are subjected to actual combustion. It will be seen that the principle of the ring kiln is similar to that of the stage kiln. In each case the clinker which has just been burned and is fully hot serves to heat the air-supply to the compartment where combustion is actually proceeding; in like manner the raw materials about to be burned are well heated by the waste gases from the compartment in full activity before they themselves are burned. (It may be noted that here and generally in this article “burn” is used in the technical sense; it is technically correct to speak of cement clinker being “burned”, although it is not a fuel; in accurate terms it is the fuel which is burned, and it is the heat it generates which raises the clinker to a high temperature, *i.e.* technically “burns” it.) By this device a great part of the heat is regenerated and a saving of fuel is effected.

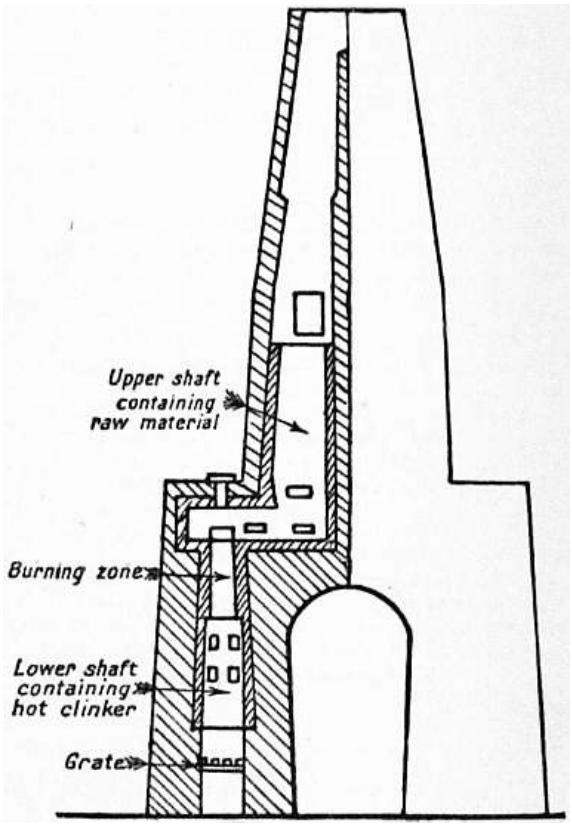


Fig. 2.

The methods of burning cement described above are obsolescent. They are being replaced by the rotatory process, so called because the cement is burned in rotating cylinders instead of in fixed kilns. These cylinders vary from 60 to 150 ft. in length, an ordinary length in modern practice being 100 to 120 ft.; their diameter correspondingly varies from 6 ft. to 7 ft. 6 in. The cylinders are made of steel plate, lined with refractory bricks, are carried on rollers at a slight angle with the horizontal, and are rotated by power. At the upper end the raw material is fed in either as a dry powder or as a slurry; at the lower end is a powerful burner. In the early days of rotatory kilns producer gas was used as a fuel, but with little success; about 1895 petroleum was used in the United States with complete success, but at a relatively heavy cost. At the present time, finely powdered coal injected by a blast of air is almost universally employed, petroleum being used only where it is actually cheaper than coal. In the working of this type of kiln the rotation and slight inclination of the cylinder cause the raw material to descend towards the lower end. At the upper end the raw material is dried and heated moderately. As it descends it reaches a part of the kiln where the temperature is higher; here the carbonic acid of the carbonate of lime, and the combined water of the clay are driven off, and the resulting lime begins to act chemically on the dehydrated clay. The material is then in a partially burnt and slightly sintered state, but it is not fully clinkered and would not make Portland cement. The material continues to descend by the rotation of the kiln and reaches the lower end nearest the burner where the temperature is highest, and is there heated so highly that the union of the lime, silica and alumina is complete, and fully burnt clinker falls out of the kiln. It is extremely hot, and is cooled usually by being passed down one or more rotating cylinders, similar to the first, but smaller, and acting as coolers instead of kilns. On its way down the cylinders the clinker meets a current of cold air and is cooled, the air being correspondingly warmed and passing on to aid in the combustion of the fuel used in heating the kiln. This regenerative heating is similar in principle and effect to that obtained by means of the shaft and ring kilns described above. The output of these kilns varies from 200 to 400 tons per kiln per week according to their size and the nature of the raw materials burned, as against 30 tons per week for an ordinary chamber kiln. A large saving in labour is also secured. The rotatory system presents many advantages and is rapidly replacing the older methods of cement making. Fig. 3 represents diagrammatically a rotatory cement plant on the Hurry & Seaman system, which was one of the first to make cement by the rotatory process successfully on a large scale, using powdered coal as fuel. Rotatory kilns of various

Rotatory kilns.

other makes are now in use, but the same principles are embodied, namely, the employment of a rotating inclined cylinder for burning the raw materials, a burner fed with powdered coal and a blast of air, and some device such as a cooling cylinder or cooling tower by which the clinker may be cooled and the air correspondingly heated on its way to the burner.

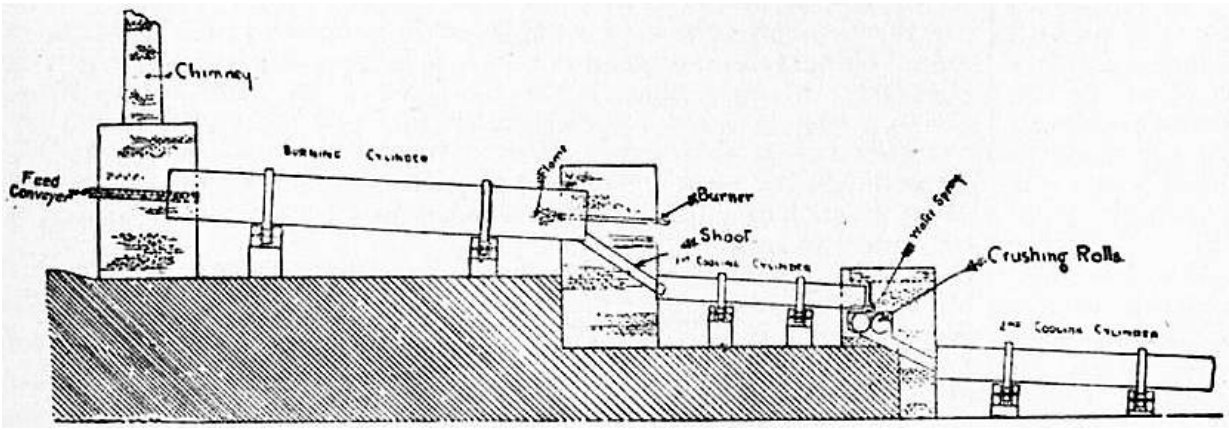


FIG. 3.

Another method of making Portland cement which has been proposed and tried with some success consists in fusing the raw materials together in an apparatus of the type of a blast furnace. The high temperature necessary to fuse cement clinker makes this process difficult to accomplish commercially, but it has many inherent merits and may be the process of the future, displacing the rotatory method.

Cement clinker.

Portland cement clinker, however produced, is a hard, rock-like substance of semi-vitrified appearance and very dark colour. The product from a well-run rotatory kiln is all evenly burnt and properly vitrified; that from an ordinary fixed kiln of whatever type is apt to contain a certain amount (5 to 15%) of underburnt material, which is yellowish and friable and is not properly clinkered. This material must be picked out, as such underburnt stuff contains free lime or unsaturated lime compounds. These may slake slowly in the finished cement and cause such expansion as may destroy the work of which it forms part. Well-burnt, well-picked clinker when ground yields good Portland cement. Nothing is added during or after grinding save a small amount (1 to 2%) of calcium sulphate in the form either of gypsum or of plaster of Paris, which is sometimes needed to make the cement slower-setting. For the same purpose a small quantity of water (up to 2%) may be added either by moistening the clinker or by blowing steam into the mills in which the clinker is ground. This small addition for this specified purpose is recognized as legitimate, but the employment of various cheap materials such as ragstone and blast-furnace slag, sometimes added as diluents or make-weights, is adulteration and therefore fraudulent.

Composition.

The composition of Portland cement varies within comparatively narrow limits, and for given raw materials the variations are tending to become smaller as regularity and skill in manufacture increase. The following analysis may be taken as typical of cements made from chalk and clay on the Thames and Medway:—

	Per cent.
Silica (SiO_2)	22.0
Insoluble residue	1.0
Alumina (Al_2O_3)	7.5
Ferric oxide (Fe_2O_3)	3.5
Lime (CaO)	62.0
Magnesia (MgO)	1.0
Sulphuric anhydride (SO_3)	1.5
Carbonic anhydride (CO_2)	0.5
Water (H_2O)	0.5
Alkalis	0.5
	———
	100.0

There may be variations from this composition according to the nature of the raw materials employed. Thus the silica may range from 19 to 27%, the alumina and ferric oxide jointly from 7 to 14%, the lime from 60 to 67%. All such variations are permissible provided that the quantity of silica and alumina is sufficient to saturate the whole of the lime and to leave none of it in a “free” condition, likely to cause the cement to expand after setting. Other things being equal, the higher the percentage of lime within the limits indicated above the stronger is the cement, but such highly limed cement is less easy to burn than cement containing about 62% of lime; and unless the burning is thorough and the raw materials are intimately mixed, the cement is apt to be unsound. Although the ultimate composition of cement, that is, the percentage of each

base and acid present, can be accurately determined by analysis, its proximate composition, *i.e.* the nature and amount of the compounds formed from these acids and bases, can only be ascertained indirectly and with difficulty. The foundations of our knowledge on this subject were laid by H. le Chatelier, whose work has since been supplemented by that of Spenser B. Newberry, W.B. Newberry and Clifford Richardson. As the outcome of these inquiries it has been established that tricalcium silicate $3CaO{\cdot}SiO_2$ is the essential constituent of Portland cement. The constituent of next importance is an aluminate, but whether this is dicalcium aluminate, $2CaO{\cdot}Al_2O_3$, or tricalcium aluminate, $3CaO{\cdot}Al_2O_3$, is still in doubt. In the following description it is assumed to be the tricalcium aluminate. The remaining silicates and aluminates present, and ferric oxide and magnesia, if existing in the moderate quantities which are usual in Portland cement of good quality, are of minor importance and may be regarded as little more than impurities. The silicates and aluminates of which Portland cement is composed are believed to exist not as individual units but as solid solutions of each other, these solid solutions taking the form of minerals recognizable as individuals. The two principal minerals are termed alite and celite; according to the best opinion, alite consists of a solid solution of tricalcium aluminate in tricalcium silicate, and celite of a solid solution of dicalcium aluminate in dicalcium silicate. Celite is little affected by water, and has but small influence on the setting; alite is decomposed and hydrated, this action constituting the main part of the setting of Portland cement. Both the components of alite react, and for simplicity their reactions may be stated in separate equations, thus:—

(1) $2(3CaO{\cdot}SiO_2) + 9H_2O = 2(CaO{\cdot}SiO_2){\cdot}5H_2O + 4Ca(OH)_2$
Tricalcium silicate. Hydrated mono-calcium silicate. Calcium hydroxide.

(2) $3CaO{\cdot}Al_2O_3 + 12H_2O = 3CaO{\cdot}Al_2O_3{\cdot}12H_2O$
Tricalcium aluminate. Hydrated tricalcium aluminate.

Since alite is a solid solution and, although an individual mineral, is not a chemical unit, the proportion of tricalcium silicate to tricalcium aluminate in a given specimen of alite will vary; but, whatever the proportions, each of these substances will react in its characteristic manner according to the equations given above.

The precise mechanism of the process of setting of Portland cement is not known with certainty, but it is probably analogous to that of the setting of plaster of Paris, consisting in the dissolution of the compounds produced by hydration while they are in a more soluble form, their transition to a less soluble form, the consequent supersaturation of the solution, and the deposition of the surplus of the dissolved substance in crystals which interlock and form a coherent mass. This theory being accepted, it is evident that a small quantity of water, by successive dissolution and deposition of a substance capable of existing in a more soluble and in a less soluble form, is able to bring about the crystallization of an indefinitely large quantity of material. It is not necessary that there should be present sufficient water to dissolve the whole of the reacting substance at any one time; it is sufficient if there is enough for hydration and a small surplus for the crystallization by successive stages as above described. It is generally admitted that the aluminate is the chief agent in the first setting of the cement, and that its ultimate hardening and attainment of strength are due to the tricalcium silicate.

As mentioned above, the constituents other than the tricalcium silicate and tricalcium aluminate of which alite is composed, are of minor importance. The function of the ferric oxide present in ordinary cement is little more than that of a flux to aid the union of silica, alumina and lime in the clinker; its role in the setting of the cement is altogether secondary. In fact, excellent Portland cement can be prepared from materials free from iron. Such cement, if free also from manganese, is white, and its manufacture has been proposed for exterior decorative use. Magnesia, if present in Portland cement in quantity not exceeding 5%, appears to be inert, but there is evidence that in larger proportion, *e.g.* 10-15%, it may hydrate and set after the general setting of the cement, and may give rise to disruptive strains causing the cement to “blow” and fail. In so-called natural cement which is comparatively lightly burnt, the magnesia appears to be inert, and as much as 20 to 30% may be present. Another constituent of Portland cement which influences its setting time is calcium sulphate, naturally formed from the sulphur in the raw materials or fuel, or intentionally added to the finished cement as gypsum or plaster of Paris. It has a remarkable retarding effect on the hydration of the calcium aluminate, and consequently on the setting of the cement; thus it is that a little gypsum is often added to convert a naturally quick-setting cement into one which sets slowly. It will be observed that in the hydration of tricalcium silicate, the main constituent of Portland cement, a large portion of the lime appears as calcium hydroxide, *i.e.* slaked lime. It is evident that this will form a pozzuolanic cement if a suitable silicious material such as trass is added to the cement. The ultimate product when set may be regarded as a mixed Portland and pozzuolanic cement. The use of trass in this manner as an adjunct to Portland cement has been advocated by W. Michaelis, and undoubtedly increases the strength of the material, but it has not become general.

The quality of Portland cement is ascertained by its analysis and by determining its specific gravity, fineness, mechanical strength and soundness. A good sample will usually have a

Testing. composition within the limits cited above and approximating to the typical figures given above. It will be ground so finely that not more than 3% will be left on a sieve of 76 × 76 meshes per sq. in., the wires of the sieve being 0.005 in. in diameter. It will have, when freshly burned, a specific gravity not lower than 3.15, and briquettes made from it and kept in water will possess a tensile strength of 400-500 lb. per sq. in. seven days after they are made, while briquettes made from a mixture of 3 parts by weight of sand and 1 of cement will give about 225 lb. per sq. in. at twenty-eight days. Formerly the soundness of cement was determined by keeping thin pats of the cement in cold water for twenty-eight days, or in warm water (110°-120° F.) for twenty-four hours, and examining for cracks or other signs of expansion. Modern practice is to measure the expansion of a test piece of cement kept in water at a temperature of 212° F. The simplest and most generally used method is due to H.L. le Châtelier, and consists in measuring the increase in circumference of a cylinder of cement 30 mm. in diameter by means of a split ring encircling the cylinder, the motion of which is magnified by two light rods extending radially. Another quantitative test for soundness is that formulated by L. Deval, who has shown that briquettes of 3 of sand and 1 of cement kept in water for two days at 80° C. = 176° F. attain approximately the same strength as similar briquettes attain at seven days in water at the ordinary temperature. In like manner briquettes kept at 176° F. for seven days are approximately equal in strength to those kept at the ordinary temperature for twenty-eight days. A cement not perfectly sound will give low results in the hot test, and a cement of indifferent soundness will crack and go to pieces. The test is admittedly severe, but can be passed without difficulty by cement made with proper care and skill. There are many modifications and elaborations of all the tests which have been mentioned. Cement for all important work is submitted to a rigorous system of testing and analysis before it is accepted and used.

Hydraulic Lime is a cement of the Portland as distinct from the pozzuolanic class. The most typical hydraulic lime is that known as Chaux du Theil, made from a limestone found at Ardèche in France. This limestone consists of calcium carbonate most intimately intermixed with very finely divided silica. It contains but little alumina and oxide of iron, which are the constituents generally necessary to bring about the union of silica and lime to form a cement, but in spite of this the silica is so finely divided and so well distributed that it unites readily with the lime when the limestone is burned at a sufficiently high temperature. English hydraulic limes are of a different class; they contain a good deal of alumina and ferric oxide, and in composition resemble somewhat irregular Portland cement.

Analyses of the two classes of hydraulic lime are as follows:—

	Chaux de Theil. Per cent.	Blue Lias. Per cent
Insoluble silicious matter	0.3	2.39
Silica (SiO_2)	21.7	14.17
Alumina (Al_2O_3)	1.8	6.79
Ferric oxide (Fe_2O_3)	0.6	2.34
Lime (CaO)	74.0	63.43
Magnesia (MgO)	0.7	1.54
Sulphuric anhydride (SO_3)	0.3	1.63
Carbonic anhydride (CO_2)	}	3.64
Water (H_20)	0.6	2.69
Alkalis and loss	· ·	1.38
	100.0	100.00

Hydraulic lime contains a good deal of uncombined lime, and has to be slaked before it is used as a cement. In France this slaking is conducted systematically by the makers, the freshly burned lime being sprinkled with water and stored in large bins where slaking proceeds slowly and regularly until the whole of the surplus uncombined lime is slaked and rendered harmless, while the cementitious compounds, notably tricalcium silicate, remain untouched. In English practice hydraulic lime is slaked by the user. Seeing that regular and perfect slaking is more easily attained when working systematically on a large scale and by storing the material for a long period, the French method is the better and more rational. The product may then be regarded as a cement of the Portland class mixed with slaked lime. When gauged with water and made into a mortar it sets slowly, but ultimately becomes almost as strong as Portland cement. Its slow setting is an advantage for some purposes, *e.g.* for foundations and abutments where settlements may occur. The structure is free to take its permanent position before the lime sets, and cracks are thus avoided. A case in point is the employment of hydraulic lime in place of Portland cement as grouting outside the cast-iron tubes used for lining tunnels made by the shield system.

Roman Cement is another cement of the Portland class which came into use shortly before the manufacture of artificial Portland cement was attempted. It is still in use, though only for special purposes where a quick-setting material is required. It is made from septaria nodules which are dredged up on the Kent and Essex coasts and consist of about 60% of calcium

carbonate mixed with clay, the mass being sufficiently indurated to remain coherent under water. The nodules are not prepared in any way, but simply burned at a moderate red heat.

The resulting cement varies somewhat in composition, but approximates to the following figures:—

	Per cent.
Insoluble silicious matter	5.86
Silica (SiO_2)	19.62
Alumina (Al_20_3)	10.30
Ferric oxide (Fe_2O_3)	7.44
Manganese dioxide (MnO_2)	1.57
Lime (CaO)	44.54
Magnesia (MgO)	2.92
Sulphuric anhydride (SO_3)	2.61
Carbonic anhydride (CO_2)	3.43
Water (H_2O)	0.25
Alkalis and loss	1.46
	———
	100.00

The most characteristic constituent is the oxide of iron, which gives the cement a reddish colour, and the presence of manganese also differentiates Roman from Portland cement, which rarely contains appreciable quantities of that element. The high percentage of alumina causes the cement to be quick-setting, and it becomes hard in about five minutes. It resists the action of water, salt or fresh, very well, and is therefore useful in situations where the work is likely to be submerged immediately after it has been put in place.

The term *Natural Cements* is applied to cements made by burning mixtures of clay and carbonate of lime naturally occurring in approximately suitable proportions. They may be regarded as badly-mixed Portland cements, and need no special description. American “natural” cements are of a somewhat different class. They are usually made from a silicious limestone containing magnesia, and are comparatively lightly burned.

The following analysis is typical of a cement of this kind:—

	Per cent.
Silica (SiO_2)	24.30
Alumina (Al_20_3)	7.22
Ferric oxide (Fe_2O_3)	5.06
Lime (CaO)	33.70
Magnesia (MgO)	20.94
Water, carbonic anhydride, and loss	8.78
	———
	100.00

These irregular cements of the Portland class are good building materials for ordinary purposes, but are not so suitable as good artificial Portland cement for heavy and important undertakings.

Passow Cement is a recent product which is in a class by itself. It is made by granulating blast furnace slag of suitable composition and finely grinding the product, either alone or with an admixture of about 10% of Portland cement clinker. It differs from ordinary slag cement (see above) in that it is not a pozzuolanic cement depending on the interaction of granulated slag and lime. The particular method of granulating slag for Passow cement produces a material which sets *per se* and attains a strength comparable with that of Portland cement. Passow cement has been successfully made from slag of different compositions in Germany, England and America.

Uses of hydraulic cements.

The chief use of hydraulic cements, whether of the pozzuolanic or Portland class, is to act as an adhesive material in work which is to be exposed to water. No doubt in times of remote antiquity it was found that the jointing of masonry which was to be immersed required the use of a cement indifferent to the action of water. Ordinary mortar failed in such positions; mortar made from lime prepared from limestones or chalks containing a little clay was found to stand; mortar made from lime mixed with trass or similar active silicious material was also found to stand. On this observation rests the whole of the present enormous employment of hydraulic cements. It was a natural transition to utilize these cements not merely for jointing masonry but also for making concrete, and the only reason why hydraulic cements, as distinct from cements which are not hydraulic (*e.g.* ordinary mortar), are used for the latter purpose is their great mechanical strength. Their use in above-water work is checked by the low price of common brick. Even in such work, where it would be thought that masses of burnt clay would be the cheapest conceivable material, concrete is at least on level terms with its rival. It must be remembered that one of the great advantages of concrete is that five-sixths of its total mass may be provided

from local sand and gravel, on which no carriage has to be paid. The cement, on which alone freight is to be reckoned, converts these from loose incoherent material into a solid stone. Thus it comes about that the largest use of cement is for manufacturing concrete for dock and harbour work, and for the making of foundations. It is also employed for the building of light bridges, floors, and pipes constructed of cement mortar disposed round a skeleton of iron rods. Such composite structures take advantage at once of the high tensile strength of iron and of the high compressive strength of cement mortar. (See also CONCRETE.)

Good hydraulic cements are highly permanent materials provided certain conditions be observed. It might be supposed that hydraulic cements from their nature would be indifferent to the action of water, but this is only true if the structures of which they form part are sufficiently compact. In this case the action of the water is checked by the film of carbonate of lime which eventually forms oh the surface of calcareous cement. This, together with the compactness of the mortar, hinders the ingress and egress of water, and prevents the dissolution and ultimate destruction of the cement. But where the concrete or mortar is not well made and is porous, the continual passage of water through it will gradually break up and dissolve away the calcareous constituents of the cement until its strength is utterly destroyed. This destructive action is increased if the water contains sulphates or magnesium salts, both of which act chemically on the calcareous constituents of the cement. As sea-water contains both sulphates and magnesium salts, it is especially necessary in concrete for harbour work to take every care to produce an impervious structure. There are various minor external causes for the failure and ultimate destruction of cement mortar and concrete, but their discussion is a matter for the specialist. Failure from inherent vice in the cement has been already touched on; it can always be traced to want of skill and care in manufacture.

Calcium Sulphate Cements.—Under this term are comprehended all cements whose setting properties primarily depend on the hydration of calcium sulphate. They include plaster of Paris, Keene's cement and many variants of these two types. The raw material is gypsum (*q.v.*). This may be almost chemically pure, when it is generally used for Keene's cement; or it may contain smaller or greater quantities of impurities, in which case it is suitable for the preparation of cements of the plaster of Paris class. The mode of preparation is to calcine the gypsum at temperatures which depend on the class of cement to be produced. If plaster of Paris is to be made, calcination is carried out at about 204° C. (= 400° F.); at this temperature, gypsum, $CaS0_4 \cdot 2H_20$, loses three-quarters of its combined water and becomes $2CaSO_4 \cdot H_20$. If a cement of the Keene's cement class is to be prepared the temperature used is higher, *e.g.* 500° C. (= 932° F.), and the whole of the combined water of the gypsum is expelled, the anhydrous sulphate $CaSO_4$ being obtained.

Plaster of Paris; Keene's cement.

To produce plaster of Paris European practice consists in baking the mineral in ovens, and in America in heating it in kettles. Both processes are inferior in economy to calcination in rotatory kilns, a process which may be regarded as the method of the present and the immediate future. Keene's cement and its congeners are made in fixed kilns so constructed that only the gaseous products of combustion come into contact with the gypsum to be burnt, in order to avoid contamination with the ash of the fuel.

The setting of plaster of Paris depends on the fact that when $2CaSO_4 \cdot H_2O$ is treated with water it dissolves, forming a supersaturated solution of $CaSO_4 \cdot 2H_2O$. The excess held temporarily in solution is then deposited in crystals of $CaSO_4 \cdot 2H_2O$. In the light of this knowledge the mode of setting of plaster of Paris becomes clear. The plaster is mixed with a quantity of water sufficient to make it into a smooth paste; this quantity of water is quite insufficient to dissolve the whole of it, but it dissolves a small part, and gives a supersaturated solution of $CaSO_4 \cdot 2H_2O$. In a few minutes the surplus hydrated calcium sulphate is deposited from the solution, and the water is capable again of dissolving $2CaSO_4 \cdot H_2O$, which in turn is fully hydrated and deposited as $CaSO_4 \cdot 2H_2O$. The process goes on until a relatively small quantity of water has by instalments dissolved and hydrated the $2CaSO_4 \cdot H_2O$, and has deposited $CaSO_4 \cdot 2H_2O$ in felted crystals forming a solid mass well cemented together. The setting is rapid, occupying only a few minutes, and is accompanied by a considerable expansion of the mass. There is reason to suppose that the change described takes place in two stages, the gypsum first forming orthorhombic crystals and then crystallizing in the monosymmetric system. Gypsum thus crystallized is in its normal monosymmetric form, more stable under ordinary conditions than the orthorhombic form. Correlatively in its process of dehydration to form plaster of Paris, monosymmetric gypsum is converted into the orthorhombic form before it begins to be dehydrated.

The principles which govern the preparation and setting of the other class of calcium sulphate cements, that is, cements of the Keene class, are not fully understood, but there is a fair amount of knowledge on the subject, both empirical and scientific. The essential difference between the setting of Keene's cement and that of plaster of Paris is that the former takes place much more slowly, occupying hours instead of minutes, and the considerable heating and expansion which

characterize the setting of plaster of Paris are much less marked.

It is the practice in Great Britain to burn pure gypsum at a low temperature so as to convert it into the hydrate $2CaSO_4 \cdot H_2O$, to soak the lumps in a solution of alum or of aluminium sulphate, and to recalcine them at about 500° C. On grinding they give Keene's cement. Instead of alum various other salts, *e.g.* borax, may be used. The quantity of these materials is so small that analyses of Keene's cement show it to be almost pure anhydrous calcium sulphate, and make it difficult to explain what, if any, influence these minute amounts of alum and the like can exert on the setting of the cement. It seems probable that the effect of the salts is inconsiderable, and that the governing condition is the temperature at which the cement has been burnt. The setting of Keene's cement takes place by the same sort of process which has been described for the setting of plaster of Paris, the chief differences being that the substance dissolved is anhydrous calcium sulphate and that the operation takes a longer time.

All cements having calcium sulphate as their base are suitable only for indoor work because of the solubility of this substance. They form excellent decorative plasters on account of their clean white colour and the sharpness of castings made from them, this latter quantity being due to their expansion when setting.

See D.B. Butler, *Portland Cement* (London, 1905); E.C. Eckel, *Cements, Limes and Plasters* (New York, 1905); G.R. Redgrave and Charles Spackman, *Calcareous Cements* (London, 1905); F.H. Lewis, "Manufacture of Hydraulic Cements in the United States," *The Mineral Industry* (New York, 1898); W.H. Stanger and Bertram Blount, "Cement Manufacture in Great Britain," *The Mineral Industry*, New York, 1897 and 1905; *Id.* "The Testing of Hydraulic Cements," *Journ. Soc. Chem. Ind.,* 1894, 13, p. 455; *Id., Proc. Inst. Civ. Eng.*, 1901; B. Blount, "Recent Progress in the Cement Industry," *Journ. Soc. Chem. Ind.,* 1906, 25, p. 1020; H.L. le Chatelier, *Recherrhes experimenlales sur la constitution des mortiers hydrauliques;* Desch, *Concrete*, No. 2, pp. 101-102; Davis, *Journ. Soc. Chem. Ind.,* 1905, 26, p. 727.

(B. Bl.)

Adhesive Cements.—Mixtures of animal, vegetable and mineral substances are employed in great variety in the arts for making joints, mending broken china and other objects, &c. A strong cement for alabaster and marble, which sets in a day, may be prepared by mixing 12 parts of Portland cement, 8 of fine sand and 1 of infusorial earth, and making them into a thick paste with silicate of soda; the object to be cemented need not be heated. For stone, marble, and earthenware a strong cement, insoluble in water, can be made as follows:—skimmed-milk cheese is boiled in water till of a gluey consistency, washed, kneaded well in cold water, and incorporated with quicklime; the composition is warmed for use. A similar cement is a mixture of dried fresh curd with $\frac{1}{10}$th of its weight of quicklime and a little camphor; it is made into a paste with water when employed. A cement for Derbyshire spar and china, &c., is composed of 7 parts of rosin and 1 of wax, with a little plaster of Paris; a small quantity only should be applied to the surfaces to be united, for, as a general rule, the thinner the stratum of a cement, the more powerful its action. Quicklime mixed with white of egg, hardened Canada balsam, and thick copal or mastic varnish are also useful for cementing broken china, which should be warmed before their application. For small articles, shellac dissolved in spirits of wine is a very convenient cement. Cements such as marine glue are solutions of shellac, india-rubber or asphaltum in benzene or naphtha. For use with wood which is exposed to moisture, as in the case of wooden cisterns, a mixture may be made of 4 parts of linseed oil boiled with litharge, and 8 parts of melted glue; other strong cements for the same purpose are prepared by softening gelatine in cold water and dissolving it by heat in linseed oil, or by mixing glue with one-fourth of its weight of turpentine, or with a little bichromate of potash. *Mahogany cement*, for filling up cracks in wood, consists of 4 parts of beeswax, 1 of Indian red and yellow-ochre to give colour. *Cutler's cement*, used for fixing knife-blades in their hafts, is made of equal parts of brick-dust and melted rosin, or of 4 parts of rosin with 1 each of beeswax and brick-dust. For covering bottle-corks a mixture of pitch, brick-dust and rosin is employed. A cheap cement, sometimes employed to fix iron rails in stone-work, is melted brimstone, or brimstone and brick-dust. For pipe-joints, a mixture of iron turnings, sulphur and sal ammoniac, moistened with water, is employed. *Japanese cement*, for uniting surfaces of paper, is made by mixing rice-flour with water and boiling it. *Jewellers'* or *Armenian cement* consists of isinglass with mastic and gum ammoniac dissolved in spirit. Gold and silver chasers keep their work firm by means of a cement of pitch and rosin, a little tallow, and brick-dust to thicken. *Temporary cement* for lathe-work, such as the polishing and grinding of jewelry and optical glasses, is compounded thus:—rosin, 4 oz.; whitening previously made red-hot, 4 oz.; wax, ¼ oz.

CEMETERY (Gr. κοιμητήριον, from κοιμᾶν, to sleep), literally a sleeping-place, the name applied by the early Christians to the places set apart for the burial of their dead. These were generally extra-mural and unconnected with churches, the practice of interment in churches or

churchyards being unknown in the first centuries of the Christian era. The term cemetery has, therefore, been appropriately applied in modern times to the burial-grounds, generally extra-mural, which have been substituted for the overcrowded churchyards (*q.v.*) of populous parishes both urban and rural.

From 1840 to 1855, attention was repeatedly called to the condition of the London churchyards by correspondence in the press and by the reports of parliamentary committees, the first of which, that of Mr Chadwick, appeared in 1843. The vaults under the pavement of the churches, and the small spaces of open ground surrounding them, were crammed with coffins. In many of the buildings the air was so tainted with the products of corruption as to be a direct and palpable source of disease and death to those who frequented them. In the churchyards coffins were placed tier above tier in the graves until they were within a few feet (or sometimes even a few inches) of the surface, and the level of the ground was often raised to that of the lower windows of the church. To make room for fresh interments the sextons had recourse to the surreptitious removal of bones and partially-decayed remains, and in some cases the contents of the graves were systematically transferred to pits adjacent to the site, the grave-diggers appropriating the coffin-plates, handles and nails to be sold as waste metal. The neighbourhood of the churchyards was always unhealthy, the air being vitiated by the gaseous emanations from the graves, and the water, wherever it was obtained from wells, containing organic matter, the source of which could not be mistaken. In all the large towns the evil prevailed in a greater or less degree, but in London, on account of the immense population and the consequent mortality, it forced itself more readily upon public attention, and after more than one partial measure of relief had been passed the churchyards were, with a few exceptions, finally closed by the act of 1855, and the cemeteries which now occupy a large extent of ground to the north, south, east and west became henceforth the burial-places of the metropolis. Several of them had been already established by private enterprise before the passing of the Burial Act of 1855 (Kensal Green cemetery dates from 1832), but that enactment forms the epoch from which the general development of cemeteries in Great Britain and Ireland began. Burial within the limits of cities and towns is now almost everywhere abolished, and where it is still in use it is surrounded by such safeguards as make it practically innocuous. This tendency has been conspicuous both in the United Kingdom and the United States. The increasing practice of cremation (*q.v.*) has assisted in the movement for disposing of the dead in more sanitary conditions; and the proposals of Sir Seymour Haden and others for burying the dead in more open coffins, and abandoning the old system of family graves, have had considerable effect. The tendency has therefore been, while improving the sanitary aspects of the disposal of the dead, to make the cemeteries themselves as fit as possible for this purpose, and beautiful in arrangement and decoration.

The chief cemeteries of London are Kensal Green cemetery on the Harrow Road; Highgate cemetery on the slope of Highgate Hill; the cemetery at Abney Park (once the residence of Dr Watts); the Norwood and Nunhead cemeteries to the south of London; the West London cemetery at Brompton; the cemeteries at Ilford and Leytonstone in Essex; the Victoria cemetery and the Tower Hamlets cemetery in East London; and at a greater distance, accessible by railway, the great cemetery at Brookwood near Woking in Surrey, and the cemetery at New Southgate. The general plan of all these cemeteries is the same, a park with broad paths either laid out in curved lines as at Kensal Green and Highgate, or crossing each other at right angles as in the case of the West London cemetery. The ground on each side of these paths is marked off into grave spaces, and trees and shrubs are planted in the intervals between them. The buildings consist of a curator’s residence and one or more chapels, and usually there is also a range of family graves with imposing tombs, massive structures containing in their corridors recesses for the reception of coffins, generally closed only by an iron grating. The provincial cemeteries in the main features of their arrangements resemble those of the metropolis. One of the most remarkable is St James’s cemetery at Liverpool, which occupies a deserted quarry. The face of the eastern side of the quarry is traversed by ascending gradients off which open catacombs formed in the living rock,—a soft sandstone; the ground below is planted with trees, amongst which stand hundreds of gravestones. The main approach on the north side is through a tunnel, above which, on a projecting rock, stands the cemetery chapel, built in the form of a small Doric temple with tetrastyle porticos.

Many of the cities of America possess very fine cemeteries. One of the largest, and also the oldest, is that of Mount Auburn near Boston. Others of importance are the Laurel Hill cemetery (1836) at Philadelphia; the Greenwood cemetery (1838) at Brooklyn (New York); the Lake View cemetery at Cleveland, Ohio; while the cemeteries at New Orleans (*q.v.*) are famous for their beauty.

The chief cemetery of Paris is that of Père la Chaise, the prototype of the garden cemeteries of western Europe. It takes its name from the celebrated confessor of Louis XIV., to whom as rector of the Jesuits of Paris it once belonged. It was laid out as a cemetery in 1804. It has an area of about 200 acres, and contains about 20,000 monuments, including those of all the great

men of France of the 19th century—marshals, generals, ministers, poets, painters, men of science and letters, actors and musicians. Twice the cemetery and the adjacent heights have been the scene of a desperate struggle; in 1814 they were stormed by a Russian column during the attack on Paris by the allies, and in 1871 the Communists made their last stand among the tombs of Père la Chaise; 900 of them fell in the defence of the cemetery or were shot there after its capture, and 200 of them were buried in quicklime in one huge grave and 700 in another. There are other cemeteries at Mont Parnasse and Montmartre, besides the minor burying-grounds at Auteuil, Batignolles, Passy, La Villette, &c. In consequence of all these cemeteries being more or less crowded, a great cemetery was laid out in 1874 on the plateau of Méry sur Oise, 16 m. to the north of Paris, with which it is connected by a railway line. It includes within 660
its circuit fully 2 sq. m. of ground. The French cemetery system differs in many respects from the English. Every city and town is required by law to provide a burial-ground beyond its barriers, properly laid out and planted, and situated if possible on a rising ground. Each interment must take place in a separate grave. This, however, does not apply to Paris, where the dead are buried, forty or fifty at a time, in the *fosses communes*, the poor being interred gratuitously, and a charge of 20 francs being made in all other cases. The *fosse* is filled and left undisturbed for five years, then all crosses and other memorials are removed, the level of the ground is raised 4 or 5 ft. by fresh earth, and interments begin again. For a fee of 50 francs a *concession temporaire* for ten years can be obtained, but where it is desired to erect a permanent monument the ground must be bought by the executors of the deceased. In Paris the undertakers' trade is the monopoly of a company, the *Société des pompes funèbres*, which in return for its privileges is required to give a free burial to the poor.

The *Leichenhäuser*, or dead-houses, of Frankfort and Munich form a remarkable feature of the cemeteries of these cities. The object of their founders was twofold—(1) to obviate even the remotest danger of premature interment, and (2) to offer a respectable place for the reception of the dead, in order to remove the corpse from the confined dwellings of the survivors. At Frankfort the dead-house occupies one of the wings of the propylaeum, which forms the main entrance to the cemetery. It consists of the warder's room, where an attendant is always on duty, on each side of which there are five rooms, well ventilated, kept at an even temperature, and each provided with a bier on which a corpse can be laid. On one of the fingers is placed a ring connected by a light cord with a bell which hangs outside in the warder's room. The use of the dead-house is voluntary. The bodies deposited there are inspected at regular intervals by a medical officer, and the warder is always on the watch for the ringing of the warning bell. One revival, that of a child, has been known to take place at Frankfort. The Leichenhaus of Munich is situated in the southern cemetery outside the Sendling Gate. At one end of the cemetery there is a semicircular building with an open colonnade in front and a projection behind, which contains three large rooms for the reception of the dead. At both Frankfort and Munich great care is taken that the attendants receive the dead confided to them with respect, and no interment is permitted until the first signs of decomposition appear; the relatives then assemble in one of the halls adjoining the Leichenhaus, and the funeral takes place. In any case there is, with ordinary care, little fear of premature interment, but in another way such places of deposit for the dead are of great use in large towns, as they prevent the evil effects which result from the prolonged retention of the dead among the living. Mortuaries for this purpose have also been established in many places in England.

In Italy the *Campo Santo* (Holy Field) is best illustrated by the famous one at Pisa, from which the name has been given to other Italian burying-grounds. Of the cemeteries still in use in southern Europe the catacombs (*q.v.*) of Sicily are the most curious. There is one of these under the old Capuchin monastery of Ziza near Palermo, where in four large airy subterranean corridors 2000 corpses are ranged in niches in the wall, many of them shrunk up into the most grotesque attitudes, or hanging with pendent limbs and head from their places. As a preparation for the niche, the body is desiccated in a kind of oven, and then dressed as in life and raised into its place in the wall. At the end of the principal corridor at Ziza there is an altar strangely ornamented with a kind of mosaic of human skulls and bones.

Cemeteries have been in use among many Eastern nations from time immemorial. In China, the high grounds near Canton and Macao are crowded with tombs, many of them being in the form of small tumuli, with a low encircling wall, forcibly recalling the ringed barrows of western Europe. But the most picturesque cemeteries in the world are those of the Turks. From them it was, perhaps, that the first idea of the modern cemetery, with its ornamental plantations, was derived. Around Constantinople the cemeteries form vast tracts of cypress woods under whose branches stand thousands of tombstones. A grave is never reopened; a new resting-place is formed for every one, and so the dead now occupy a wider territory than that which is covered by the homes of the living. The Turks believe that till the body is buried the soul is in a state of discomfort, and the funeral, therefore, takes place as soon as possible after death. No coffin is used, the body is laid in the grave, a few boards are arranged round it, and then the earth is shovelled in, care being taken to leave a small opening extending from the head of the corpse to

the surface of the ground, an opening not unfrequently enlarged by dogs and other beasts which plunder the grave. A tombstone of white marble is then erected, surmounted by a carved turban in the case of a man, and ornamented by a palm branch in low relief if the grave is that of a woman. The turban by its varying form indicates not only the rank of the sleeper below but also the period of his death, for the fashion of the Turkish head-dress is always changing. A cypress is usually planted beside the grave, its odour being supposed to neutralize any noxious exhalations from the ground, and thus every cemetery is a forest, where by day hundreds of turtle doves are on the wing or perching on the trees, and where bats and owls swarm undisturbed at night. Especially for the Turkish women the cemeteries are a favourite resort, and some of them are always to be seen praying beside the narrow openings that lead down into a parent's, a husband's, or a brother's grave. Some of the other cemeteries of Constantinople contrast rather unfavourably with the simple dignity of those which belong to the Turks. That of the Armenians abounds with bas-reliefs which show the manner of the death of whoever is buried below, and on these singular tombstones there are frequent representations of men being decapitated or hanging on the gallows.

See also the articles Burial and Burial Acts; Cremation; Funeral Rites; Churchyard.

CENCI, BEATRICE (1577-1599), a Roman woman, famous for her tragic story; poetic fancy has woven a halo of romance about her, which modern historic research has to a large extent destroyed. Born at Rome, she was the daughter of Francesco Cenci (1549-1598), the bastard son of a priest, and a man of great wealth but dissolute habits and violent temper. He seems to have been guilty of various offences and to have got off with short terms of imprisonment by bribery; but the monstrous cruelty which popular tradition has attributed to him is purely legendary. His first wife, Ersilia Santa Croce, bore him twelve children, and nine years after her death he married Lucrezia Petroni, a widow with three daughters, by whom he had no offspring. He was very quarrelsome and lived on the worst possible terms with his children, who, however, were all of them more or less disreputable. He kept various mistresses and was even prosecuted for unnatural vice, but his sons were equally dissolute. His harsh treatment of his daughter Beatrice was probably due to his discovery that she had had an illegitimate child as the result of an intrigue with one of his stewards (A. Bertolotti, in his *Francesco Cenci*, publishes Beatrice's will in which she provides for this child), but there is no evidence that he tried to commit incest with her, as has been alleged. The eldest son Giacomo was a riotous, dishonest young scoundrel, who cheated his own father and even attempted to murder him (1595). Two other sons, Rocco and Cristoforo, both of them notorious rakes, were killed in brawls. Finally Francesco's wife Lucrezia and his children Giacomo, Bernardo and Beatrice, assisted by a certain Monsignor Guerra, plotted to murder him. Two bravos were hired (one of them named Olimpio, according to Bertolotti, was probably Beatrice's lover), and Francesco was assassinated while asleep in his castle of Petrella in the kingdom of Naples (1598). Giacomo afterwards had one of the bravos murdered, but the other was arrested by the Neapolitan authorities and confessed everything. Information having been communicated to Rome, the whole of the Cenci family were arrested early in 1599; but the story of the hardships they underwent in prison is greatly exaggerated. Guerra escaped; Lucrezia, Giacomo and Bernardo confessed the crime; and Beatrice, who at first denied everything, even under torture, also ended by confessing. Great efforts were made to obtain mercy for the accused, but the crime was considered too heinous, and the pope (Clement VIII.) refused to grant a pardon; on the 11th of September 1599, Beatrice and Lucrezia were beheaded, and Giacomo, after having been tortured with red-hot pincers, was killed with a mace, drawn and quartered. Bernardo's penalty, on account of his youth, was commuted to perpetual imprisonment, and after a year's confinement he was pardoned. The property of the family was confiscated.

The romantic character of the history of this family has been the subject of poems, dramas and novels. Shelley's tragedy is well known as a magnificent piece of writing, although the author adopts a purely fictitious version of the story. Nor is F.D. Guerrazzi's novel, *Beatrice Cenci* (Milan, 1872), more trustworthy. The first attempt to deal with the subject on documentary evidence is A. Bertolotti's *Francesco Cenci e la sua famiglia* (2nd ed., Florence, 1879), containing a number of interesting documents which place the events in their true light; cf. Labruzzi's article in the *Nuova Antologia*, 1879, vol. xiv., and another in the *Edinburgh Review*, January 1879.

CENOBITES (from Gr. κοινός, common, and βίος, life), monks who lived together in a convent or community under a rule and a superior,—in contrast to hermits or anchorets who live in isolation. The Basilians (*q.v.*) in the East and the Benedictines (*q.v.*) in the West are the chief cenobitical orders (see MONASTICISM).

CENOMANI, a branch of the Aulerci in Gallia Celtica, whose territory corresponded generally to Maine in the modern department of Sarthe. Their chief town was Vindinum or Suindinum (corrupted into Subdinnum), afterwards Civitas Cenomanorum (whence Le Mans), the original name of the town, as usual in the case of Gallic cities, being replaced by that of the people. According to Caesar (*Bell. Gall.* vii. 75. 3), they assisted Vercingetorix in the great rising (52 B.C.) with a force of 5000 men. Under Augustus they formed a *civitas stipendiaria* of Gallia Lugdunensis, and in the 4th century part of Gallia Lugdunensis iii. About 400 B.C., under the leadership of Elitovius (Livy v. 35), a large number of the Cenomani crossed into Italy, drove the Etruscans southwards, and occupied their territory. The statement of Cato (in Pliny, *Nat. Hist.* iii. 130), that some of them settled near Massilia in the territory of the Volcae, may indicate the route taken by them. The limits of their territory are not clearly defined, but were probably the Athesis (Adige or Etsch) on the east, the Ollius (Oglio, or perhaps the Addua) on the west, and the Padus on the south. Livy gives their chief towns as Brixia (Brescia) and Verona; Pliny, Brixia and Cremona. The Cenomani nearly always appear in history as loyal friends and allies of the Romans, whom they assisted in the Gallic war (225 B.C.), when the Boii and Insubres took up arms against Rome, and during the war against Hannibal. They certainly joined in the revolt of the Gauls under Hamilcar (200), but after they had been defeated by the consul Gaius Cornelius (197) they finally submitted. In 49, with the rest of Gallia Transpadana, they acquired the rights of citizenship.

The orthography and the quantity of the penultimate vowel of Cenomani have given rise to discussion. According to Arbois de Jubainville, the Cenomăni of Italy are not identical with the Cenomāni (or Cenomanni) of Gaul. In the case of the latter, the survival of the syllable “man” in Le Mans is due to the stress laid on the vowel; had the vowel been short and unaccented, it would have disappeared. In Italy, Cenomani is the name of a people; in Gaul, merely a surname of the Aulerci.

See A. Voisin, *Les Cénomans anciens et modernes* (Le Mans, 1862); A. Desjardins, *Géographic historique de la Gaule romaine,* ii. (1876-1893); Arbois de Jubainville, *Les Premiers Habitants de l’Europe* (1889-1894); article and authorities in *La Grande Encyclopédie*; C. Hulsen in Pauly-Wissowa’s *Realencyclopadie*, iii. pt. 2 (1899); full ancient authorities in A. Holder, *Alt-celtischer Sprachschatz*, i. (1896).

CENOTAPH (Gr. κενός, empty, τάφος, tomb), a monument or tablet to the memory of a person whose body is buried elsewhere. The custom arose from the erection of monuments to those whose bodies could not be recovered, as in the case of drowning.

CENSOR (from Lat. *censere*, assess, estimate; in Gr. τιμητής). I. *In ancient Rome*, the title of the two Roman officials who presided over the census, the registration of individual citizens for the purpose of determining the duties which they owed to the community. In the etymology of the word lurks the idea of the arbitrary assignment of burdens or duties. Varro defines *census* as *arbitrium*, and derives the name *censores* from the position of these magistrates as *arbitri populi* (Varro, *de Ling. Lat.* v. 81; *ap.* Non. p. 519). This original idea of “discretionary power” was never entirely lost; although ultimately it came to be more intimately associated with the appreciation of morals than with the assignment of burdens. From the point of view of its moral significance the censorship was the Roman manifestation of that state control of conduct which was a not unusual feature of ancient societies. It is true that Rome possessed sumptuary laws, and laws dealing with moral offences, which it was the duty of other magistrates to enforce; but

the organization for the control of conduct was mainly exhibited in the censorship, and, as thus exhibited, was at once simple and comprehensive.

The censorship was believed to have been instituted in 443 B.C. to relieve the consuls of the duties of registration. Since the periods of registration were quinquennial, it was not a continuous office; but its tenure does not seem to have been fixed until 434 B.C., when a *lex Aemilia* provided that the censors should hold office for eighteen months. This magistracy was at first confined to patricians; a plebeian censor is first mentioned in 351 B.C. A *lex Publilia* of 339 B.C. is said to have enacted that one censor must be a plebeian. Two plebeian censors were for the first time elected in 131 B.C. The election always took place in the Comitia Centuriata (see COMITIA). The censorship, although lacking the powers implied in the imperium and the right of summoning the senate and the people, was not only one of the higher magistracies, but was regarded as the crown of a political career. It was an irresponsible office; and the only limitations on its powers were created by the restriction of tenure to a year and a half, the fact that re-election was forbidden, and the restraint imposed on each censor by the fact that no act of his was valid without the assent of his colleague.

The original functions of the censors were (1) the registration of citizens in the state-divisions, such as tribes and centuries; (2) the taxation of such citizens based on an estimate of their property; (3) the right of exclusion from public functions on moral grounds, known as the *regimen morum*; (4) the solemn act of purification (*lustrum*) which closed the census. Two other functions were subsequently added:—(5) the selection of the senate (*lectio senatus*, see SENATE), and (6) certain financial duties such as the leasing of the contracts for tax-collecting and for the repair of public buildings. The first four of these functions were those of the census, which was a detailed examination of the citizen body as represented by heads of families (*patres familiarum*) in the Campus Martius. The equites were a select portion of this citizen body; but the review of these knights took place, not in the Campus, but in the Forum (see EQUITES). It was in connexion with this review of the ordinary citizens and the knights, as well as with the choice of senators, that the censors published their edicts stating the moral rules which they intended to enforce. The offences which they punished were sometimes concerned with family life and private relations, sometimes with breaches of political duty. Certain professions, such as that of an actor or gladiator, also invoked their stigma, and at times the disqualifications they pronounced were the consequence of a previous judicial condemnation. *Infamia* was the general name given to the disabilities pronounced by the censor. These varied in degree from the deprivation of a senator of his seat, or a knight's loss of his horse, to exclusion from the tribes or centuries, an exclusion which entailed the loss of voting power. All the disabilities pronounced by one pair of censors might be removed by their successors.

The censorship, although its control over the senate came to be weakened (see SENATE), lasted as long as the republic; and it was only suspended, not abolished, during the principate. Although the princeps exercised censorial functions, he was seldom censor. Yet the office itself was held by Claudius I. and Vespasian. Domitian assumed the title of life censor (*censor perpetuus*), but the precedent was not followed. A fruitless attempt to galvanize the republican office into new life was made in A.D. 251, during the reign of the emperor Decius. 662

AUTHORITIES.—Mommsen, *Romisches Staatsrecht*, ii. 331 foll. (3rd ed., Leipzig, 1887); Daremberg-Saglio, *Dictionnaire des antiquités grecques et romaines*, i. 990 foll. (1875, &c.); Lange, *Romische Alterthumer*, i. 572 foll. (Berlin, 1856, &c.); de Boor, *Fasti Censorii* (Berlin, 1873); Gerlach, *Die romische Censur in ihrem Verhaltnisse zur Verfassung* (Basel, 1842); Nitzsch, "Über die Census" in *Neues Jahrbuch f. Phil.* lxxiii. 730 (Leipzig, 1856); Zumpt, "Die Lustra der Römer" in *Rhein. Museum*, xxv. 465, xxvi. i.

(A. H. J. G.)

II. In modern times the word "censor" is used generally for one who exercises supervision over, or criticizes, the conduct of other persons. In the universities of Oxford and Cambridge it is the title of the official head or supervisor of the non-collegiate students (*i.e.* those who are not attached to a college, hall or hostel). In Oxford the censor is nominated by the vice-chancellor and the proctors, and holds office for five years; in Cambridge he is similarly appointed, and holds office for life. The censors of the Royal College of Physicians are the officials who grant licences.

Council of Censors, in American constitutional history, is the name given to a council provided by the constitution of Pennsylvania from 1776 to 1790, and by the constitution of Vermont from 1777 to 1870. Under both constitutions the council of censors was elected once in seven years, for the purpose of inquiring into the working of the governmental departments, the conduct of the state officers, and the working of the laws, and as to whether the constitution had been violated in any particular. The Vermont council of censors, limited in number to thirteen, had power, if they thought the constitution required amending in any particular, to call a convention for the purpose. A convention summoned by the council in 1870 amended the constitution by abolishing the censors.

For the censorship of the press, see PRESS LAWS; for the censorship of plays, THEATRE: *Law*, and LORD CHAMBERLAIN.

CENSORINUS, Roman grammarian and miscellaneous writer, flourished during the 3rd century A.D. He was the author of a lost work *De Accentibus*, and of an extant treatise *De Die Natali*, written in 238, and dedicated to his patron Quintus Caerellius as a birthday gift. The contents are of a varied character: the natural history of man, the influence of the stars and genii, music, religious rites, astronomy, the doctrines of the Greek philosophers. The second part deals with chronological and mathematical questions, and has been of great service in determining the principal epochs of ancient history. The whole is full of curious and interesting information. The style is clear and concise, although somewhat rhetorical, and the Latinity, for the period, good. The chief authorities used were Varro and Suetonius. Some scholars, indeed, hold that the entire work is practically an adaptation of the lost *Pratum* of Suetonius. The fragments of a work *De Natali Institutione*, dealing with astronomy, geometry, music and versification, and usually printed with the *De Die Natali* of Censorinus, are not by him. Part of the original MS., containing the end of the genuine work, and the title and name of the author of the fragment are lost.

The only good edition with commentary is still that of H. Lindenbrog (1614); the most recent critical editions are by O. Jahn (1845), F. Hultsch (1867), and J. Cholodniak (1889). There is an English translation of the *De Die Natali* (the first eleven chapters being omitted) with notes by W. Maude (New York, 1900).

CENSUS (from Lat. *censere*, to estimate or assess; connected by some with *centum, i.e.* a count by hundreds), a term used to denote a periodical enumeration restricted, in modern times, to population, and occasionally to industries and agricultural resources, but formerly extending to property of all kinds, for the purpose of assessment.

Operations of this character have been conducted with different objects from very ancient times. The fighting strength of the children of Israel at the Exodus was ascertained by a count of all males of twenty years old and upwards, made by enumerators appointed for each clan. The Levites, who were exempted from military duties, were separately enumerated from the age of thirty upwards, and a similar process was ordained subsequently by Solomon, in order to distribute amongst them the functions assigned to the priestly body in connexion with the temple. The census unwillingly carried out by Joab at the behest of David related exclusively to the fighting men of the community, and the dire consequences ascribed to it were quoted in reprobation of such inquiries as late as the middle of the 18th century. It appears, too, that a register of the population of each clan was kept during the Babylonian captivity and its totals were published on their return to Jerusalem. In the Persian empire there was apparently some method in force by which the resources of each province were ascertained for the purpose of fixing the tribute. In China, moreover, an enumeration of somewhat the same nature was an ancient institution in connexion with the provincial revenues and military liabilities. In Egypt, Amasis had the occupation of each individual annually registered, nominally to aid the official supervision of morals by discouraging disreputable means of subsistence; and this ordinance, according to Herodotus, was introduced by Solon into the Athenian scheme of administration, where it developed later into an electoral record.

It was in Rome, however, that the system from which the name of the inquiry is derived was first established upon a regular footing. The original census was ascribed to Servius Tullius, and in the constitution which goes by his name it was decreed that every fifth year the population should be enumerated along with the property of each family—land, live-stock, slaves and freedmen. The main object was to ensure the accurate division of the people into the six main classes and their respective centuries, which were based upon considerations of combined numbers and wealth. With the increase of the city the operation grew in importance, and was followed by an official *lustrum*, or purificatory sacrifice, offered on behalf of the people by the censors or functionaries in charge of the classification. Hence the name of lustrum came to denote the intercensal term, or a period of five years. The word census, too, came to mean the property qualification of the class, as well as the process of registering the resources of the

individual. Later, it was used in the sense of the imposition itself, in which it has survived in the contracted form of *cess*. Unfortunately the statistics of population thus collected were subordinated to the fiscal interests of the inquiry, and no record has been handed down relating to the population of the city and its neighbourhood. In the time of Augustus the census was extended to the whole empire. In the words of the Gospel of St Luke, he ordered "the whole world to be *taxed*," or, according to the revised version, to be *enrolled*. The compilation of the results of this the most comprehensive enumeration till then attempted was engaging the attention of the emperor, it is said, just before his death, but was never completed. The various inquiries instituted during the middle ages, such as the Domesday Book and the Breviary of Charlemagne, were so far on the Roman model that they took little or no account of the population, the feudal system probably rendering information regarding it unnecessary for the purposes of taxation or military service.

The foundations of the census on the modern system were laid in Europe towards the middle or end of the 17th century. Sweden led the way, by making compulsory the parish record of births, deaths and marriages, kept by the clergy, and extending it to include the whole of the domiciled population of the parish. In France, Colbert, in 1670, ordered the extension to the rural communes of the system which had for many years been in force in Paris of registering and periodically publishing the domestic occurrences of the locality. Five years before this, however, a periodical enumeration by families and individuals had been established in the colony of New France, and was continued in Quebec from 1665 till 1754. This, therefore, may be considered to be the earliest of modern censuses.

Efforts have been almost unceasingly made since 1872 by statistical experts in periodical conference to bring about a general understanding, first, as to the subjects which may be considered most likely to be ascertained with approximate accuracy at a census, and secondly—a point of scarcely less importance—as to the form in which the results of the inquiry should be compiled in order to render comparison possible between the facts recorded in the different areas. In regard to the scope of the inquiry, it is recognized that much is practicable in a country where the agency of trained officials is employed throughout the operation which cannot be expected to be adequately recorded where the responsibility for the correctness of the replies is thrown upon the householder. The standard set up by eminent statisticians, therefore, may be taken to represent an ideal, not likely to be attained anywhere under present conditions, but towards which each successive census may be expected to advance. The subjects to which most importance is attached from the international standpoint are age, sex, civil condition, birthplace, illiteracy and certain infirmities. Occupation, too, should be included, but the record of so detailed a subject is usually considered to be better obtained by a special inquiry, rather than by the rough and ready methods of a synchronous enumeration. This course has been adopted in Germany, Belgium and France, and an approach to it is made in the decennial census of Canada and the United States. Religious denomination, another of the general subjects suggested, is of considerably more importance in some countries than in others, and the same may be said of nationality, which is often usefully supplemented by the return of mother-tongue. Nor should it be forgotten that the internal classification and the combinations of the above subjects are also matters to be treated upon some uniform plan, if the full value of the statistics is to be extracted from the raw material. On the whole, the progress towards a general understanding on many, if not most, of the questions here mentioned which has been made in the present generation, is a gratifying tribute to those who have long laboured in the cause of efficient enumeration.

The British Empire

England and Wales.—Up to the beginning of the 19th century the number of the population was a matter of estimate and conjecture. In 1753 a bill was introduced by a private member of the House of Commons, backed by official support, to provide for the annual enumeration of the people and of the persons in receipt of parochial relief. It was violently opposed as "subversive of the last remains of English liberty" and as likely to result in "some public misfortune or an epidemical distemper." After passing that House, however, the bill was thrown out by the House of Lords. The fear of disclosing to the enemies of England the weakness of the country in fighting-material was one of the main objections offered to the proposal. By the end of the century, however, owing to a great extent to the publication of the essays of Malthus, the pendulum had swung far in the opposite direction, it was thought desirable to possess the means of judging from time to time the relations between an increasing population and the means of subsistence. A census bill, accordingly, again brought in by a private member, became law without opposition at the end of 1800, and the first enumeration under it took place in March of the following year, the operations being confined to Great Britain. The inquiry was entrusted in England to the overseers, acting under the justices of the peace and the high constables, and in Scotland, to village schoolmasters, under the sheriffs. A supplementary

statement of births, deaths and marriages for each parish was required from the clergy, who transmitted it to parliament through the bishops and primates successively. There was no central office or control. The schedule required the number of houses, inhabited and otherwise, the population of each family, by sex, and the occupation, under one of the three heads, (a) agriculture, (b) trade, manufacture or industry, or (c) other than these two. The results, which were not satisfactory, were published without comment. Ten years later, the chief alteration in the inquiry was the substitution of the main occupation of the family for that of the individual. The report on this census contained a very valuable exposition of the difficulties involved in such operations and the numerous sources of error latent in an apparently simple set of questions. In 1821 an attempt to get a return of ages was made, but it was not repeated in 1831, when the attention of the enumerators was concentrated upon greater detail in the occupation record. Their efforts were successful in getting a better, but still far from complete result. The creation, in 1834, of poor law unions, and the establishment, in 1836, of civil registration districts, as a rule coterminous with them, provided a new basis for the taking of a census, and the operations in 1841 were made over accordingly to the supervision of the registrar-general and his staff. The inquiry was extended to the sex, age and occupation of every individual; those born in the district were distinguished from others, foreigners being also separately returned. The number of houses inhabited, uninhabited and under construction respectively, was noted in the return. The parish statement of births, deaths and marriages was sent up by the clergy for the last time. The most important innovation, however, was the transfer of the responsibility for filling up the schedule from the overseers to the householders, thereby rendering possible a synchronous record.

With some modification in detail, the system then inaugurated has been since maintained. In 1851 the relationship to the head of the family, civil condition, and the blind and deaf-mute were included in the inquiry. On this occasion, the act providing for the census was interpreted to authorize the collection of details regarding accommodation in places of public worship and the attendance thereat, as well as corresponding information about educational establishments. A separate report was published on the former subject which proved something of a storm centre. The census of 1871 obtained for the first time a return of persons of unsound mind not confined in asylums. During the next ten years, the separate areas for which population returns had to be prepared were seriously multiplied by the creation of sanitary districts, to the number of 966. The necessity, for administrative or other purposes, of tabulating separately the returns for so many cross-divisions of the country constitutes one of the main difficulties of the English census operations, more particularly as the boundaries of these areas are frequently altered. In anticipation of the census of 1891, a treasury committee was appointed to consider the various suggestions made in regard to the form and scope of the inquiry. Its proposals were adopted as to the subdivision of the occupation column into employer, employed and independent worker, and as to the record upon the schedule of the number of rooms occupied by the family, where not more than five. Separate entry was also made of the persons living upon property or resources, but not following any occupation. No action was taken, however, upon the more important recommendation that midway between two censuses a simple enumeration by sex and age should be effected. A return was also prepared in 1891, for Wales, of those who could speak only Welsh, only English, and both languages, but, owing to the inclusion of infants, the results were of little value. In 1901 the same information was called for, excluding all under three years of age. The term tenement, too, was substituted for that of storey, as the subdivision of a house, whilst in addition to inhabited and uninhabited houses, those occupied by day, but not by night, were separately recorded. The nationality of those born abroad, which used to be returned only for British subjects, was called for from all not born within the kingdom.

Scotland.—In the acts relating to the census from 1801 to 1851, provision for the enumeration of Scotland was made with that for England and Wales, allowance being made for the differences in procedure, which mainly concerned the agency to be employed. In 1855, however, civil registration of births and deaths was established in Scotland, and the conduct of the census of 1861 was, by a separate act, entrusted to the registrar-general of that country. The same course was followed at the three succeeding enumerations, but in 1901 the former practice was resumed. The complexity of administrative areas, though far less than in England, was simplified, and the census compilation proportionately facilitated, by the passing of the Local Government Act for Scotland, in 1889. In 1881, the definition of a house in Scotland was made identical with that in England, since previously what was called a house in the northern portion of Great Britain was known as a tenement in the south, and vice versa. Since 1861 a return has been called for in Scotland of the number of rooms with one or more windows, and that of children of school-age under instruction is also included in the inquiry. The number of persons speaking Gaelic was recorded for the first time in 1881. The question was somewhat expanded at the next census, and in 1901 was brought into harmony with the similar inquiry as to Welsh and Manx.

Ireland.—An estimate of the population of Ireland was made as early as 1672, by Sir W. Petty,

and another in 1712, in connexion with the hearth-money, but the first attempt to take a regular census was made in 1811, through the Grand Juries. It was not successful, and in 1821 again, the inquiry was considered to be but little more satisfactory. The census of 1831 was better, but the results were considered exaggerated, owing to the system of paying enumerators according to the numbers they returned. The census, therefore, was supplemented by a revisional inquiry three years afterwards, in order to get a good basis for the newly introduced system of public instruction. The completion of the ordnance survey and the establishment of an educated constabulary force brought the operations of 1841 up to the level of those of the sister kingdom. The main difference in procedure between the two inquiries is that in Ireland the schedule is filled in by the enumerator, a member of the constabulary, or, in Dublin, of the metropolitan police, instead of being left to the householder. The tabulation of the returns, again, is carried out at the central office from the original schedule, and not, as in England, from the book into which the former has been copied by the enumerating agency. The inquiry in Ireland is more extensive than that in Great Britain. It includes, for instance, a considerable amount of information regarding holdings and stock. The details of house accommodation are fuller. A column is provided for the degree of education, and another for religious denomination, an addition which has always been successfully resisted in England. This last information was made voluntary in 1881 and the following enumerations without materially affecting the extent of the record. The inquiry as to infirmities, too, is made to extend to those *temporarily* incapacitated from work, whether at home or in a hospital. There is also a column for the entry of persons speaking the Irish language only or able to speak both that and English. In the report of 1901 for England and Wales (p. 170) a table is given showing, for the three divisions of the United Kingdom, the relative number of persons speaking the ancient languages either exclusively or in addition to English.

British Colonies and Dependencies.—A simultaneous and uniform census of the British empire is an ideal which appeals to many, but its practical advantages are by no means commensurate with the difficulties to be surmounted. Scattered as are the colonies and dependencies over the world, the date found most suitable for the inquiry in the mother country and the temperate regions of the north is the opposite in the tropics and inconvenient at the antipodes. Then, again, as to the scope of the inquiry, the administrative purposes for which information is thus collected vary greatly in the different countries, and the inquiry, too, has to be limited to what the conditions of the locality allow, and the population dealt with is likely to be able and willing to answer. By prearrangement, no doubt, uniformity may be obtained in regard to most of the main statistical facts ascertainable at a census, at all events in the more advanced units of the empire, and proposals to this effect were made by the registrar-general of England and Wales in his report upon the figures for 1901. Previous to that date, the only step towards compilation of the census results of the empire had been a bare statement of area and population, appended without analysis; comparison or comment, to the reports for England and Wales, from the year 1861 onwards. In 1905, however, the returns published in the colonial reports were combined with those of the United Kingdom, and the subjects of house-room, sex, age, civil condition, birthplace, occupation, and, where available, instruction, religion and infirmities, were reviewed as fully as the want of uniformity in the material permitted (Command paper, 2860, 1906). The measures taken by the principal states, colonies and dependencies for the periodical enumeration of their population are set forth below.

Canada.—The first enumeration of what was afterwards called Lower Canada, took place, as above stated, in 1665, and dealt with the legal, or domiciled, population, not with that actually present at the time of the census, a practice still maintained, in contrast to that prevailing in the rest of the empire. The record was by families, and included the sex, age and civil condition of each individual, with a partial return of profession or trade. Later on, the last item was abandoned in favour of a fuller return of agricultural resources, a feature which has remained a prominent part of the inquiry. After the British occupation, a census was taken in 1765 and 1784, and annually from 1824 to 1842, the information asked for differing from time to time. Enumerations were conducted independently by the different states until 1871, when the first federal census was taken of the older parts of the Dominion. Since then, the enumeration has been decennial, except in the case of the more recently colonized territories of Manitoba and the North-West, where an intermediate census was found necessary in 1885-1886. The census of Canada is organized on the plan adopted in the United States rather than in accordance with British practice, and includes much which is the subject of annual returns in the latter country, or is not officially collected at all. The details of deaths in the year preceding the census, for instance, are called for, there being no registration of such occurrences in the rural tracts. In consideration of the large immigrant population again, the birthplace of each parent is recorded, with details as to nationality, naturalization and date of immigration. Occupation is dealt with minutely, in conjunction with temporary unemployment, average wage or salary earned, and other particulars. No less than eleven schedules are employed, most of them relating to details of industries and production. The duty of filling up so comprehensive a return, involving an answer to 561 questions, is not left to the householder, but entrusted to

enumerators specially engaged, working under the supervision of the Department of Agriculture. Owing to the sparse population and difficulties of communication in a great part of the dominion, the inquiry, though referred to a single date, is not completed on that day, a month being allowed to the enumerator for the collection of his returns and their revision and transmission to the central office. A special feature in the operations is the provision, necessitated by the record of the *legal* population, for the inclusion in the local return of the persons temporarily absent on the date of the census, and their adjustment in the general aggregates, a matter to which considerable attention is paid. The very large mass of detail collected at these inquiries entails an unusually long time spent in compilation; the statistics of population, accordingly, are available considerably in advance of those relating to production and industries.

Australasia.—As the sphere of the census operations in Canada has been gradually spreading from the small beginnings on the east coast to the immense territories of the north-west, so, in the island continent, colonization, first concentrated in the south-east, has extended along the coasts and thence into the interior, except in the northern region. The first act of effective occupation of the country having been the establishment of a penal settlement, the only population to be dealt with in the earlier years of British administration was that under restraint, with its guardians and a few scattered immigrants in the immediate neighbourhood of Sydney Cove. This was enumerated from 1788 onwards by official “musters,” at first weekly, and afterwards at lengthening intervals. The record was so inaccurate that it had no statistical value until 1820, when the muster was taken after due preparation and with greater care, approximating to the system of a regular census. The first operation, however, called by the latter name, was the enumeration of 1828, when an act was passed providing for the enumeration of the whole population, the occupied area and the live-stock. The details of population included sex, children and adults respectively, religion and *status*, that is whether free (immigrants or liberated convicts), on ticket-of-leave, or under restraint. A similar inquiry was made in 1833 and again in 1836. In 1841 a separate census was taken of New Zealand and Tasmania respectively. The scope of the inquiry in New South Wales was somewhat extended and made to include occupations other than agriculture and stock-breeding. Five years later, the increase of the population justified the further addition of particulars regarding birthplace and education. The record of *status*, too, was made optional, and in 1856 was omitted from the schedule. In that year, moreover, Victoria, which had become a separate colony, took its own census. South Australia, too, was enumerated in 1846, ten years after its foundation as a colony. From 1861 the census has been taken decennially by all the states except Queensland, where, as in New Zealand, it has been quinquennial since 1875 and 1881 respectively. Up to and including the census of 1901 each state conducted separately its own inquiries. The scheme of enumeration is based on that of Great Britain, modified to suit the conditions of a thin and widely scattered population. The schedules are distributed by enumerators acting under district supervisors; but it is found impossible to collect the whole number in a single day, nor does the mobility of the population in the rural tracts make such expedition necessary. In more than one state the police are employed as enumerators, but elsewhere, a staff has to be specially recruited for the purpose. The operations were improved and facilitated by means of an interstatal conference held before the census of 1891, at which a standard schedule was adopted and a series of general tables agreed upon, to be supplemented in greater detail according to the requirements of each state. The standard schedule, in addition to the leading facts of sex, age, civil condition, birthplace, occupation and house-room, includes education and sickness as well as infirmities, and leaves the return of religious denomination optional with the householder. Under the head of occupation, the bread-winner is distinguished from his dependants and is returned as employer, employed, or working on his own account, as is now the usual practice in census-taking. Each state issues its own report, in which the returns are worked up in the detail required for both local administrative purposes, and for comparison with the corresponding returns for the neighbouring territory. The reports for New South Wales and Victoria are especially valuable in their statistical aspect from the analysis they contain of the vital conditions of a comparatively young community under modern conditions of progress.

South Africa.—Almost from the date of their taking possession of the Cape of Good Hope and its vicinity, the Netherlands East Indian Company instituted annual returns of population, live-stock and agricultural produce. The results from 1687 for nearly a century were recorded, but do not appear to have been more accurate than those subsequently obtained on the same method by the British government, by whom they were discontinued in 1856. The information was collected by district officials, unguided by any general instructions as to form or procedure. The first synchronous census of the colony, as it was then constituted, took place in 1865, on a fairly comprehensive schedule. Ten years later the inquiry was extended to religion and civil condition, and for the census of 1891, again, a rather more elaborate schedule was used. The next census was deferred till 1904, in consequence of the disorganization produced by the Boer war. The inquiry was on the same lines as its predecessors, with a little more detail as to industries and religious denomination. Speaking generally, the administration of the operations

is conducted upon the Australian plan, with special attention to allaying the distrust of the native and more ignorant classes, for which purpose the influence of the clergy was enlisted. In some tracts it was found advisable to substitute a less elaborate schedule for that generally prescribed. In Natal, indeed, where the first independent census was taken in 1891, the Kaffir population was not on that occasion enumerated at all. In 1904, however, they were counted on a very simple schedule, by sex and by large age-groups up to 40 years old, with a return of birthplace, in a form affording a fair indication of race. Natives of India, an element of considerable extent and importance in this colony, are enumerated apart from the white population, but in full detail, recognizing the remarkable difference between the European and the Oriental in the matter of age distribution and civil condition. The Transvaal and the Orange River colonies were enumerated in 1904. In the latter, a census had been taken in 1890, in considerable detail, but that of the Transvaal, in 1896, seems to have been far from complete or accurate even in regard to the white population. In Southern Rhodesia the white residents were enumerated in 1891, but it was not until 1904 that the whole population was included in the census. The difficulty in all these cases is that of procuring a sufficient quantity of efficient agency, especially where a large and illiterate native population has to be taken into account. For this reason, amongst others, no census had been taken up to 1906 of Northern Rhodesia, the British possessions and protectorates of eastern Africa, or, again, of Nigeria and the protectorates attached to the West African colonies of Gambia, Sierra Leone and Lagos.

The West Indies.—Each of the small administrative groups here included takes its census independently of the rest, though since 1871 all take it about the date fixed for that of the United Kingdom. The information required differs in each group, but the schedule is, as a rule, of a simple character, and the results of the inquiry are usually set forth with comparatively little comment or analysis. In some of the groups distinctions of colour are returned in general terms; in others, not at all. On the other hand, considerable detail is included regarding the indentured labourers recruited from India, and those of this class who are permanently settled on the land in Guiana and Trinidad. No census was taken in the former, or in Jamaica and Barbados, in 1901.

Ceylon.—Here the census is taken decennially, on the same date as in India, in consideration of the constant stream of migration between the two countries. The schedule is much the same as in India with the substitution of race for caste. Until 1901, however, it was not filled in by the enumerator, as in India, but was distributed before and collected after the appointed date as in Great Britain.

India.—The population of India is the largest aggregate yet brought within the scope of a synchronous and uniform enumeration. It amounts to three-fourths of that of the British Empire, and but little less than a fifth of the estimated population of the world. Between 1853 and 1881 each province conducted its own census operations independently, with little or no attempt at uniformity in date, schedule or tabulation. In the latter year the operations were placed for the first time under central administration, and the like procedure was adopted in 1891 and 1901, with such modification of detail as was suggested by the experience of the preceding census. On each occasion new areas had to be brought within the sphere of enumeration, whilst the necessity for the use in the wilder tracts of a schedule simpler in its demands than the standard, grew less as the country got more accustomed to the inquiry, and the efficiency of the administrative agency increased. Not more than 5% of the householders in India can read and write, and the proportion capable of fully understanding the schedule and of making the entries in it correctly is still lower. From the literate minority, therefore, agency has to be drawn in sufficient strength to take down every particle of the information dictated by the heads of families. As it would be impossible for an enumerator to get through this task in the course of the census night for more than a comparatively small number of houses, the operation is divided into two processes. First a preliminary record is made a short time before the night in question, of the persons ordinarily residing in each house. Then, on that night, the enumerator, reinforced if necessary by aid drafted from outside, revisits his beat, and brings the record up to date by striking out the absent and entering the new arrivals. The average extent of each beat is arranged to include about 300 persons. Thus, in 1901, not far from a million men were required for enumeration alone. To this army must be added the controlling agency, of at least a tenth of the above number, charged with the instruction of their subordinates, the inspection and correction of the preliminary record, and the transmission of the schedule books to the local centre after the census has been taken. The supply of agency for these duties is, fortunately, not deficient. Irrespective of the large number of clerks, village scribes and state and municipal employés which can be drawn upon with but slight interruption of official routine, there is a fair supply of casual literary labour up to the moderate standard required. The services, too, of the educated public are often voluntarily placed at the disposal of the local authorities for the census night, with no desire for remuneration beyond out-of-pocket expenses, and the addition, perhaps, of a personal letter of thanks from the chief official of the district. By means of a well-organized chain of tabulating centres, the preliminary totals, by sexes, of the 294 millions

enumerated in 1901 were given to the public within a fortnight of the census, and differed from the final results by no more than 94,000, or .03%. The schedule adopted contains in addition to the standard subjects of sex, age, civil condition, birthplace, occupation and infirmities, columns for mother-tongue, religion and sect, and caste and sub-caste. It is printed in about 20 languages. The results for each province or large state are tabulated locally, by districts or linguistic divisions. The final compilation is done by a provincial superintendent, who prepares his own report upon the operations and results. This work has usually an interest not found in corresponding reports elsewhere, in the prominent place necessarily occupied in it by the ethnographical variety of the population.

Foreign Countries

Inquiries by local officials in connexion with measures of taxation, such as the hearth-tax in France, were instituted in continental Europe as early as the 14th century; but as the basis of an estimate of population they were intrinsically untrustworthy. Going outside Europe, an extreme instance of the results of combining a census with more definite administrative objects may be found in the census of China in 1711, when the population enumerated in connexion with a poll-tax and liability to military service, was returned as 28 millions; but forty years later, when the question was that of the measures for the relief of widespread distress, the corresponding total rose to 103 millions! The notion of obtaining a periodical record of population and its movement, dissociated from fiscal or other liabilities, originated, as stated above, in Sweden, where, in 1686, the birth and death registers, till then kept voluntarily by the parish clergy, were made compulsory and general, the results for each year being communicated to a central office. A census, as a special undertaking, was not, however, carried out in that country until 1749. The example of Sweden was followed in the next year by Finland, and twenty years later, by Norway, where the parish register was an existing institution, as in the neighbouring state. Several other countries followed suit in the course of the 18th century, though the results were either partial or inaccurate. Amongst them was Spain, though here a trustworthy census was not obtained until 1857, or perhaps 1887. Some of the small states of Italy, too, recorded their population in the middle of the above century, but the first general census of that country took place in 1861, after its unification. In Austria, a census was taken in 1754 by the parish clergy, concurrently with the civil authorities and the military commandants. Hungary was in part enumerated thirty years later. The starting-point of the modern census, however, in either part of the dual monarchy, was not until 1857. Speaking generally, most of the principal countries began the current series of their censuses between 1825 and 1860. The German empire has taken its census quinquennially since its foundation, but long before 1871 a census at short intervals used to be taken in all the states of the Zollverein, for the purpose of ascertaining the contribution to the federal revenue, the amount of which was revisable every three years. The last great country to enter the census field was Russia. From 1721, what are known as revisions of the population were periodically carried out, for military, fiscal and police purposes; but these were conducted by local officials without central direction or systematic organization. In 1897 a general census was taken as synchronously throughout the empire as was found possible. It embraced a population second to that of India alone, as China, probably the most populous country in the world, has not yet been subjected to this test. The inquiry was made in great detail, under central control, and on a plan sufficiently elastic to suit the requirements of so varied a country and population. As in India, the schedules had to be issued in an unusual number of languages, and were dealt with locally in the earlier stages of tabulation. The principal regions of which the population is still a matter of mere conjecture are the Turkish empire, Persia, Afghanistan, China and the Indo-Chinese peninsula, in Asia, nearly nine-tenths of Africa, and a considerable portion of South America.

(J. A. B.)

United States

Modern census-taking seems to have originated in the United States. Professor von Mayr declares in a recent and authoritative work, “It was no European state, but the United States of America that made a beginning of census-taking in the large and true sense of that word,” and Professor H. Wagner, writing of the censuses of Sweden, said to have been taken in the 18th century, uses these words, “Since 1749 careful parish registers have been kept by the clergy and have in general the value of censuses.” The same authority, although mentioning a reported census of Norway in 1769, indicates his conviction that the first real census of that country was in 1815. Sweden, Norway and the United States are the only countries with any claim to have taken the first modern census, as distinguished from a register of tax-payers, &c., the lineal descendant of the old Roman census, and the innovation seems to be due to the United States. If so, the first modern census was the American census of 1790. At the present date more than three-fifths of the estimated population of the world has been enumerated in this way. It is of

interest accordingly to note how and why the device originated.

The Federal census, which began in 1790 and has been taken every ten years since under a mandate contained in the Constitution of the United States, was the outgrowth of a controversy in the convention which prepared the document. Representatives of the smaller states as a rule claimed that the vote, and so the influence, of the states in the proposed government should be equal. Representatives of the larger states as a rule claimed that their greater population and wealth were entitled to recognition. The controversy ended in the creation of a bicameral legislature in the lower branch of which the claim of the larger states found recognition, while in the upper, the Senate, each state had two votes. In the House of Representatives seats were to be distributed in proportion to the population, and the convention, foreseeing rapid changes of population, ordained an enumeration of the inhabitants and a redistribution or reapportionment of seats in the House of Representatives every ten years.

The provision of the Constitution on the subject is as follows:— “Representatives and direct taxes shall be apportioned among the several states which may be included within this Union according to their respective numbers, which shall be determined by adding to the whole number of free persons, including those bound to service for a term of years and excluding Indians not taxed, three-fifths of all other persons. The actual enumeration shall be made within three years after the first meeting of the Congress of the United States, and within every subsequent term of ten years, in such manner as they shall by law direct.”

In 1790 the population was reported classed as slaves and free, the free classed as white and others, the free whites as males and females, and the free white males as under or above sixteen years of age. In 1800 and 1810 the same classification was preserved, except that five age-groups instead of two were given for free white males and the same five were applied also to free white females. In connexion with the census of 1810 an attempt, perhaps the earliest in any country, was made to gather certain industrial statistics showing “the number, nature, extent, situation and value of the arts and manufactures of the United States.” In 1820 a sixth age class was introduced for free white males, an age classification of four periods was applied to the free coloured and the slaves of each sex, and the number of aliens and of persons engaged in agriculture, in manufactures and in commerce was called for. The inquiry into industrial statistics begun in 1810 was also repeated and extended.

In 1830 thirteen age classes were employed for free whites of each sex, and six for the free coloured and the slaves of each sex. The number of aliens, of the deaf and dumb and the blind were also gathered.

The law under which the census of 1840 was taken contained a novel provision for the preparation in connexion with the census of statistical tables giving “such information in relation to mines, agriculture, commerce, manufactures and schools as will exhibit a full view of the pursuits, industry, education and resources of the country.” This was about the first indication of a tendency, which grew in strength for half a century, to load the Federal census with inquiries having no essential or necessary connexion with its main purpose, which was to secure an accurate enumeration of the population as a basis for a reapportionment of seats in the House of Representatives. This tendency was largely due to a doubt whether the Federal government under the Constitution possessed the power to initiate general statistical inquiries, a doubt well expressed in the 9th edition of the *Encyclopaedia Britannica* by Francis A. Walker, himself a prominent member of the party whose contention he states:—

> “The reservation by the states of all rights not granted to the general government makes it fairly a matter of question whether purely statistical inquiries, other than for the single purpose of apportioning representation, could be initiated by any other authority than that of the states themselves. That large party which advocates a strict and jealous construction of the constitution would certainly oppose any independent legislation by the national Congress for providing a registration of births, marriages and deaths, or for obtaining social and industrial statistics, whether for the satisfaction of the publicist or for the guidance of the legislature. Even though the supreme court should decide such legislation to be within the grant of powers to the general government, the distrust and opposition, on constitutional grounds, of so large a portion of the people, could not but go far to defeat the object sought.”

The difficulty stated in the foregoing quotation, although now mainly of historic importance, exerted great influence upon the development of the American census prior to 1900.

The pioneer work of the census of 1840 in the fields of educational statistics, statistics of occupations, of defective classes and of causes of death, suffered from numerous errors and defects. Public discussion of them contributed to secure radical modifications of scope and method at the census of 1850. Before the census law was passed, a census board, consisting of three members of the president’s cabinet, was appointed to draft plans for the inquiry, and the essential features of its report prepared after consultation with a number of leading statisticians were embodied in the law.

The census of 1850 was taken on six schedules, one for free inhabitants, one for slaves, one for deaths during the preceding year, one for agriculture, one for manufactures and one for social statistics. The last asked for returns regarding valuation, taxation, educational and religious statistics, pauperism, crime and the prevailing rates of wages in each municipal division. It was also the first American census to give a line of the schedule to each person, death or establishment enumerated, and thus to make the returns in the individual form indispensable for a detailed classification and compilation. The results of this census were tabulated with care and skill, and a preliminary analysis gave the salient results and in some cases compared them with European figures.

The census of 1860 followed the model of its predecessor with slight changes. When the time for the next census approached it was felt that new legislation was needed, and a committee of the House of Representatives, with James A. Garfield, afterwards president of the United States, at its head, made a careful and thorough study of the situation and reported an excellent bill, which passed the House, but was defeated by untoward influences in the Senate. In consequence the census of 1870 was taken with the outgrown machinery established twenty years earlier, a law characterized by Francis A. Walker, the superintendent of the census, who administered it, as “clumsy, antiquated and barbarous.” It suffered also from the fact that large parts of the country had not recovered from the ruin wrought by four years of civil war. In consequence this census marks the lowest ebb of American census work. Tie accuracy of the results is generally denied by competent experts. The serious errors were errors of omission, were probably confined in the main to the Southern states, and were especially frequent among the negroes.

Since 1870 the development of census work in the United States has been steady and rapid. The law, which had been prepared for the census of 1870 by the House committee, furnished a basis for greatly improved legislation in 1879, under which the tenth census was taken. By this law the census office for the first time was allowed to call into existence and to control an adequate local staff of supervisors and enumerators. The scope of the work was so extended as to make the twenty-two quarto volumes of the tenth census almost an encyclopaedia, not only of the population, but also of the products and resources of the United States. Probably no other census in the world has ever covered so wide a range of subjects, and perhaps none except that of India and the eleventh American census has extended through so many volumes. The topics usually contained in a census suffered from the great addition of other and less pertinent matter, and the reputation of the work was unfavourably affected by the length of time required to prepare and publish the volumes (the last ones not appearing until near the end of the decade), the original underestimate of the cost of the work, which made frequent supplementary appropriations necessary, the resignation of the superintendent, Francis A. Walker, in 1882, and the disability and death of his successor, Charles W. Seaton. The eleventh census was taken under a law almost identical with that of the tenth, and extended through twenty-five large volumes, presenting a work almost as encyclopaedic, but much more distinctively statistical.

The popular opinion of a census, at least in the United States, depends largely upon the degree to which its figures for the population of the country, of states, and especially of cities, meet or fail to meet the expectations of the interested public. Judged by this standard, the census of 1890 was less favourably received than that of 1880. The enumerated population of the country in 1880 was larger than had been anticipated; and in the face of these figures it was difficult for local complaints, even where they were made, to find hearing and acceptance. But according to the eleventh census the decennial rate of growth of population fell suddenly from over 30%, which the figures had shown between 1870 and 1880, and in every preceding decade of the century, except that of the Civil War, to less than 25%, in spite of an immigration nearly double that of any preceding decade. For this change no adequate explanation was offered by the census office. Hence the protests of those who believed that the figures for population were too small swelled into a general chorus of dissatisfaction. But the census was probably more correct than the critics. Most of the motives influencing popular estimates of population in the United States tend to exaggeration. The convention which drafted the Constitution of the United States attempted to secure a balance of interests by apportioning both representatives in Congress and direct taxes according to population. A passage in *The Federalist* suggests the motives of the convention as follows:—

> “As the accuracy of the census to be obtained by Congress will necessarily depend in a considerable degree on the disposition if not co-operation of the states, it is of great importance that the states should feel as little bias as possible to swell or reduce the amount of their numbers. Were their share of representation alone to be governed by this rule, they would have an interest in exaggerating their inhabitants. Were the rule to decide their share of taxation alone, a contrary temptation would prevail. By extending the rule to both objects the states will have opposite interests, which will control and balance each other, and produce a requisite impartiality.”

With the disappearance of direct taxation as a source of federal revenue, the motive mentioned

for understating the population disappeared. On the other hand, the desire for many representatives in Congress has been reinforced by the more influential feelings of local pride and of rivalry with other cities of somewhat similar size. Hence a complaint that the population is overstated is seldom heard, and hence, also, popular charges of an under-count afford little evidence that the population was really larger than stated by the census.

After the detailed tabulation had been completed, it was shown that the number of persons under ten years of age in 1890 was surprisingly small, and that this deficiency in children was a leading cause of the slow growth in population. Before the tabulation had been made Francis A. Walker wrote:—"If the birth-rate among the previously existing population did not suffer a sharp decline ... the census of 1890 cannot be vindicated. To ascertain the facts we must await the tabulation of the population by periods of life, and ascertain how many of the inhabitants of the United States of 1890 were under ten years of age." These results thus confirmed the accuracy of the count of 1890. Efforts to invalidate the census returns by comparison with the registration records of Massachusetts cannot be deemed conclusive, since in the United States, as in Great Britain, the census must be deemed more accurate and less subject to error than registration records. A strong argument in favour of the eleventh census, apart from its self-consistency, is that its results as a whole fit in with the subsequent state enumerations. In eleven cases such enumerations have been taken; and on computing from them and the results of the federal census of 1880 what the population at the date of the eleventh census should have been, if the annual rate of increase had been uniform, it appears that in no case, except New York City and Oregon, was the difference between the enumerations and these estimates over 4%. In Oregon about 30,000 more people were found in 1890 than the estimate would lead one to expect; in New York city, about 100,000 less. It seems not improbable that in the latter, where the difficulties incident to a count during the summer are almost insurmountable, serious omissions occurred. Still, such a comparison confirms the accuracy of the eleventh census as a whole.

The results of the twelfth census (1900) further refute the argument that would maintain the eleventh census to be inaccurate because it showed a smaller rate of increase in population during the preceding decade than had been recorded by other censuses during earlier decades. The rate of increase during the decade ending in 1900 was even less than that for the preceding decade; and it is impossible that a falling off so marked could in two successive enumerations be the result of sheer inaccuracy. The rate of increase from 1890 to 1900, eliminating from the computation the population of Alaska, Hawaii, Indian Territory and Indian reservations, was 20.7; the rate of increase if these places are included—in which case the figures of the population of Hawaii in 1890 must be taken from the census of the Hawaiian government in that year—was 21%.

> The law regulating the twelfth census deserves to rank with those of 1790, 1850 and 1879 as one of the four important laws relative to census work. By this law the census office was far more independent than ever before. Appointments and removals were made by the director of the census rather than by the secretary of the interior, and in all plans for the execution of the law the head of the office was responsible for success. The law divided the subjects of census inquiry into two parts—first, those of primary importance, requiring the aid of the enumerator; and, secondly, those of subsidiary importance, capable of production without the aid of the enumerator. The former had to be finished and published by 1st July 1902; the latter were not to be undertaken until the former were well advanced towards completion. By this means the attention of the office could be concentrated on a small number of subjects rather than distributed over the long list treated in the volumes of the tenth and eleventh censuses.
>
> Under the federal form of government, with its delegation of all residuary powers to the several states, the United States have no system of recording deaths, births and marriages. Hence there is no such basis as exists in nearly every other civilized state for a national system of registration, and the country depends upon the crude method of enumerators' returns for its information on vital statistics, except in the states and cities which have established a trustworthy registration system of their own. These are the New England states and a few others in their vicinity or influenced by their example. Enumerators' returns in this field are so incomplete that hardly two-thirds of the deaths which have occurred in any community during the preceding year are obtained by an enumerator visiting the families, no satisfactory basis for the computation of death-rates is afforded, and the returns have comparatively little scientific value. In the regions where census tables and interpretations are derived from registration records kept by the several states or cities they are often made more complete than those in the state or municipal documents. The census of agriculture is also liable to a wide margin of error, owing to defects in farm accounts and the inability of many farmers to state the amount or the value even of the leading crops. The census figures relate to the calendar year preceding 1st June 1900, and hurried and careless answers about the preceding year's crop are almost sure to have been given by many farmers in the midst of the summer's work.
>
> The difficulties facing the manufacturing census were of a different character. A large proportion of the industries of the country keep satisfactory accounts, and can answer the

questions with some correctness. But manufacturers are likely to suspect the objects of the census, and to fear that the information given will be open to the public or betrayed to competitors. Furthermore, the manufacturing schedule presupposes some uniformity in the method of accounting among different companies or lines of business, and this is often lacking. Another source of error in the manufacturing census of the United States is that the words of the census law are construed as requiring an enumeration of the various trades and handicrafts, such as carpentering. The deficiencies in such returns are gross and notorious, but the census office feels obliged to seek for them and to report what it finds, however incomplete or incorrect the results may be. Even on the population returns certain answers, such as the number of the divorced or the number unable to read and write, may be open to question.

The wide range of the American census, and the publication of uncertain figures, find a justification in the fact that the development of accurate census work requires a long educational process in the office, and, above all, in the community. Rough approximations must always precede accurate measurements; and these returns, while often inaccurate, are better than nothing, and probably improve with each decade.

Besides, the breadth of its scope, in which the American census stands unrivalled, the most important American contribution to census work has been the application of electricity to the tabulation of the results, as was first done in 1890. The main difficulties which this method reduced were two. The production of tables for so enormous a population as that of the United States through the method of tallying by hand requires a great number of clerks and a long period of time, and when complete cannot be verified except by a repetition of the process. The new method abbreviates the time, since an electric current can tally almost simultaneously the data, the tallying of which by hand would be separated by appreciable intervals. The method also renders comparatively easy the verification of the results of certain selected parts.

Judged by European standards the cost of the American census is very great. The following table gives the total and the per capita cost of each enumeration.

Date.	Cost.		Date.	Cost.	
	Total in dollars.	Per Capita in cents.		Total in dollars.	Per Capita in cents.
1790	44,377	1.12	1850	1,423,351	6.13
1800	66,109	1.24	1860	1,969,377	6.26
1810	178,445	2.46	1870	3,421,198	8.87
1820	208,526	2.16	1880	5,790,678	11.48
1830	378,545	2.94	1890	11,547,127	18.33
1840	833,371	4.88	1900	16,116,930	21.16

For the sake of comparison it may be stated that the per capita cost of the English census of 1901 was 2.24 cents, or little more than one-tenth that of the American census. This difference is due in part to the greater scope and complexity of the American census, and in part to the fact that in the United States the field work is done by well-paid enumerators, while in England it is done in most cases by the heads of families, who are not paid.

The course of events has clearly established the fact that the authority of the Federal government in this field is greater than the strict constructionists of a previous generation as represented by General Walker in the passage already quoted believed it to be. Decision after 669
decision of individual instances has made it a settled practice for the Federal government to co-operate with or to supplement the state governments in the gathering of statistics that may furnish a basis for state or Federal legislation. The law has allowed the Federal census office in its discretion to compile and publish the birth statistics of divisions in which they are accurately kept; one Federal report on the statistics of marriages and divorces throughout the country from 1867 to 1886 inclusive was published in 1889, and a second for the succeeding twenty-year period was published in 1908-1909; an annual volume gives the statistics of deaths for about half the population of the country, including all the states and cities which have approximately complete records of deaths; Federal agencies like the bureau of labour and the bureau of corporations have been created for the purpose of gathering certain social and industrial statistics, and the bureau of the census has been made a permanent statistical office.

The Federal census office has been engaged in the compilation and publication of statistics of many sorts. Among its important lines of work may be mentioned frequent reports during the cotton ginning season upon the amount of cotton ginned, supplemental census reports upon occupations, on employees and wages, and on further interpretation of various population tables, reports on street and electric railways, on mines and quarries, on electric light and power plants, on deaths in the registration area 1900-1904, on benevolent institutions, on the insane, on paupers in almshouses, on the social statistics of cities and on the census of manufactures in 1905. Congress has recently entrusted it with still further duties, and it has developed into the main statistical office of the Federal government, finding its nearest analogue probably in the Imperial Statistical Office in Berlin.

(W. F. W.)

CENTAUREA, in botany, a genus of the natural order Compositae, containing between four and five hundred species, and of wide distribution, but with its principal centre in the Mediterranean region. The plants are herbs with entire or cut often spiny-toothed leaves, and ovoid or globose involucres surrounding a number of tubular, oblique or two-lipped florets, the outer of which are usually larger and neuter, the inner bisexual. Four species are native in Britain. *C. nigra* is knapweed, common in meadows and pastureland; *C. Cyanus* is the bluebottle or cornflower, a well-known cornfield weed; *C. Calcitrapa* is star-thistle, a rare plant, found in dry waste places in the south of England, and characterized by the rose-purple flower-heads enveloped by involucral bracts which end in a long, stiff spine. Besides cornflower, a few other species are worth growing as garden plants; they are readily grown in ordinary soil:—*C. Cineraria*, a half-hardy perennial, native of Italy, is remarkable for its white downy foliage; *C. babylonica* (Levant) has large downy leaves and a tall spike of small yellow flowers; *C. dealbata* (Caucasus) is a low-growing plant with larger rose-coloured heads; *C. macrocephala* (Caucasus) has large yellow heads; *C. montana* (Pyrenees) large handsome blue heads; and *C. ragusina* (S.E. Europe) beautiful silver-haired leaves and yellow flowers.

CENTAURS, in Greek mythology, a race of beings part horse part man, dwelling in the mountains of Thessaly and Arcadia. The name has been derived (1) from κεντεῖν (goad) and ταῦρος (bull), implying a people who were primarily herdsmen, (2) from κεντεῖν and the common termination -αυρος or αὔρα (“air”) *i.e.* “spearmen.” The former is unsatisfactory partly from the philological standpoint, and the latter, though not certain, is preferable. The centaurs were the offspring of Ixion and Nephele (the rain-cloud), or of Kentauros (the son of these two) and some Magnesian mares or of Apollo and Hebe. They are best known for their fight with the Lapithae, caused by their attempt to carry off Deidameia on the day of her marriage to Peirithous, king of the Lapithae, himself the son of Ixion. Theseus, who happened to be present, assisted Peirithous, and the Centaurs were driven off (Plutarch, *Theseus*, 30; Ovid, *Metam.* xii. 210; Diod. Sic. iv. 69, 70). In later times they are often represented drawing the car of Dionysus, or bound and ridden by Eros, in allusion to their drunken and amorous habits. Their general character is that of wild, lawless and inhospitable beings, the slaves of their animal passions, with the exception of Pholus and Chiron. They are variously explained by a fancied resemblance to the shapes of clouds, or as spirits of the rushing mountain torrents or winds. As children of Apollo, they are taken to signify the rays of the sun. It is suggested as the origin of the legend, that the Greeks in early times, to whom riding was unfamiliar, regarded the horsemen of the northern hordes as one and the same with their horses; hence the idea of the Centaur as half-man, half-animal. Like the defeat of the Titans by Zeus, the contests with the Centaurs typified the struggle between civilization and barbarism.

In early art they were represented as human beings in front, with the body and hind legs of a horse attached to the back: later, they were men only as far as the waist. The battle with the Lapithae, and the adventure of Heracles with Pholus (Apollodorus, ii. 5; Diod. Sic. iv. II) are favourite subjects of Greek art (see Sidney Colvin, *Journal of Hellenic Studies*, i. 1881, and the exhaustive article in Roscher’s *Lexikon der Mythologie*). Fig. 34 in article Greek Art (the west pediment of the temple of Zeus at Olympia) represents the attempt of the Centaurs to carry off the bride of Peirithous.

CENTAURUS (“The Centaur”), in astronomy, a constellation of the southern hemisphere, mentioned by Eudoxus (4th century B.C.) and Aratus (3rd century B.C.), Ptolemy catalogued thirty-seven stars in it. *α-Centauri* is a splendid binary star. Its components are of the 1st magnitude, and revolve in a period of eighty-one years; and since its parallax is 0.75″, it is the nearest star to the earth; *ω-Centauri*, the finest globular star-cluster in the heavens, consists of about 6000 stars in a space of about 20′ diameter, of which about 125 variables have been examined. *Nova Centauri*, a “new” star, was discovered in 1895 by Mrs Fleming in photographs taken at Harvard.

CENTAURY (*Erythraea Centaurium*, natural order Gentianaceae), an annual herb with erect, smooth stem, usually branched above, and a terminal inflorescence with numerous small red or pink regular flowers with a funnel-shaped corolla. The plant occurs in dry pastures and on sandy coasts in Britain, and presents many varieties, differing in length of stem, degree of branching, width and shape of leaves, and laxity or closeness of the inflorescence. Several other species of the genus are grown as rock-plants.

CENTENARY (from Lat. *centenarius*, of or belonging to a hundred, from *centeni*, distributive of *centum*, hundred), a space of a hundred years, and particularly the celebration of an event on the lapse of a hundred years, a centennial anniversary. The word “centennial” (from Lat. *centennis*, from *centum*, and *annus*, a year), though usually an adjective as in “the Centennial State,” the name given to Colorado on its admission to statehood in 1876, is also used as a synonym of centenary.

CENTERVILLE, a city and the county-seat of Appanoose county, Iowa, U.S.A., in the south part of the state, about 90 m. N.W. of Keokuk. Pop. (1890) 3668; (1900) 5256; (1905, state census) 5967 (487 being foreign-born); (1910) 6936. Centerville is served by the Chicago, Burlington & Quincy, the Chicago, Rock Island & Pacific and the Iowa Central railways. Among the principal buildings are the county court-house and the Federal building, and the city has a public library and a hospital. It is in one of the most productive coal regions of the state; it ships coal, limestone and livestock, has large bottling works, and manufactures iron, brick and tile, machine-shop products, woollen goods, shirts, cigars and flour. The place was platted in 1846, was called Chaldea until 1849, when the present name was adopted, was incorporated as a town in 1855, and in 1870 was chartered as a city of the second class. The city limits were extended in 1906-1907.

CENTIPEDE, the characteristic member of the group Chilopoda, a class of the Arthropoda, formerly associated with the Diplopoda (Millipedes), the Pauropoda and the Symphyla, to constitute the now abandoned group Myriapoda. The resemblance between the Chilopoda and the Diplopoda is principally superficial and due to the elongation and vermiform shape of the body, which in both is composed of a number of similar or subsimilar somites not differentiated as are those of Insecta, existing Arachnida and most Crustacea, into series or “tagmata” of varying function. Until 1893 no one doubted the correctness of the assumption that the Chilopoda and Diplopoda were orders of a class Myriapoda of the same systematic status as the Arachnida or Hexapoda. But in that year, R.I. Pocock and J.S. Kingsley independently pointed out that they differ as much from each other as either differs from the Hexapoda; and should, therefore, rank as distinct classes of Arthropods. Pocock, indeed, definitely associated the Chilopoda with the Hexapoda in a group, the Opisthogoneata (Opisthogonea), equivalent to a group, the Progoneata (Prosogonea), comprising the Diplopoda, Pauropoda and Symphyla. As the basis for this classification was taken the position of the generative orifices which open in the Opisthogonea at the posterior end and in the Prosogonea near the anterior end of the body. As a matter of fact, in the Chilopoda they are situated on the penultimate or pretelsonic somite; in the Hexapoda upon the antepenultimate somite (male) or a little farther forward (female). Moreover, the recent researches of Heymons into the embryology of *Scolopendra*, one of the Chilopods, has shown a close correspondence in the number of cephalic metameres between the Chilopoda and Hexapoda, a correspondence which has not yet been established in the case of the Diplopoda or Symphyla. This last discovery bears out the view of relationship between the

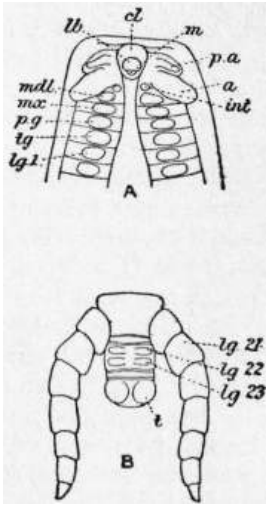
centipedes and insects, to the exclusion of the Diplopoda, Symphyla and Pauropoda. But even if in the future it can be shown that all these groups can be brought into line with respect to the metamerism of the head, the position of the generative orifices will remain as a fundamental and constant character, distinguishing the Chilopoda from the other groups of so-called "Myriapods" and the Hexapoda from the Symphyla, which in many particulars they resemble.

Structure of the Chilopoda.—The exoskeletal elements of a typical somite consist of a dorsal plate or tergum, a ventral plate or sternum, a lateral or pleural membrane, often strengthened with chitinous sclerites, and a pair of appendages. At the anterior extremity there is a head-shield or cephalite, which bears eyes, when present, and a pair of antennae. In all centipedes, except the *Scutigeridae*, the preantennal portion of the cephalite is sharply reflexed, ventrally forming an area called the clypeus. The inferior edge of this bears the labrum, which is usually represented by a small median, and two large lateral plates. The appendages are modified as a single pair of antennae, four pairs of jaws or gnathites, a variable number of walking legs and a single pair of generative limbs or gonopods. The antennae, articulated to the forepart of the head and preoral in position, are long and flexible and consist of fourteen or more segments. The jaws of the first pair of mandibles are stout and bi-segmented, with a dentate cutting edge. Those of the second pair or maxillae vary considerably in structure in different groups. They are foliaceous and are usually regarded as biramous. In some genera (*Scutigera*, *Lithobius*) the inner branch consists of two distinct segments meeting those of the opposite side in the middle line. The outer branch, which is always larger, consists of three or four segments. Generally, however, the basal segments of the two branches are coalesced with each other and with the corresponding segments of the opposite side to form a single broad transverse plate. The above described condition seen in *Scutigera* suggests that two pairs of jaws may be involved in the formation of the maxillae in the Chilopoda. The jaws of the third pair, the palpognaths or second pair of maxillae, resemble dwarfed walking legs, and consist of five or six segments, of which the basal or coxa is united mesially to its fellow. The jaws of the fourth pair, the toxicognaths or poison-jaws, are long and powerful, and consist like the legs primarily of six segments, whereof the basal is large and usually fused with its fellow to form a large coxal plate, the second is small and generally suppressed by fusion with the third, the fourth and fifth are also small, while the sixth is transformed into a great piercing fang, at the tip of which opens the duct of a poison gland lodged within the appendage.

The tergal elements of the somites bearing the antennae, mandibles and maxillae appear to be represented by the head-shield or cephalite. The tergal element of the somite bearing the palpognath is usually suppressed; that of the toxicognath is sometimes of large size as in some Geophilomorpha (*Himantarium*), sometimes small as in *Scutigera*, *Lithobius*, *Craterostigmus*, sometimes suppressed probably by fusion with the tergum of the first leg-bearing somite as in the Scolopendromorpha. The sternal plates of all the jaw-bearing somites have disappeared, except in the case of the somite of the toxicognath, where it may be vestigial. In the case of the somites bearing the walking legs the tergal and sternal elements are preserved without fusion with the corresponding plates of the preceding or succeeding somites, so that great flexibility of the body is retained. The only exception to this is presented by *Scutigera*, where the terga corresponding to the somites bearing the fifteen pairs of legs are reduced by fusion and suppression to seven. The walking legs are articulated to the inferior portion of the pleural or lateral area of the somites close to the external margins of the sterna, which widely separate those of the left from those of the right side. Generally speaking the legs resemble each other, although as a rule they progressively increase in length towards the posterior end of the body. They consist typically of six segments, of which the basal is termed the coxa and the apical the tarsus. The tarsus is armed with a single terminal claw, and, except in the Geophilomorpha and a few genera of other orders, is divided by a mesial transverse joint into two segments, as is the case in *Scolopendra* and *Lithobius* for example. But in some of the longer-legged, swift-footed centipedes of the order Lithobiomorpha (*e.g. Henicops*, *Cermalobius*) the tarsi are further subdivided. The multiplication of sub-segments reaches its maximum in *Scutigera*, where the tarsi are extremely long, slender, flexible and annulated. The legs of the last pair are directed backwards in a line parallel with the long axis of the body, so that their coxae, fused in some cases with the pleural sclerites (*Scolopendra*, *Geophilus*), or free and of large size (*Scutigera*, *Lithobius*), serve to protect the small genital and anal somites. They are often greatly modified. In the males of some species of *Lithobius* one or more of the segments is inflated or furnished with tubercle-bearing, tactile bristles; in some Geophilomorpha the whole limb is thickened in the male sex. In most Scolopendromorpha the basal segment is armed beneath with spines or spikes (*Dacetum*, *Scolopocryptops*); sometimes the whole appendage is thickened and terminated by a sharp and serrate claw (*Theatops*, *Plutonium*). In these cases the legs act as weapons of defence and offence. In other cases (*Newportia*) the tarsi lose the claw, become many-jointed and act as feelers, while in *Alipes* the terminal segments are flattened, leaf-like and furnished with a peculiar stridulating organ. The genital somite is always small and sometimes retractile within the somite bearing the last pair of legs. Its tergal plate is usually retained, but its sternal plate is generally suppressed. In females of the Lithobiomorpha and Scutigeromorpha the appendages of this somite—the gonopods—are jointed, forcipate and relatively well developed although small. In the females of the other orders they are greatly reduced or absent. In the males their development varies considerably. They are well developed

in *Scutigera*, where they form two pairs of digitiform sclerites, whereas in the Geophilomorpha they are reduced to a pair of very short, two-jointed limbs. The anal somite is always small and limbless. In *Craterostigmus* the genital and anal somites are represented by a pair of elongate valves projecting between the legs of the last pair. The structure of the gonopods is unknown, and the homology between the two valves and the skeletal elements of the somites in question not clearly understood.

A study of the development of *Scolopendra* has shown that the antennae of the adult are the appendages of the second postoral metamere and the mandibles those of the fourth, the first postoral metamere, which has a pair of transient preantennal appendages, and the third, which has no appendages, being excalated at an early stage of embryonic growth. Furthermore, behind the legs of the last pair two pairs of appendages are present. The second of these persists as the gonopods of the adult, but the first is suppressed. Possibly, however, it is represented in the male of *Scutigera* by the anterior branches of the gonopods. The cerebral or cephalic portion of the nervous system consists of a quadrilobate mass. From the two upper lobes, which are set transversely, arise the ocular nerves; from the two lower lobes, which are united by a transverse commissure, spring the antennal nerves in front and the chords which form the oesophageal collar behind. These chords unite below the oesophagus to form the compound suboesophageal ganglion, whence the nerves for the four pairs of jaws arise. The ventral system consists of a double chord uniting in each of the leg-bearing segments in a ganglionic swelling which gives off four pairs of nerves to the limbs and tissues of the somite. There is a single ganglion in the genital segment.



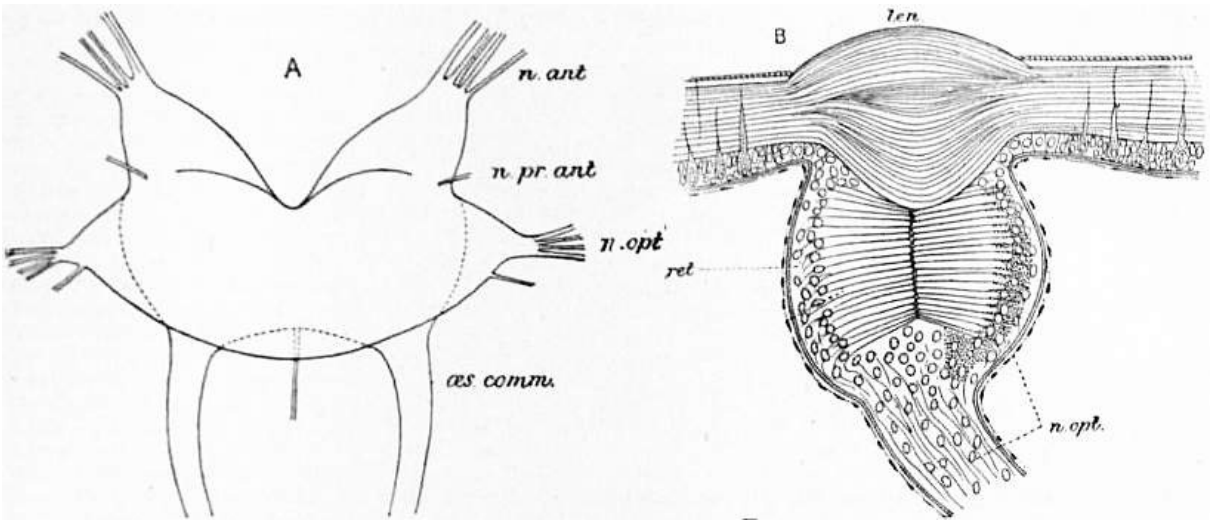
Modified from Heymons, *Bib. Zool.*, 1901, by permission of E. Nagele.

FIG. 1.

A, Diagram of anterior extremity of an early embryo of *Scolopendra*, ventral view; *cl*, clypeus; *lb*, labrum; *m*, mouth; *p.a*, preantennal appendage; *a*, antenna; *int*, premandibular rudiment; *mdl*, mandible; *mx*, maxilla; *p.g*, palpognath; *t.g*, toxicognath; *lg. 1*, first pair of walking legs.

B, Posterior end of a later embryo of *Scolopendra*, ventral view, showing the anal segment or telson (*t*); the legs of the last pair in the adult (*lg.* 21) and the two rudimentary pairs of legs (*lg.* 22, *lg.* 23).

Eyes are frequently absent. When present they may be either simple or compound, *i.e.* consisting externally of a single lens (monomeniscous) of or an aggregation of lenses (polymeniscous). Simple eyes vary in number on each side of the head from one, as in *Henicops*, to many as forty, as in some species of *Lithobius*. In *Scolopendra*, where there are four, the corneal lens is a biconvex thickening of the cuticle. The soft or retinal portion of the eye beneath the lens consists of an aggregation of large cells forming a single layer continuous with the epidermic cells of the circumocular area. Thus the eye is monostichous. The arrangement of the cells, however, is peculiar. They are invaginated to form what may be described as a very deep cup with exceedingly thick walls and correspondingly narrow median space, the outer surface of the cup being formed by the inner or proximal ends of the cells and the inner surface by their outer or distal ends. It results from this arrangement that the cells forming all but the bottom of the invagination lie horizontally, *i.e.* at right angles to the vertical axis of the eye. From the distal ends of the cells are secreted chitinous rhabdomeres, forming a rhabdom which occupies and fills up the central portion of the cup beneath the middle of the corneal lens. The outer ends of the cells are nucleated and are continuous with the fibres of the optic nerve, which passes from the outer surface of the bottom of the cup to the brain. Compound eyes are found only in the *Scutigeridae*. Externally the eye consists of one hundred or more little lenses or lenticles. The retinal portion is composed of a corresponding number of ocular units or ommatidia. Each ommatidium is an elongated cone with its broad extremity abutting against the corneal lenticle. It consists of a non-nucleated crystalline cone developed from embryonic cells, and is enveloped in three tiers of large nucleated cells. The cells of the outermost tier are heavily pigmented; those of the middle and innermost (proximal) tiers, the retinal cells, are at their inner extremities produced into threads continuous with the fibres of the optic nerve. In the space between these cells and the crystalline cone which they surround, there is a layer of rhabdomeres deposited apparently by the cells.



A and B after Heymons, *Bibl Zool*, 1901, by permission of E. Nagele.

A, Brain of *Scolopendra*. *n. ant*, Antennal nerves; *n. opt*, ocular nerves; *n. pr. ant*, preantennal nerves; *oes. comm*, oesophageal commissure.

B, Section of Eye of Scolopendra. *len*, Corneal lens; *ret*, retinal or visual cells; *n. opt*, optic nerve.

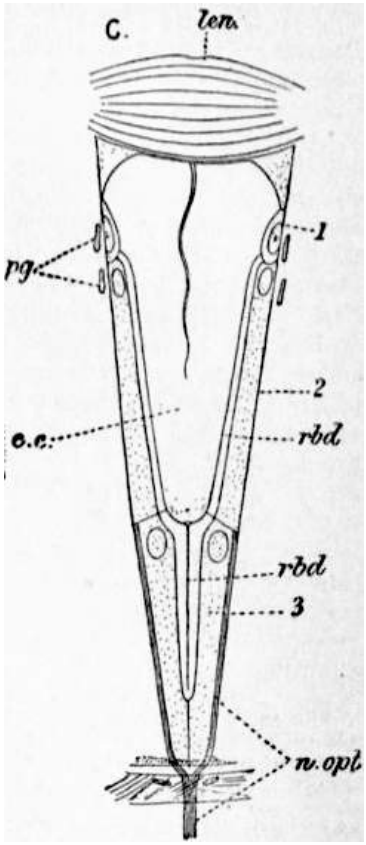


FIG. 2.

C after Adensamer, *Verh. z. b. Verein*, Vienna, 1893, pl. vii.

C, Ocular unit or ommatidium of compound Eye of *Scutigera*. *len*, corneal lenticle; *c.c*, crystalline cone; *1*, pigmented cells of outermost tier; *2*, *3*, retinular cells of middle and innermost tiers; *rbd*, rhabdomeres; *n. opt*, optic nerve; *pg*, pigment cells.

The alimentary canal is a simple tube running without convolutions from the mouth to the anus. Its anterior portion or pharynx, which arises from the stomodaeal invagination in the embryo, is short; a pair of large, so-called salivary glands open into it. The mesenteric part of the canal is relatively wide and receives at its junction with the hind-gut the excretory products of a pair of very long and slender malpighian tubes of proctodaeal origin. The posterior end of the canal, arising from the proctodaeum, is relatively short and narrow.

The generative organs vary in structural details in different centipedes. In the male of *Lithobius* the testes consist of a single coiled tube lying above the alimentary canal. The slender

vas deferens which proceeds from its hinder end divides posteriorly into a right and left branch, embracing the gut and uniting beneath it to form a common chamber or atrium within the genital orifice. The atrium receives the secretion of two pairs of large accessory glands; and a pair of tubes, or vesiculae seminales, open, one on each side, into the divided sperm ducts close to their point of origin above the intestine. The organs of the female are very similar. There is a large median ovary followed by a short oviduct forming a circum-intestinal collar and a common atrium. Into the latter open a pair of short receptacula seminis and the slender duct of two pairs of large accessory glands. There is nothing in the female corresponding to the supra-intestinal vesiculae seminales of the male. In the male of *Scolopendra*, on the contrary, there are as many as twelve pairs of somewhat sausage-shaped testes, approximated two by two. From each pair proceed two slender ducts which open into a median duct coiled in the posterior third of the body and much expanded in the last three of the leg-bearing segments. The right and left portions of the intestinal ring of the genital duct are unequally developed, and there are no vesiculae seminales, but two pairs of accessory glands communicate with the genital atrium as in *Lithobius*. In the female *Scolopendra* the right and left portions of the intestinal collar are also unequally developed, and only a single pair of accessory glands besides the receptacula seminis open into the atrium.

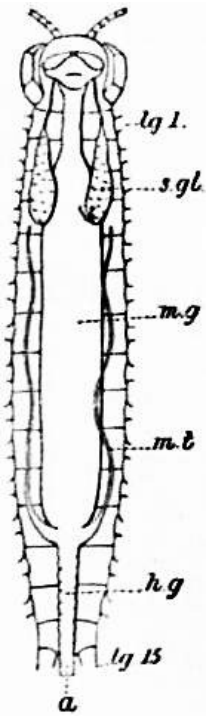
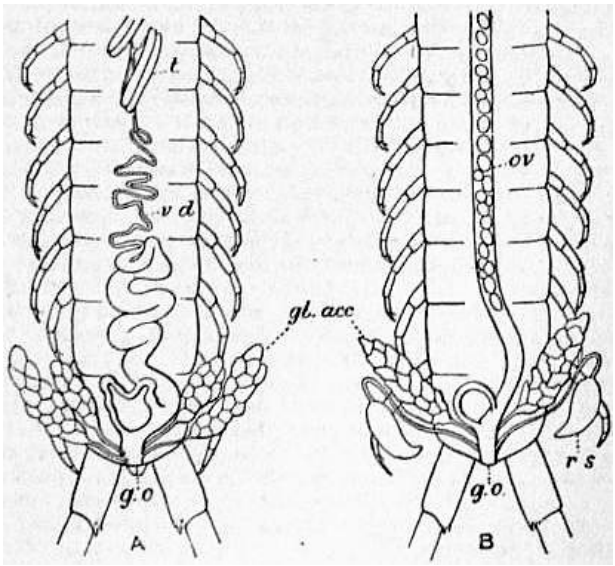


FIG. 3.—Diagram of Alimentary Canal of *Lithobius*.

a, Anus.
mg Mid-Gut.
hg, Hind-Gut.
mt, Malphighian tubule.
s.gl, Salivary gland.
lg. 1, *lg.* 15, Legs of first and fifteenth pairs.

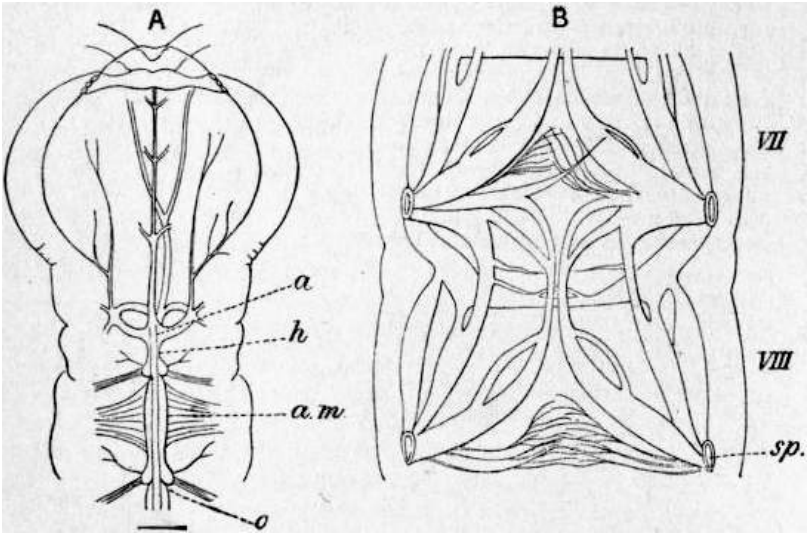


After Heymons, *Bibl. Zool*, 1901, by permission of E. Nagele.

FIG. 4.—Posterior portion of generative organs of male of *Scolopendra* (A), of female (B). *t*, Testes; *v.d*, vas deferens; *ov*, ovary; *r.s*, receptaculum seminis; *gl. acc*, accessory glands; *g.o*, generative orifice.

The heart is tubular and lies in the middle dorsal line immediately beneath the integument. It consists of a series of chambers corresponding roughly to the leg-bearing segments, and lies in a blood-sinus formed by a pericardial membrane whence large alary muscles extend to the sides of the body. Each chamber gives off in *Scolopendra* a pair of fine lateral vessels, and is furnished at its posterior extremity with a pair of orifices by which the blood re-enters the organ from the pericardial space. From the anterior chamber, which lies in the first or second leg-bearing segment, proceed three arteries, a median which runs forwards into the head to supply the brain and other organs, and a lateral which with its fellow of the opposite side forms an oesophageal aortic collar. From the sides of the latter arise vessels to the gnathites, and from its inferior portion an unpaired vessel passes forwards into the head and another backwards above the nerve chord to the posterior end of the body, supplying each segment in its course with a delicate lateral branch. In *Scolopendra* the chambers of the heart, excepting the first and last,

which are small, are subequal in size; but in forms like *Scutigera* where the terga are very unequal in size a corresponding inequality in the size of the chambers is manifested.



A after Newport, *Phil. Trans.*, 1843. B after Haase, *Zool. Beitrage*, i. pt. 65, 1884, by permission of J.N. Kern. C after Haase, *loc. cit.*

A, Anterior extremity of *Scolopendra*, showing two chambers of the heart (h), the aortic ring (a), the alae cordis (a.m) and a cardiac orifice (o).

B, Two segments of *Scolopendra*, showing the branching and anastomosing tracheae and a spiracle (sp).

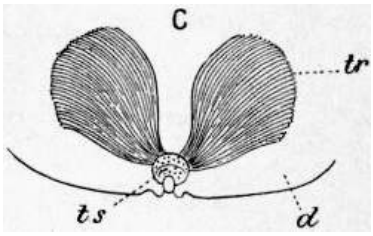


FIG 5.

C, A pair of tufted tracheae of *Scutigera*. d, Dorsal plate; t.s, tracheal sac; tr, tracheal tubes.

In all centipedes, except *Scutigera*, respiration is effected by chitinized tracheal tubes which extend with their ramifications throughout the body and open to the exterior by means of spiracles perforating the lateral or pleural membrane of more or fewer of the somites below the edge of the terga. Spiracles are never present upon the anal, genital and last leg-bearing somites, and only rarely, as in *Henicops*, upon the somite bearing the legs of the first pair. In the majority of cases the spiracles are circular, sigmoid or slit-like orifices, with chitinized rim, leading into a pocket-like integumental infolding, from which emanate numerous small tracheal tubes which soon anastomose to form the main tracheal trunks. In *Dacetum*, one of the *Scolopendridae*, there is no pocket-like infolding, the small tracheal tubes opening direct to the exterior on a large subcircular plate where their apertures fuse to form a complicated network. The apertures, as in the case of other genera, are protected by fine hairs; and the tracheae themselves are strengthened by a fine spiral filament. In the *Lithobiidae* the tracheae do not anastomose; but in *Scolopendra* and *Geophilus* the main trunks in each segment fuse transversely with those of the opposite side and also longitudinally with those of the preceding and succeeding segments.

In *Scutigera* the tracheae differ both in structure and position from those of all other Chilopoda. The spiracles, unpaired and seven in number, open in the median dorsal line. Each leads into a short sac from which five tracheal tubes depend into the pericardial blood-sinus.

Existing Chilopoda may be classified as follows, into five orders referable to two subclasses—

Subclass I. Pleurostigma.
- Order 1 Geophilomorpha.
- Order 2 Scolopendromorpha.
- Order 3 Craterostigmomorpha.
- Order 4 Lithobiomorpha.

Subclass II. Notostigma.
- Order 5 Scutigeromorpha.

Subclass 1, Pleurostigma.—Chilopods furnished with a rich system of branching tracheal tubes, the spiracles of which are paired and open upon the pleural area of more or fewer of the somites. Each leg-bearing somite contains a distinct tergum and sternum, the number of sterna never exceeding that of the terga. Eyes are either preserved or lost; when preserved they are represented either by a single one-lensed ocellus or by an aggregation of such ocelli on each side of the head. The anterior portion of the head, bearing the labrum, is bent sharply downwards and backwards beneath the larger posterior portion lying behind the antennae, so that these appendages, approximated in the middle line, project directly forwards from the margin of the head formed by this retroversion of the labral area. The maxillae are short and have no sensory organ; the palpognaths consist of four segments, and the toxicognaths have their basal segments fused to form a single coxal plate.

Order 1. Geophilomorpha.—Chilopods with a large and indefinite number of somites, most of which are partially or completely divided into a smaller anterior segment, represented by a pretergal and two presternal sclerites, and a larger posterior segment bearing the spiracles and legs. Spiracles are present upon all the leg-bearing somites except the first and last; and the legs which are short and subequal in length consist of six segments, the basal of which remains small. There are no eyes, and the antennae consist invariably of fourteen segments. The tergal plate of the somite bearing the toxicognaths always remains distinct and separates the head-shield from the tergum of the first leg-bearing somite. The penultimate and antepenultimate segments of the toxicognaths are reduced on the preaxial side of the appendage to the condition of arthrodial integumental folds and suppressed on the postaxial side where the distal segment or fang is firmly jointed to the femoral segment. In the last leg-bearing somite the pleural sclerites coalesce with the coxa of the appendage; but the second segment (trochanter) of this appendage does not fuse with the third (femur). The genital and anal somites are not retractile within the last leg-bearing somite, and the gonopods typically persist in the male as small two-jointed appendages and in the female as jointed or unjointed sclerites. The young are hatched with the full number of segments.

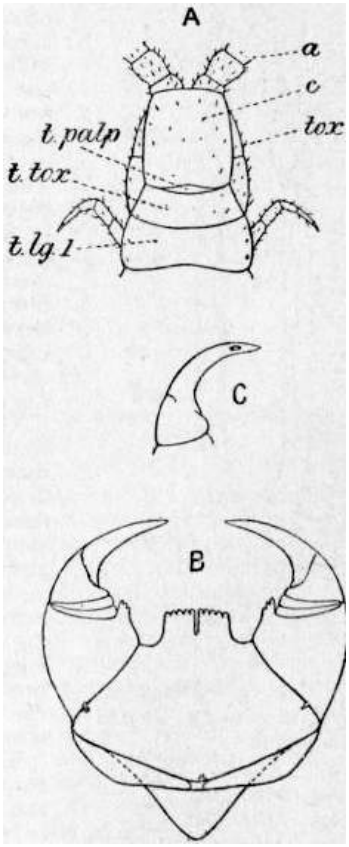


Fig. 6.

A, Upper view of anterior extremity in *Geophilus*.
a, Basal segments of antennae.
c, Cephalic plate.
t.palp, Tergal plate of somite, bearing palpognaths.
t.tox, Tergal plate of somite, bearing toxicognaths (*tox*).
t.lg.1, Tergal plate of somite, bearing legs of first pair.

B, Toxicognaths of *Scolopendra*, showing the large coxal plate and the reduced penultimate and antepenultimate segments.

C, Terminal segment or fang of the same, showing the orifice of the poison gland.

(After Latzel, *Die Myr. öst.-ung. Mon.* vol. i. "Chilopoda," Vienna, 1880.)

Remarks.—The Geophilomorpha are universally distributed in suitable localities. The number of families into which the order should be divided is as yet unsettled, some authors admitting several groups of this rank, others referring all the genera to a single family, *Geophilidae*. In habits the *Geophilidae* are mostly subterranean, living in the earth and feeding principally upon earthworms. Occasionally they may be found eating fruit or fungi, probably for the sake of moisture. Although without eyes, they are extremely sensitive to light, and when exposed to it crawl away in serpentine fashion to the nearest sheltered spot, feeling the way with their antennae. They can, however, progress with almost equal facility backwards, using the legs of the posterior pair as feelers. Differing from the majority of the family in habits are the two species *Linotaenia maritima* and *Schendyla submarina*, which live under stones or seaweed between tide-marks on the coasts of western Europe. Most, if not all, the species are provided with glands, which open upon the sterna and secrete a fluid which in some forms (*Himantarium*) is blood-red, while in others it is phosphorescent. In the tropical form *Orphnaeus phosphoreus* the fluid is known to possess this property; and its luminosity has been repeatedly observed in England in the autumn in the case of *Linotaenia acuminata* and *L. crassipes*.

The number of pairs of legs within this family varies from between thirty and forty to over one hundred and seventy. Corresponding discrepancies are observable in size, the smallest specimens being less than 1 in. long and barely 1 mm. wide, while the largest example recorded, a specimen of *Notiphilides* from Venezuela, was 11 in. long and ⅓ of an inch wide.

When pairing takes place the female fertilizes herself by taking up a spermatophore which a male has left upon a sheet of web for that purpose. The female lays a cluster of eggs in some sheltered spot, sometimes in a specially prepared nest, and encircling them with her body, keeps guard until the young disperse and shift for themselves.

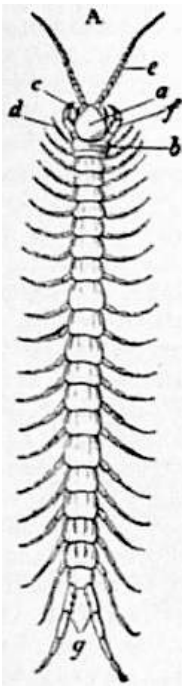


FIG. 7.—*Scolopendra morsitans* (after Buffon).

A, *a*, Cephalic plate.
b, Tergum of segment, bearing first pair of legs (*d*).
c, Tip of palpognath.
e, Antenna.
f, Toxicognath.
g, Last pair of appendages, enlarged and directed backwards.

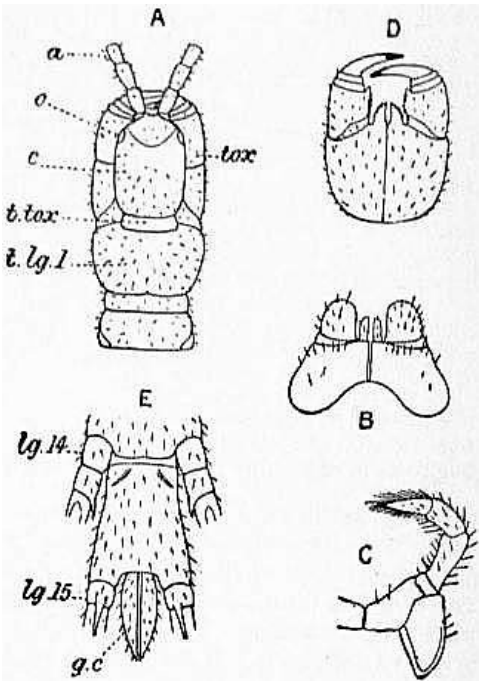
Order 2. Scolopendromorpha.—Chilopods differing principally from the Geophilomorpha in that the number of leg-bearing somites is definitely fixed at twenty-three or twenty-one. These are differentiated into larger and smaller, which alternate with nearly complete regularity. The anterior portion of each somite is only partially cut off as a subsegment. The tergal plate of the somite bearing the toxicognaths is suppressed, probably by fusion with the tergum of the first leg-bearing somite. The antennae consist of a number of segments varying from seventeen to about thirty, and usually differing in the individuals of a species. The second segment (trochanter) of the legs of the last pair is coalesced with the third (femur). In only one genus, namely *Plutonium*, which occurs in Italy, is there a pair of spiracles for each leg-bearing segment, except the first and last, as in the Geophilomorpha. In most genera there are only nine pairs of spiracles situated upon the 3rd, 5th, 8th, 10th, 12th, 14th, 16th, 18th and 20th leg-bearing segments, as in *Scolopendra*, *Cormocephalus*, *Cryptops*, &c. In genera with twenty-three pairs of legs, like *Scolopocryptops*, there is an additional pair of spiracles on the twenty-second pedigerous segment; and a few genera such as *Rhysida, Edentistoma*, possess a pair upon the 7th segment. Eyes, when present, are always four in number on each side. The newly hatched young has the full complement of appendages.

This order is divided into four families:—*Scolopendridae* (*Scolopendra*, *Rhysida*), *Cryptopidae* (*Cryptops*, *Theatops*), *Scolopocryptopidae* (*Scolopocryptops*, *Otocryptops*) and *Newportudae* (*Newportia*). Apart from the frigid zones it is cosmopolitan in distribution, though only one genus (*Cryptops*) extends into north temperate latitudes. In the tropics and warmer countries of the southern hemisphere the genera and species are particularly abundant, and individuals reach the greatest dimensions, some specimens of the tropical American species *Scolopendra gigantea* exceeding 12 in. in length. They are strictly carnivorous, their diet consisting of any animal, vertebrate or invertebrate, small enough to be overcome. They live in damp obscure places, under logs of wood or stones, and are nocturnal, shunning, like the *Geophilidae*, exposure to light; and as in the *Geophilidae*, the females guard their eggs and young until the latter disperse to lead an independent life.

Order 3. Craterostigmomorpha.—Chilopods with twenty-one tergal plates as in the typical genera of Scolopendromorpha, but with only fifteen pairs of legs as in the Lithobiomorpha. As in some members of the latter order there is a single ocellus on each side of the head, the penultimate and antepenultimate segments of the toxicognaths are complete on the postaxial side of the appendage, and spiracles are present upon the 3rd, 5th, 8th, 10th, 12th and 14th leg-bearing somites. In the size and shape of the head, of the toxicognaths, of the tergal plate of this somite, and of the first leg-bearing somite, great similarity to some genera of Geophilomorpha (*e.g. Mecistocephalus*) is presented; but in the structure of the posterior end of the body this order differs from all the other orders of Chilopoda. The skeletal elements of the last leg-bearing segment are welded together to form a subcylindrical tube, and the genital and anal somites are represented by a pair of chitinous valves capable of opening below for the escape of the genital and intestinal products.

This order, containing the family *Craterostigmidae*, is based upon a remarkable genus and species *Craterostigmus tasmanianus*, of which only two specimens are known. These were collected under stones upon the summit of Mount Rumney in Tasmania. They are about 1½ in. in

length; but nothing has been recorded of their habits. The chief morphological interest attaching to *Craterostigmus* is that, apart from certain structural peculiarities of its own, it presents features previously believed to be found exclusively either in the Scolopendromorpha, or the Geophilomorpha, or the Lithobiomorpha; and it shows how the Lithobiomorpha may be derived from a Scolopendromorphous type most nearly resembling *Plutonium* by the excalation of the third, sixth, ninth, eleventh, fourteenth and seventeenth leg-bearing somites.



After Pocock. *Q.J.M.S.* vol. 45, pl. 23, 1902.

FIG. 8.

A, Anterior end of *Craterostigmus* from above.
a, Basal segments of antennae.
c, Cephalic plate with eyes (*o*).
t.tox, Tergal plate of somite bearing toxicognaths (*tox*).
t.lg.1, Tergal plate of somite bearing legs of the first pair.
B, Maxillae.
C, Palpognath.
D, Toxicognath.
E, Last segment with genital capsule (*g.c*), and basal segments of legs of 14th and 15th pairs (*lg*. 14, *lg*. 15).

Order 4. Lithobiomorpha. Chilopoda with fifteen pairs of leg-bearing somites differentiated into larger and smaller, the 1st, 3rd, 5th, 7th, 8th, 10th, 12th and 14th being large, the others small. Spiracles present upon all the larger with the exception sometimes of the 1st. The toxicognaths are relatively weaker than in the orders hitherto considered, and have their basal segments less firmly fused mesially. In correlation with their weaker muscularity the first leg-bearing segment is relatively small. The gonopods, present and usually jointed in both sexes, are especially well developed and forcipate in the female, and arise from a large ventral plate resulting from the fusion of their coxae with the sternum of the genital somite. The antennae are many-jointed, and there is a single ocellus or a cluster of ocelli on each side of the head. The coxae of the legs are large, and those of the last four or five pairs usually contain glands opening by large orifices. The newly-hatched young has only seven pairs of legs, the remaining pairs being successively added as growth proceeds.

The genera of this order are divisible into three families, the *Lithobiidae* (*Lithobius, Bothropolys*), *Henicopidae* (*Henicops, Haasiella*), the *Cermatobiidae* (*Cermatobius*). *Cermatobius*, based upon a single species, *martensii*, from the isl. of Adenara, is of peculiar interest, since in the absence of coxal pores, and the length and multi-articulation of the antennae and tarsal segments, it approaches more nearly to *Scutigera* than does any other pleurostigmous Chilopod. It is also stated that the spiracles have assumed a more dorsal position, thus foreshadowing the completely dorsal situation they have taken up in the Notostigma. The *Henicopidae*, containing centipedes of small size, attains its maximum of development in the southern continents and islands, more particularly Australia, New Zealand, South Africa and South America. One genus (*Lamyctes*) however, occurs in Europe. The *Lithobiidae*, on the contrary, are almost exclusively northern in range, being particularly abundant and of large size individually in Europe, extra-tropical Asia, and North and Central America. In habits the *Lithobiidae* closely resemble the *Scolopendridae*. They are, however, comparatively far more agile with their shorter, more compact bodies and stronger legs. They are mostly of small size, the largest species, *Lithobius fusciatus*, of south Europe measuring only 2 in. in length of body. The females do not guard their eggs, but coat them with soil and leave them to their fate.

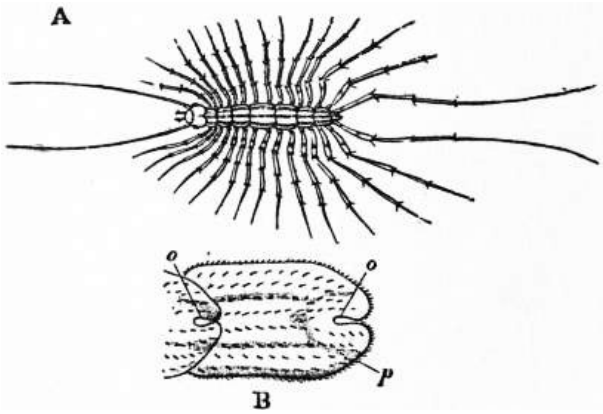
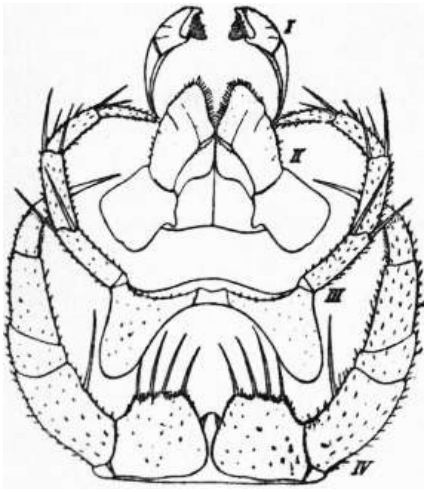


FIG. 9.—A, *Scutigera rubrolineata* (after Buffon). B, Tergum and part of a second of the same enlarged to show the position of the stigmata *o, o; p*, hinder margin of tergum.

SUBCLASS 2, NOTOSTIGMA.—Chilopods with a series of median dorsal tracheal sacs furnished with tubes dipping into the pericardial blood space, and opening each by an unpaired spiracle upon the 1st, 3rd, 5th, 8th, 10th, 12th and 14th leg-bearing somites. This characteristic is accompanied by the complete disappearance of the tergum of the 7th, either by fusion with that of the 8th or by excalation, and by the evanescence of the terga of the 2nd, 4th, 6th, 9th, 11th and 13th pedigerous somites. The preantennal area of the head is not strongly reflexed inferiorly, and the eyes are large and compound. The maxillae are long and have a sensory organ, the palpognaths are long, spiny and composed of five segments, like the primitive Chilopod leg, and the toxicognaths have their basal segments disunited and independently movable. Gonopods duplicated in the male.



After Latzel, *Die Myr öst-ung. Mon.* vol. i. "Chilopoda," Vienna, 1880.

FIG. 10.—Gnathites of *Scutigera*.
I. Mandibles.
II. Maxillae.
III. Palpognaths.
IV. Toxicognaths.

This subclass contains the single order Scutigeromorpha and the family *Scutigeridae*. As in the Lithobiomorpha there are fifteen pairs of legs, the gonopods are well developed in both sexes and the young is hatched with only seven pairs of legs. The legs and antennae in the adult are extremely long and many jointed. In habits as well as in structure the *Scutigeridae*, of which *Scutigera* is the best-known genus, differ greatly from other centipedes. Although they hide under stones and logs of wood like *Lithobius*, they are not lucifugous but diurnal, and may be seen chasing their foes in the blazing sun. They run with astonishing speed and have the power of dropping their legs when seized. South of about the 40th parallel of north latitude they are universally distributed in suitable localities. In most species the body only reaches a length of about 1 in.; but twice that size or more is reached by examples of the Indian species *Scutigera longicornis*.

Some fossils of Carboniferous age have been described as Chilopoda by Scudder, who refers them to two families, *Gerascutigeridae* and *Eoscolopendridae*. But until the specimens have been examined by zoologists the genera they are alleged to represent cannot be taken seriously into consideration. Remains of centipedes closely related to existing forms have been recorded from Oligocene beds.

(R. I. P.)

CENTLIVRE, SUSANNA (c. 1667-1723), English dramatic writer and actress, was born about 1667, probably in Ireland, whither her father, a Lincolnshire gentleman named Freeman, had been forced to flee at the Restoration on account of his political sympathies. When sixteen she married the nephew of Sir Stephen Fox, and on his death within a year she married an officer named Carroll, who was killed in a duel. Left in poverty, she began to support herself, writing for the stage, and some of her early plays are signed S. Carroll. In 1706 she married Joseph Centlivre, chief cook to Queen Anne, who survived her. Her first play was a tragedy, *The Perjured Husband* (1700), and she herself appeared for the first time at Bath in her comedy *Love at a Venture* (1706). Among her most successful comedies are—*The Gamester* (1705); *The Busy Body* (1709); *A Bold Stroke for a Wife* (1718); *The Basset-table* (1706); and *The Wonder! a*

Woman keeps a Secret (1714), in which, as the jealous husband, Garrick found one of his best parts. Her plots, verging on the farcical, were always ingenious and amusing, though coarse after the fashion of the time, and the dialogue fluent. She never seems to have acted in London, but she was a friend of Rowe, Farquhar and Steele. Mrs Centlivre died on the 1st of December 1723. Her dramatic works were published, with a biography, in 1761 (reprinted 1872).

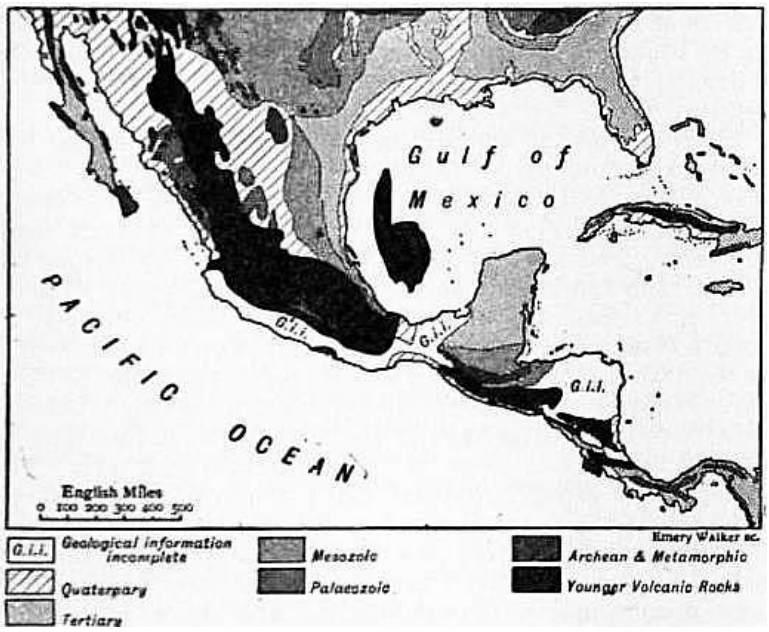
CENTO, a town of Emilia, Italy, in the province of Ferrara, 18 m. S.E. direct from the town of Ferrara; 50 ft. above sea-level; it is reached by road (6 m. to the W.) from the station of S. Pietro in Casale, 15 m. S.W. by W. of Ferrara, and also by a steam tramway (18 m. N.) from Bologna to Pieve di Cento, on the opposite bank of the Reno. Pop. (1901) 4307 (town), 19,078 (commune). It is connected by a navigable canal with Ferrara. It was the birthplace of the painter Giovanni Francesco Barbieri (Guercino). The communal picture-gallery and several churches contain works by him, but none of first-rate importance. A statue of him stands in front of the 16th century Palazzo Governativo. The town was surrounded by walls, the gates of which are preserved. The origin of the name is uncertain.

CENTO (Gr. κέντρων, Lat. *cento*, patchwork), a composition made up by collecting passages from various works. The Byzantine Greeks manufactured several out of the poems of Homer, among which may be mentioned the life of Christ by the famous empress Eudoxia, and a version of the Biblical history of Eden and the Fall. The Romans of the later empire and the monks of the middle ages were fond of constructing poems out of the verse of Virgil. Such were the *Cento Nuptialis* of Ausonius, the sketch of Biblical history which was compiled in the 4th century by Proba Falconia, wife of a Roman proconsul, and the hymns in honour of St Quirinus taken from Virgil and Horace by Metellus, a monk of Tegernsee, in the latter half of the 12th century. Specimens may be found in the work of Aldus Manutius (Venice, 1504; Frankfort, 1541, 1544). In 1535 Laelius Capitulus produced from Virgil an attack upon the dissolute lives of the monks; in 1536 there appeared at Venice a *Petrarca Spirituale*; and in 1634 Alexander Ross (a Scotsman, and one of the chaplains of Charles I.) published a *Virgilius Evangelizans, seu Historia Domini nostri Jesu Christi Virgilianis verbis et versibus descripta*.

CENTRAL AMERICA, that portion of the American continent which lies between Mexico and Colombia, comprising the British crown colony of British Honduras, and the six independent republics of Guatemala, Salvador, Honduras, Nicaragua, Costa Rica and Panama. These seven divisions are described in separate articles. Central America is bounded towards the N. by the Caribbean Sea, and towards the S. by the Pacific Ocean, and extends between 7° 12′ and 18° 3′ N. and between 77° 12′ and 92° 17′ W. It has an area of about 208,500 sq. m., and stretches for some 1300 m. from N.W. to S.E., in a succession of three serpentine curves, reaching its greatest breadth, 450 m., between the Peninsula of Nicoya and the north coast of Honduras, and diminishing to 35 m. in the Isthmus of Panama. The eastern boundary of Central America was usually regarded as identical with that of Costa Rica until 1903, when the republic of Panama was formed out of the northern territories of Colombia; and the more modern definition given above does not command the universal assent of geographers, because it fails to include the whole region up to the natural frontier on the north-west, *i.e.* the Isthmus of Tehuantepec in Mexico. It has, however, the support of political and historical considerations, as well as of common usage; and it may therefore be regarded as adequate, although, in respect of climate and natural products, it would be more accurate to define Central America as lying between Tehuantepec and Darien.

Physical Features.—The *Cordilleras*, or mountain chains of Central America do not form a complete link between the western ranges in the north and south of the continent, for their continuity is interrupted by various depressions, of which the chief is the lacustrine basin of Nicaragua. With these exceptions, they traverse Central America from end to end, their main

axis trending from north-west to south-east. They do not, as a rule, rise in sharply serrated ridges or series of volcanic crests, like the Andes, but the central Cordilleras are disposed in a succession of mountain masses, with many lesser chains radiating from them. The principal summits have an altitude of 12,000 and even, in a few cases, of 13,000 ft., and the general character of the ranges is volcanic, many craters being still active. Large tracts of land remained imperfectly surveyed at the beginning of the 20th century, owing to the unhealthiness of the tropical climate, and the dense underwoods which impede exploration. In the northern part of Guatemala, on the Pacific coast of the same country, in British Honduras, along the Segovia river, on the Mosquito Coast, and in the basin of Lake Nicaragua and the San Juan river, there are broad stretches of comparatively flat country. The main line of watershed is everywhere nearer to the Pacific than to the Atlantic, except in southern Costa Rica and Panama, where it is almost equidistant from the two oceans. In consequence, the rivers of the Pacific seaboard are mostly short and swift,—mere mountain torrents, in many instances, until they reach the sands and swamps which border the sea. The rivers of the Atlantic littoral descend more gradually, and by longer channels. The largest of them is the Segovia, in Nicaragua and Honduras, which has a course of 450 m. Lake Nicaragua, the largest inland sheet of water, has an area exceeding 3500 sq. m. There are also several mountain lakes of exceptional interest and beauty, such as Atitlán and Amatitlán, in Guatemala, besides two great land-locked salt-water lakes—the Pearl Lagoon of the Mosquito Coast, and the Carataska Lagoon in Honduras.



Geology.—The neck of land which unites the continents of North and South America is not, geologically, the direct continuation of either, but constitutes a third element which is wedged, as it were, between the other two. The folds in the earth's crust which form the Andes and the Western ranges of North America, are not continued along the connecting isthmus, where, on the contrary, the strata are folded from west to east, obliquely across the trend of the continent. It should, however, be noticed that the Andes, as they approach the Caribbean sea, bend round towards the east; and it is probable that the folds of the North American Cordillera similarly bend eastward beneath the volcanic rocks of Mexico. The folds of Central America are tangential to the two arcs thus formed.

By far the greater part of Central America and Mexico is covered by Cretaceous and Tertiary deposits, both sedimentary and volcanic; but the foundation on which they rest is exposed at intervals. From the Rio Grande to the southern declivity of the Mexican plateau the existence of ancient crystalline rocks at the surface is yet unproved, but they probably occur in the Sierra Madre del Pacifico. South of the plateau, in the state of Oaxaca, low mountain ridges composed of granites and gneisses, supposed to be of Archaean age, begin to appear. They strike from west to east, and mark the front of the series of east and west folds which stand *en échelon* across the Central American region. Between the 15th and 17th parallels of latitude, in the state of Chiapas and in the republic of Guatemala, there is a second group of ridges composed of granites and schists with an eastward trend. In this case the evidence of age is clear, for the rocks are covered by a limestone which is proved to be Pre-Carboniferous. Similar rocks, supposed to be of Archaean or at least of early Palaeozoic age, occupy considerable areas in British Honduras, Honduras and northern Nicaragua, and occur also in Costa Rica and perhaps in Panama; and wherever the strike has been observed, it is approximately from west to east. The presence of Palaeozoic rocks has been proved in Guatemala and the adjacent state of Chiapas, where limestones have been found containing many unmistakable Carboniferous fossils, and below these is a considerable thickness of beds supposed to be Silurian. Nowhere else in the Central American region is there any palaeontological evidence of Palaeozoic rocks.

The Mesozoic series begins with sands and red or yellow clays containing plant remains and possibly of Triassic age; but the occurrence of these deposits is limited to a few small isolated outcrops. Jurassic beds have been found in Mexico but not in Central America. The Cretaceous system, consisting of a lower series of clays, sandstones and conglomerates, followed conformably by an upper series of limestones, covers a considerable area in Chiapas, Guatemala and Honduras, and is found also in Costa Rica. The upper series contains hippurites. The greater part of the eastern half of the Mexican plateau is also formed of Cretaceous beds.

The Tertiary system may be conveniently divided into two divisions. The lower, of Eocene and Oligocene age, consists generally of sand and clays which were evidently laid down near a shore line. The upper division also, including the Pliocene and Pleistocene (which have not yet been clearly distinguished from each other), is usually of shallow water origin; but in the northern part of Yucatan it includes beds of chalky limestone, like those of the Antilles, which may have been deposited in a deeper sea.

It is probable that folding took place at more than one geological epoch, and the whole series of beds up to the Oligocene is involved in the folds. The Pliocene, on the other hand, is usually undisturbed, and the final effort must, therefore, have occurred during the Miocene period, which appears to have been a period of great earth movement throughout the Caribbean region. From the southern extremity of the Mexican plateau to the Colombian border, the strike of the folds—of the Mesozoic and early Tertiary deposits, as well as of the older rocks—is in general from east to west; but there is one considerable exception. On both sides of the deep depression which crosses Honduras from Puerto Cortez to the Gulf of Fonseca, the strike is commonly from north to south. The depression is probably a “Graben” or trough formed by faulting.

The great volcanoes of Mexico and Central America stand upon the Pacific side of the continent, and it is only where the land contracts to a narrow neck that their products spread over to the Caribbean shore. The extent of the volcanic deposits is very great, and over a wide area they entirely conceal the original structural features of the country. The eruptions began towards the close of the Cretaceous period and continue to the present day. The rocks are lavas and ashes, chiefly of andesitic or basaltic composition, but rhyolites and trachytes also occur, and phonolite has been met with in one or two places.

According to R.T. Hill, there is but little geological evidence of any Tertiary or later connexion between the Caribbean Sea and the Pacific, excepting, perhaps, a shallow opening during the Eocene period. It should, however, be stated that all authorities are not agreed upon this point, and K. Sapper found marls and sandstones which he believes to belong to the Upper Tertiary, lying horizontally at a height of about 7500 ft. in the Mexican state of Chiapas. Unfortunately the fossils obtained from these beds were lost.

Climate.—The climate of Central America is subject to the most marked local differences of heat and cold, owing partly to the proximity of two oceans, partly to the variations of altitude which render such territories as the swamps of the coast, or the lowlands of British Honduras and northern Guatemala, totally unlike the alpine regions of Salvador and Costa Rica. The whole area may, however, be roughly divided into a tropical zone (*tierra caliente*), from sea-level to about 1500 ft.; a temperate zone (*tierra templada*), from 1500 to 5000 ft.; and a cold zone (*tierra fria*), above 5000 ft. These figures are, of course, only approximately correct; and it often happens that, at the same elevation, the heat is greater on the Pacific than on the Atlantic versant. The rainy season on the Pacific slope varies in duration from four to six months, between April and December. It lengthens as the altitude increases. On the coast, it corresponds with the prevalence of the south-west monsoon, the tempestuous *Cordonazo de San Francisco*, or “Flagellation of St Francis,” as it is called in Mexico, and it is often interrupted by an interval of two or three weeks of fine weather, known as the *Veranillo de San Juan*, or “Little summer of St John.” In the rainy season, the morning has usually a clear sky; about two or three o’clock in the afternoon the clouds begin to gather in great cumulus masses; suddenly the lightning flashes out and the rain crashes down; and by evening the sky is clear and starry. North winds are most usual during the dry season. On the Atlantic coast the trade-winds may bring rain in any month, and, owing to the moist atmosphere, the heat is more oppressive. The rainfall may vary in successive years from less than 50 in. to nearly 200 in., owing to the occurrence of cloud-bursts. Frosts are not rare above 7000 ft., but snow seldom falls.

Fauna.—The fauna of Central America is more closely connected with the fauna of South than with that of North America. As the region is comparatively small, and its limits conventional, there are comparatively few species that it can claim as peculiarly its own. It is almost entirely free from the presence of animals dangerous to man. Of felines it possesses the jaguar (*Felis onza*), popularly called the tiger; the cuguar (*Felis concolor*), popularly called the lion; the tigrillo (*Felis tigrina*), which is sometimes kept tame; and other species. Several species of monkeys (*Mycetes* and *Ateles*) are numerous in the warm coast region. The Mexican deer (*Cervus mexicanus*) has a wide range both in the lowlands and highlands. Besides the tapir there are several varieties of wild pig, such as the marrano de monte (*Sus torquatus*) and the jabali or javali (*Sus labiatus javali*). The *Edentata* are represented by a species of armadillo, the honey-bear (*Myrmecophaga tomandua*), and the *Myrmecophaga didactyla;* and among the rodents may be mentioned, besides rats, hares and rabbits, the fruit-eating cotorra and tepes-cuinte

(*Dasyprocta aguti* and *Coelogenys paca*), and the troublesome *Geomys mexicana.* The manatee is common in all the larger streams. Much annoyance is caused to the agriculturist by the little marsupial called the tacuacine, or the *Didelphys carcinora,* its allied species. The bats are so numerous that villages have sometimes had to be left to their undisputed occupancy. In the south-east of Costa Rica the inhabitants are at times compelled to withdraw, with all their live-stock, before the swarms of large migratory vampires which in a single night can bleed the strongest animal to death. Most of the domestic animals—the horse, ox, goat, sheep, pig, dog, rabbit, common fowl, peacock and pigeon—are of European origin, and are popularly grouped together as *animales de Castilla.* For the bird collector there is a rich harvest. The catalogue of the National Museum at Washington shows that Costa Rica alone possesses more than twice as many species of birds as the whole of Europe. Among birds of prey it is sufficient to mention *Corogyps atratus,* the commonest of the vultures, which acts as a universal scavenger, the *Cathartes aura,* the beautiful *Polyborus vulgaris,* and the king of the vultures (*Sarcorhamphus papa*). Neither the condor of the southern continent nor the great eagles of the northern are known. The parrot, macaw and toucan are found in all parts; the crow, blackbird, Mexican jay, ricebird, swallow, rainbird, wood-pecker, humming-bird and trogon are also widely distributed. A bird of the last-named genus, the quetzal, quijal or quesal (*Trogon resplendens*) is of special note, not only from the fact that its yellow tail-feathers. 2 or 3 ft. long, were formerly worn as insignia by the Indian princes, but because it has been adopted as the emblematical figure on the national arms of Guatemala. The gallinaceous order is well represented, and comprises several peculiar species, as the pavo de cacho, and the Peten turkey (*Meleagris ocellata*), which has a bronze sheen on its plumage; and aquatic birds, it is almost needless to add, are unusually numerous in a region so richly furnished with lagoons, rivers and lakes.

Besides the alligator, which swarms in many rivers, the almost endless varieties of Central American reptiles include the harmless boba or chicken-snake, python and black snake; the venomous corali, taboba, culebra de sangre and rattlesnake; iguanas of great size, scorpions, edible lizards and other lizards said to be poisonous. In the rivers and lakes, as in both seas, fish of many kinds abound; turtles and tortoises are exported; and there are valuable pearl and oyster fisheries. Insect life is even richer and more varied. Of the *Coleoptera*, the Camelicorns, the Longicorns, the Curculionids, and the Chrysomelines are said to be best represented, and of the *Lepidoptera* the prevalent genera are—*Ageronia, Papilio, Heliconia, Sphinx* and *Bombyx*. There are five species of bees, and the European honey-bee, known as *aveja de Castilla* or “bee of Castile,” has been naturalized. Ants are common, and may sometimes be seen marching in a column 3 or 4 m. long. The mosquito, wood-tick, flea and locust are unfortunately no less plentiful in certain districts, but their distribution varies greatly, the mosquito being almost unknown in parts of Honduras. A curious species of butterfly is the *Timetes Chiron,* which migrates in countless multitudes from the forests of Honduras to the Mosquito Coast, but is never known to return.

Flora.—The flora of Central America ranges from the alpine to the tropical, with the transition from one climatic zone to another. Although its forest growths are, on the whole, inferior in size to those of corresponding latitudes in the eastern hemisphere, it is unsurpassed for beauty, luxuriance and variety. In the volcanic districts, the soil is extremely fertile, yielding, where cultivated and irrigated, magnificent crops of sugar, cotton, rice, tobacco, coffee, cocoa and maize. Indigo is produced in small quantities; sugar yields two or three crops, and maize as many as four, this cereal supplying a chief staple of food. Plantains, bananas, beans, tomatoes, yams, arrowroot, pine-apples, guavas, citrons and many other tropical fruits are also cultivated, while the extensive primeval forests abound in mahogany, cedars, rosewood, ironwood, rubber, gum copal, vanilla, sarsaparilla, logwood and many other dye-woods, medicinal plants, and valuable timbers. Conspicuous amongst the forest trees are the giant ceiba, or pyramidal bombax, and the splendid Coyal palm (*Cocos butyracea,* L.), with feathery leaves 15 to 20 ft. long, golden flowers 3 ft. high, and a sap which when fermented produces the intoxicating *chicha* or *vino de Coyol.* In Guatemala occurs the remarkable *Herrania purpurea,* a “Chocolate tree,” whose seeds yield a finer flavoured chocolate than the cocoa itself. The same country is famous for its magnificent orchids, huge arborescent thistles, and a remarkable plant called by the Spaniards *Flor de la Calentura*, “fever flower,” from the heat which it is said to emit at the moment of fertilization. Salvador produces an abundance of medicinal plants, notably the so-called Peruvian balsam (*Myrospermum salvatorense*); in Honduras there are immense forests of conifers, resembling those of the Landes in France; in Nicaragua a characteristic tree is the cortes (*Tecoma sideroxylori*) yielding timber as hard as ebony, and noteworthy for the golden blossom with which it is entirely covered after the leaves have fallen.

Inhabitants—In 1905 the population of Central America numbered about 4,750,000, and this total tends to increase, despite the unhealthy climate of many districts, the terribly high average of infant mortality, and the slow progress of immigration. Some authorities estimate it at 5,500,000. The vast majority of the inhabitants are of mixed Indian and Spanish blood, but the Indian element predominates everywhere except in Costa Rica, where the whites are exceptionally numerous. The Indian races have not shown the same power to adapt themselves to modern civilization as the Mexicans; in some regions there are tribes remaining in a state of complete savagery although before the Spanish conquest their ancestors attained a high level of

culture (see below under *Archaeology*). The density of population throughout Central America is little more than 25 per sq. m.; and it is clear that several large areas now thinly peopled once maintained a far greater number of inhabitants. Such are parts of the Nicaraguan lake district, where the flora consists in great measure of plants that were formerly cultivated by the Indians. The depopulation of these areas was effected partly by tribal wars, partly by the harsh rule of the Spaniards. Apart from the German agricultural settlements in Guatemala and elsewhere, the foreign population is chiefly confined to the seaports and other centres of commerce, Great Britain, Germany and the United States being largely represented among the wealthier classes of residents; while the foreign labourers are mostly Italians or negroes, with a few Chinese on the Pacific coast.

History.—Central America was discovered by Columbus in August 1502; and part of the territory which is now Costa Rica was conquered by the Spaniards under Pedro Arias de Avila after 1513. Between 1522 and 1525, the authority of Avila was superseded, and his work of conquest completed by Hernando Cortes, who had already subjugated Mexico. Panama formed part of a distinct Spanish government, "New Granada"; British Honduras was colonized, though not formally annexed, in the 18th century; and over the Mosquito Coast the British government exercised a nominal protectorate after 1665. Otherwise the rest of Central America remained a Spanish dependency bearing the general name of "Guatemala," until 1821. It ranked as a captaincy-general under the rule of a military governor, and was organized in five departments, corresponding in area with the modern republics of Guatemala, Honduras, Salvador, Nicaragua and Costa Rica. For three centuries it was administered by Spanish officials, who almost invariably devoted their whole energy to enriching themselves and the home authorities. The old Indian civilization was swept away; the native races were enslaved, maltreated and, for a time, demoralized. But their history offers no parallel to that of the West Indian Caribs, who failed to survive, and were replaced by hordes of African slaves. In Central America the Indians not only survived, thus leaving no room for any large negro population, but quickly acquired the language, religion and habits of their masters, with whom they intermarried. By the close of the 18th century, the majority had attained something like uniformity of life and thought. Racial distinctions had been obscured by intermarriage; even the term *Ladino*, or "Latin," came to mean an educated man, whether of Spanish or Indian blood. Nowhere, except in Mexico, has a mixed or coloured race more completely absorbed the civilization of its white rulers; but so gradual and silent was the process that it passed almost unnoticed. Its result, the successful revolt of the Spanish colonies—colonies mainly peopled by Indians or half-castes—was no more a conflict of rival races or civilizations than the rebellion of the British colonies in North America.

"New Granada" attained its independence in 1819; and in 1821 "Guatemala" declared itself free. That the subsequent history of the Central American republics has been largely a record of civil war, maladministration and financial dishonesty, is perhaps due in part to racial inferiority. In part, however, it may be explained by the absence of any tradition of good government; perhaps also by the brevity and artificiality of the evolution which converted a debased slave-population into the citizens of modern democratic states. The five divisions of "Guatemala" were temporarily incorporated in the Mexican empire during 1822, but regained their autonomy (as Guatemala, Honduras, Salvador, Nicaragua and Costa Rica) on the declaration of a Mexican republic, and in July 1823 combined to form the Republic of the United States of Central America. The Liberal or Federalist party, which was supreme in Honduras, found itself opposed by the Conservatives, including the clergy and former Spanish officials, who were very influential in Guatemala. A bitter and protracted struggle ensued. In 1837-1839 a Conservative rising, under Rafael Carrera, president of Guatemala, resulted in the overthrow of the Liberals, under General Francisco Morazan of Honduras; and in 1842, after a vain attempt to restore the Federal republic, Morazan was captured and shot. A fresh union of the republics (except Costa Rica) was concluded in 1842, and dissolved in 1845. The year 1850 was signalized by the conclusion, on the 19th of April, of the Clayton-Bulwer treaty (*q.v.*) between Great Britain and the United States, which was designed to facilitate the construction of an interoceanic canal. The history of this project is given in detail under Panama Canal. One important result of the treaty was the abandonment, in 1860, of the British protectorate over the Mosquito Coast. This event had been preceded by a decade of political disturbances. In 1850 Honduras, Salvador and Nicaragua had combined to restore federal unity; but their allied armies were defeated by the Guatemalans under Carrera. In 1856 the American adventurer, William Walker, endeavoured to usurp the government of Nicaragua; in 1860 he invaded Honduras and was captured and shot. His object was to assist the slave-holders of the United States by adding new slave-states to the Union. A further attempt to restore federal unity failed in 1885, and its promoter, Justo Rufino Barrios, president of Guatemala, lost his life. In 1895 the Greater Republic of Central America was formed by the union of Nicaragua, Salvador and Honduras; and a constitution was framed providing for the admission of Guatemala and Costa Rica; in December 1898 it was dissolved, as unsatisfactory to Salvador. On the 4th of November 1903 Panama, which had since 1863 formed part of Colombia, declared itself an autonomous republic. Its independence was immediately

recognized by the United States, and shortly afterwards by the European powers. The United States also forbade the landing of any Colombian force on the territories of Panama, and thus guaranteed the security of the new state.

BIBLIOGRAPHY.—For a general description of Central America, and especially of its physical features, the following monographs by K. Sapper are of prime importance:—*In den Vulcangebieten Mittelamerikas und Westindiens* (Stuttgart, 1905); *Mittelamerikanische Reisen und Studien aus den Jahren 1888 bis 1900* (Brunswick, 1902), and *Das nordliche Mittelamerika nebst einem Ausflug nach dem Hochland von Anahuac* (Brunswick, 1897); these all contain many useful illustrations and maps. See also *Central America and the West Indies*, by A.H. Keane, edited by Sir C. Markham (London, 1901, 2 vols., with maps and illustrations); *Central and South America*, by H.W. Bates (London, 1882); *The Spanish American Republics*, by T. Child (London, 1892); and *Expedition nach Zentral und Sudamerika*, by P. Preuss (Berlin, 1901). For geology, see "The Geological History of the Isthmus of Panama and Portions of Costa Rica," by R.T. Hill, in *Bull. Mus. Comp. Zool. Harvard*, vol. xxviii., No. 5 (1898); and the following by K. Sapper:— "Grundzüge der physikalischen Geographic von Guatemala," in *Petermann's Mitt.* Ergänzungsheft, No. 113 (1894), "Über Gebirgsbau und Boden des nördlichen Mittelamerika," ibid., No. 127 (1899), and "Über Gebirgsbau und Boden des südlichen Mittelamerika," *ibid.*, No. 151 (1905). *The States of Central America*, by E.G. Squier (New York, 1858), is still valuable, as are others of the numerous essays, pamphlets, &c., on Central American affairs left by this author; see the bibliography of his writings published in New York in 1876. The *Bulletins of the Bureau of American Republics* (Washington, from 1893) give ample information on commerce and industry. See also *History of Central America*, by H. Bancroft (San Francisco, 1881-1887. 3 vols.).

ARCHAEOLOGY OF CENTRAL AMERICA

Discoveries and investigations carried on during the 19th century have thrown much light on the splendid past of Central America. The still extant ruins of great buildings, unlike anything which is known in the old world, testify to the high culture attained in pre-Columbian days by several native peoples differing greatly from one another in speech and racial affinities. As a science the archaeology of Central America has scarcely yet emerged from its infancy. Entire branches are still wholly uninvestigated. Amongst the numerous problems which await solution must still be reckoned the decipherment of the inscriptions, which hitherto has not progressed beyond the discovery of calendar systems and the relative datings involved in such systems.

For a complete survey of this ancient civilization, so far as it has been investigated, it is necessary to include with Central America, properly so called, a considerable portion of the Mexican territories south and east of the isthmus of Tehuantepec. The peoples inhabiting Yucatan, Campeche, Guatemala, Chiapas and Oaxaca present at the first view striking ethnical differences. On a linguistic basis, however, they may be united into several large groups. Thus, Yucatan and the greater part of Guatamala are inhabited by the Mayas, with whom may be included the still savage Lacantun or Lacandones. Related to these linguistically are the Tzendals in Chiapas and the Quiches and Cackchiquels in Guatemala, as well as the less important tribes of the Mam, Pokoman, Pokonchi, Tzotzil, Tzutuhil and Ixil. Between these there are patches of country in which dialects of the Mexican are spoken. In Oaxaca there is an extraordinary mixture of languages, some of which, like that of the Huave of Tehuantepec, are of quite unknown affinities; the bulk of the population, however, is composed of Mixtecs and Zapotecs with which the Mixe and Zoque on the east are connected. Mexican dialects also occur in isolated parts of Oaxaca.

Mayan Culture.—The civilization of the Mayas may well have been reared upon one more ancient, but the life of that culture of which the ruins are now visible certainly lasted no more than 500 years. The date of its extinction is unknown, but in certain places, notably Mayapan and Chichenitza, the highest development seems to be synchronous with the appearance of foreign, viz. Mexican or Nahua elements (see below). This quite distinctive local character suggests that the cities in question played a certain preponderating role, a hypothesis with which the scanty documentary evidence is in agreement. On the other hand the Mayan culture evinces an evident tendency to assimilate heterogeneous elements, obliterating racial distinctions and imposing its own dominant character over a wide area. Oaxaca, the country of the Mixtecs and Zapotecs, became, as was natural from its geographical position midway between Yucatan and Mexico, the meeting-ground where two archaeological traditions which are sharply contrasted in their original homes united.

Architecture

Central American architecture is characterized by a fine feeling for construction, and the execution is at once bold and aesthetically effective. Amongst the various ruins, some of which represent the remains of entire cities, while others are no more than groups of buildings or single buildings, certain types persistently recur. The commonest of such types are pyramids and galleries. The pyramids are occasionally built of

brick, but most usually of hewn stone with a covering of finely-carved slabs. Staircases lead up to the top from one or more sides. Some pyramids are built in steps. Usually the platform on the top of a pyramid is occupied by buildings, the typical distribution of which is into two parts, viz. vestibule and sanctuary. In connexion with the pyramid there are various subsidiary structures, such as altars, pillars, and sacrificial stones, to meet the requirements of ritual and worship, besides habitations for officials and “tennis-courts” for the famous ball-game like that played by the Mexicans. The tennis-courts always run north and south, and all the buildings, almost without exception, have a definite orientation to particular points of the compass. Frequently the pyramids constitute one of the four sides of a quadrangular enclosure, within which are contained other pyramids, altars or other buildings of various dimensions.

The normal type of gallery is an oblong building, of which the front facing inwards to the enclosure is pierced by doors. These divide it into a series of rooms, behind which again there may be a second series. Occasionally the rooms are distributed round a central apartment, but this is ordinarily done only when a second storey has to be placed above them. The gallery-buildings may rise to as much as three storeys, the height, size and shape of the rooms being determined by the exigencies of vaulting. The principle of the true arch is unknown, so that the vaults are often of the corbelled kind, the slabs of the side-walls being made to overlap in succession until there remains only so narrow a space as may be spanned by a single flat stone. At Mitla, where the material used in the construction of the buildings was timber instead of stone, the larger rooms were furnished with stone pillars on which the beams could rest. The same principle recurs in certain ruins at Chichenitza. The tops and sides of the doors are often decorated with carved reliefs and hieroglyphs, and the entrances are sometimes supported by plain or carved columns and pilasters, of which style the serpent columns of Chichenitza afford the most striking example. On its external front one of these galleries may have a cornice and half-pillars. Above this is a plain surface of wall, then a rich frieze which generally exhibits the most elaborate ornamentation in the whole building. The subjects are geometrical designs in mosaic, serpents’ heads and human masks. The corners of the wall terminate in three-quarter pillars, above which the angles of the frieze frequently show grotesque heads with noses exaggerated into trunks. The roof of the gallery is flat and occasionally gabled.

Principal Sites.—Such are the general characteristics of Central American buildings, but it must be understood that almost every site exhibits peculiarities of its own, and the number of the ruined settlements even as at present known is very large. The most considerable are enumerated below.

Yucatan.—Of the very numerous ruins which are distributed over Yucatan and the islands of the east coast the majority still await exploration. A few words of special notice may be devoted to one or two sites in the centre of the peninsula which have already become famous. At Uxmal the buildings consist of five considerable groups, viz.—the Casa del Adivino, which is a step-pyramid 240 ft. long by 160 ft. wide and 80 ft. high, crowned by a temple 75 ft. long by 12 ft. wide; the Casa de Monjas, a striking erection of four oblong buildings on an extensive terrace; the Casa de Tortugas, Casa del Gobernador, and Casa de Palomas, the last of which is a group of six galleries surrounding a court. At Izamal there is a very imposing group of ruins, as yet quite insufficiently explored. At Chichenitza, a city of first-rate importance, situated 22 m. west of Valladolid, the ruins consist of eight principal groups, the chief of which are as follows. The Casa de Monjas, a three-storeyed building, attributable to several distinct periods; the Caracol, a round structure with dome in imitation of a snail-shell, showing evident traces of Mexican influence; El Castillo, a large temple standing on a base 200 ft. long and 75 ft. high, approached by staircases on all four sides, and furnished with serpent-pillars of a kind unknown anywhere else except at Uxmal and Tula near Mexico; an unnamed temple-pyramid, which is remarkable for a group of caryatid figures; a tennis-court; and finally the Tiger Temple, which contains marvellous coloured reliefs representing figures of warriors and place-hieroglyphs, all executed in a distinctively Mexican style. Yet another evidence of Mexican influence at Chichenitza is to be noted in five figures of the so-called Chac-mol type, that is to say, horizontal figures in which the arms are extended to the navel which is indicated by a cup-like depression. This Chac-mol type is characteristic of such sites as Tlascala and Cempoallan.

Other important sites in Yucatan are Chacmaltun, with fine wall-paintings; Tantah, with remarkable pillared facades; the ruins of Labna, Chunhuhub, and the caves of Loltun; and Xlabpak de Santa Rosa, where there is a three-storeyed temple palace. Two sculptured reliefs are of great interest; they represent a person holding a staff on which is a figure of the god Ah-bolon-tzacab.

Guatemala.—The Guatemalan ruins are distributed over a wide area. The most numerous and extensive are on the Usumacinta river. The most important sites in that district are Piedras Negras, and Yaxchilan or Menche Tinamit, where there are temples covered with sculptured reliefs and hieroglyphic inscriptions, and stelae and slabs carved with human figures placed in niches. In the Peten district, Tikal is famous for its splendid sculptures representing Kukulkan

and other divinities. Near the modern city of Guatemala are the vast ruins of Guatemala-Mixco. Chacujál, which Cortes visited on his expedition of 1524-1525 is very possibly to be identified with the modern Pueblo Viejo on the river Tinaja. Chaculá and Quen-Santo between the headwaters of the Rio de Chiapas and the Rio Lacantun are two sites of a strongly marked local character. Series of three pyramids are peculiar to these two settlements, as also are pyramids with human figures on their platforms. Stelae discovered at Quen Santo have a calendar character, which proves that Mayan science had penetrated into what was probably the home of an old Lacantun culture.

Santa Lucia Cozumalhuapa, on the Pacific slope of the Cordilleras, is a very peculiar site. The ruins are those of a settlement which had already been deserted before Alvarado's expedition of 1522. The sculptures of gods, goddesses and other figures, executed on enormous blocks of stone, show a distinctively Mexican character, with which, however, various Mayan features are blended. They may perhaps be attributed to some offshoot of the Nahua stock, probably the Pipil Indians, which developed on lines of its own in this remote corner.

Near the frontier of Honduras are the remarkable ruins of Quirigua, which rival Copan in importance and have suffered less from the ravages of the climate. The ruins of temples and palaces contain gigantic stone stelae of very fine workmanship, on which are sculptured human and animal figures representing hieroglyphs of the calendar dates.

Honduras.—Copan, one of the most important seats of Mayan civilization, lies close to the borders of Guatemala. The ruins comprise great buildings, temples, pyramids, &c. and contain sculptures of the highest interest. Especially noteworthy are altars in the form of a turtle and stelae covered with hieroglyphs. The hieroglyphs are of the kind usually found in such ruins, the meaning of which is so far clear that it is known that the commencement of an inscription records certain dates in the complicated calendar system of the Mayas. A collation of these dates demonstrates that the most ancient on record are separated from the most recent by an interval of only a few centuries. From this it may be concluded that the Mayan civilization, whether or not it was preceded by anything older, flourished for only a comparatively short period, the beginning of which cannot be placed many centuries before A.D. 1000.

According to Squier (*Honduras*, London, 1870, p. 75) the other principal ruins of Honduras are to be found in plains of the department of Comayagua, near Yarumela, near Lajamini, and in the ruined town of Cururu. They are "large, pyramidal, terraced structures, often faced with stones, conical mounds of earth and walls of stone." Further ruins, such as those of Calamulla, Jamalteca, Maniana, Guasistagua, Chapuluca and Chapulistagua, are found in the department of Comayagua in the side valleys and adjoining tablelands. The most interesting and most extensive are the ruins of Tenampua (Pueblo Viejo), about 20 m. south-east of Comayagua. Here ramparts, defence works, terraced stone mounds and numerous large pyramids are to be found. Squier found further ruins in the west of Honduras, which have also been described in part by Stephens, and were probably first mentioned in 1576 by Diego Garcia de Palacio (*Carta dirigida al Rei de España*, published by Squier, New York, 1860).

(Click to enlarge.)

At Rio Ulloa are remains which testify to the existence of a large population in past days. Possibly they may be identified with a site of the name of Naco mentioned by Las Casas and by Bernal Diaz (*Histoire véridique de la conquête de la Nouvelle Espagne*, translated by D. Fourdanet, 2nd ed., Paris, 1877, ch. 178, p. 690).

Chiapas (Mexico).—The principal site is Palenque, the ruins of which were amongst the earliest of all to attract attention. The style of architecture, with the gigantic vaults and singular comb-shaped gables, distinguishes Palenque from Copan and Quirigua, which it surpasses also in the unequalled magnificence of its sculptures. Five out of the remarkably uniform series of buildings may be specially mentioned. They are the Great Palace, a complex structure of galleries and courts commanded by a three-storeyed tower, the Temples of the Cross, which are galleries constructed on terraces and containing the well-known reliefs, the Temple of Inscriptions, the Sun Temple and the Temple of the Relief. The sculptured figures of Palenque are familiar from many reproductions. The most characteristic groups represent a deity

standing between worshippers who hold a staff surmounted by the water-god Ah-bolon-tzacab, the “god of the nine medicines.” The inscriptions on the famous Cross and in the Sun Temple contain calendar-datings which are remarkable as showing a particular combination of numbers and hieroglyphs, which does not occur elsewhere.

A whole series of sites is included within the geographical limits of Chiapas, which from the archaeologist’s standpoint must be considered as belonging properly to Guatemala. The country has been quite insufficiently explored.

Oaxaca (Mexico).—The bulk of the population of the province of Oaxaca is composed of a distinct racial group, best represented by the Zapotecs, who have been for an unknown length of time the intermediaries between the Nahua civilization of Mexico on the west and the Mayan on the east. The influence of the two separate currents may be detected in the bastard calendar system no less than in the still undeciphered inscriptions. The principal ruins are those of Mitla, the burial city of the priests and kings of the ancient Zapotecs, which bear a quite distinct character, though presenting certain analogies with the Mexican. One of the chief structures is a step-pyramid, rising in three steps to a height of 130 ft., another is a pyramid of brick. Besides these there are courts, surrounded by palaces which represented necropolises, the dwellings of the priests, of the chief priest, and of the king (with an audience-hall). The wall paintings of the “palaces” are especially admirable, and it is to be noted that the deities represented in them are those of the Mexican pantheon.

Monte Alban is interesting for the definitely Zapotec character of its sculptures. Quiengola near Tehuantepec is a site with extensive ruins including a fine tennis court.

British Honduras.—The antiquities of British Honduras have been but little investigated. In the scanty literature relating to them a few accounts of ruined places are to be found. In style these buildings closely resemble those of the neighbouring Yucatan. The ruins in the colony New Boston, mentioned by Froebel (*Central America*, p. 167), are of this kind. F. de P. Castells (see *American Antiquarian*, Chicago, 1904, vol. xxvi. pp. 32-37) describes the ruins, in the north of the colony, of “Ixim chech,” supposed to be the Indian form of the English name “Indian Church.” They are on the road to the Lake of Yaxha (green water), where further ruins are to be found. Thomas Gann gives detailed accounts of numerous mounds also in the northern part of British Honduras (see *19th Annual Report of the Bureau of American Ethnology*, Washington, 1900, part i. pp. 661-692, with plates). The most interesting ruins are those which have been discovered in Santa Rita, at the mouth of the New River, near the town of Corosal. Here wonderful wall paintings in stucco came to light, which unfortunately Gann could only save in part. The remainder were destroyed by Indians. It should be remarked that a number of the mounds in Santa Rita were erected over ruins of buildings which must therefore be of older date than the mounds.

Salvador.—Pedro de Alvarado in his expedition of 1524 calls this whole district *Cuscatan* (Mex. *Cozcatlan*), that is, “Land of precious stones, of treasures, of abundance.” A further description of the land is given by Palacio (l.c.) in 1576. Although there are numerous relics of Mayan civilization buried in the earth; few ruins are to be seen on the surface. Karl Sapper has described three large ruins: Cuzcatlan near the capital, Tehuacan near S. Vicente, and Zacualpa on the Lake of Güija in the extreme north-west of the country. The ruins show a distinct affinity in style to those of the Mayan buildings in Guatemala, but they are less fine and artistically perfect. Probably the central and western districts of San Salvador were originally peopled by the same race of Mayas, and these tracts of country were later settled by the Mexican-speaking Pipiles.

A characteristic feature of the extensive ruins of Zacualpa is that the pyramids and ramparts have perpendicular steps which are higher than they are broad, and this peculiarity may be attributed to the influence of the Maya tribes, who are related to the Mams of Guatemala.

Decipherment of the Mayan Hieroglyphs.—The key to the decipherment, so far as this has progressed at present, was furnished by the *Historia de las Cosas de Yucatan*, a work written by Diego de Landa, the first bishop of the country. This professed to give, with much other more or less doubtful information, the full account of a calendar system analogous to that of the Mexicans, which was said to have been used by the Mayas (see Mexico). The signs for each of the 20 days and for the 18 weeks of 20 days are figured by Landa. The first step was to compare these with the hieroglyphic characters contained in the few Mayan picture manuscripts (Codex Troano, Cortesianus, Peresianus, Dresden Codex) which have survived the destructive fanaticism of the Spanish missionaries. Förstemann’s acute analysis detected that the bars and dots which occur along the margin and in the body of the pictorial scenes represented numerals, dots standing for each integer up to five, while for five a bar was used. Next, it was found that the order in which these numeral-signs are placed is regular, and that there are never more than five in a group. It was established that the first sign in such a group is that for the numeral 1 (*Kin*), the next that for 20 (*Uinal*), the third for 18×20 (*Tun*), the fourth for 18×20×20 (*Katun*),

and the fifth for 18×20×20×20, that is to say, a cycle.

Had the available material for study been confined to the manuscripts, little more progress would have been made beyond establishing subsidiary details in the actual calendar. But when a similar analysis was applied to the numerous monuments discovered and figured by Maudslay and others, some important results of a general bearing were obtained. It was found that many of the hieroglyphs of various forms upon the stones were also of numeral value, and, what was of great importance, that they all referred back to a single starting-point. This starting-point or zero is no doubt the mythological date at which, according to Mayan cosmology, the world was created. It is placed at nine or ten cycles before the time when Copan and Quirigua were erected and the picture manuscripts made. And it is by reference to it in the inscriptions that such students as Seler, Goodman and others have been enabled, as already stated, to obtain a record of the relative chronology of the most famous monuments, to confine the period of their erection within the space of a few centuries, and approximately to fix even their absolute antiquity. Though much yet remains to be done, these are substantial results which have already been won from the study of the hieroglyphs.

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(W. L.*)

CENTRAL FALLS, a city of Providence county, Rhode Island, U.S.A., on the Blackstone river, about 5 m. N. of Providence. Pop. (1900) 18,167; (1905, state census) 19,446, of whom 8792 were foreign-born, 4164 being French-Canadian, 1587 being English, and 1292 being Irish; (1910) 22,754. It is served by the New York, New Haven & Hartford railway. The Blackstone furnishes good water-power, and the chief industry of the city is the manufacture of cotton goods; other important industries are the refining of copper and the manufacture of woollens, silks and hair-cloth. The total value of the factory product in 1905 was $5,090,984, being 12.9% more than in 1900. A settlement was established here about 1763 and was first a part of Smithfield, and then, after 1871, of Lincoln. About 1780 a chocolate mill was erected, and from then until 1827 the settlement was known as Chocolateville. It was incorporated as the Central Falls Fire District of Smithfield in 1847, and in 1895 was chartered as a city.

CENTRALIA, a city of Marion county, Illinois, U.S.A., in the S. part of the state, about 62 m. E. of St Louis. Pop. (1890) 4763; (1900) 6721 (571 foreign-born); (1910) 9680. The city is served by the Chicago, Burlington & Quincy, the Illinois Central, the Illinois Southern, and the Southern railways; the first two have repair shops here. Centralia is situated in the central part of southern Illinois, popularly known as “Egypt.” Among its manufactures are window glass, envelopes, cigars, concrete blocks and flour. In and near the city coal is mined, and apples, strawberries and other fruits are raised, and the city is a shipping point for coal and fruit. Centralia was first settled in 1853, and was first chartered as a city in 1859.

CENTRAL INDIA, a collection of native states in India forming a separate agency, which must not be confounded with the Central Provinces. The Central India agency was formed in 1854, when Sir R. Hamilton was appointed agent to the governor-general. It lies between 21° 24′ and 26° 52′ N. and between 74° 0′ and 83° 0′ E., and may be said to consist of two large detached tracts of country which, with Jhansi as a pivot, spread outwards east and west into the peninsula, reaching northward to within some 30 m. of Agra, and southward to the valley of the Nerbudda and the Vindhya and Satpura ranges. The total area is 78,772 sq. m. It is bounded on the N. and N.E. by the United Provinces, on the W. and S.W. by Rajputana, some native states of the Bombay presidency, and Khandesh. The Central Provinces and the Bengal district of Chota Nagpur enclose it on the S. and E., while the Jhansi district of the United Provinces separates the two tracts.

Central India may be divided into three great natural divisions: the highlands of the Malwa plateau, with a mean elevation of some 1500 ft. above sea-level; the low-lying country some 600 ft. above sea-level, comprising the greater part of the eastern section of the agency; and the hilly tracts, which lie mostly to the south. The Malwa plateau consists of great undulating plains, separated by flat-topped hills, whose sides are boldly terraced, with here and there a scarp rising above the general level; it is covered with long grass, stunted trees and scrub, which owing to the presence of deciduous plants is of a uniform straw colour, except in the rains. The foundation of this plateau is a bed of sandstone and shales belonging to the Vindhyan series. This bed, which stretches east and west from Sasseram to Neemuch, and north and south from Agra to Hoshangabad, comprises the whole of the agency except the northern part of Bundelkhand. On the plateau itself the sandstone is generally overlaid by the Deccan trap, a blackish-coloured basaltic rock of volcanic origin, the high level tableland having been formed by a succession of lava flows, the valleys of Central India being merely “denudation hollows” carved out by the action of rain and rivers. It is apparently the northern limit of what was once a vast basaltic plain stretching from Goona to Belgaum, “one of the most gigantic outpourings of volcanic matter in the world.” The sandstone bed on which it rests is visible at a point just north of Goona, and in a small area round Bhilsa and Bhopal, as it is in those places freed from the layer of trap. The low-lying land includes roughly that part of the agency which lies to the east of the plateau and comprises the greater part of the political divisions of Bundelkhand and Baghelkhand and the country round Gwalior. The formation save in north Bundelkhand is sandstone of the Vindhyan series, free as a rule from “trap.” In the north of Bundelkhand the prevailing rock is gneiss and quartz. The quartz takes the shape of long serrated ridges, which are in many places a characteristic feature of the landscape. Trap appears here and there in intrusive dykes. The hilly tracts lie chiefly to the south of the agency, where the Vindhya, Satpura and Kaimur ranges are met with. The country is rough forest and jungle land little used for cultivation. The greater part of Central India is covered with the well-known “black cotton soil,” produced by the disintegration of the trap rock. It is a very rich loamy earth, possessing great fertility and an unusual power of retaining moisture, which makes artificial irrigation little needed. Opium and millet are the principal crops grown upon it. The ordinary “red soil” covers a large part of northern Bundelkhand, and as it requires much irrigation, tanks are a special feature in this country. Ethnologically as well as climatically the differences between the plateau and the eastern part of the agency are distinct and the languages markedly so. The plateau is inhabited by pure-blooded Rajput races, whose ancestry can be traced back for centuries, with all their numerous offshoots. The inhabitants of the low-lying country are also Rajputs, but their descent is mixed and as a rule the families of the plateau will have no marriage connexion with them. The races of the hilly tracts are semi-civilized tribes, who often flee at the mere sight of a white man, and have as yet been but little affected by the Hindu religion of their Rajput rulers. Of the climate of the plateau, Abul Fazl, the author of the *Ain-i-Akbari*, says: “The climate is so temperate that in the winter there is no occasion for warm clothing, nor is it necessary in summer to cool the water with saltpetre. But in the four rainy months the night here is cold enough to render a quilt necessary.” The rains of the south-east

monsoon reach Central India as a rule about the 12th of July, and last until the end of September.

Administrative Divisions.—The Central India agency is divided for administrative purposes into eight units, two classed as residencies and six as agencies. These are the residencies of Gwalior and Indore, and the agencies of Baghelkhand, Bhopal, Bhopawar, Bundelkhand, Indore and Malwa. But these divisions are purely an artificial grouping for the purposes of the British government, the original native divisions consisting of 16 states and 98 minor states and estates. The 15 large states are Gwalior, Indore, Rewa, Bhopal, Dhar, Barwani, Datia, Orchha, Charkhari, Chhattarpur, Panna, Dewas (senior branch), Dewas (junior branch), Jaora and Ratlam. At the close of the Pindari War in 1818 the whole country that is now under the Central India agency was in great confusion and disorder, having suffered heavily from the extortions of the Mahratta armies and from predatory bands. It had been the policy of the great Mahratta chiefs, Holkar and Sindhia, to trample down into complete subjection all the petty Rajput princes, whose lands they seized and from whom they levied heavy contributions of money. Many of these minor chiefs had been expelled from their possessions, had taken refuge in the hills and forest, and retaliated upon the Mahratta usurpers by wasting the lands which they had lost, until the Mahrattas compounded for peace by payment of blackmail. In this state of affairs all parties agreed to accept the interposition of the British government for the restoration of order, and under Lord Hastings the work of pacification was effected. The policy pursued was to declare the permanency of the rights existing at the time of the British interposition, conditionally upon the maintenance of order; to adjust and guarantee the relations of subordinate and tributary chiefs to their superiors so as to prevent all further disputes or encroachments; and to settle the claims of the ousted landholders, who had resorted to pillage or blackmail, by fixing grants of land to be made to them, or settling the money allowances to be paid to them. The general result was to place all the privileges, rights and possessions of these inferior chiefs under the guarantee or protection of the British government, to whom all disputes between the superior and inferior states must be referred, and whose decision is final upon all questions of succession to hereditary rights or rulership. The states have no general ethnological affinity, such as exists in Rajputana. Their territories are in many cases neither compact nor continuous, consisting of a number of villages here and there, with a nucleus of more or less importance round the chief town. Their relations to the government of India and to each other present many variations. Ten of them are under direct treaty with the government of India; others are held under *sanads* and deeds of fealty and obedience; while a third class, known as the mediatized states, are held under agreements mediated by the British government between them and their superior chiefs.

Population.—The total population of the Central India agency in 1901 was 8,628,781, showing a decrease during the decade of 16.4%. Considerable losses were caused by the famines of 1897-1898 and 1899-1900, which were severely felt, especially in Bhopal and Malwa. The greater part of the population of Central India is of the Hindu religion, but a few Mahommedan groups still exist, either traces of the days when the Mogul emperors extended their sway from the Punjab to the Deccan, or else the descendants of those northern adventurers who hired out their services to the great Mahratta generals. Of the first Bhopal is the only example, while Jaora is the only notable instance of the other. Roughly there are four great sections of the population: the Mahratta section, who belong to the ruling circles; the Rajputs, who are also hereditary noblemen; the trading classes, consisting chiefly of Marwaris and Gujaratis; and lastly, the jungle tribes of Dravidian stock. The Mahrattas are foreigners, and, though rulers of the greater part of Central India, have no true connexion with the soil and are little met with outside cities, the vicinity of courts, and administrative centres. The Rajputs with all their endless ramifications form a large portion of the population. Originally invaders, they have so long held a stake in the soil that they have become almost part of the indigenous population. The Marwaris hold practically all the trade of Central India, with the exception of the Bora class of Mahommedans. They are either Vaishnavite Hindus or else Jains. Their advent into Central India dates, except in the case of one or two families, from the time of the Mahratta invasion only. The Jain portion of this community is very wealthy. The last section, that of the jungle tribes, is mostly of Dravidian or mixed Aryo-Dravidian origin, these tribes being the modern representatives of the former rulers and inhabitants of this country.

The British agent to the governor-general resides at Indore, and there are British cantonments at Mhow, Neemuch and Nowgong. The whole country is fairly provided with railways, largely at the expense of Sindhia.

CENTRAL PROVINCES AND BERAR, a province of British India, which was formed in October 1903 by the amalgamation of the Central Provinces and the Hyderabad Assigned Districts. The total area of the provinces is 113,281 sq. m., and the population on that area in 1901 was 10,847,325. As is shown by its name the province is situated in the centre of the Indian peninsula, comprising a large proportion of the broad belt of hill and plateau country which separates the plains of Hindustan from the Deccan. It is bounded on the N. and N.E. by the Central India states, and along a small strip of the Saugor district by the United Provinces; on the W. by Bhopal, Indore and the Khandesh district of Bombay; on the S. by Hyderabad and the large *zamindari* estates of the Madras presidency; and on the E. by these latter estates and the tributary states of Bengal. In October 1905 most of Sambalpur and five Oriya-speaking hill-states were transferred from the Central Provinces to Bengal, while the Hindi-speaking states of Chota Nagpur were transferred from Bengal to the Central Provinces. The province, therefore, now consists of the five British divisions of Jubbulpore, Nerbudda, Nagpur, Chhattisgarh and Berar, which are divided into the twenty-two districts of Saugor, Damoh, Jubbulpore, Mandla, Seoni, Narsinghpur, Hoshangabad, Nimar, Betul, Chhindwara, Wardha, Nagpur, Chanda, Bhandara, Balaghat, Raipur, Bilaspur, Amraoti, Akola, Ellichpur, Buldana and Wun; and the fifteen tributary states of Makrai, Bastar, Kanker, Nandgaon, Kairagarh, Chhuikhadan, Kawardha, Sakti, Raigarh, Sarangarh, Chang Bhakar, Korea, Sirguja, Udaipur and Jashpur.

Central Provinces.

The Central Provinces are divided into two parts by the Satpura range of hills (*q.v.*), which runs south of the Nerbudda river from east to west; so that, speaking generally, it consists of districts north of the Satpuras, districts on the Satpura plateau, and districts south of the Satpuras. North of the Satpuras is the rich valley of the Nerbudda, which may be said to begin towards the north of the Jubbulpore district and to extend westward through the district of Narsinghpur as far as the western limit of Hoshangabad, a distance of nearly 300 m. The elevation of the valley above the sea varies from 1400 ft. at Jubbulpore to 1120 at Hoshangabad. In breadth it is about 30 m., extending between the Satpuras and the southern scarp of the Vindhyas. This great plain, 10,613 sq. m. in extent, contains for the most part land of extreme fertility. The continuation of the valley west of Hoshangabad forms the northern portion of the district of Nimar, the farther limit of which touches the Khandesh district of the Bombay presidency. Towards the river, though rich in parts, this tract of country is generally wild and desolate, but nearer the base of the hill range there is a large natural basin of fertile land which is highly cultivated. South of the Satpuras lies the great plain of Chhattisgarh at a mean elevation above the sea of 1000 ft.; it has an area of 23,000 sq. m., and forms the upper basin of the Mahanadi. Farther to the west and again divided off by hills is the great plain of Nagpur, extending over 24,000 sq. m. Its general surface inclines towards the south from 1000 ft. above the sea at Nagpur to 750 ft. at Chanda. To the south the province is shut in by the wide mountainous tract which stretches from the Bay of Bengal through Bastar to the Godavari, and west of that river is continued onward to the rocky ridges and plateaus of Khandesh by a succession of ranges that enclose the plain of Berar along its southern border.

Berar.

Berar consists mainly of the valley lying between the Satpura range of mountains in the north and the Ajanta range in the south. The Gawilgarh hills, a range belonging to the Satpura mountains, form the northern border. On the east the frontier is marked by the Wardha river down to its confluence with the Penganga, and on the south by the Penganga for about two-thirds of the frontier's length. The tract is half surrounded on the east, north and north-west by the Central Provinces, with which it is amalgamated. In addition to the Melghat mountain tract which walls it in on the north, Berar is divided into two sections, the Payanghat or lowland country, bounded on the north by the Gawilgarh hills, and on the south by the outer scarps of the Ajanta range, and the Balaghat or upland country above the Ajanta ridge, sloping down southwards beyond the ghats or passes which lead up to it. The Payanghat is a wide valley running up eastward between this ridge and the Gawilgarh hills, varying in breadth from 40 to 50 m., and broader towards the end than at its mouth. It contains all the best land in Berar; it is full of deep, rich, black alluvial soil, of almost inexhaustible fertility, and it undulates sufficiently to maintain a natural system of drainage, but there is nothing picturesque about this broad strip of champaign country. The upland tract, on the contrary, is diversified with low-lying plains, high plateaus, fertile bottoms and rocky wastes, and is rendered picturesque by rivers and groves.

Natural Features.—The provinces may be divided into two tracts of upland and three of plain, consisting of the Vindhya and Satpura plateaus, and the Berar, Nagpur and Chhattisgarh plains. To the north the districts of Saugor and Damoh form the southern boundary of the Vindhyan escarpment. In this region the sandstone rocks are generally overlaid with heavy black soil formed from the decaying trap, which is principally devoted to the cultivation of the spring crops, wheat and grain, while rice and hill millets are sown in the lighter and more sandy soils. Next, the long and narrow valley of the Nerbudda from Jubbulpore to Hoshangabad is formed of deep alluvial deposits of extreme richness and excellently suited to the growth of wheat. To the south of the Nerbudda the Satpura range stretches across the province, containing the greater part of five districts, its crystalline and sandstone rocks rising in places through the superficial stratum of trap, and with large areas of shallow stony land still covered to a great extent with

forest interspersed by black-soil valleys of great fertility. In the latter are grown wheat and other spring crops, while the lighter kinds of rice and the hill millets are all that the poorer land can bear. To the south of the Satpuras and extending along its base from west to east lie successively the Berar, Nagpur and Chhattisgarh plains. The surface soil of Berar is to a great extent a rich black vegetable mould; and where this surface soil does not exist, there are muram and trap with a shallow upper crust of inferior light soil. The Nagpur country, drained by the Wardha and Wainganga rivers, contains towards the west the shallow black soil in which autumn crops like cotton and the large millet, *juar*, which do not require excessive moisture, can be successfully cultivated. The eastern part of the Nagpur country and the Chhattisgarh plain, comprising the Mahanadi basin, form the great rice tract of the province, its heavy rainfall and hard yellowish soil rendering it excellently adapted for the growth of this crop.

Climate.—As regards climate the districts of the Central Provinces are generally divided into hot and cool ones. In the latter division are comprised the two Vindhyan districts of Saugor and Damoh, Jubbulpore at the head of the Nerbudda valley, and the four Satpura districts of Mandla, Seoni, Betul and Chhindwara, which enjoy, owing to their greater elevation, a distinctly lower average temperature than the rest of the province. The ordinary variation is from 3 to 4 degrees, the mean maximum reading in the shade in a cooler district being about 105° as against 108° in the hotter ones for the month of May, and 79° as against 83° for the month of December. In the cold weather the temperature in Nagpur and the other hot districts is about the same as in Calcutta and substantially higher than that of northern India. The climate of Berar differs very little from that of the Deccan generally, except that in the Payanghat valley the hot weather may be exceptionally severe. The rainfall of the province is considerably heavier than in northern India, and the result of this is a cooler and more pleasant atmosphere during the monsoon season. The average rainfall, before it was affected by the abnormal seasons which followed 1892, was 51 in., varying from 33 in. in Nimar to 65 in Balaghat. In the autumn months malarial fever is prevalent in all thickly forested tracts and also in the rice country; but on the whole the province is considered to be healthy, and as the rains break fairly regularly in June and produce an immediate fall in the temperature, severe heat is only experienced for a period of from two to three months.

Agriculture.—Broadly speaking, the northern districts of the province produce principally cold weather crops, such as wheat and grain, and the eastern ones principally rice. At the beginning of the decade 1891-1901 wheat was the staple product of the Vindhyan and Nerbudda valley districts, and was also grown extensively in all the Satpura districts except Nimar and in Wardha and Nagpur. Cotton and juar were produced principally in Nimar, Nagpur, Wardha and the southern portion of Chhindwara, and the latter also in Chanda. In the Satpura districts the inferior soil was and is principally devoted to hill millets. Rice is an important crop in Damoh, Jubbulpore, Mandla, Seoni and Chanda, and is the chief staple of Bhandara, Balaghat, and the two eastern districts of Raipur and Bilaspur. The staple crops of Berar are cotton and juar. The succession of bad seasons which marked the end of the decade affected the distribution of the principal crops, but with the advent of more prosperous seasons things tend to return to their old level.

Industries.—The only important industries are connected with cotton and coal. In 1904 the total number of factories was 391, almost entirely cotton presses and ginning factories, which received an immense impetus from the rise in cotton prices. In 1896 a brewery was established at Jubbulpore. Two coal-mines are worked in the Central Provinces, at Warora and Mopani, to each of which there is a branch line of railway. In 1903-1904 there was a total yield of 160,000 tons, valued at about £45,000. In connexion with the Warora colliery there is a fire-clay business. The Mopani colliery, which dates back to 1860, is worked by a joint-stock company.

Trade.—The trade of the Central Provinces is conducted mainly by rail with Bombay and with Calcutta. The chief imports are cotton piece goods, cotton twist, salt, sugar, provisions, railway materials, raw cotton, metals, coal, tobacco, spices and kerosene oil. The chief exports are raw cotton, rice, wheat, oil-seeds, hides and lac. The exports of wheat are liable to extreme fluctuations, especially during famine periods.

Railways.—Until recently, the only railway in the Central Provinces was the Great Indian Peninsula, with two branches, one terminating at Nagpur, the other at Jubbulpore, whence it was continued by the East Indian system to Allahabad. The Bengal-Nagpur line has now opened up the eastern portion of the country, bringing it into direct connexion with Calcutta; and a new branch of the Indian Midland, from Saugor through Damoh, has been partly constructed as a famine work. Large portions, however, in the hilly centre and in the south-east, are still remote from railways.

Administration.—The administration of the province is conducted by a chief commissioner on behalf of the governor-general of India in council, assisted by members of the Indian civil service, provincial civil service, subordinate civil service, district and assistant superintendents of police, and officers specially recruited for various departments. The form of the administration of Berar was in 1903 entirely reorganized. Under the original settlement concluded by the treaties of 1853 and 1860 the revenues of the province were assigned primarily for the maintenance of the Hyderabad contingent, such surplus as accrued from year

to year being made over to the nizam, while the province itself was administered in trust by the government of India through the resident at Hyderabad. In November 1902 a fresh settlement was arranged and Berar was leased in perpetuity to the British government in return for an annual rental of 25 lakhs. It remained under the administration of the resident until the 1st of October 1903, from which date it was amalgamated with the Central Provinces for administrative purposes. As the immediate result of this change the offices of heads of departments in Berar, except the judicial commissionership and the conservatorship of forests, were amalgamated with the corresponding appointments in the Central Provinces, and Berar is now treated as one of the divisions of that province for purposes of revenue administration, with a divisional commissioner as its immediate head.

Population.—The population of the Central Provinces and Berar as now defined according to the census of 1901 was 10,847,325, and is of very diverse ethical construction, having been recruited by immigration from the countries surrounding it on all sides. There are six main divisions of the people: the Dravidian tribes, who formerly held the country; Hindi-speaking immigrants from the north and north-west into Saugor, Damoh, the Nerbudda valley and the open country of Mandla and Seoni; Rajasthani-speaking immigrants from Central India into Nimar, Betul and parts of Hoshangabad, Narsinghpur and Chhindwara; Marathi-speaking immigrants from Bombay into Berar, the Mahratta districts and the southern tahsil of Betul; the Telugu castes in the Sironcha and Chanda tahsil of Chanda and the south of Bastar; and the Hindu immigrants into Chhattisgarh, who are supposed to have arrived many centuries ago when the Haihaya dynasty of Ratanpur rose into power.

Language.—Owing to the diversity of race, the diversity of language is equally great. Thirty languages and a hundred and six dialects are found in the Central Provinces alone, and twenty-eight languages and sixty-eight dialects in Berar. The chief of these languages are Western Hindi, Eastern Hindi, Rajasthani, Marathi, Oriya, Telugu and Dravidian dialects. Of these last the chief dialects are Gondi, Oraon or Kurukh, Kandhi and Kanarese, of which Gondi is by far the most important. There are also the Munda languages, of which the chief are Korku, Kharia and Munda or Kol. The chief languages of Berar are Marathi, Urdu, Gondi, Banjari, Hindi, Marwari, Telugu, Korku and Gujarati.

History.—The authentic history of the greater part of the country embraced in the Central Provinces does not begin till the 16th century A.D. By the people of northern India the country was known as Gondwana, after the savage tribes of Gonds by whom it was inhabited. The Mussulman invaders of the Deccan passed it by, not caring to enter its mountain fastnesses and impenetrable forests; though occasional inscriptions show that parts of it had fallen from time to time under the dominion of one or other of the great kingdoms of the north, *e.g.* of Asoka, of the Guptas of Maghada, or of the ancient Hindu kingdom of Vidarbha (Berar); and inscriptions and numerous discoveries of coins prove that, during the middle ages, the open spaces were occupied by a series of Rajput dynasties. Of these the most important was that of the Haihayas of Ratanpur, a family which, settled from time immemorial in the Nerbudda valley, had towards the close of the 10th century succeeded the Pandava dynasty of Maha Kosala (Chhattisgarh) and ruled, though from the 16th century onwards over greatly diminished territories, until its overthrow by the Mahrattas in 1745. The second ruler of this dynasty, Ratnaraja, was the founder of Ratanpur.

The inscriptional records cease abruptly in the 12th century, and no more is known of the country until the rise of the Gond dynasties from the 14th to the 16th centuries. The first of these is mentioned in 1398, when Narsingh Rai, raja of Kherla, is said by Ferishta to have ruled all the hills of Gondwana. He was finally overthrown and killed by Hoshang Shah, king of Malwa. The 16th century saw the establishment of a powerful Gond kingdom by Sangram Sah, who succeeded in 1480 as the 47th of the petty Gond rajas of Garha-Mandla, and extended his dominions so as to include Saugor and Damoh on the Vindhyan plateau, Jubbulpore and Narsinghpur in the Nerbudda valley, and Seoni on the Satpura highlands. Sangram Sah died in 1530; and the break up of his dominion began with the enforced cession to the Mogul emperor by Chandra Sah (1563-1575) of Saugor and Damoh and of that portion of his territories which afterwards formed the state of Bhopal.

About 200 years after Sangram Sah’s time, Bakht Buland, the Gond chieftain of a principality seated at Deogarh in Chhindwara, having visited Delhi, set about introducing the civilization he had there admired. He founded the city of Nagpur, which his successor made his capital. The Deogarh kingdom, at its widest extent, embraced the modern districts of Betul, Chhindwara, Nagpur, with parts of Seoni, Bhandara and Balaghat. In the south of the province Chanda was the seat of another Gond dynasty, which first came into prominence in the 16th century. The three Gond principalities of Garha-Mandla, Deogarh and Chanda were nominally subject to the Mogul emperors. In addition to the acquisitions made in the north at the expense of Garha-Mandla, the Moguls, after the annexation of Berar, established governors at Paunar in Wardha and Kherla in Betul. Having thus hemmed in the Gond states, however, they made no efforts to assert any effective sovereignty over them; the Gond rajas for their part were content with practical independence within their own dominions. Under their peaceful rule their territories

flourished, until the weakening of the Mogul empire and the rise of the predatory Bundela and Mahratta powers, with the organized forces of which their semi-barbarous feudal levies were unable to cope, brought misfortune upon them.

In the 17th century Chhatarsal, the Bundela chieftain, deprived the Mandla principality of part of the Vindhyan plateau and the Nerbudda valley. In 1733 the peshwa of Poona invaded Bundelkhand; and in 1735 the Mahrattas had established their power in Saugor. In 1742 the peshwa advanced to Mandla and exacted the payment of *chauth* (tributary blackmail), and from this time until 1781, when the successors of Sangram Sah were finally overthrown, Garha-Mandla remained practically a Mahratta dependency. Meanwhile the other independent principalities of Gondwana had in turn succumbed. In 1743 Raghoji Bhonsla of Berar established himself at Nagpur, and by 1751 had conquered the territories of Deogarh, Chanda and Chhattisgarh. In 1741 Ratanpur had surrendered to the Mahratta leader Bhaskar Pant without a blow, and the ancient Rajput dynasty came to an end. In Chanda and Deogarh the Gond rajas were suffered by Raghoji Bhonsla and his successor to carry on a shadowy existence for a while, in order to give them an excuse for avoiding the claims of the peshwa as their overlord; though actually decisions in important matters were sought at Poona. Raghoji died in 1755, and in 1769 his son and successor, Janoji, was forced to acknowledge the peshwa's effective supremacy. The Nagpur state, however, continued to grow. In 1785 Mudhoji (d. 1788), Janoji's successor, bought from the Poona court the cession of Mandla and the upper Nerbudda valley, and between 1796 and 1798 this was followed by the acquisition of Hoshangabad and the larger part of Saugor and Damoh by Raghoji II. (d. 1816). Under this latter raja the Nagpur state covered practically the whole of the present Central Provinces and Berar, as well as Orissa and some of the Chota Nagpur states.

In 1803 Raghoji joined Sindhia against the British; the result was the defeat of the allies at Assaye and Argaon, and the treaty of Deogaon, by which Raghoji had to cede Cuttack, Sambalpur and part of Berar. Up to this time the rule of the Bhonsla rajas, rough warriors of peasant extraction, had been on the whole beneficent; but, soured by his defeat, Raghoji now set to work to recover some of his losses by a ruthless exploitation of the peasantry, and until the effective intervention of the British in 1818 the country was subjected to every kind of oppression. After Raghoji II.'s death in 1816 his imbecile son Parsaji was deposed and murdered by Mudhoji, known as Appa Sahib. In spite of a treaty signed with the British in this year, Mudhoji in 1817 joined the peshwa, but was defeated at Sitabaldi and forced to cede the rest of Berar to the nizam, and parts of Saugor and Damoh, with Mandla, Betul, Seoni and the Nerbudda valley, to the British. After a temporary restoration to the throne he was deposed, and Raghoji III., a grandchild of Raghoji II., was placed on the throne. During his minority, which lasted till 1840, the country was well administered by a British resident. In 1853, on the death of Raghoji III. without heirs, Nagpur lapsed to the British paramount power. Until the formation of the Central Provinces in 1861, Nagpur province, which consists of the present Nagpur division, Chhindwara and Chhatisgarh, was administered by a commissioner under the central government.

The territories in the north ceded in 1817 by the peshwa (parts of Saugor and Damoh) and in 1818 by Appa Sahib were in 1820 formed into the Saugor and Nerbudda Territories under an agent to the governor-general, and in 1835 were included in the newly formed North-West Provinces. In 1842, in consequence of a rising, they were again placed under the jurisdiction of an agent to the governor-general. Restored to the North-West Provinces in 1853, they were finally joined with the Nagpur province to constitute the new Central Provinces in 1861. On the 1st of October 1903 Berar also was placed under the administration of the commissioner of the Central Provinces (for history see Berar). In 1905 the greater part of Sambalpur district, with the feudatory states of Bamra, Rairakhol, Sonpur, Patna and Kalahandi, were transferred to Bengal, while the feudatory states of Chang Bhakar, Korea, Surguja, Udaipur and Jashpur were transferred from Bengal to the Central Provinces.

During the decade 1891-1901 the Central Provinces suffered from famine more severely than any other part of India. The complete failure of the rain in the autumn of 1896 caused scarcity to develop suddenly into famine, which lasted until the end of 1897. The total number of persons in receipt of relief reached its maximum of nearly 700,000 in May 1897. The expenditure on relief alone was about a million sterling; and the total cost of the famine, including loss of revenue, amounted to nearly twice that amount. During 1897 the death-rate for the whole province rose to sixty-nine per thousand, or double the average, while the birth-rate fell to twenty-seven per thousand. The Central Provinces were stricken by another famine, yet more severe and widespread, caused by the complete failure of the rains in 1899. The maximum of persons relieved for the whole province was 1,971,000 in June 1900. In addition, about 68,000 persons were in receipt of relief in the native states. During the three years 1899-1902 the total expenditure on famine relief amounted to about four millions sterling. Berar also suffered from the famines of 1897 and 1900.

See *The Imperial Gazetteer of India* (Oxford, 1908), x. 99, for list of authorities.

CENTUMVIRI (*centum*, hundred; *vir*, man), an ancient court of civil jurisdiction at Rome, probably instituted by Servius Tullius.[1] Its antiquity is attested by the symbol and formula used in its procedure, the lance (*hasta*) as the sign of true ownership, the oath or wager (*sacramentum*), the ancient formula for recovery of property or assertion of liberty. It is probably alluded to in Livy's account of the Valerio-Horatian laws of 449 B.C. (Livy iii. 55, *Consules ... fecerunt sanciendo ut qui tribunis plebis, aedilibus, judicibus, decemviris nocuisset, ejus caput Jovi sacrum esset*). If the *judices* here mentioned are the *centumviri*, it is clear that they formed a tribunal which represented the interests of the *plebs*. This is in accordance with Cicero's account (*de Orat.* i. 38. 173) of the sphere of their jurisdiction. He says this was mainly concerned with the property of which account was taken at the census; it was therefore in their 684
power to make or unmake a citizen. They also decided questions concerning debt. Hence the *plebs* had an interest in securing their decisions against undue influence. They were never regarded as magistrates, but merely as *judices*, and as such would be appointed for a fixed term of service by the magistrate, probably by the *praetor urbanus*. But in Cicero's time they were elected by the *Comitia Tributa*. They then numbered 105. Their original number is uncertain. It was probably increased by Augustus and in Pliny's time had reached 180. The office was probably open in quite early times to both patricians and plebeians. The term is also applied in the inscriptions of Veii to the municipal senates and Cures, which numbered 100 members.

AUTHORITIES.—Tigerström, *De Judicibus apud Romanos* (Berlin, 1826); Greenidge, *Legal Procedure of Cicero's Time*, pp. 40 ff., 58 ff., 182 ff., 264 (Oxford, 1901); Bethmann-Hollweg, *Der romische Civilprozess*, ii. 53 ff. (Bonn, 1864); Pauly-Wissowa, *Realencyclopadie*, iii. 1935 ff. (Wlassak).

(A. M. CL.)

1 Mommsen (*Staatsrecht*, i³. 275, n. 4, ii³. 231, n. 1, 590 f.) believed that the *Centumviri* were instituted about 150 B.C.

CENTURION (Lat. *centurio*), in the ancient Roman army, an officer in command of a *centuria*, originally a body of a hundred infantry, later the sixtieth part of the normal legion. There were therefore in the legion sixty centurions, who, though theoretically subordinate to the six military tribunes, were the actual working officers of the legion. For the most part the centurions were promoted from the ranks: they were arranged in a complicated order of seniority; the senior centurion of the legion (*primus pilus*) was an officer of very high importance. Besides commanding the centuries of the legion, centurions were "seconded" for various kinds of special service, *e.g.* for staff employment, the command of auxiliaries. See further ROMAN ARMY.

CENTURIPE (formerly CENTORBI, anc. Κεντόριπα or *Centuripae*), a town of Sicily, in the province of Catania, situated 2380 ft. above sea-level in a commanding situation, 7 m. N. of the railway station of Catenanuova-Centuripe, which is 28 m. W. from Catania. Pop. (1901) 11,311. Thucydides mentions it as a city of the Sicels. It became an ally of the Athenians at the time of their expedition against Syracuse, and maintained its independence almost uninterruptedly (though it fell under the power of Agathocles) until the First Punic War. Cicero describes it, perhaps with some exaggeration, as being far the largest and richest city of Sicily, and as having a population of 10,000, engaged in the cultivation of an extensive territory. It was granted Latin rights before the rest of Sicily. It appears to have suffered much in the war against Sextus Pompeius, and not to have regained its former prosperity under the empire. Frederick II. entirely destroyed it in 1233, but it was soon rebuilt. Considerable remains of the ancient city walls and of buildings, mostly of the Roman period, still exist, and numerous antiquities, including some fine Hellenistic *terra-cottas*, have been discovered in casual

excavations.

See F. Ansaldi, *I Monumenti dell' antica Centuripi* (Catania, 1851); P. Orsi in *Atti del Congresso Internazionale di Scienze Storiche* (Rome, 1904), v. 177.

(T. As.)

CENTURY (from Lat. *centuria*, a division of a hundred men), the name for a unit in the Roman army, originally amounting to one hundred men, and for one of the divisions into which the Roman people was separated for voting purposes (see COMITIA). The word is applied to any group of one hundred, and more particularly to a period of a hundred years, and to the successive periods of a hundred years, dating before or after the birth of Christ. The "Century-plant" is a name given to the Agave (*q.v.*), or American aloe, from the supposition that it flowered once only in every hundred years.

CEOS (Gr. Κέως, mod. *Zea* or *Tzia*), an island in the Aegean Sea, belonging to the group of the Cyclades and the eparchy of Syra, 14 m. off the coast of Attica. Its greatest length is about 15 m. and its breadth about 8 m. It rises gradually towards the centre, where it culminates in Mount Elias, 1864 ft. high. Among its natural productions are lemons, citrons, olives, wine and honey; it also exports a considerable quantity of valonia. There were formerly four towns of some importance in the island:—Iulis, about 3 m. from the north-west shore; Coressia, the harbour of Iulis, with a temple of Apollo Smintheus in the neighbourhood; Carthaea, in the south-east, with a temple of Apollo; and Poieëssa, in the south-west. Of these Iulis is represented by the town of Zea, and Carthaea by the village of 'S tais Polais; traces of the other two can still be made out. Iulis was the birthplace of the lyric poets Simonides and Bacchylides, the philosophers Prodicus and Ariston, and the physician Erasistratus; the excellence of its laws was so generally recognized that the title of Cean Laws passed into a proverb. One of them forbade a citizen to protract his life beyond sixty years. The people of Ceos fought on the Greek side at Artemisium and Salamis; they joined the Delian League and also the later Athenian alliance in 377 B.C. They revolted in 363-362, but were reduced again, and the Athenians established a monopoly of the ruddle, or red earth, which was one of the most valuable products of the island. In A.D. 1207 it was divided between four Italian adventurers; after forming part of the duchy of Naxos in 1537, it passed under Turkish rule in 1566. Silver coins of Carthaea and Coressia have been found dating from the 6th century B.C. (see NUMISMATICS: *Greek*, "Cyclades and Sporades"). The present population of the island is about 4000, of which the capital has about 2000.

See Pridik, *De Cei Insulae rebus* (1892).

(E. GR.)

CEPHALIC INDEX, the term in use by anthropologists to express the percentage of breadth to length in any skull. The principle employed by Retzius is to take the longer diameter of a skull, the antero-posterior diameter, as 100; if the shorter or transverse diameter falls below 80 the skull may be classed as long (dolichocephalic), while if it exceeds 80 the skull is broad (brachycephalic) (see CRANIOMETRY).

CEPHALONIA (Ital. *Cefalonia*, ancient and modern official Greek *Cephallenia*, Κεφαλληνία), an island belonging to the kingdom of Greece, and the largest of those known as the Ionian Islands, situated on the west side of the mainland, almost directly opposite the Gulf of Corinth.

The name was traditionally derived from Cephalus, the Attic hero who was regarded as having colonized the island. The tradition, which is repeated by Aristotle, is probably due solely to the similarity of the names (see J.G. Frazer, *Pausanias*, i. 37, 6 note). Pop. (1907) 71,235. Its extreme length is 31 m., and its breadth varies from about 20 m. in the southern portion to 3 m. or less in the projecting part, which runs parallel with the island of Ithaca, at a distance of about 4 m. across the strait of Guiscardo or Viscaro. The whole island, with its area of 348 English sq. m., is covered with rocky hills of varying elevation, the main range running from north-west to south-east. The ancient Mount Aenos, now Elato, Monte Negro, or the Black Mountain (5315 ft.), frequently retains the snow for several months. It is not only the loftiest part of the sierra, but also the highest land in the whole Ionian group. The name “Black” was given from the darkness of the pine woods which still constitute the most striking feature in Cephalonian scenery, although their extent has been greatly curtailed by fire. The summit is called Megálo Sorós. The island is ill supplied with fresh water; there are few permanent streams except the Rakli, and springs are apt to fail in dry summers. In the western part of the island a gulf runs up from the south, a distance of about 7 m.; on its east side stands the chief town Argostoli, with about 10,000 inhabitants, and on its west side the rival city of Lixouri, with 6000. About a mile west of the town are the curious sea mills; a stream of sea water running down a chasm in the shore is made to turn the wheels. About 5 m. from Argostoli is the castle of St George, a building of Venetian origin, and the strongest fortification in the island. On an eminence east-south-east of Argostoli are the ruins of the ancient Cranii, and Lixouri is close to or upon those of Pale; while on the other side of the island are the remains of Samos on the bay of the same name, of Proni or Pronni, farther south above the vale of Rakli and its blossoming oleanders, and of an unknown city near the village of Scala. The ruins of this city include Roman baths, a brick-built temple, rock-cut tombs, and tessellated pavements; and Cranii, Proni and Samos are remarkable for stretches of Cyclopean and Hellenic walls, partly of the most irregular construction, and partly preserving almost unimpaired the results of the most perfect skill. The inhabitants of Cephalonia have all along been extremely active; and no slight amount of toil has 685
been expended in the construction of terraces on the steep sides of the hills. Owing to the thinness of the population, however, but a small proportion of the soil is under cultivation, and the quantity of grain grown in the island is comparatively meagre. The staple is the currant, in the production of which the island surpasses Zante. The fruit is smaller than that of the Morea, and has a peculiar flavour; it finds a market mainly in Holland, Belgium and Germany. The grape vine also is grown, and the manufacture of wine is a rising industry. The olive crop is of considerable importance, and the culture of cotton in the low grounds has been successfully attempted. Manufactures are few and undeveloped, but lace from the aloe fibre, Turkey carpets and basket-work are produced by the villagers, and boats are built at both the principal towns. Of all the seven Ionian islands Cephalonia and Zante are most purely Greek, and the inhabitants display great mental activity.

In the Homeric poems Cephalonia is generally supposed to be mentioned under the name of Same, and its inhabitants, among the subjects of Ulysses, to be designated Cephallenes (see, however, under Ithaca). In the Persian War they took but little part; in the Peloponnesian they sided with the Athenians. The town of Pale was vainly besieged by Philip of Macedon in 218 B.C., because it had supported the Aetolian cause. In 189 B.C. all the cities surrendered to the Romans, but Same afterwards revolted, and was only reduced after a siege of four months. The island was presented by Hadrian to Athens, but it appears again at a later date as “free and autonomous.” After the division of the Roman empire, it continued attached to Byzantium till 1082, when it was captured by Robert Guiscard, who died, however, before he could repress the revolt of 1085. In 1204 it was assigned to Gaius, prince of Tarentum, who accepted the protection of Venice in 1215; and after 1225 it was held along with Santa Maura and Zante by a succession of five counts of the Tocco family at Naples. Formally made over to Venice in 1350 by the prince of Tarentum, it was afterwards captured by the Turks in 1479; but the Hispanico-Venetian fleet under Benedetto Pessaro and Gonsalvo of Cordova effected their expulsion in 1500, and the island continued in Venetian possession till the fall of the republic. For some time it was administered for the French government, but in 1809 it was taken by the British under Cuthbert, Lord Collingwood. Till 1813 it was in the hands of Major de Bosset, a Swiss in the British service, who displayed an industry and energy in the repression of injustice and development of civilization only outdone by the despotic vigour of Sir Charles Napier, who held the same office for the nine years from 1818 to 1827. During the British protectorate the island made undoubted advances in material prosperity, but was several times the scene of political disturbances. It retained longer than the sister islands traces of feudal influence exerted by the landed proprietors, but has been gradually becoming more democratic. Under the Venetians it was divided into eight districts, and an elaborate system of police was in force; since its annexation to Greece it has been broken up into twenty demarchies, each with its separate jurisdiction and revenues, and the police system has been abolished.

Authorities.—A special treatise on the antiquities of Cephalonia was written by Petrus Maurocenus. See Holland’s *Travels* (1815); Ansted’s *Ionian Islands* (1863); Viscount Kirkwall’s

Four Years in Ionian Islands (1864); Wiebel's *Die Insel Kephalonia*; parliamentary papers. Riemann, *Recherches archéologiques sur les Iles Ioniennes* (Paris, 1879-1880); Partsch, *Kephallenia und Ithaka* (1890); see also CORFU; IONIAN ISLANDS.

(E. GR.)

CEPHALOPODA, the fifth of the classes into which the zoological phylum Mollusca is divided (see MOLLUSCA). The Cephalopoda are mainly characterized by the concrescence of the foot and head. The foot grows forward on each side so as to surround the mouth, the two upgrowths meeting on the dorsal side of the head—whence the name Cephalopoda. The perioral portion of the foot is drawn out into paired arm-like processes; these may be beset with sheathed tentacles or with suckers or hooks, or both. The epipodia are expanded into a pair of muscular lobes right and left, which are bent round towards one another so that their free margins meet and constitute a short tube—the siphon or funnel. The hind-foot is either very small or absent. A distinctive feature of the Cephalopoda is their bilateral symmetry and the absence of anything like the torsion of the visceral mass seen in the Anisopleurous Gastropoda.

The anus, although it may be a little displaced from the median line, is approximately median and posterior. The mantle-skirt is deeply produced posteriorly, forming a large sub-pallial chamber around the anus. By the side of the anus are placed the single or paired apertures of the nephridia, the genital apertures (paired only in *Nautilus*, in female Octopoda, female *Ommatostrephes* and male *Eledone*), and the paired ctenidia. The visceral hump or dome is elevated, and may be very much elongated in a direction almost at right angles to the primary horizontal axis of the foot.

A shell is frequently, but not invariably, secreted on the visceral hump and mantle-skirt. The shell is usually light in substance or lightened by air-chambers in correlation with the free-swimming habits of the Cephalopoda. It may be external or internal, that is, enclosed in folds of the mantle. Very numerous minute pigmented sacs, capable of expansion and contraction, and known as chromatophores, are usually present in the integument. The sexes are separate.

The ctenidia are well developed as paired gill-plumes, serving as the efficient branchial organs (figs. 4, 24),

The vascular system is very highly developed; the heart consists of a pair of auricles and a ventricle (figs. 12, 28). Branchial hearts are formed on the afferent vessels of the branchiae. It is not known to what extent the minute subdivision of the arteries extends, or whether there is a true capillary system.

The pericardium is extended so as to form a very large sac, passing among the viscera dorsalwards and sometimes containing the ovary or testis—the viscero-pericardial sac—which opens to the exterior either directly or through the renal organs. It has no connexion with the vascular system. The renal organs are always paired sacs, the walls of which invest the branchial afferent vessels (figs. 28, 29). They open each by a pore into the viscero-pericardial sac, except in *Nautilus*. The anal aperture is median and raised on a papilla. Jaws (fig. 6, *e*) and a radula (fig. 9) are well developed. The jaws have the form of powerful beaks, either horny or calcified (*Nautilus*), and are capable of inflicting severe wounds.

Cerebral, pleural and pedal ganglia are present, but the connectives are shortened and the ganglia concentrated and fused in the cephalic region. Large special ganglia (optic, stellate and supra-buccal) are developed. Sense-organs are highly developed; the eye exhibits a very special elaboration of structure in the Dibranchiata, and a remarkable archaic form in the nautilus. Otocysts are present in all. The typical osphradium is not present, except in *Nautilus*, but other organs are present in the cephalic region, to which an olfactory function is ascribed both in *Nautilus* and in the other Cephalopoda.

Hermaphroditism is unknown in Cephalopoda; male and female individuals always being differentiated. The genital aperture and duct is sometimes single, when it is the left; sometimes the typical pair is developed right and left of the anus. The males of nearly all Cephalopoda have been shown to be characterized by a peculiar modification of the arm-like processes or lobes of the fore-foot, connected with the copulative function. The term hectocotylization is applied to this modification (see figs. 6, 24). Elaborate spermatophores or sperm-ropes are formed by all Cephalopoda, and very usually the female possesses special capsule-forming and nidamental glands for providing envelopes to the eggs (fig. 4, *g.n.*). The egg is large, and the development is much modified by the presence of an excessive amount of food-material diffused in the protoplasm of the egg-cell. Trochosphere and veliger stages of development are consequently not recognizable.

The Cephalopoda are divisible into two orders, Tetrabranchiata and Dibranchiata, the names

of which (due to Sir R. Owen) describe the number of gill-plumes present; but in fact there are several characters, of as great importance as those derived from the gills, by which the members of these two orders are separated from one another.

Order 1. Tetrabranchiata (= Schizosiphona, Tentaculifera).

Characters.—The inrolled lateral margins of the epipodia are not fused, but form a siphon by apposition (fig. 4). The circumoral lobes of the fore-foot carry numerous retractile tentacles, not suckers (fig. 6). There are two pairs of ctenidial gills (hence Tetrabranchiata), and two pairs of renal organs, consequently four renal apertures (fig. 4). The viscero-pericardial chamber opens by two independent apertures to the exterior, and not into the renal sacs. There are two oviducts (right and left) in the female, and two sperm-ducts in the male, the left duct in both sexes being rudimentary. A large external shell, either coiled or straight, is present, and is not enclosed by reflections of the mantle-skirt. The shell consists of a series of chambers, the last-formed of which is occupied by the body of the animal, the hinder ones (successively deserted) containing gas (fig. 1). The pair of cephalic eyes are hollow chambers (fig. 14. A), opening to the exterior by minute orifices (pin-hole camera), and devoid of refractive structures. A pair of osphradia are present at the base of the gills (fig. 4, *olf*). Salivary glands are wanting. An ink-sac is *not* present. Branchial hearts are *not* developed on the branchial afferent vessels.

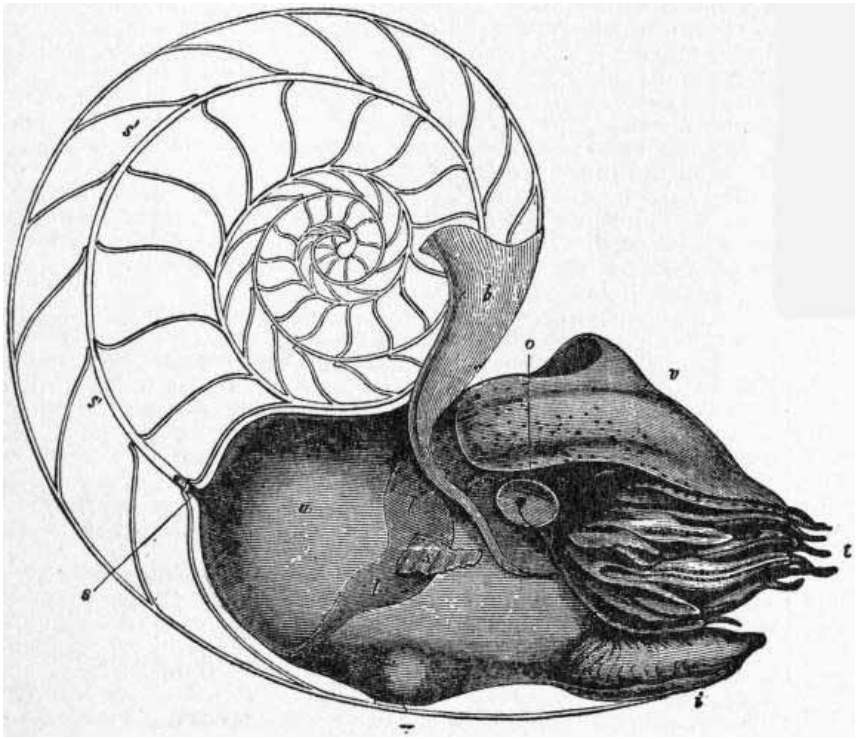


Fig. 1.—Lateral view of the female Pearly Nautilus, contracted by spirit and lying in its shell, the right half of which is cut away (from Gegenbaur, after Owen).

a, Visceral hump.

b, Portion of the free edge of the mantle-skirt reflected on to the shell,—the edge of the mantle-skirt can be traced downwards and forwards around the base of the mid-foot or siphon i.

l, l, Superficial origin of the retractor muscle of the mid-foot (siphon), more or less firmly attached to the shell, of which a small piece (*s*) is seen between the letters *l, l*.

s, (farther back) points to the siphuncular pedicle, which is broken off short and not continued, as in the perfect state, through the whole length of the siphuncle of the shell, also marked s and s'.

o, points to the right eye.

t, is placed near the extremities of the contracted tentacles of the outer or annular lobe of the fore-foot—the jointed tentacles are seen protruding a little from their long cylindrical sheaths.

v, The dorsal "hood" formed by an enlargement in this region of the annular lobe of the fore-foot (*m* in figs. 2, 3).

V, A swelling of the mantle-skirt, indicating the position on its inner face of the nidamental gland (see fig. 4, *g.n.*).

Visceral Hump and Shell.—The visceral hump of *Nautilus* (if we exclude from consideration the fine siphuncular pedicle which it trails, as it were, behind it) is very little, if at all, affected by the coiled form of the shell which it carries, since the animal always slips forward in the shell as it grows, and inhabits a chamber which is practically cylindrical (fig. 1). Were the deserted chambers thrown off instead of being accumulated behind the inhabited chamber as a coiled series of air-chambers, we should have a more correct indication in the shell of the extent and

form of the animal's body. Amongst Gastropods it is not very unusual to find the animal slipping forward in its shell as growth advances and leaving an unoccupied chamber in the apex of the shell. This may indeed become shut off from the occupied cavity by a transverse septum, and a series of such septa may be formed, but in no Gastropod are these apical chambers known to contain a gas during the life of the animal in whose shell they occur. A further peculiarity of the nautilus shell and of that of the allied extinct *Ammonites*, *Scaphites*, *Orthoceras*, &c., and of the living *Spirula*, is that the series of deserted air-chambers is traversed by a cord-like pedicle extending from the centro-dorsal area of the visceral hump to the smallest and first-formed chamber of the series. No structure comparable to this siphuncular pedicle is known in any other Mollusca. The siphuncle does not communicate with the coelomic cavity; it is a simple vascular process of the mantle, whose cavity consists of a venous sinus, and whose wall contains a ramification of the pallial artery. There appears to be no doubt that the deserted chambers of the nautilus shell contain in the healthy living animal a gas which serves to lessen the specific gravity of the whole organism. This gas is said to be of the same composition as the atmosphere, with a larger proportion of nitrogen. With regard to its origin we have only conjectures. Each septum shutting off an air-containing chamber is formed during a period of quiescence, probably after the reproductive act, when the visceral mass of the nautilus may be slightly shrunk, and gas is secreted from the dorsal integument so as to fill up the space previously occupied by the animal. A certain stage is reached in the growth of the animal when no new chambers are formed. The whole process of the loosening of the animal in its chamber and of its slipping forward when a new septum is formed, as well as the mode in which the air-chambers may be used as a hydrostatic apparatus, and the relation to this use, if any, of the siphuncular pedicle, is involved in obscurity, and is the subject of much ingenious speculation. In connexion with the secretion of gas by the animal, besides the parallel cases ranging from the protozoon *Arcella* to the physoclistic fishes, from the hydroid *Siphonophora* to the insect-larva *Corethra*, we have the identical phenomenon observed in the closely allied *Sepia* when recently hatched. Here, in the pores of the internal rudimentary shell, gas is observable, which has necessarily been liberated by the tissues which secrete the shell, and not derived from any external source (Huxley).

The coiled shell of *Nautilus*, and of the majority of extinct Tetrabranchiata, is peculiar in its relation to the body of the animal, inasmuch as the curvature of the coil proceeding from the centro-dorsal area is towards the head or forwards, instead of away from the head and backwards as in other discoid coiled shells such as *Planorbis*; the coil is in fact absolutely reversed in the two cases. Such a shell is said to be exogastric. But in some extinct forms, *e.g. Phragmoceras*, *Cyrtoceras*, *Ptenoceras*, the shell is coiled towards the ventral side, when it is termed endogastric. Amongst the extinct allies of the nautilus (Tetrabranchiata) we find shells of a variety of shapes, open coils such as *Scaphites*, leading on to perfectly cylindrical shells with chamber succeeding chamber in a straight line (*Orthoceras*), whence again we may pass to the corkscrew spires formed by the shell of *Turrilites*. In some extinct genera, *e.g. Gomphoceras*, among the Nautiloidea the aperture of the shell is contracted and the edge of the aperture is lobed. In these cases the animal was probably able only to protrude its appendages and not its whole head. The ventral part of the aperture corresponding to the funnel is separated from the dorsal part by a constriction. Hence it is possible to distinguish the ventral and dorsal sides of the shell and to decide whether it was exogastric or endogastric. The direction of the coil of the shell cannot be determined by the position of the siphuncle, which traverses the septa centrally, ventrally or dorsally. Contracted shell apertures occur also in Ammonitoidea, the condition reaching an extreme in *Morphoceras*, where the original aperture is subdivided by the ingrowth of the sides, so that only five small separate apertures remain. Of these the central probably corresponded to the mouth, two lateral to the eyes, and the remaining two to the pedal appendages.

Head, Foot, Mantle-skirt and Sub-pallial Chamber.—In the pearly nautilus the ovoid visceral hump is completely encircled by the free flap of integument known as mantle-skirt (figs. 2, 3, *d, e*). In the antero-dorsal region this flap is enlarged so as to be reflected a little over the coil of the shell which rests on it. In the postero-ventral region the flap is deepest, forming an extensive sub-pallial chamber, at the entrance of which e is placed in fig. 3. A view of the interior of the sub-pallial chamber, as seen when the mantle-skirt is retroverted and the observer faces in the direction indicated by the reference line passing from e in fig. 3, is given in fig. 4. With this should be compared the similar view of the sub-pallial chamber of the Dibranchiate *Sepia*. It should be noted as a difference between *Nautilus* and the Dibranchiates that in the former the nidamental gland (in the female) lies on that surface of the pallial chamber formed by the dependent mantle-flap (fig. 4, *g.n.*; fig. 1, V), whilst in the latter it lies on the surface formed by the body-wall; in fact in the former the base of the fold forming the mantle-skirt comprises in its area a part of what is unreflected visceral hump in the latter.

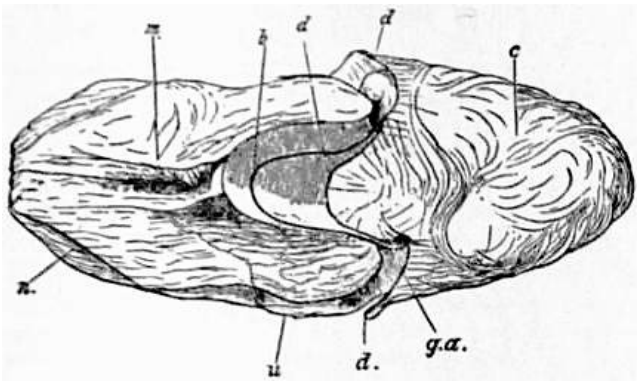


FIG. 2.—Spirit specimen of female Pearly Nautilus, removed from its shell, and seen from the antero-dorsal aspect (drawn from nature by A.G. Bourne).

m, The dorsal "hood" formed by the enlargement of the outer or annular lobe of the fore-foot, and corresponding to the sheaths of two tentacles (*g, g* in fig. 6).
n, Tentacular sheaths of lateral portion of the annular lobe.
u, The left eye.
b, The nuchal plate, continuous at its right and left posterior angles with the root of the mid-foot, and corresponding to the nuchal cartilage of Sepia.
c, Visceral hump.
d, The free margin of the mantle-skirt, the middle letter *d* points to that portion of the mantle-skirt which is reflected over a part of the shell as seen in fig. 1, *b*; the cup-like fossa to which b and d point in the present figure is occupied by the coil of the shell.
g.a. points to the lateral continuation of the nuchal plate b to join the root of the mid-foot or siphon.

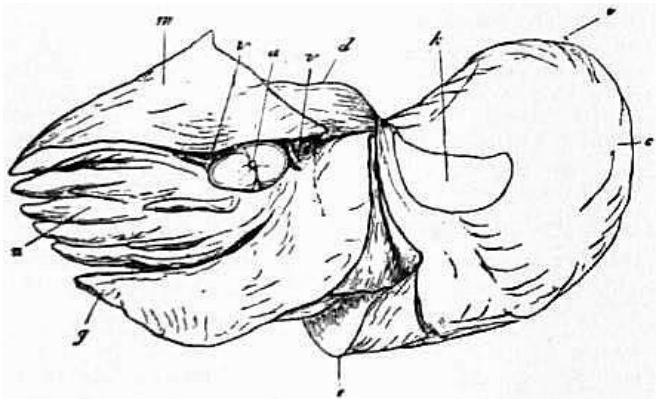


FIG. 3.—Lateral view of the same specimen as that drawn in fig. 2. Letters as in that figure with the following additions—

e, points to the concave margin of the mantle-skirt leading into the sub-pallial chamber.
g, The mid-foot or siphon.
k, The superficial origin of its retractor muscles closely applied to the shell and serving to hold the animal in its place.
l, The siphuncular pedicle of the visceral hump broken off short.
v, v, The superior and inferior ophthalmic tentacles.

The apertures of the two pairs of renal sacs, of the viscero-pericardial sac, of the genital ducts, and of the anus, are shown in position on the body-wall of the pallial chamber of *Nautilus* in figs. 4, 5. There are nine apertures in all, one median (the anus) and four paired. Besides these apertures we notice *two* pairs of gill-plumes which are undoubtedly typical ctenidia, and a short papilla (the osphradium) between each anterior and posterior gill-plume (see figs. 4, 5, and explanation). As compared with this in a Dibranchiate, we find (fig. 25) only four apertures, viz. the median anus with adjacent orifice of the ink-sac, the single pair of renal apertures, and one asymmetrical genital aperture (on the left side) except in female Octopoda and a few others, where the genital ducts and their apertures are paired. No viscero-pericardial pores are present on the surface of the pallial chamber, since in the Dibranchiata the viscero-pericardial sac opens by a pore into each nephridium instead of directly to the surface. A single pair of ctenidia (gill-plumes) is present instead of the two pairs in *Nautilus*. The existence of two pairs of ctenidia and of two pairs of renal sacs in *Nautilus*, placed one behind the other, is highly remarkable. The interest of this arrangement is in relation to the general morphology of the Mollusca, for it is impossible to view this repetition of organs in a linear series as anything else than an instance of metameric segmentation, comparable to the segmentation of the ringed worms and Arthropods. The only other example which we have of this metamerism in the Mollusca is presented by the Chitons. There we find not two pairs of ctenidia merely, but sixteen pairs (in some species more) accompanied by a similar metamerism of the dorsal integument, which carries eight shells. In *Chiton* the renal organs are not affected by the metamerism as they are in *Nautilus*. It is

impossible on the present occasion to discuss in the way which their importance demands the significance of these two instances among Mollusca of incomplete or partial metamerism; but it would be wrong to pass them by without insisting upon the great importance which the occurrence of these isolated instances of metameric segmentation in a group of otherwise unsegmented organisms possesses, and the light which they may be made to throw upon the nature of metameric segmentation in general.

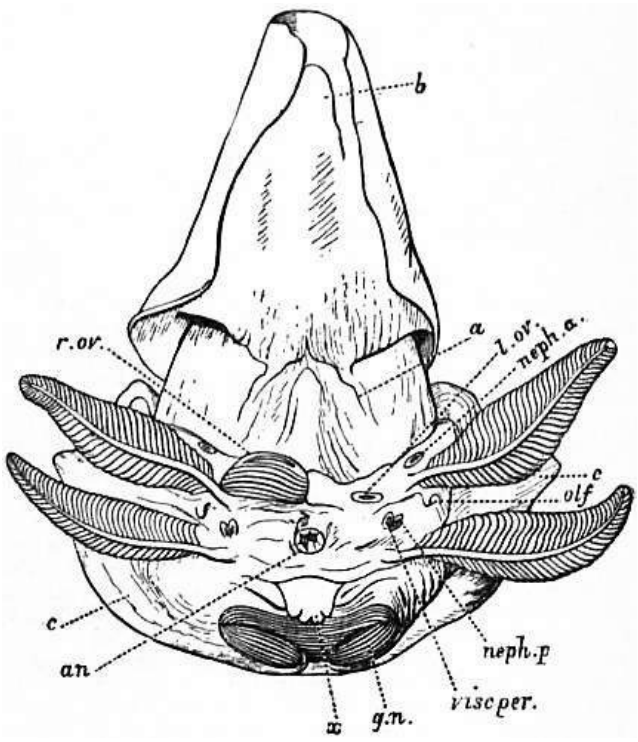


FIG. 4.—View of the postero-ventral surface of a female Pearly Nautilus, the mantle-skirt (*c*) being completely reflected so as to show the inner wall of the sub-pallial chamber (drawn from nature by A.G. Bourne).

a, Muscular band passing from the mid-foot to the integument.
b, The valve on the surface of the funnel, partially concealed by the inrolled lateral margin of the latter.
c, The mantle-skirt retroverted.
an, The median anus.
x, Post-anal papilla of unknown significance.
g.n., Nidamental gland.
r.ov, Aperture of the right oviduct.
l.ov, Aperture of the rudimentary left oviduct (pyriform sac of Owen).
neph.a, Aperture of the left anterior renal sac.
neph.p, Aperture of the left posterior renal sac.
viscper, Left aperture of the viscero-pericardial sac.
olf, The left osphradium placed near the base of the anterior gill-plume.

The four gill-plumes (ctenidia) are not lettered.

The foot and head of *Nautilus* are in the adult inextricably grown together, the eye being the only part belonging primarily to the head which projects from the all-embracing foot. The fore-foot or front portion of the foot has the form of a number of lobes carrying tentacles and completely surrounding the mouth (figs. 2, 3). The epipodia incline towards each other posteriorly so as to form an incomplete siphon (fig. 4), a condition which is completed and rendered permanent in the tubular funnel of Dibranchiata. The epipodial nature of the funnel is well seen in young embryos, in which this organ is situated laterally and posteriorly between the mantle and the foot.

The lobes of the fore-foot of *Nautilus* and of the other Cephalopoda require further description. It has been doubted whether these lobes were rightly referred (by T.H. Huxley) to the fore-foot, and it has been maintained by some zoologists (H. Grenadier, H. von Jhering) that they are truly processes of the head. It appears to be impossible to doubt that the lobes in question are the fore-portion of the foot, when their development is examined (see fig. 35), further, when the fact is considered that they are

innervated by the pedal ganglion. The fore-foot of *Nautilus* completely surrounds the buccal cone (fig. 6, e), so as to present an appearance with its expanded tentacles similar to that of the disk of a sea-anemone (*Actinia*). A.G. Bourne, of University College, prepared from actual specimens the drawings of this part in the male and female *Nautilus* reproduced in fig. 6, and restored the parts to their natural form when expanded. The drawings show very strikingly the difference between male and female. In the females (lower figure), we observe in the centre of the disk the buccal cone e carrying the beak-like pair of jaws which project from the finely papillate buccal membrane. Three tentaculiferous lobes of the fore-foot are in immediate contact with this buccal cone; they are the right and left (*c, c*) inner lobes, and the inferior inner lobe (*d*)—called inferior because it really lies ventralwards of the mouth. This inner inferior lobe is clearly a double one, representing a right and left inner inferior lobe fused into one. A lamellated organ on its surface, known as Owen's organ, probably olfactory in function (*n*), marks the separation of the constituent halves of this double lobe. Each half carries a group of fourteen tentacles. The right and the left inner lobes (*c, c*) each carry twelve tentacles. External to these three lobes the muscular substance of the mouth-embracing foot is raised into a wide ring, which becomes especially thick and large in the dorsal region where it is notably modified in form, offering a concavity into which the coil of the shell is received, and furnishing a protective roof to the retracted mass of tentacles. This part of the external annular lobe of the fore-foot is called the "hood" (figs. 2, 3, *m*). The median antero-posterior line traversing this hood exactly corresponds to the line of concrescence of the two halves of the fore-foot, which primitively grew forward one on each side of the head, and finally fused together along this line in front of the mouth. The tentacles carried by the great annular lobe are nineteen on each side, thirty-eight in all. They are called "digital," and are somewhat larger than the "labial" tentacles carried on the three inner lobes. The dorsalmost pair of tentacles (marked *g* in fig. 6) are the only ones which actually belong to that part of the disk which forms the great dorsal hood m. The hood is, in fact, to a large extent formed by the enlarged sheaths of these two tentacles. All the tentacles of the circumoral disk are set in remarkable tubular sheaths, into which they can be drawn. The sheaths of some of those belonging to the external or annular lobe are seen in fig. 3, marked n. The sheaths are muscular as well as the tentacles, and are simply tubes from the base of which the solid tentacle grows. The functional significance of this sheathing arrangement is as obscure as its morphological origin. With reference to the latter, it appears highly probable that the tubular sheath represents the cup of a sucker such as is found on the fore-foot of the Dibranchiata. In any case, it seems to the writer impossible to doubt that each tentacle, and its sheath on a lobe of the circumoral disk of Nautilus, corresponds to a sucker on such a lobe of a Dibranchiate. W. Keferstein follows Sir R. Owen in strongly opposing this identification, and in regarding such tentacle as the equivalent of a whole lobe or arm of a Decapod or Octopod Dibranch. The details of these structures, especially in the facts concerning the hectocotylus and spadix, afford the most conclusive reasons for dissenting from Owen's view. On the ventral side an extensive part of the internal surface of the muscular ring is laminated, forming the so-called "organ of Valenciennes," peculiar to the female and serving for the attachment of the spermatophores. We have so far enumerated in the female nautilus ninety tentacles. Four more remain which have a very peculiar position, and almost lead to the suggestion that the eye itself is a modified tentacle. These remaining tentacles are placed one above (before) and one below (behind) each eye, and bring up the total to ninety-four (fig. 3 *v, v*).

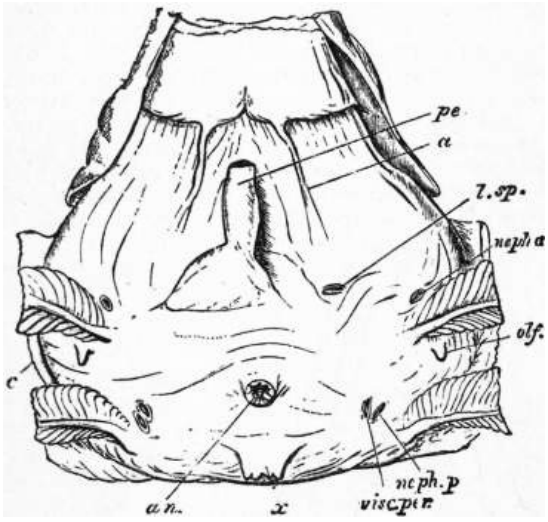


FIG. 5.—View of the postero-ventral surface of a male Pearly Nautilus, the mantle-skirt (*c*) being completely reflected so as to show the inner wall of the sub-pallial chamber, and the four ctenidia and the foot cut short (drawn from nature by A.G. Bourne). *pe*, Penis, being the enlarged termination of the right spermatic duct; *l.sp*, aperture of the rudimentary left spermatic duct (pyriform sac of Owen). Other letters as in fig. 4.

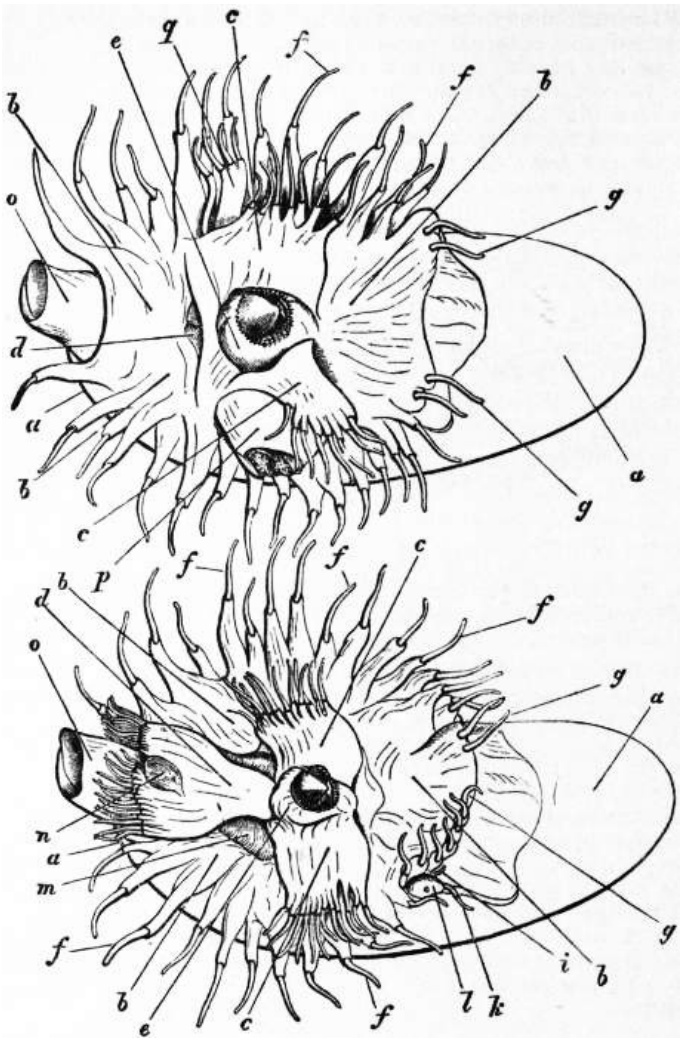


FIG. 6.—Male (upper) and female (lower) specimens of *Nautilus pompilius* as seen in the expanded condition, the observer looking down on to the buccal cone *e*; one-third the natural size linear. The drawings have been made from actual specimens by A.G. Bourne, B. Sc., University College, London.

a, The shell.

b, The *outer* ring-like expansion (annular lobe) of the circumoral muscular mass of the fore-foot, carrying nineteen tentacles on each side—posteriorly this is enlarged to form the "hood" (marked *v* in fig. 1 and *m* in figs. 2 and 3). giving off the pair of tentacles marked *g* in the present figure.

c, The right and left inner lobes of the fore-foot, each carrying twelve tentacles in the female, in the male subdivided into *p*, the "spadix" or hectocotylus on the left side, and *q*, the "anti-spadix," a group of four tentacles on the right side—it is thus seen that the subdivided right and left inner lobes of the male correspond to the undivided right and left inner lobes of the female.

d, The inner inferior lobe of the fore-foot, a bilateral structure in the female carrying two groups, each of fourteen tentacles, separated from one

f, The tentacles of the outer circumoral lobe or annular lobe of the fore-foot projecting from their sheaths.

g, The two most posterior tentacles of this series belonging to that part of the annular lobe which forms the hood (*m* in figs. 2 and 3).

i, Superior ophthalmic tentacle.

k, Inferior ophthalmic tentacle.

l, Eye.

m, Paired laminated organ on each side of the base of the inner inferior lobe (*d*) of the female.

n, Olfactory lamellae upon the inner inferior lobe (in the female).

o, The siphon (mid-foot).

p, The spadix (in the male), the hectocotylized portion of the left inner lobe of the fore-foot representing four modified tentacles, eight being left unmodified.

q, The anti-spadix (in the male), being four of the twelve tentacles of the right inner lobe of the fore-

another by a lamellated organ *n*, supposed to be olfactory in function—in the male the inner inferior lobe of the fore-foot is very much reduced, and has the form of a paired group of lamellae (*d* in the upper figure).

e, The buccal cone, rising from the centre of the three inner lobes, and fringing the protruded calcareous beaks or jaws with a series of minute papillae.

foot isolated from the remaining eight, and representing on the right side the differentiated spadix of the left side. The four tentacles of the anti-spadix are set, three on one base and one on a separate base.

In the adult male nautilus we find the following important differences in the tentaculiferous disk as compared with the female (see upper drawing in fig. 6). The inner inferior lobe is rudimentary, and carries no tentacles. It is represented by three groups of lamellae (*d*), which are not fully exposed in the drawing. The right and left inner lobes are subdivided each into two portions. The right shows a larger portion carrying eight tentacles, and smaller detached groups (*q*) of four tentacles, of which three have their sheaths united whilst one stands alone. These four tentacles may be called the "anti-spadix." The left inner lobe shows a similar larger portion carrying eight tentacles, and a curious conical body behind it corresponding to the anti-spadix. This is the "spadix." It carries no tentacles, but is terminated by imbricated lamellae. These lamellae appear to represent the four tentacles of the anti-spadix of the right internal lobe, and are generally regarded as corresponding to that modification of the sucker-bearing arms of male Dibranchiate Siphonopods to which the name "hectocotylus" is applied. The spadix is in fact the hectocotylized portion of the fore-foot of the male nautilus. The hectocotylized arm or lobe of male Dibranchiata is connected with the process of copulation, and in the male nautilus the spadix has probably a similar significance, though it is not possible to suggest how it acts in this relation. It is important to observe that the modification of the fore-foot in the male as compared with the female nautilus is not confined to the existence of the spadix. The anti-spadix and the reduction of the inner inferior lobe are also male peculiarities. The external annular lobe in the male does not differ from that of the female; it carries nineteen tentacles on each side. The four ophthalmic tentacles are also present. Thus in the male nautilus we find altogether sixty-two tentacles, the thirty-two additional tentacles of the female being represented by lamelliform structures.

Musculature, Fins and, Cartilaginous Skeleton.—Without entering into a detailed account of the musculature of *Nautilus*, we may point out that the great muscular masses of the fore-foot and of the mid-foot (siphon) are ultimately traceable to a large transverse mass of muscular tissue, the ends of which are visible through the integument on the right and left surfaces of the body dorsal of the free flap of the mantle-skirt (fig. 1, *l*, *l*, and fig. 3, *k*). These muscular areae have a certain adhesion to the shell, and serve both to hold the animal in its shell and as the fixed supports for the various movements of the tentaculiferous lobes and the siphon. They are to be identified with the ring-like area of adhesion by which the foot-muscle of the limpet is attached to the shell of that animal. In the Dibranchs a similar origin of the muscular masses of the fore-foot and mid-foot from the sides of the shell—modified, as this is, in position and relations—can be traced.

In *Nautilus* there are no fin-like expansions of the integument, whereas such occur in the Decapod Dibranchs along the sides of the visceral hump (figs. 15, 16). As an exception among Octopoda lateral fins occur in *Pinnoctopus* (fig. 38, A), and in *Cirrhoteuthis* (fig. 38, D).

In *Nautilus* there is a curious plate-like expansion of integument in the mid-dorsal region just behind the hood, lying between that structure and the portion of mantle-skirt which is reflected over the shell. This is shown in fig. 2, *b*. If we trace out the margin of this plate we find that it becomes continuous on each side with the sides of the funnel. In *Sepia* and other Decapods (not in Octopods) a closely similar plate exists in an exactly corresponding position (see *b* in figs. 10, 26). In *Sepia* a cartilaginous development occurs here immediately below the integument forming the so-called "nuchal plate," drawn in fig. 8, D. The morphological significance of this

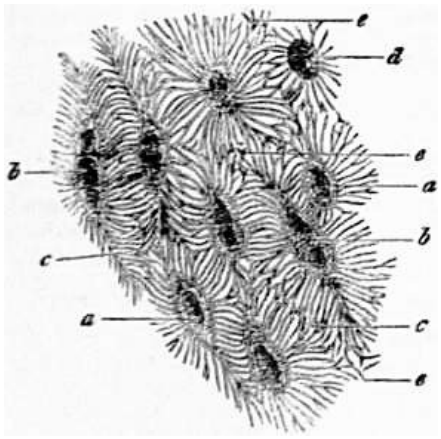


FIG. 7.—Minute structure of the cartilage of *Loligo* (from Gegenbaur, after Furbringer)

a, Simple cells.
b, Dividing cells.

nuchal lamella, as seen both in *Nautilus* and in *Sepia*, is not obvious. Cartilage having the structure shown in fig. 7 occurs in various regions of the body of Cephalopoda. In all Glossophorous Mollusca the lingual apparatus is supported by internal skeletal pieces, having the character of cartilage; but in the Cephalopoda such cartilage has a wider range.

c, Canaliculi.
d, An empty cartilage capsule with its pores.
e, Canaliculi in section.

In *Nautilus* a large H-shaped piece of cartilage is found, forming the axis of the funnel (fig. 8, A, B). Its hinder part extends up into the head and supports the peri-oesophageal nerve-mass (*a*), whilst its two anterior rami extend into the tongue-like siphon. In *Sepia*, and Dibranchs generally, the cartilage takes a different form, as shown in fig. 8, C. The processes of this cartilage cannot be identified in any way with those of the capito-pedal cartilage of *Nautilus*. The lower larger portion of this cartilage in *Sepia* is called the cephalic cartilage, and forms a complete ring round the oesophagus; it completely invests also the ganglionic nerve-collar, so that all the nerves from the latter have to pass through foramina in the cartilage. The outer angles of this cartilage spread out on each side so as to form a cup-like receptacle for the eyes. The two processes springing right and left from this large cartilage in the median line (fig. 8, C) are the “pre-orbital cartilages”; in front of these, again, there is seen a piece like an inverted T, which forms a support to the base of the “arms” of the fore-foot, and is the “basi-brachial” cartilage. The Decapod Dibranchs have, further, the “nuchal cartilage” already mentioned, and in *Sepia*, a thin plate-like “sub-ostracal” or (so-called) dorsal cartilage, the anterior end of which rests on and fits into the concave nuchal cartilage. In Octopoda there is no nuchal cartilage, but two band-like “dorsal cartilages.” In Decapods there are also two cartilaginous sockets on the sides of the funnel—“siphon-hinge cartilages”—into which fleshy knobs of the mantle-skirt are loosely fitted. In *Sepia*, along the whole base-line of each lateral fin of the mantle (fig. 15), is a “basi-pterygial cartilage.” It is worthy of remark that we have, thus developed, in Dibranch Cephalopods a more complete internal cartilaginous skeleton than is to be found in some of the lower vertebrates. There are other instances of cartilaginous endo-skeleton in groups other than the Vertebrata. Thus in some capito-branchiate Chaetopods cartilage forms a skeletal support for the gill-plumes, whilst in the Arachnids (*Mygale*, *Scorpio*) and in *Limulus* a large internal cartilaginous plate—the ento-sternite—is developed as a support for a large series of muscles.

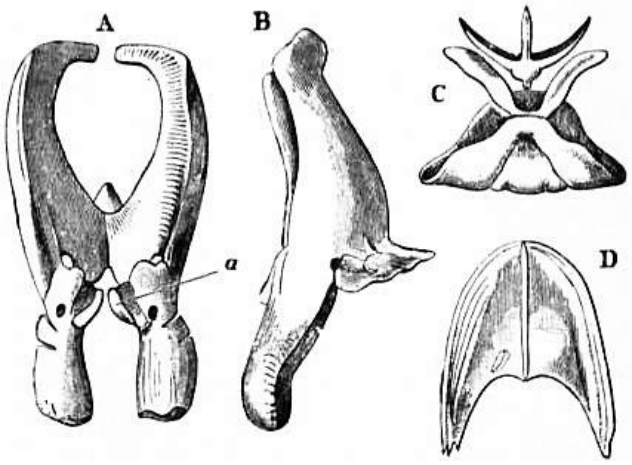


FIG. 8.—Cartilaginous skeleton of Cephalopoda (after Keferstein.)

A, Capito-pedal cartilage of *Nautilus pompilius.*
a points to the ridge which supports the pedal portion of the nerve-centre.
B, Lateral view of the same—the large anterior processes are sunk in the muscular substance of the siphon.
C, Cephalic cartilages of *Sepia officinalis*.
D, Nuchal cartilage of *Sepia officinalis*.

Alimentary Tract.—The buccal cone of *Nautilus* is terminated by a villous margin (buccal membrane), surrounding the pair of beak-like jaws, of which the ventral projects over the dorsal. These are very strong and dense in *Nautilus*, being calcified. Fossilized beaks of Tetrabranchiata are known under the name of rhyncholites. In Dibranchs the beaks are horny, but similar in shape to those of *Nautilus*. They resemble in general those of a parrot, the lower beak being the larger and overlapping the upper or dorsal beak. The lingual ribbon and odontophoral apparatus have the structure which is typical for Glossophorous Mollusca. In fig. 9, A is represented a single row of teeth from the lingual ribbon of *Nautilus*, and in fig. 9, B, C, of other Cephalopoda.

In *Nautilus* a long and wide crop or dilated oesophagus (fig. 10, *cr*) passes from the muscular buccal mass, and at the apex of the visceral hump passes into a highly muscular stomach,

resembling the gizzard of a bird (fig 10, *gizz*). A nearly straight intestine passes from the muscular stomach to the anus, near which it develops a small caecum. In other Cephalopods the oesophagus is usually narrower and the muscular stomach more capacious, whilst a very important feature in the alimentary tract is formed by the caecum. In all but *Nautilus* the caecum lies near the stomach, and may be very capacious—much larger than the stomach in *Loligo vulgaris*—or elongated into a spiral coil. The simple U-shaped flexure of the alimentary tract, as seen in fig. 10, is the only important one which it exhibits in the Cephalopoda. The acini of the large liver of *Nautilus* are compacted into a solid reddish-brown mass by a firm membrane, as also is the case in the Dibranchiata. The liver has four paired lobes in *Nautilus*, which open by two bile-ducts into the alimentary canal at the commencement of the intestine. The bile-ducts unite before entering the intestine. In Dibranchiata the two large lobes of the liver are placed antero-dorsally (beneath the shell in Decapoda), and the bile-ducts open into the caecum. Upon the bile-ducts in Dibranchiata are developed yellowish glandular diverticula, which are known as “pancreas,” though neither physiologically nor morphologically is there any ground for considering either the so-called liver or the so-called pancreas as strictly equivalent to the glands so denominated in the Vertebrata. In *Nautilus* the equivalents of the pancreatic diverticula of the Dibranchs can be traced upon the relatively shorter bile-ducts.

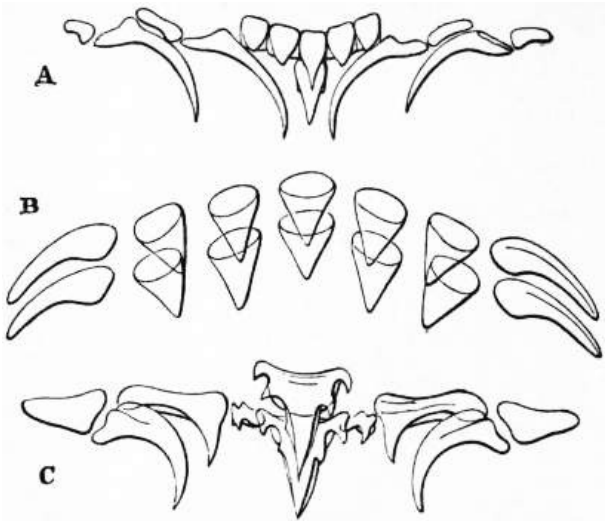


FIG. 9.—Lingual dentition of Cephalopoda. A, A single row of lingual teeth of *Nautilus pompilius* (after Keferstein). B, Two rows of lingual teeth of *Sepia officinalis* (after Troschel). C, Lingual teeth of *Eledone cirrhosa* (after Loven).

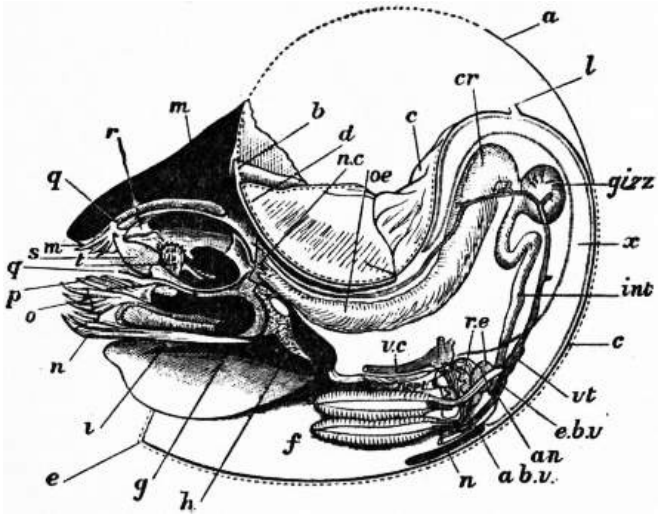


FIG. 10.—Diagram representing a vertical approximately median antero-posterior section of *Nautilus pompilius* (from a drawing by A.G. Bourne). The parts which are quite black are the cut muscular surfaces of the foot and buccal mass.

a, The shell.
b, The nuchal plate, identical with the nuchal cartilage of *Sepia* (see fig. 2, *b*).
c, The integument covering the visceral hump.
d, The mantle flap or skirt in the dorsal region where it rests against the coil of the shell.
q, Buccal membrane.
r, Upper jaw or beak.
s, Lower jaw or beak.
t, Lingual ribbon.
x, The viscero-pericardial sac.
n.c, Nerve-collar.
oe, Oesophagus.
cr, Crop.
gizz, Gizzard.

e, The inferior margin of the mantle-skirt resting on the lip of the shell represented by the dotted line.
f, The pallial chamber with two of the four gills.
g, The vertically cut median portion of the mid-foot (siphon).
h, The capito-pedal cartilage (see fig. 8).
i, The valve of the siphon.
l, The siphuncular pedicle (cut short).
m, The hood or dorsal enlargement of the annular lobe of the fore-foot.
n, Tentacles of the annular lobe.
p, Tentacles of inner inferior lobe.
int, Intestine.
an, Anus.
nept, Aperture of a nephridial sac.
r.e, Renal glandular masses on the walls of the afferent branchial veins (see fig. 11).
a.b.v, Afferent branchial vessel.
e.b.v, Efferent branchial vessel.
vt, Ventricle of the heart.

Posterior salivary glands are not developed in *Nautilus*, but on each side in the wall of the buccal mass is a gland corresponding to the anterior salivary gland of the Dibranchiata. No ink-sac is present in *Nautilus*.

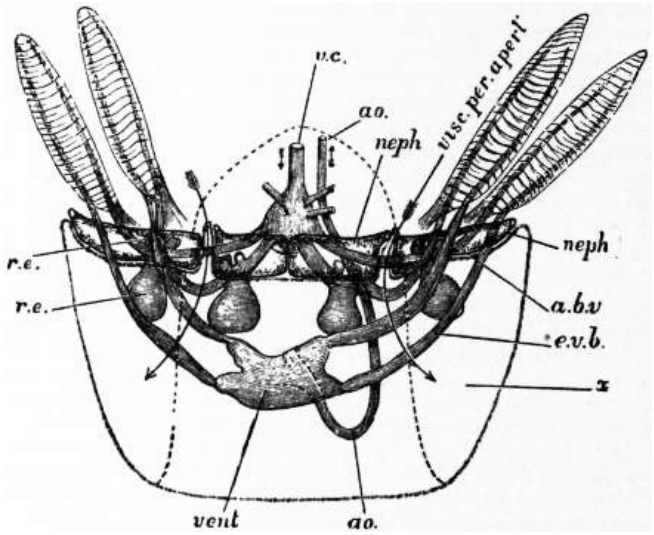


FIG. 11.—Diagram to show the relations of the four nephridial sacs, the viscero-pericardial sac, and the heart and large vessels in *Nautilus* (drawn by A.G. Bourne).

neph, *neph*, on the right side point to the two nephridia of that side (the two of the opposite side are not lettered)—each is seen to have an independent aperture.
x is the viscero-pericardial sac, the dotted line indicating its backward extension.
visc. per. apert, marks an arrow introduced into the right aperture of the viscero-pericardial sac.
r.e, *r.e*, point to the glandular enlarged walls of the afferent branchial vessels—two small glandular bodies of the kind are seen to project into each nephridial sac, whilst a larger body of the same kind depends from each of the four branchial afferent vessels into the viscero-pericardial sac.
v.c, Vena-cava.
vent, Ventricle of the heart.
ao, Cephalic aorta (the small abdominal aorta not drawn).
a.b.v, Branchial vessel.
e.v.b, Efferent branchial vessel.

Coelom, Blood-vascular System and Excretory Organs.—Nautilus and the other Cephalopoda conform to the general Molluscan characters in regard to these organs. Whilst the general visceral cavity forms a lacunar blood-system or series of narrow spaces, connected with the trunks of a well-developed vascular system, that part of the original coelom surrounding the heart and known as the Molluscan pericardium is shut off from this general blood-lymph system, and communicates, directly in *Nautilus*, in the rest through the renal sacs, with the exterior. In the Cephalopoda this specialized pericardial cavity is particularly large, and has been recognized as distinct from the blood-carrying spaces, even by anatomists who have not considered the pericardial space of other Mollusca to be thus isolated. The enlarged pericardium, which may even take the form of a pair of sacs, has been variously named, but is best known as the viscero-pericardial sac or chamber. In *Nautilus* this sac occupies the whole of the postero-dorsal surface and a part of the antero-dorsal (see fig. 10, *x*), investing the genital and other viscera which lie below it, and having the ventricle of the heart suspended in it. Certain membranes forming incomplete septa, and a curious muscular band—the pallio-cardiac band—traverse the sac. The four branchial afferent veins, which in traversing the walls of the four renal sacs give off, as it were, glandular diverticula into those sacs, also give off at the same points four much larger glandular masses, which hang freely into the viscero-pericardial chamber (fig. 11, *r.e*). In *Nautilus* the viscero-pericardial sac opens to the exterior directly by a pair of apertures, one placed close to the right and one close to the left posterior renal aperture (fig. 5, *visc. per*). This direct opening of the pericardial sac to the exterior is an exception to what occurs in all other Mollusca. In all other Molluscs the pericardial sac opens into the renal organs, and through them or the one renal organ to the exterior. In *Nautilus* there is no opening from the viscero-pericardial sac into the renal sacs. Therefore the external pore of the viscero-pericardial sac may possibly be regarded as a shifting of the reno-pericardial orifice from the actual wall of the renal sac to a position alongside of its orifice. Parallel cases of such shifting are seen in the varying position of the orifice of the ink-bag in Dibranchiata, and in the orifice of the genital ducts of Mollusca, which in some few cases (*e.g. Spondylus*) open into the renal organs, whilst in other cases they open close by the side of the renal organs on the surface of the body. The viscero-pericardial sac of the Dibranchs is very large also, and extends into the dorsal region. It varies in shape—that is to say, in the extensions of its area right and left between the various viscera—in different genera, but in the Decapods is largest. In an extension of this chamber is placed the ovary of *Sepia*, whilst the ventricle of the heart and the branchial hearts and their appendages also lie in it. It is probable that water is drawn into this chamber through the renal sacs, since sand and other foreign matters are found in it. In all it opens into the pair of renal sacs by an orifice on the wall of each, not far from the external orifice (fig. 29, *y, y'*). There does not seem any room for doubting that each orifice corresponds to the reno-pericardial orifice which we have seen in the Gastropoda, and shall find again in the Lamellibranchia.

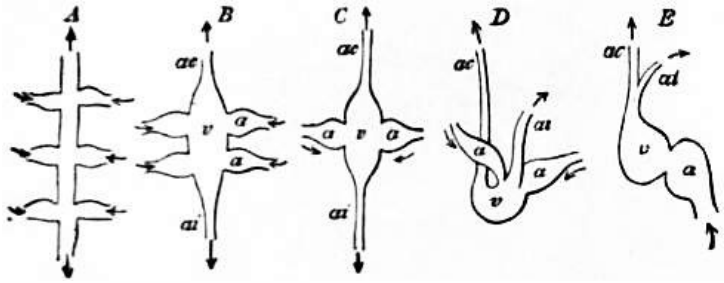


FIG. 12.—Diagram to show the relations of the heart in the Mollusca. (From Gegenbaur.)

A, Part of the dorsal vascular trunk and transverse trunks of a worm.
B, Ventricle and auricles of *Nautilus*.
C, Of a Lamellibranch, of *Chiton*, or of *Loligo*.
D, Of *Octopus*.
E, Of a Gastropod.
a, Auricle.
v, Ventricle.
ac, Arteria = cephalica = (aorta).
ai, Arteria abdominalis. The arrows show the direction of the blood-current.

The circulatory organs, blood-vessels and blood of *Nautilus* do not differ greatly from those of Gastropoda. The ventricle of the heart is a four-cornered body, receiving a dilated branchial efferent vessel (auricle) at each corner (fig. 11). It gives off a cephalic aorta anteriorly, and a smaller abdominal aorta posteriorly. The diagram, fig. 12, serves to show how this simple form of heart is related to the dorsal vessel of a worm or of an Arthropod, and how by a simple flexure of the ventricle (D) and a subsequent suppression of one auricle, following on the suppression of one branchia, one may obtain the form of heart characteristic of the anisopleurous Gastropoda (excepting the Aspidobranchia). The flexed condition of the heart is seen in *Octopus*, and is to some extent approached by *Nautilus*, the median vessels not presenting that perfect parallelism

which is shown in the figure (B). The most remarkable feature presented by the heart of *Nautilus* is the possession of four instead of two auricles, a feature which is simply related to the metamerism of the branchiae. By the left side of the heart of *Nautilus*, attached to it by a membrane, and hanging loosely in the viscero-pericardial chamber, is the pyriform sac of Owen. This has been shown to be the rudimentary left oviduct or sperm-duct, as the case may be (E.R. Lankester and A.G. Bourne), the functional right ovi-sac and its duct being attached by a membrane to the opposite side of the heart.

The cephalic and abdominal aortae of *Nautilus* appear, after running to the anterior and posterior extremes of the animal respectively, to open into sinus-like spaces surrounding the viscera, muscular masses, &c. These spaces are not large, but confined and shallow. Capillaries are stated to occur in the integument. In the Dibranchs the arterial system is very much more complete; it appears in some cases to end in irregular lacunae or sinuses, in other cases in true capillaries which lead on into veins. An investigation of these capillaries in the light of modern histological knowledge is much needed. From the sinuses and capillaries the veins take origin, collecting into a large median trunk (the vena cava), which in the Dibranchs as well as in *Nautilus* has a ventral (postero-ventral) position, and runs parallel to the long axis of the animal. In *Nautilus* this vena cava gives off at the level of the gills four branchial afferent veins (fig. 11, *v.c.*), which pass into the four gills without dilating. In the Dibranchs at a similar position the vena cava gives off a right and a left branchial afferent vein, each of which, traversing the wall of the corresponding renal sac and receiving additional factors, dilates at the base of the corresponding branchial plume, forming there a pulsating sac—the branchial heart. Attached to each branchial heart is a curious glandular body, which may possibly be related to the larger masses (fig. 11, *r.e.*) which depend into the viscero-pericardial cavity from the branchial afferent veins of *Nautilus*. From the dilated branchial heart the branchial afferent vessel proceeds, running up the adpallial face of the gill-plume. From each gill-plume the blood passes by the branchial efferent vessels to the heart, the two auricles being formed by the dilatation of these vessels.

The blood contains the usual amoeboid corpuscles, and a diffused colouring matter—the haemocyanin of Fredericque—which has been found also in the blood of *Helix*, and in that of the Arthropods *Homarus* and *Limulus*. It is colourless in the oxidized, blue in the deoxidized state, and contains copper as a chemical constituent.

The renal sacs and renal glandular tissue are closely connected with the branchial advehent vessels in *Nautilus* and in the other Cephalopoda. The arrangement is such as to render the typical relations and form of a renal tube difficult to trace. In accordance with the metamerism of *Nautilus* already noticed, there are two pairs of renal organs. Each assumes the form of a sac opening by a pore to the exterior. As is usual in renal tubes a glandular and a non-glandular portion are distinguished in each sac; these portions, however, are not successive parts of a tube, as happens in other cases, but they are localized areae of the wall of the sac. The glandular renal tissue is, in fact, confined to a tract extending along that part of the sac's wall which immediately invests the great branchial afferent vein. The vein in this region gives off directly from its wall a complete herbage of little venules, which branch and anastomose with one another, and are clothed by the glandular epithelium of the renal sac. The secretion is accumulated in the sac and passed by its aperture to the exterior. Probably the nitrogenous excretory product is very rapidly discharged; in *Nautilus* a pink-coloured powder is found accumulated in the renal sacs, consisting of calcium phosphate. The presence of this phosphatic calculus by no means proves that such was the sole excretion of the renal glandular tissue. In *Nautilus* a glandular growth like that rising from the wall of the branchial vessel into its corresponding renal sac, but larger in size, depends from each branchial afferent vessel into the viscero-pericardial sac and forms the pericardial gland—probably identical with the "appendage" of the branchial hearts of Dibranchs.

The chief difference, other than that of number, between the renal organs of the Dibranchs and those of *Nautilus*, is the absence of the accessory growths depending into the viscero-pericardial space just mentioned, and, of more importance, the presence in the former of a pore leading from the renal sac into the viscero-pericardial sac (*y*, *y´* in fig. 29). The external orifices of the renal organs are also more prominent in Dibranchs than in *Nautilus*, being raised on papillae (*np* in fig. 29; *r* in fig. 25). In *Sepia* the two renal sacs give off each a diverticulum dorsalwards, which unites with its fellow and forms a great median renal chamber, lying between the ventral portions of the renal organs and the viscero-pericardial chamber. In *Loligo* the fusion of the two renal organs to form one sac is still more obvious, since the ventral portions are united. In *Octopus* the renal sacs are quite separate.

Gonads and Genital Ducts.—In *Nautilus* it has been shown by E. Ray Lankester and A.G. Bourne that the genital ducts of both sexes are paired right and left, the left duct being rudimentary and forming the "pyriform appendage," described by Sir R. Owen as adhering by membranous attachment to the ventricle of the heart, and shown by W. Keferstein to communicate by a pore with the exterior. The ovary (female gonad) or the testis (male gonad) lies in *Nautilus*, as in the Dibranchs, in a distinct cavity walled off from the other viscera, near the centro-dorsal region. This chamber is formed by the coelomic or peritoneal wall; the space

enclosed is originally part of the coelom, and in *Sepia* and *Loligo* is, in the adult, part of the viscero-pericardial chamber. In *Octopus* it is this genital chamber which communicates by a right and a left canal with the renal sac, and is the only representative of pericardium. The ovary or testis is itself a growth from the inner wall of this chamber, which it only partly fills. In *Nautilus* the right genital duct, which is functional, is a simple continuation to the pore on the postero-dorsal surface of the membranous walls of the capsule in which lies the ovary or the testis, as the case may be. The gonad itself appears to represent a single median or bilateral organ.

The ovary forms a large projection into the genital coelom, and the coelomic epithelium is deeply invaginated into the mass of the gonad, so as to constitute an ovarian cavity communicating with the coelom by a narrow aperture. The ova originate in the epithelium, migrate below it and then, as they enlarge, project into the ovarian cavity, pushing the epithelium before them. Each ovum is surrounded by a follicular epithelium which is nourished by numerous blood-vessels, and which penetrates into the surface of the ovum in numerous folds. When mature, the ovum is contained in a membrane or chorion with a micropyle, and escapes by dehiscence of the follicle into the genital coelom and duct. In its passage to the exterior the ovum passes a glandular structure on the wall of the genital capsule, which probably secretes the gelatinous substance enclosing the eggs. In addition to this internal gland there are other accessory glands, which are not related to the genital duct or sac but are differentiations of the wall of the pallial cavity, and occur on the inner wall of the pallium in *Nautilus*, on the somatic wall in Dibranchiata. In *Nautilus* they form a continuous mass. These produce the external envelopes of the eggs.

In the male the testis is a specialized portion of the wall of the genital coelom, and has a structure comparable to that of the ovary. The spermatozoa pass through an orifice from the cavity of the testis to the genital capsule, and thence to the spermiduct. The spermiduct is provided with a glandular pouch, and opens into a terminal reservoir known as Needham’s sac or the spermatophore sac. The function of this pouch is to form the spermatophore, which is an elastic tube formed of structureless secretion and invaginated into itself. The deeper part contains the spermatozoa, the external part is called the connective, and is usually much contracted and spirally coiled. When the spermatophore is expelled into the water the connective is extended and evaginated, and the sac containing the sperms bursts. In *Nautilus* the spermatophore when uncoiled is a little over 30 mm. in length. These spermatophores are somewhat similar to those formed in certain pulmonate Gastropods.

The eggs are laid shortly after copulation. In *Nautilus* they are laid separately, each being about 4 cm. long and contained in two thick shells, the outer of which is partly open.

Nervous System.—Nautilus, like the other Cephalopoda, exhibits a great concentration of the typical Molluscan ganglia, as shown in fig. 13. The ganglia take on a band-like form, and are but little differentiated from their commissures and connectives—an archaic condition reminding us of *Chiton*. The special optic outgrowth of the cerebral ganglion, the optical ganglion (fig. 13, *o*), is characteristic. The cerebral ganglion-pair (*a*) lying above the oesophagus is connected with two suboesophageal ganglion-pairs, of band-like form. The anterior of these is the pedal *b, b*, and supplies the circumoral lobes and tentacles, and the funnel, a fact which proves the pedal origin of these organs. The hinder band is the visceral and pleural pair fused; from its pleural portion nerves pass to the mantle, from its visceral portion nerves to the branchiae and genital ganglion (fig. 13, *d*), and in immediate connexion with the latter is a nerve to the osphradium or olfactory papilla. A labial commissure arises by a double root from the cerebral ganglia and gives off a stomatogastric commissure, which passes under the pharynx immediately behind the radula and bears a buccal ganglion on either side.

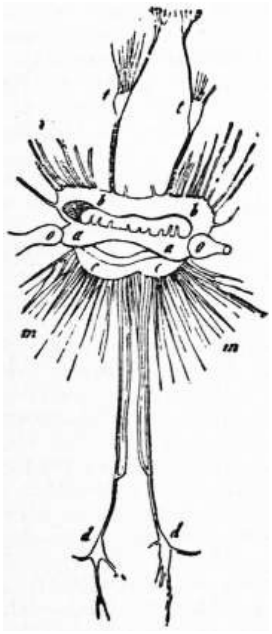


FIG. 13.—Nervous system of *Nautilus pompilius* (from Genebaur, after Owen).

t, t, Ganglion-like enlargements on nerves passing from the pedal ganglion to the inner series of tentacles.
t′, Nerves to the tentacles of the outer or annular lobe.
b, Pedal ganglion-pair
a, Cerebral ganglion-pair.
c, Pleuro-visceral ganglionic

Special Sense-Organs.—Nautilus possesses a pair of osphradial papillae (fig. 4, *olf*) corresponding in position and innervation to Spengel’s organ placed at the base of the ctenidia (branchiae) in all classes of Mollusca. This organ has not been detected in other Cephalopoda. *Nautilus* possesses other olfactory organs in the region of the head. Just below the eye is a small triangular process (not seen in our figures), having the structure of a shortened and highly-modified tentacle and sheath. By A.

Valenciennes, who is followed by W. Keferstein, this is regarded as an olfactory organ. The large nerve which runs to this organ originates from the point of juncture of the pedal with the optic ganglion. The lamelliform organ upon the inner inferior tentacular lobe of *Nautilus* is possibly also olfactory in function. In Dibranchs behind the eye is a pit or open canal supplied by a nerve corresponding in origin to the olfactory nerve of *Nautilus* above mentioned. Possibly the sense of taste resides in certain processes within the mouth of *Nautilus* and other Cephalopoda.

band (fused pleural and visceral ganglion-pairs).
d, Genital ganglion placed on the course of the large visceral nerve, just before it gives off its branchial and its osphradial branches.
m, Nerves from the pleural ganglion to the mantle-skirt.

The otocysts of *Nautilus* were discovered by J.D. Macdonald. Each lies at the side of the head, ventral to the eye, resting on the capito-pedal cartilage, and supported by the large auditory nerve which apparently arises from the pedal ganglion but originates in the cerebral. It has the form of a small sac, 1 to 2 mm. in diameter, and contains whetstone-shaped crystals, such as are known to form the otoliths of other Mollusca.

The eye of *Nautilus* is among the most interesting structures of that remarkable animal. No other animal which has the same bulk and general elaboration of organization has so simple an eye as that of *Nautilus*. When looked at from the surface no metallic lustre, no transparent coverings, are presented by it. It is simply a slightly projecting hemispherical box like a kettle-drum, half an inch in diameter, its surface looking like that of the surrounding integument, whilst in the middle of the drum-membrane is a minute hole (fig. 3, *u*). Sir R. Owen very naturally thought that some membrane had covered this hole in life, and had been ruptured in the specimen studied by him. It, however, appears from the researches of V. Hensen that the hole is a normal aperture leading into the globe of the eye, which is accordingly filled by sea-water during life. There is no dioptric apparatus in *Nautilus*, and in place of refracting lens and cornea we have actually here an arrangement for forming an image on the principle of “the pin-hole camera.” There is no other eye known in the whole animal kingdom which is so constructed. The wall of the eye-globe is tough, and the cavity is lined solely by the naked retina, which is bathed by sea-water on one surface and receives the fibres of the optic nerve on the other (see fig. 14, A). As in other Cephalopods (*e.g.* fig. 33, *Ri, Re, p*), the retina consists of two layers of cells, separated by a layer of dark pigment. The most interesting consideration connected with this eye of *Nautilus* is found when the further facts are noted—(1) that the elaborate lens-bearing eyes of Dibranchiata pass through a stage of development in which they have the same structure as the eye of *Nautilus*—namely, are open sacs (fig. 34); and (2) that amongst other Mollusca examples of cephalic eyes can be found which in the adult condition are, like the eye of *Nautilus* and the developing eye of Dibranchs, simple pits of the integument, the cells of which are surrounded by pigment and connected with the filaments of an optic nerve. Such is the structure of the eye of the limpet (*Patella*), and in such a simple eye we obtain the clearest demonstration of the fact that the retina of the Molluscan cephalic eye, like that of the Arthropod cephalic eye and unlike that of the vertebrate myelonic eye, is essentially a modified area of the general epiderm, and that the sensitiveness of its cells to the action of light and their relation to nerve-filaments is only a specialization and intensifying of a property common to the whole epiderm of the surface of the body. What, however, strikes us as especially remarkable is that the simple form of a pit, which in *Patella* serves to accumulate a secretion which acts as a refractive body, should in *Nautilus* be glorified and raised to the dignity of an efficient optical apparatus. In all other Mollusca, starting as we may suppose from the follicular or pit-like condition, the eye has proceeded to acquire the form of a *closed* sac, the cavity of the closed vesicle being then filled partially or completely by a refractive body (lens) secreted by its walls (fig. 14, B). This is the condition attained in most Gastropoda. It presents a striking contrast to the simple Arthropod eye, where, in consequence of the existence of a dense exterior cuticle, the eye does not form a vesicle, and the lens is always part of that cuticle.

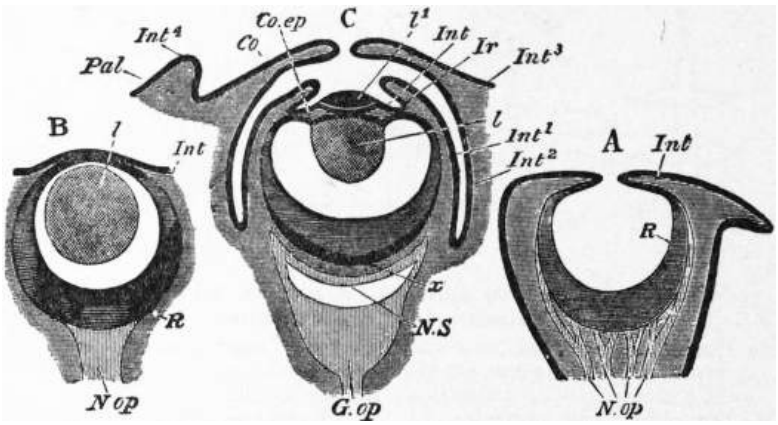


FIG. 14.—Diagrams of Sections of the Eyes of Mollusca.

A, *Nautilus* (and *Patella*).

l^1, Outer portion of the lens

B, Gastropod (*Limax* or *Helix*).
C, Dibranchiate Cephalopod (Oigopsid).
Pal, Eyelid (outermost fold).
Co, Cornea (second fold).
Ir, Iris (third fold).
Int 1,2,3,4, Different parts of the integument.
l, Deep portion of the lens.
Co.ep, Ciliary body.
R, Retina.
N.op, Optic nerve.
G.op, Optic ganglion.
x, Inner layer of the retina.
N.S., Nervous stratum of the retina. (From Balfour, after Grenacher.)

The development of *Nautilus* is still entirely unknown. Dr Arthur Willey, during his sojourn in the East Indies, made special efforts to obtain fertilized eggs, both by offering rewards to the native fishermen and collectors and by keeping the living adults in captivity, but without success.

Phylogeny and Classification.—As *Nautilus* is the only living genus of the Tetrabranchiata, our knowledge of all the rest is based upon the study of their fossil shells. A vast number of species of shell similar in structure to that of *Nautilus* are known, chiefly from Primary and Secondary formations. These are divided into two sub-orders by differences in the form and structure of the initial chamber. In the Nautiloidea this chamber has the form of an obtuse cone, on the apex of which is a slit-like mark or cicatrix, elongated dorso-ventrally and placed opposite to the blind end of the siphuncle, which indents the front wall of the initial chamber but does not enter its cavity. In the Ammonoidea, on the other hand, the initial chamber is inflated, and is spheroidal, oval or pyriform in shape, with no cicatrix, and separated from the first air-chamber by a constriction. The siphuncle also commences with a dilatation which deeply indents the front wall of the initial chamber, called the protoconch, but does not penetrate into its cavity. Munier-Chalmas has shown that the cavity of the protoconch is traversed by a tubular organ, the “prosiphon,” which does not communicate with the true siphuncle, the place of which it is supposed to take in the early life of the animal. It is generally held, as suggested by Alpheus Hyatt, that the initial chamber of the Nautiloidea corresponds not to the protoconch of the Ammonoids, but to the second chamber of the latter, and that there existed in the young Nautiloids a true initial chamber, a protoconch which was either uncalcified or deciduous. The shell of the living nautilus does not decide this question, as its early stages are unknown, and there is a little vacuity in the centre of the spirally coiled shell which may have been originally occupied by the true protoconch.

The septa in the Nautiloidea are generally concave towards the aperture of the shell, their curvature therefore directed backwards (fig. I); in the Ammonoidea, on the other hand, the convexity is usually towards the aperture, the curvature therefore directed forwards. The lines along which the edges of the septa are united to the shell are known as “sutures,” and these in the Nautiloidea are simply curved or slightly lobed, whereas in the Ammonoidea they are folded in various degrees of complexity; the projections of the suture towards the mouth of the shell are called saddles, those in the opposite direction lobes. The siphuncle in the *Nautilus* pierces the centres of the septa, and in fossil Nautiloids it is usually central or sub-central. In a few cases it is marginal, and in that case may be external, *i.e.* ventral, or internal, *i.e.* dorsal. In Ammonoids the siphuncle is always marginal, and usually external. Its walls in the living *Nautilus* are strengthened by the deposit of calcareous granules, and in some fossil forms the wall is completely calcified. But this proper calcified wall is quite distinct from calcareous tubes surrounding the siphuncle, which are developed from the septa. In the pearly nautilus each septum is prolonged backwards at the point where it is pierced by the siphuncle, forming a shelly tube somewhat like the neck of a bottle. In many fossil forms these septal necks are continued from the septum from which they arise to the next, so that the siphuncle is enclosed in a complete secondary calcareous tube. In the majority of Nautiloids the septal necks are directed backwards, and they are said to be retrosiphonate. In the majority of the Ammonoids the septal necks are continued forwards from the septa to which they belong, and such forms are termed prosiphonate.

The Tetrabranchiata were most abundant in the Palaeozoic and Mesozoic periods. The Nautiloidea are the most ancient, appearing first in the Upper Cambrian, the genera being most numerous in the Palaeozoic period, and comparatively few surviving into the Secondary. On the other hand, the Ammonoidea are scarce in Palaeozoic formations, being represented in deposits earlier than the Carboniferous only by comparatively simple types, such as *Clymenia* and *Goniatites*. In the Secondary period Ammonoids were very abundant, both in genera and species and in individuals, and with few local exceptions none are known to have survived even to the commencement of the Tertiary. In the widest sense the genus *Nautilus* has existed since the Ordovician (Silurian) period, but the oldest types are not properly to be placed in the same genus as the existing form. Even with this qualification the genus is very ancient, shells very similar to those of the living *Nautilus* being found in the Upper Cretaceous.

It has been maintained by some zoologists that the Ammonoidea were Dibranchiate, though it would not follow from this that the shell was, therefore, internal. They are, however, generally classed with the Tetrabranchiata, and the absence of all evidence of the possession of an ink-sac

is in favour of this view. There can be little doubt that they gave rise to the Dibranchiata.

About 2500 fossil species are included in the Nautiloidea, but only a few species of the genus *Nautilus* survive. Some of the fossil forms are very large, the shell reaching a length of 2 metres, or 6 ft. 6 in. Of the Ammonoidea more than 5000 species have been described, and some of the coiled forms are 70 cm., or nearly 2 ft. 6 in. in diameter.

Associated with various forms of Ammonoids there have been found peculiar horny or calcified plates, sometimes contained within the body-chamber of the shell, sometimes wholly detached. The most typical form of these structures has been named *aptychus.* It consists of two bilaterally symmetrical halves, of somewhat semicircular shape, and attached to one another by their straight inner margins, like a pair of doors. In some cases the aptychus is thin and horny, but more often it is thick and calcified, in which case the principal layer has a peculiar cellular structure. The surface may be smooth or sculptured, and one side is usually marked by concentric lines of growth. Another type is similar, except that the two halves are united in the middle line; bodies of this character are called *synaptychus*; they occur in the body-chamber of species of *Scaphites*. Another form called *anaptychus* consists of a thin horny undivided plate which is concentrically striated. This is associated with species of *Ammonites* and *Goniatites*.

Many theories have been proposed in explanation of these structures. According to Sir Richard Owen, the aptychus is an operculum developed in a part of the body corresponding to the hood of *Nautilus*. E. Ray Lankester suggested that the double plate was borne on the surface of the nidamental gland, with the form and sculpturing of which in *Nautilus* it closely agrees. On this view the aptychus would occur only in females. The most recent view is that these structures could not have been opercula because of their constant position inside the body-chamber, and that they were not external secretions at all, but a calcified internal cartilage situated at the base of the funnel.

Classification of Tetrabranchiata.—Cephalopoda in which the mantle is entirely enclosed by a multilocular siphunculated shell, which may or may not be coiled. Only the last compartment of the shell occupied by the body of the animal. Numerous pedal tentacles around the mouth, which are retractile within sheaths. Halves of the funnel not united. Two pairs of ctenidia, and two pairs of renal tubes without reno-pericardial apertures. Pericardium opens directly to exterior. Cephalic cartilage wholly ventral. Optic vesicles with apertures, without crystalline lens.

Sub-order 1. *Nautiloidea.*—Initial chamber not inflated, with dorso-ventral cicatrix at extremity.

Fam. 1. *Orthoceratidae*. Shell straight or slightly curved, with a simple aperture, large terminal chamber and cylindrical siphuncle. *Orthoceras*, Silurian to Trias. *Baltoceras*, Silurian.

Fam. 2. *Actinoceratidae*. Shell straight or slightly curved, with wide siphuncle contracted at level of septa. *Actinoceras*, Silurian to Carboniferous. *Discosorus*, Silurian. *Huronia*, Silurian. *Loxoceras*, Silurian to Carboniferous.

Fam. 3. *Endoceratidae*. Shell straight, with wide margina siphuncle, necks produced into tubes fitting into one another. *Endoceras*, Silurian.

Fam. 4. *Gomphoceratidae*. Shell globular, straight or arcuate, aperture contracted. *Gomphoceras*, Silurian. *Phragmoceras*, Silurian.

Fam. 5. *Ascoceratidae*. Shell straight, ampulliform, summit truncate, terminal chamber extending nearly whole length of shell ventrally. *Ascoceras*, Silurian. *Glossoceras*, Silurian.

Fam. 6. *Poterioceratidae*. Shell straight or curved, fusiform, aperture simple, siphuncle contracted at septa. *Poterioceras*, Silurian to Carboniferous. *Streptoceras*, Silurian.

Fam. 7. *Cyrtoceratidae*. Shell slightly curved, aperture simple, siphuncle wide, septa approximated. *Cyrtoceras*, Devonian.

Fam. 8. *Lituitidae*. Shell coiled in one plane with the terminal part uncoiled, aperture contracted. *Lituites*, Silurian. *Ophidioceras*, Silurian.

Fam. 9. *Trochoceratidae*. Shell helicoidally coiled, dextral or sinistral, the last whorl generally uncoiled. *Trochoceras*, Devonian. *Adelphoceras*, Devonian.

Fam. 10. *Nautilidae*. Shell coiled in one plane, aperture wide and simple, siphuncle central. *Nautilus*, recent. *Trocholites*, Silurian. *Gyroceras*, Silurian to Carboniferous. *Hercoceras*, Silurian. *Ptenoceras*, Devonian. *Discites*, Carboniferous.

Fam. 11. *Bactritidae*. Shell straight, conical, siphuncle narrow and marginal, necks long, infundibuliform, sutures undulating. *Bactrites*, Silurian and Devonian.

Sub-order 2. *Ammonitoidea*,—Initial chamber spheroidal; siphuncle narrow and simple; septa

convex towards aperture; sutures complex.

Tribe 1. *Retrosiphonata.*—Siphuncular necks projecting behind the septa as in Nautiloidea. Sutures form simple undulations. Occur exclusively in Palaeozoic strata from Devonian upwards.

Fam. 1. *Goniatitidae*. Shell nautiloid, with simple sutures and ventral siphuncle. *Goniatites*, Devonian and Carboniferous. *Anarcestes*, Devonian.

Fam. 2. *Clymeniidae*. Shell nautiloid, with simple sutures, siphuncle dorsal, that is, internal. *Clymenia*, Upper Devonian.

Tribe 2. *Prosiphonata.*—Siphuncular necks projecting in front of the septa. Sutures form deeply indented lobes and saddles.

Fam. 1. *Arcestidae*. Globular and smooth or nearly smooth, with reduced umbilicus, terminal chamber very deep, an aptychus present. *Popanoceras*, Permian. *Cyclolobus*, Permian, *Arcestes*, Trias. *Lobites*, Trias.

Fam. 2. *Tropitidae*. Shells globular, but having radiating and tuberculated costae. *Thalassoceras*, Permian. *Tropites*, Trias. *Sibirites*, Trias.

Fam. 3. *Ceratitidae*. Shells coiled, with a large umbilicus, terminal chamber short, sutures with simple saddles. *Trachyceras*, Upper Trias. *Ceratites*, Trias. *Dinarites*, Trias.

Some genera with helicoidal shells are related to these coiled forms, viz. *Cochloceras*, Trias; also some straight forms, *e.g. Rhab-doccras*, Trias.

Fam. 4. *Pinacoceratidae*. Shell compressed, smooth, terminal chamber short, sutures very complicated, convex. *Pinacoceras*, Trias.

Fam. 5. *Phylloceratidae*. Shell coiled, the whorls overlapping each other, sutures formed of numerous lobes and saddles. *Phytloceras*, Jurassic.

Fam. 6. *Lytoceratidae*. Shell discoid, whorls loosely united or uncoiled, sutures deeply indented, but with only three saddles and lobes. *Lytoceras*, Jurassic and Cretaceous. *Macroscaphites*, Cretaceous. *Reunites*, Cretaceous. *Ptychoeeras*, Cretaceous. *Turrilites*, Cretaceous. *Baculites*, Cretaceous.

Fam. 7. *Ammonitidae*. Shell coiled, with narrow whorls which do not embrace one another, aperture simple, a horny anaptychus present. *Ammonites*, Jurassic. *Arietites*, Jurassic. *Aegoceras*, Lias.

Fam. 8. *Harpoceratidae*. Shell discord and flattened, with a carinated border, aperture provided with lateral projections, a calcareous aptychus, formed of two pieces. *Harpoceras*, Jurassic. *Oppelia*, Jurassic. *Lissoceras*, Jurassic and Cretaceous.

Fam. 9. *Amaltheidae*. Shell flattened, with a prominent carina continued anteriorly into a rostrum. *Amaltheus*, Lias. *Cardioceras*, Jurassic. *Schloenbachia*, Cretaceous.

Fam. 10. *Stephanoceratidae*. Shell not carinated, but with radiating costae, which are often bifurcated, aperture often with lateral projections which contract it, aptychus formed of two pieces. *Stephanoceras, Morphoceras, Pensphinctes, Peltoceras*, Jurassic. *Hoplites*, Cretaceous. *Acanthoceras*, Cretaceous. *Cosmoceras*, Jurassic. Various more or less uncoiled forms are related to this family, viz. *Scaphites, Crioceras*, Cretaceous.

Order 2. Dibranchiata (= Holosiphona, Acetabulifera)

Characters.—Cephalopoda in which the inflected margins of the epipodia are fused so as to form a complete tubular siphon (fig. 24, *i*). The circumoral lobes of the fore-foot carry suckers disposed upon them in rows, *not* tentacles (see figs. 15, 24). There is a single pair of typical ctenidia (fig. 25) acting as gills (hence Dibranchiata), and a single pair of renal organs, opening by apertures right and left of the median anus (fig. 25, *r*) and by similar internal pores into the pericardial chamber, which consequently does not open directly to the surface as in *Nautilus*. The oviducts are sometimes paired right and left (Octopoda, Oigopsida), sometimes that of one side only is developed (Myopsida). The sperm-duct is always single except, according to W. Keferstein, in *Eledone moschata.*

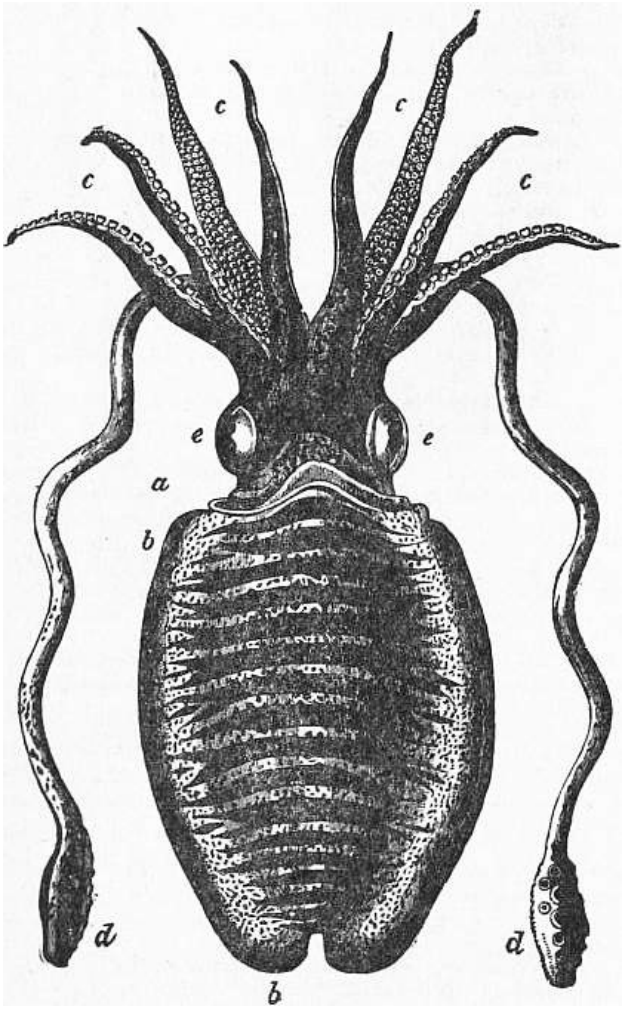


FIG. 15.—*Sepia officinalis*, L., about ½ natural size, as seen when dead, the long prehensile arms being withdrawn from the pouches at the side of the head, in which they are carried during life when not actually in use. *a*. Neck; *b*, lateral fin of the mantle-sac; *c*, the eight shorter arms of the fore-foot; *d*, the two long prehensile arms; *e*, the eyes.

A plate-like shell is developed in a closed sac formed by the mantle (figs 20, 21), except in the Octopoda, which have none, and in *Spirula* (fig. 17, D) and the extinct *Belemnitidae*, &c., which have a small chambered shell resembling that of *Nautilus* with or without the addition of plate-like and cylindrical accessory developments (fig. 17, A, C, fig. 19).

The pair of cephalic eyes are highly-developed vesicles with a refractive lens (fig. 33), cornea and lid-folds,—the vesicle being in the embryo, an open sac like that of *Nautilus* (fig. 34). Osphradia are not present, but cephalic olfactory organs are recognized. One or two pairs of large salivary glands with long ducts are present. An ink-sac formed as a diverticulum of the rectum and opening near the anus is present in all Dibranchiata (fig. 25, *t*), and has been detected even in the fossil *Belemnitidae.* Branchial hearts are developed on the two branchial afferent blood-vessels (fig. 28, *vc′*, *vi*).

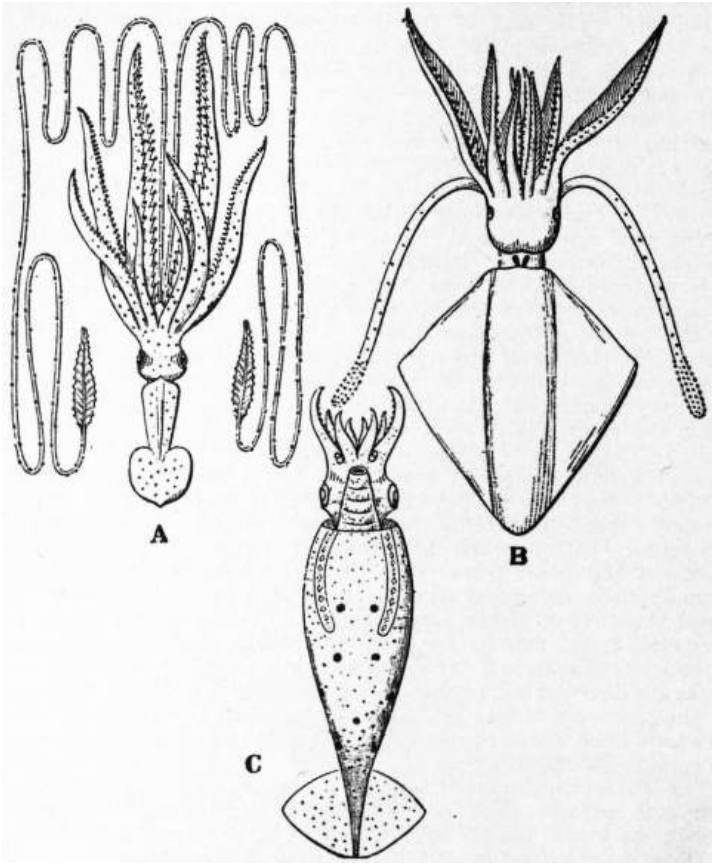


FIG. 16.—Decapodous Cephalopods.

A, *Cheiroteuthis Veranyi*, d'Orb. (from the Mediterranean).
B, *Thysanoteuthis rhombus*, Troschel (from Messina).
C, *Loligopsis cyclura*, Fér. and d'Orb. (from the Atlantic Ocean).

In the Dibranchiata the shell shows various stages of degeneration, culminating in its complete disappearance in *Octopus*. As in other Mollusca, there is a tendency in Cephalopods for the mantle to extend over the outside of the shell from its edges, and when these secondary mantle-folds entirely cover the shell and meet or fuse together the shell is surrounded by the mantle both externally and internally, and is said to be internal, though it remains always a cuticular structure external to the epidermis. This procebs is generally accompanied by a reduction of the size of the shell in comparison with that of the body, so that the relations of the two are gradually reversed, the body outgrows its house and instead of the mantle being enclosed by the shell, the shell is enclosed by the mantle. The earliest stage of this process is shown in the recent *Spirula,* though it is perhaps not impossible that in some of the later fossil Ammonoids the shell was becoming more and more internal. The shell of *Spirula* (fig. 18) is coiled somewhat like that of *Nautilus*, but the coils are not in contact, the direction of the coil is endogastric or ventral instead of exogastric, and the shell is very much smaller than the body. Like that of *Nautilus* it is divided by septa and traversed by a siphuncle. The relation of the animal to the terminal chamber is as in *Nautilus,* but the body extends far beyond the aperture, and folds of the mantle grow up over the shell and cover it everywhere except part of the dorsal and ventral surfaces.

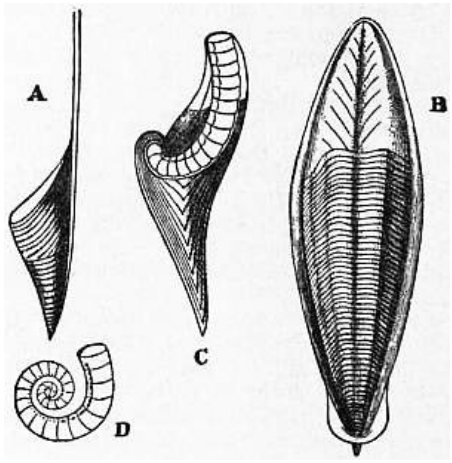
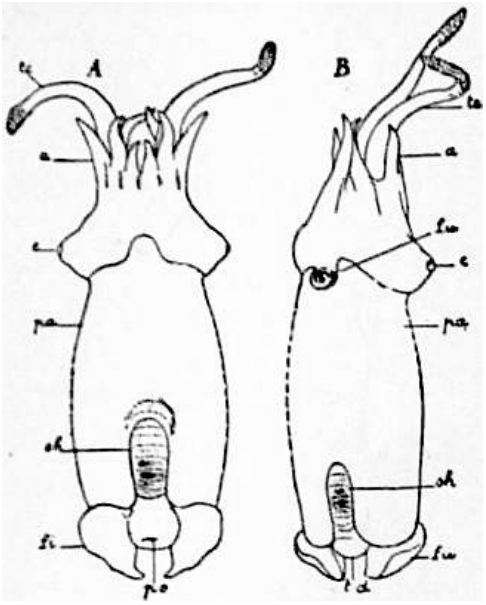


FIG. 17.—Internal Shells of Cephalopoda.

A, *Conoteutliis dupiniana*, d'Orb. (from the Neocomian of France).
B, Shell *Sepia orbigniana*. Fér. (Mediterranean).
C, Shell of *Spirulirostra Bellardii*, d'Orb. (from the Miocene of Turin). The specimen is cut so as to show in section the chambered shell and the laminated "guard" deposited upon its surface.
D, Shell of *Splrula laevis*, Gray (New Zealand).



After Chun, from Lankester's *Treatise an Zoology*

FIG. 18.—*Spirula.*

A, Dorsal aspect.
B, Ventral aspect.
a, Arms.
e, Eyes.
fi, Fins.
fu, Funnel.
pa, Mantle.
po, Posterior fossa.
sh, Shell.
te, Tentacular arms.
td, Terminal pallial disk.

The next modification in the enclosed shell is the addition to it of secondary deposits of calcareous matter, by the inner surface of the shell-sac. Successive layers are deposited on the posterior part of the original shell, whether coiled or straight, and these layers form a conical mass, which may attain great thickness. A somewhat coiled shell with such a deposit is seen in *Spirulirostra* (fig. 17, C) of the Miocene. In the next stage of modification secondary secretion forms a long and broad projection of the dorsal lip of the aperture; this is well developed in the belemnites (fig. 19). Thus in these modified shells three parts are to be distinguished: the original septate shell, which has been called the phragmacone; the posterior conical deposit, called the rostrum or guard; and the anterior somewhat flat projection, called the proostracum. In the living Dibranchiata other than *Spirula* the phragmacone and rostrum have become very rudimentary. The shell of *Sepia* (fig. 20) consists almost entirely of the proostracum, the little ventral hollow posteriorly representing the phragmacone, and the posterior pointed projection, the rostrum. In the *Oigopsida* the shell is represented by a proostracum which is no longer calcified by forms a chitinous plume or gladuius, and a similar rudiment occurs in *Loliginidac* (fig. 21) and *Sepiolidae*. Lastly, in the Octopoda the shell is represented only by small chitinous rudiments to which the retractor muscles of the head and funnel are attached; these are paired in *Octopus*, unpaired in other cases as in *Cirrhoteuthis*.

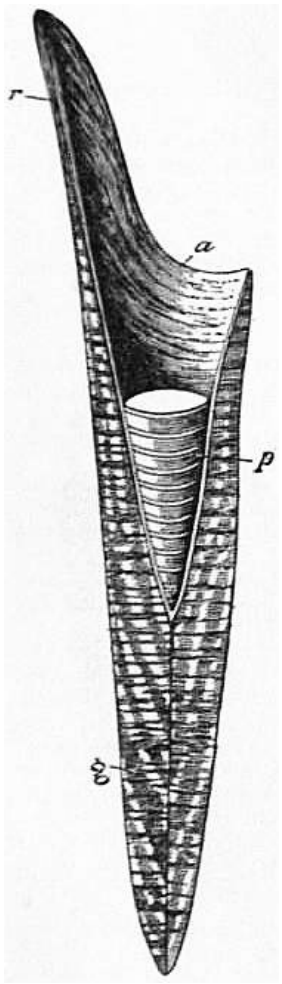


FIG. 19.—Digram of shell Belemnite (after Phillips). *r*. Horny pen or "proostracum": A, conical cavity or "alveolus," in which the chambered "phragmacone" (*p*) is contained: *g*, "guard," or "rostrum."

The early appearance of the sac of the mantle in which the shell is enclosed has led to an erroneous identification of this sac with the primitive shell-sac or shell-gland of the Molluscan embryo. The first appearance of the shell-sac in Dibranchiata is shown in figs. 35, 36. Its formation as an open upgrowth of the centro-dorsal area, and the fact that it appears and

disappears without closing in *Argonauta* and *Octopus*, was demonstrated by E. Ray Lankester.

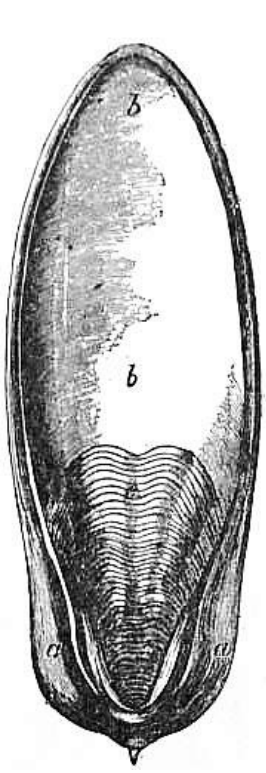


FIG. 20.

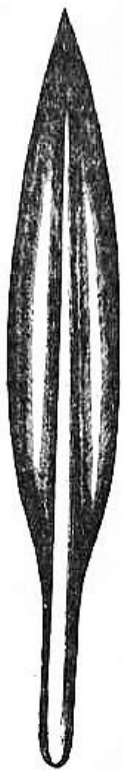


FIG. 21.

FIG. 20.—The calcareous internal shell of *Sepia officinalis*, the so-called cuttle-bone, *a*, Lateral expansion; *b*, anterior cancellated region; *c*, laminated region, the laminae enclosing air.

FIG. 21.—The horny internal shell or gladius or pen of *Lohgo*.

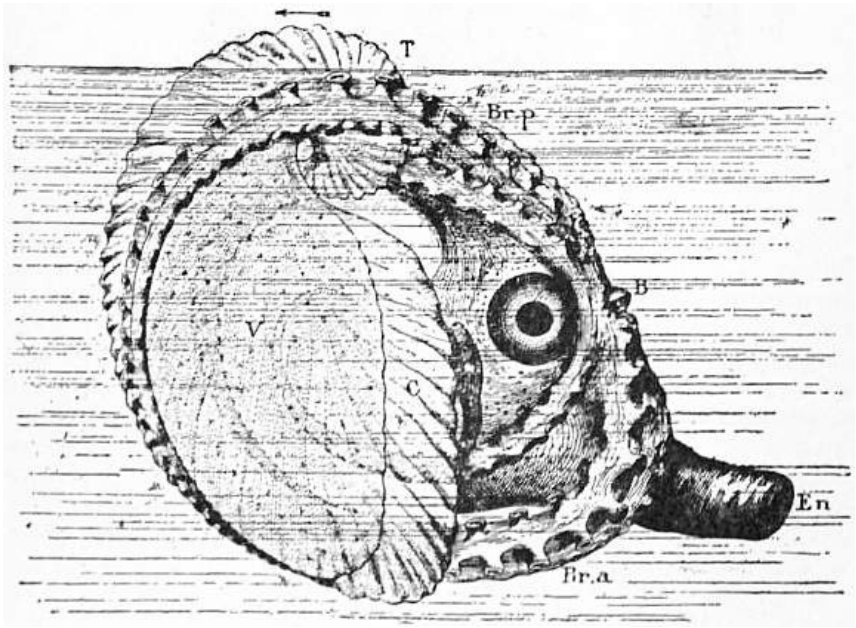


FIG. 22.—The Argonaut in life. (After Lacaze-Duthiers) *Tr*. Float: *Br.a*, anterior arms: *Br.p*, posterior arms: V, the expanded portion of them, once called the sails; B, the beak; C, the shell; *En*, the Funnel.

In *Argonauta* (the paper nautilus) the female only possesses a shell, in which the body is contained; but this is not homologous with the true shell in other cases; it is a structure *sui generis* secreted by the expanded arms of the dorsal pair which are closely applied to it on either side (fig. 22).

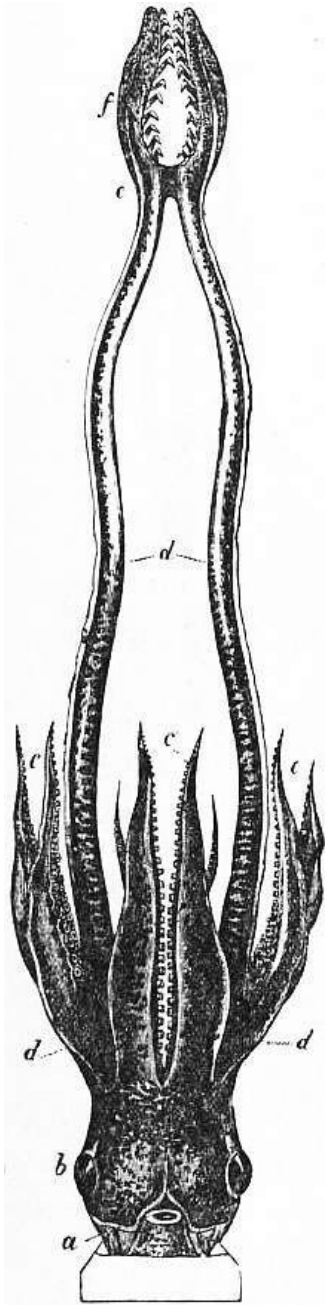


FIG. 23.—Head and circumoral processes of the fore-foot of *Onychoteuthis* (from Owen).

a, Neck.
b, Eye.
c, The eight short arms.
d, Long prehensile arms, the clavate extremities of which are provided with suckers at e, and with a double row of hooks beyond at f. The temporary conjunction of the arms by means of the suckers enables them to act in combination.

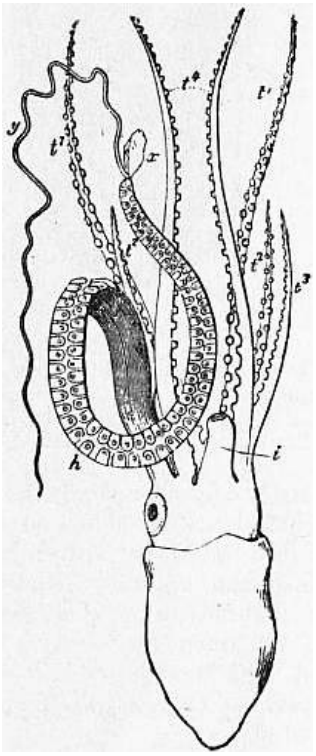


FIG. 24.—Male of *Ocythoe catenulata*, Steenstrup (*Octopus carena*, Ver.), showing the hectocotylized arm. (From Gegenbaur.)

t^1, t^2, t^3, t^4, The first, second, third and fourth arms or processes of the fore-foot.
h, The third arm of the right side hectocotylized.
x, The apical sac of the hectocotylized arm.
y, The filament which issues from the sac when development is complete.
i, The siphon.

Head, Foot, Mantle and Mantle-cavity.—If we now compare the fore-foot of the Dibranchiata with that of *Nautilus*, we find in the first place a more simple arrangement of its lobes, which are either four or five pairs of tapering processes (called "arms"), arranged in a series around the buccal cone, and a substitution of suckers for tentacles on the surface of these lobes (figs. 15 and 24). The most dorsally placed pair of arms, corresponding to the two sides of the hood of *Nautilus*, are in reality the most anterior, and are termed the first pair. In the Octopoda there are four pairs of these arms (fig. 38), in the Decapoda five pairs, of which the fourth is greatly elongated (figs. 15, 16). In *Sepia*, *Sepiola* and *Rossia*, each of these long arms is withdrawn into a pouch beside the head, and is only ejected for the purpose of prehension. In *Loligo* they are completely retractile, very slightly so in the majority of the Oigopsida, and in *Rhynchoteuthis* they are united to form a beak-like appendage. A gradual reduction of the tentacular arms can be seen in the Decapoda, leading to their total absence in Octopoda; thus in *Leachia*, *Chaunoteuthis* and others these arms are reduced to mere stumps. In some *Cheiroteuthidae* and *Cranchiidae* the ordinary or sessile arms, especially the dorsal pairs, are reduced. In the Octopoda they are not unfrequently connected by a web, and form an efficient swimming-bell,

e.g. in *Cirrhoteuthidae* and *Amphuretidae*. The suckers are placed on the adoral surface of the arms, and may be in one, two or four rows, and very numerous. In place of suckers in some genera, *e.g. Veranya*, we find on certain arms or parts of the arms horny hooks; in other cases a hook rises from the centre of each sucker. The hooks on the long arms of *Onychoteuthis* are drawn in fig. 23. In various species of *Cheiroteuthis* the suckers on the tentacular arms are very feeble, but the bottom of the cup is covered by a number of anastomosed epithelial filaments which are used as a fishing-net. The fore-foot, with its apparatus of suckers and hooks, is in the Dibranchiata essentially a prehensile apparatus, though the whole series of arms in the Octopoda serve as swimming organs, and in many (*e.g.* the common octopus or poulp) the sucker-bearing surface is used as a crawling organ.

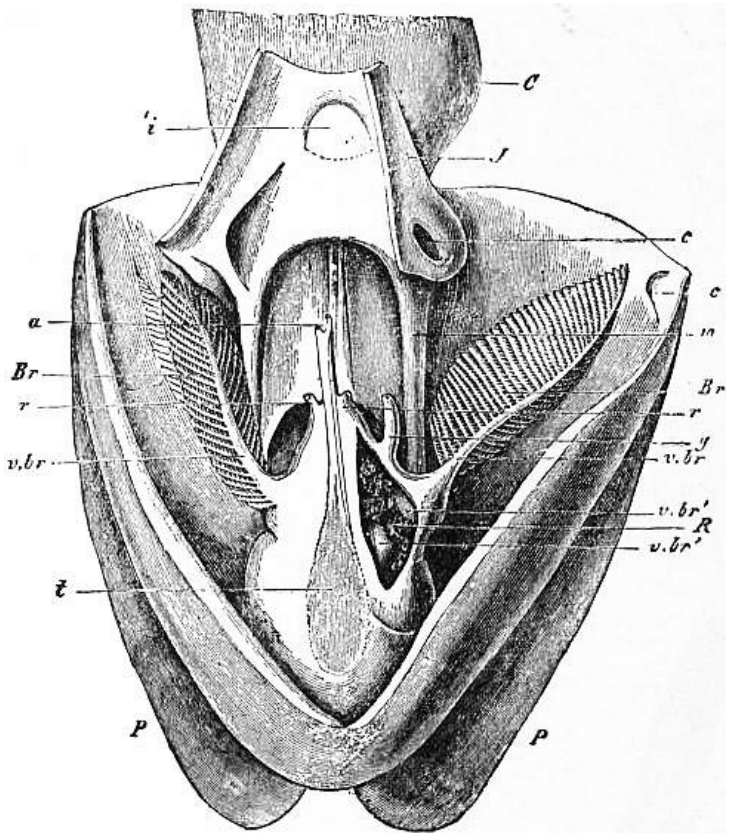


FIG. 25.—View of the postero-ventral surface of a male *Sepia*, obtained by cutting longitudinally the firm mantle-skirt and drawing the divided halves apart. This figure is strictly comparable with fig. 4. (From Gegenbaur.)

C, The head.
J, The mid-foot or siphon, which has been cut open so as to display the valve *i*.
R, The glandular tissue of the left nephridium or renal-sac, which has been cut open (see fig. 29).
P, P, The lateral fins of the mantle-skirt.
Br, The single pair of branchiae (ctenidia).
a, The anus—immediately below it is the opening of the ink-bag.
c, Cartilaginous socket in the siphon to receive *c′*, the cartilaginous knob of the mantle-skirt—the two constituting the "pallial hinge apparatus" characteristic of Decapoda, not found in Octopoda.
g, The azygos genital papilla and aperture.
i, Valve of the siphon (possibly the rudimentary hind-foot)
m, Muscular band connected with the fore-foot and mid-foot (siphon) and identical with the muscular mass *k* in fig. 3.
r, Renal papillae, carrying the apertures of the nephridia.
v.br, Branchial efferent blood-vessel.
v br′, Bulbous enlargements of the branchial blood-vessels (see figs 28, 29).
t, Ink-bag.

In the males of the Dibranchiata one of the arms is more or less modified in connexion with the reproductive function, and is called the "hectocotylized arm." This name is derived from the condition assumed by the arm in those cases in which its modification is carried out to the greatest extent. These cases are those of the Octopods *Argonauta argo* and *Ocythoe catenulata* (fig. 24). In the males of these the third arm (on the left side in *Argonauta*, on the right side in

Ocythoe) is found before the breeding season to be represented by a globular sac of integument. This sac bursts, and from it issues an arm larger than its neighbours, having a small sac at its extremity in *Ocythoe* (fig. 24. *x*), from which subsequently a long filament issues. Before copulation the male charges this arm with the spermatophores or packets of spermatozoa removed from its generative orifice beneath the mantle-skirt, and during coitus the arm becomes detached and is left adhering to the female by means of its suckers. A new arm is formed at the cicatrix before the next breeding season. The female, being much larger than the male, swims away with the detached arm lodged beneath her mantle-skirt. There, in a way which is not understood, the fertilization of the eggs is effected. Specimens of the female *Ocythoë* with the detached arm adherent were examined by Cuvier, who mistook the arm for a parasitic worm and gave to it the name *Hectocotylus*. Accordingly, the correspondingly modified arms of other Cephalopoda are said to be hectocotylized. J.J.S. Steenstrup has determined the hectocotylized condition of one or other of the arms in a number of male Dibranchs as follows:—in all, excepting *Argonauta* and *Ocythoe* and *Tremoctopus*, the modification of the arm is slight, consisting in a small enlargement of part or the whole of the arm, and the obliteration of some of its suckers; in *Octopus* and *Eledone* the third right arm is hectocotylized; in *Rossia* and *Sepiola* the fourth left arm is hectocotylized along its whole length, and the fourth right arm also in the middle only; in *Sepia* the fourth left arm is modified at its base only; in *Sepioteuthis*, the same at its apex; in *Loligo*, the same also at its apex; in *Loliolus*, the same along its whole length; in *Ommatostrephes*, *Onychoteuthis* and *Loligopsis* no hectocotylized arm has hitherto been observed. Thus, speaking generally, it is one or both of the fourth pair of short arms which are modified in the Decapoda, of the third pair in the Octopoda. In the pallial cavity are situated one pair of gills in the Dibranchiata (fig. 25), attached dorsally along the whole of their afferent borders. On each side of the branchia is a series of lamellae, least in number in the Octopoda. Each lamella is transversely folded, and the folds are in turn folded, so that the respiratory surface is increased. On the somatic wall of the pallial cavity, between and ventral to the gills, are the following apertures: the anus and opening of the ink-sac, close together in the median line; a pair of apertures of the renal sacs, on either side of the median line; external to the renal orifice, on the left side, the genital aperture in *Cirrhoteuthidae* and Myopsida. In other Octopoda, and in nearly all the Oigopsida among the Decapoda, the genital ducts are paired in the female, but only the left is developed in the male. The funnel forms a complete tube in the Dibranchiata, and in the majority of the Decapoda, as in *Nautilus*, it is provided with an internal valve projecting from its somatic surface, which allows water to pass outwards but prevents it passing inwards. The mantle performs rhythmical respiratory movements of expansion and contraction, the water entering between funnel and mantle and passing out through the funnel. In Decapoda the edge of the mantle bears internally on each side a cartilaginous projection which fits into a corresponding depression on the external surface of the funnel; this is called the “resisting apparatus,” and serves to make the union of mantle and funnel firmer during expiration. More powerful expiratory movements are used for sudden retrograde locomotion through the water.

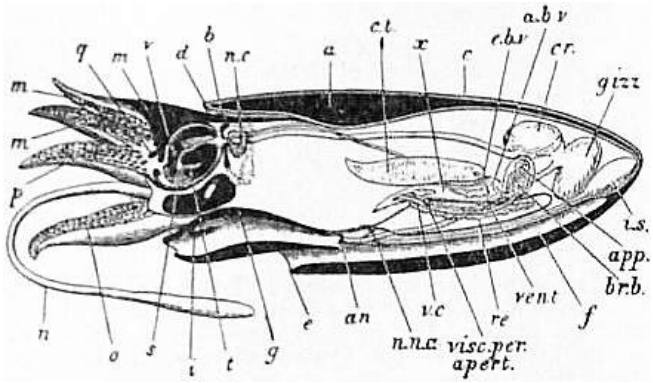


FIG. 26.—Diagram representing a vertical approximately median antero-posterior section of *Sepia officinalis* (from a drawing by A.G. Bourne). The lettering corresponds with that of fig. 10, with which this drawing is intended to be compared.

a, Shell (here enclosed by a growth of the mantle).
b, The nuchal plate (here a cartilage).
c, (The reference line should be continued through the black area representing the shell to the outline below it), the integument covering the visceral hump.
d, The reflected portion of
s, The lower beak or jaw.
t, The lingual ribbon.
x, The viscero-pericardial sac.
n.c, The nerve-collar.
cr, The crop.
gizz, The gizzard.
an, The anus.
c.t, The left ctenidium or gill-plume.
vent, Ventricle of the heart.
a.b.v, Afferent branchial

the mantle-skirt forming the sac which encloses the shell.
e, The inferior margin of the mantle-skirt (mouth of the pallial chamber).
f, The pallial chamber.
g, The vertically cut median portion of the siphon.
i, The valve of the siphon.
m, The two upper lobes of the fore-foot.
n, The long prehensile arms of the same.
o, The fifth or lowermost lobe of the fore-foot.
p, The third lobe of the fore-foot.
q, The buccal membrane.
v, The upper beak or jaw.
vessel.
e.b.v, Efferent branchial vessel.
re, Renal glandular mass.
n.n.a, Left nephridial aperture.
visc.per.apert, Viscero-pericardial aperture (see fig. 29).
br.b, Branchial heart.
app, Appendage of the same.
i.s, Ink-bag.

Luminous Organs.—In certain Oigopsida living in deep water, *e.g. Histioteuthis, Calliteuthis, Histiopsis, Pterygioteuthis*, the surface of the skin bears photogenous organs directed towards the oral extremity. Anatomically these consist of a deeper photogenous layer and a more superficial refracting layer. In some cases, *e.g. Pterygioteuthis*, they occur even within the mantle-cavity.

Fins.—In the majority of the Decapoda and in the *Cirrhoteuthidae*, the mantle is produced into lateral symmetrical expansions which have the function of fins. They originate at the aboral extremity where they remain in *Spirula* (fig. 18). In most other Oigopsida they are terminal, but more dorsal than ventral, *e.g. Loligopsis* (fig. 16), and there may be two on each side, as in *Grimalditeuthis*. In other cases they extend laterally along a greater length of the body, as in *Sepia* (fig. 15). In *Ctenopteryx* they have a superficial resemblance to the fins of fishes, consisting of a thin membrane supported by a series of muscular rods.

Chromatophores.—These are characteristic of the Dibranchiata, apparently absent in *Nautilus*. They are originally single cells of ectodermic origin which sink below the epidermis and become connected with radiating muscular fibres. The cells are single but multinuclear. Different cells contain pigments of different colours, yellow, brown, red or blue. Each cell in life is in constant tremulous movement; under the influence of nervous excitement the cells are suddenly expanded or contracted, producing blushes of colour and pallor. By reflex action of which the afferent stimulus acts upon the eyes as in fishes, the chromatophores assume a condition which approximates the colour of the animal to that of surrounding objects. In the Decapoda there are also reflecting elements which produce iridescent hues.

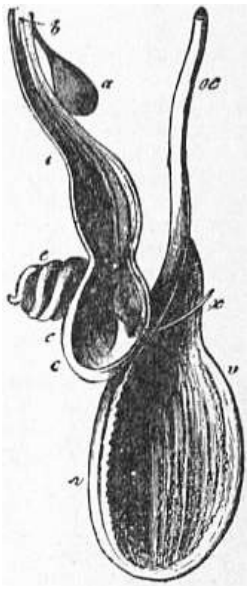


FIG. 27.—Alimentary canal of *Loligo sagittata* (from Gegenbaur). The buccal mass is omitted.

oe, Oesophagus.
v, The stomach opened longitudinally.
x, Probe passed through the pylorus.
c, Commencement of the caecum.
e, Its spiral portion.
i, Intestine.
a, Ink-bag.
b, Its opening into the rectum.

Aquiferous Cavities.—In addition to the pockets into which the tentacular arms of Decapoda are retracted, there are in several Dibranchiata cavities in the integument which open to the exterior by special pores but have no communication with the vascular system or other internal cavities of the body. In *Ocythoe* there are such pores on the back of the head and at the base of the funnel; buccal pouches on the ventral side of the mouth, internal to the arms, occur in some genera, one in *Loligo*, two in *Sepia*. In some species of *Sepia* there are pouches in the mantle.

Alimentary Tube.—The principal differences from *Nautilus* are the following:—the mandibles are similar in shape, but are chitinous, not calcified. In the radula there are three teeth on each side of the median tooth in each row, except in *Gonatus*, in which there are only two lateral teeth, and the *Cirrhoteuthidae*, in which the radula has entirely disappeared. In front of the radula is the so-called tongue, a fleshy projection corresponding to the sub-radular organ of other Mollusca.

In most of the Dibranchiata there are two pairs of salivary glands. In the Decapoda the ducts of the posterior pair unite into a median duct which opens on the surface of the sub-radular organ. The anterior pair is but slightly developed except in the Oigopsida. In the

Octopoda there are also two pairs, but the posterior pair, except in *Cirrhoteuthis* where they are absent, are large and displaced backwards, being situated near the oesophageal proventriculus. Connected with the intestine immediately beyond the pylorus is a thin-walled caecum, spherical in *Rossia* and *Leachia*, elongated in *Loligo*, but usually coiled into a spiral (fig. 27). The hepatic ducts open into the caecum. The liver is developed as a paired gland, more or less fused into one in the adult, but the ducts are always paired. The ducts are covered by a number of glandular follicles forming what is called the pancreas.

The ink-sac, absent in *Nautilus*, is a rectal caecum developed from its dorsal wall. It is present in all Dibranchiata except *Octopus arcticus, O. piscatorum* and *Cirrhoteuthis*. It consists of a deeper part or gland proper and a reservoir. It extends to the posterior extremity of the body in *Sepia*, but in *Octopoda* is usually embedded in the surface of the liver. The pigment of the secretion is melanin, and its function is to produce a dense opacity in the water, which conceals the animal.

Vascular System (fig. 28).—The ventricle lies in the pericardial cavity, except in Octopoda where this cavity is much reduced. The auricles, one pair, are contractile expansions of the efferent branchial vessels. The heart gives off an anterior or cephalic and a posterior or abdominal aorta. The vascular system is almost perfect, arteries and veins being united by capillaries. The principal vein is a vena cava passing backwards ventrally from the cephalic region and dividing into two afferent branchial veins, each of which receives a pallial and an abdominal vein. Each of these afferent branchial vessels is enclosed in the cavity of a renal organ and is covered externally by the glandular tissue which forms the excretory part of the "kidney" (fig. 29). Each afferent vessel is expanded into a contractile branchial heart, which is provided with a glandular appendage. The latter corresponds to the glandular masses which are attached to the afferent branchial veins in *Nautilus*, and to the pericardial glands of other Molluscs.

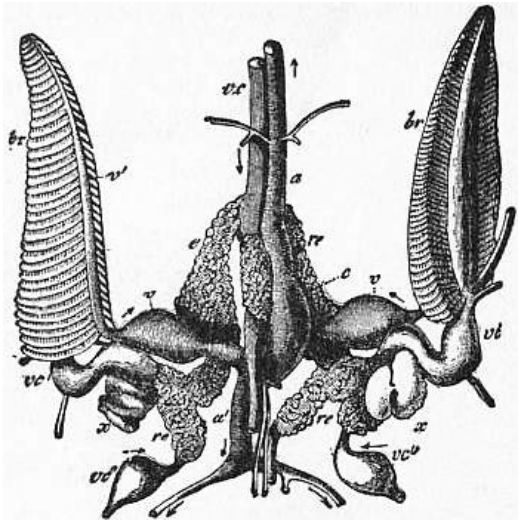


FIG. 28.—Circulatory and excretory organs of *Sepia* (from Gegenbaur, after John Hunter).

br, Branchiae (ctenidia).
c, Ventricle of the heart.
a, Anterior artery (aorta).
a', Posterior artery.
v, The right and left auricles (enlargements of the efferent branchial veins).
v', Efferent branchial vein on the free face of the gill-plume.
v.c, Vena cava.
vi, *vc'*, Afferent branchial vessels (branches of the vena cava, see fig. 29).
vc'', Abdominal veins.
x, Branchial hearts and appendages.
re, *e*, Glandular substance of the nephridia developed on the wall of the great veins on their way to the gills. The arrows indicate the direction of the blood-current.

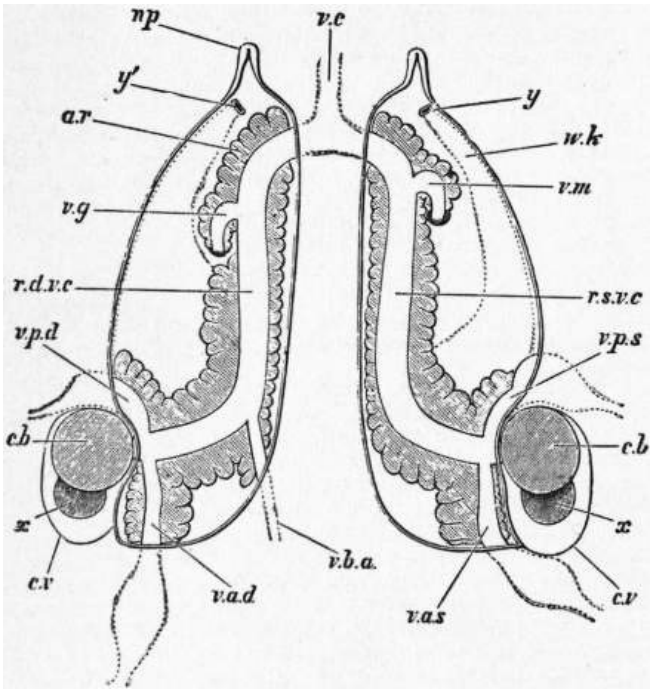


FIG. 29.—Diagram of the nephridial sacs, and the veins which run through them, in *Sepia officinalis* (after Vigelius). The nephridial sacs are supposed to have their upper walls removed.

v.c, Vena cava.
r.d.v.c, Right descending branch of the same.
r.s.v.c, Left descending branch of the same.
v.b.a, Vein from the ink-bag.
v.m, Mesenteric vein.
v.g, Genital vein.
v.a.d, Right abdominal vein.
v.a.s, Left abdominal vein.
v.p.d, Right pallial vein.
v.p.s, Left pallial vein.
c.b, Branchial heart.
x, Appendage of the same.
c.v, Capsule of the branchial heart.
np, External aperture of the right nephridial sac.
y, Reno-pericardial orifice placing the left renal sac or nephridium in communication with the viscero-pericardial sac, the course of which below the nephridial sac is indicated by dotted lines.
y', The similar orifice of the right side.
a.r, Glandular renal outgrowths.
w.k, Viscero-pericardial sac (dotted outline).

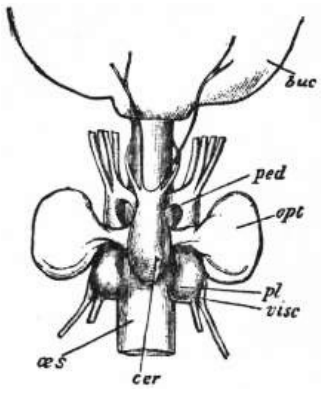


FIG.30.

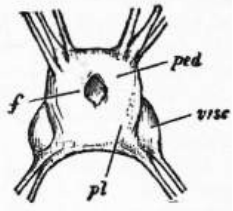


FIG.31.

FIGS. 30, 31.—Nerve-centres of *Octopus*. Figure 30 gives a view from the dorsal aspect, figure 31 one from the ventral aspect.

buc, The buccal mass.
ped, Pedal ganglion.
opt, Optic ganglion.
cer, Cerebral ganglion.
pl, Pleural ganglion.
visc, Visceral ganglion.
oes, Oesophagus.
f, Foramen in the nerve-mass formed by pedal, pleural and visceral ganglion-pairs, traversed by a blood-vessel.

Coelom.—The coelom forms a large sac with a constriction between the anterior or pericardial division and the posterior or genital division, and it is produced into lateral diverticula which contain the branchial hearts; but in the Octopoda the pericardial division is suppressed and the genital division communicates by long ducts with sacs containing the appendages of the branchial hearts. The renal sacs communicate with the pericardium by pores near the external renal apertures; in the Octopoda the reno-pericardial openings are in the capsules of the branchial hearts. The genital ducts pass from the genital coelom to the exterior. They are paired in female Oigopsida and Octopoda except *Cirrhoteuthidae*, but only the left persists in the males of all Dibranchiata, and in the female Myopsida.

In the oviduct is a glandular enlargement, and in addition to this the females are provided with the so-called nidamental glands which are developed on the somatic wall of the pallial cavity, one on each side of the rectum, except in certain Oigopsida (*Enoploteuthis, Cranchia, Leachia*) and in the Octopoda, in which these organs are absent. The latter fact is related to the habit of the majority of the Octopoda of guarding or "incubating" their eggs, which have little protective covering. In the other cases the eggs are surrounded by a tough gelatinous elastic material secreted by the nidamental glands.

The vas deferens is at first narrow and convoluted, then dilates into a vesicula seminalis at the end of which is a glandular diverticulum called the prostate. By the vesicula and the prostate the spermatophores are formed. These have a structure similar to those of *Nautilus*, and in the Octopoda may be as much as 50 mm. in length. Beyond the prostate the duct opens into a large terminal reservoir which has been called Needham's sac, and in which the spermatophores are stored.

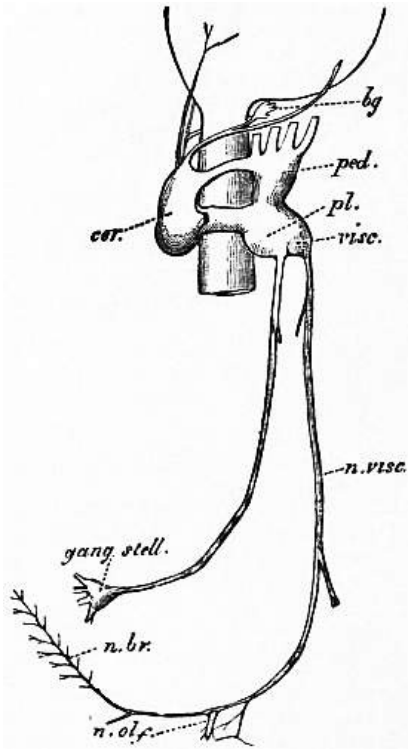


FIG. 32.—Lateral view of the nervous centres and nerves of the right side of *Octopus vulgaris* (from a drawing by A.G. Bourne).

bg, Buccal ganglion.
cer, Cerebral ganglion.
ped, Pedal ganglion.
pl, Pleural, and visc., visceral region of the pleuro-visceral ganglion.
gang. stell, The right stellate ganglion of the mantle connected by a nerve to the pleural portion.
n.visc, The right visceral nerve.
n.olf, Its (probably) olfactory branches.
n.br, Its branchial branches.

Nervous System and Sense-Organs.—The figures (30, 31, 32) representing the nerve-centres of *Octopus* serve to exhibit the disposition of these parts in the Dibranchiata. The ganglia are more distinctly swollen than in *Nautilus*. In *Octopus* an infra-buccal ganglion-pair are present, corresponding to the buccal ganglion-pair of Gastropoda. In Decapoda a supra-buccal ganglion-pair connected with these are also developed. Instead of the numerous radiating pallial nerves of *Nautilus*, we have in the Dibranchiata on each side (right and left) a large pleural nerve passing from the pleural portion of the pleuro-visceral ganglion to the mantle, where it enlarges to form the stellate ganglion. From each stellate ganglion nerves radiate to supply the powerful muscles of the mantle-skirt. The two stellate ganglia are connected, except in *Sepiola*, by a transverse supra-oesophageal commissure, which represents the pallial cords united by a commissure above the intestine in Amphineura. The nerves from the visceral portion of the pleuro-visceral ganglion have the same course as in *Nautilus*, but no osphradial papilla is present. An enteric nervous system is richly developed in the Dibranchiata, connected with the somatic nervous centres through the buccal ganglia, as in the Arthropoda through the stomato-gastric ganglia, and anastomozing with deep branches of the visceral nerves of the viscero-pleural ganglion-pair. It has been especially described by A. Hancock in *Ommatostrephes*. Upon the stomach it forms a single large and readily detected gastric ganglion.

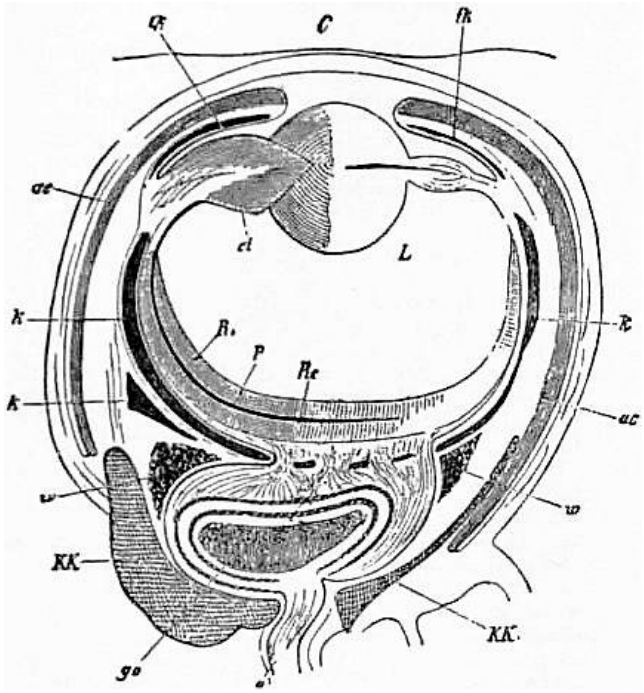


FIG. 33.—Horizontal section of the eye of *Sepia* (Myopsid). (From Gegenbaur, after Hensen.)

KK, Cephalic cartilages (see fig. 8).
C, Cornea (closed).
L, Lens.
ci, Ciliary body.
Ri, Internal layer of the retina.
Re, External layer of the retina.
p, Pigment between these.
o, Optic nerve.
go, Optic ganglion.
k and *k'*, Capsular cartilage.
ik, Cartilage of the iris.
w, White body.
ae, Argentine integument.

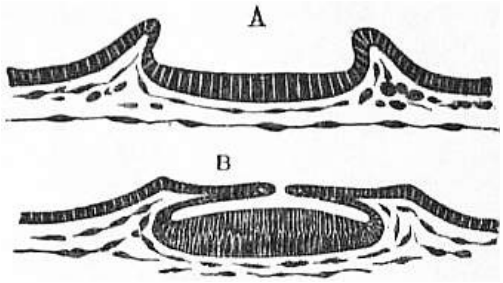


FIG. 34.—Diagrams of sections showing the early stage of development of the eye of *Loligo* when it is, like the permanent eye of *Nautilus* and of *Patella*, an open sac. (From Lankester.)

A, First appearance of the eye as a ring-like upgrowth.

B, Ingrowth of the ring-like wall so as to form a sac, the primitive optic vesicle of *Loligo*.

In the Dibranchiate division of the Cephalopoda the greatest elaboration of the dioptric apparatus of the eye is attained, so that we have in this class the extremes of the two lines of development of the Molluscan eye, those two lines being the punctigerous and the lentigerous. The structure of the Dibranchiate's eye is shown in section in fig. 14, C, and in fig. 33, and its development in figs. 34 and 37. The open sac which forms the retina of the young Dibranchiate closes up, and constitutes the posterior chamber of the eye, or primitive optic vesicle (fig. 37, A, *poc*). The lens forms as a structureless growth, secreted by both the internal and external surfaces of the front wall of the optic vesicle (fig. 37, B, *l*). The integument around the primitive optic vesicle which has sunk below the surface now rises up and forms firstly nearest the axis of the eye the iridian folds (*if* in B, fig. 37; *ik* in fig. 33; *Ir* in fig. 14), and then secondly an outer circular fold grows up like a wall and completely closes over the iridian folds and the axis of the primitive vesicle (fig. 33, C). This covering is transparent, and is the cornea. In the oceanic Decapoda the cornea does not completely close, but leaves a central aperture traversed by the optic axis. These forms are termed Oigopsidae by C. d'Orbigny, whilst the Decapoda with closed cornea are termed Myopsidae. In the Octopoda the cornea is closed, and there is yet another fold thrown over the eye. The skin surrounding the cornea presents a free circular margin, and can be drawn over the surface of the cornea by a sphincter muscle. It thus acts as an adjustable diaphragm, exactly similar in movement to the iris of Vertebrates. *Sepia* and allied Decapods have a horizontal lower eyelid, that is to say, only one-half of the sphincter-like fold of integument is movable. The statocysts are situated ventrally between the pedal and visceral ganglia, and are entirely enclosed in the cranial cartilage. The cavity of each is continued into a small blind process which is the remnant of the embryonic connexion of the vesicle with the external surface. The sensory epithelium is at the anterior end of the vesicle

forming a macula acustica, and in the cavity is a single otolith, partly calcareous and partly organic except in *Eledone*, in which it is entirely organic. The nerve arises from the cerebral ganglion on each side and passes through the pedal ganglion.

There is no branchial osphradium in the Dibranchiata corresponding to that of *Nautilus*, but the olfactory organ or rhinophore near the eye is present. In *Sepia* and the majority of the Dibranchiata it is a simple pit, in some of the Oigopsida it is a projection which may be stalked.

Reproduction and Development.—The modification of one or a pair of the arms in the male for purposes of copulation has already been described. In many genera the sexes differ from one another in other characters also. As a rule the males are more slender or smaller than the females. The maximum degree of sexual dimorphism occurs in *Argonauta* among the Octopods; in this genus the female may be fifteen times as large as the male, and the peculiar modification of the dorsal arms for the secretion of the shell occurs in the female only, no shell being formed in the male. In most cases the females are much more numerous than the males, but the opposite relation appears to exist in those Octopoda in which the hectocotylus is autotomous, for as many as four hectocotyli have been found in the pallial cavity of a single female. When the hectocotylus is not detached it is usually inserted into the pallial cavity of the female so as to deposit the spermatophores in or near the aperture of the oviduct, but in *Sepia* and *Loligo* they are merely deposited on the ventral lobes of the buccal membrane.

The eggs are laid shortly after copulation. In the Octopoda and in *Sepia*, *Sepiola* and *Rossia*, each egg has a separate envelope continued into a long stalk by which it is attached with several others in a cluster. In *Argonauta* the eggs are carried by the female in the cavity of the shell. In *Loligo* the eggs are very numerous, and are enclosed in cylindrical transparent gelatinous strings united at one end into a cluster.

The Cephalopoda appear to be the only Invertebrates in which the egg is mesoblastic and telolecithal like that of Vertebrata. This is the result of the large quantity of the yolk, and the position the latter assumes in relation to the blastoderm. In all other Mollusca the segmentation is complete though in some cases very unequal. In the egg of *Loligo*, which has been chiefly studied (fig. 35), the protoplasmic pole is at the narrower end of the egg, and segmentation is restricted to this end, forming a layer of ectoderm cells. From one part of the periphery of the ectoderm proliferation of cells takes place and gives rise to a layer of scattered nuclei over the whole surface of the yolk. The region of proliferation marks the anal side of the ectoderm, and the layer of nuclei forms the perivitelline membrane. This process must be regarded as equivalent to the first stage of invagination, the yolk being surrounded by hypoblast cells or their nuclei. Later on the same anal edge of the ectoderm forms another cellular layer, the endoderm proper, which forms a continuous sheet below the ectoderm.

The mesoderm also originates at the anal side of the ectoderm and extends in two bands right and left between ectoderm and endoderm. After the mesoderm is thus established, a little vesicle lying upon and open to the yolk is formed from the endoderm, and this vesicle ultimately gives rise to the stomach, the two lobes of the liver and the intestine. The buccal mass and oesophagus arise from a stomodaeal invagination, and the anus is formed later from a short proctodaeal invagination.

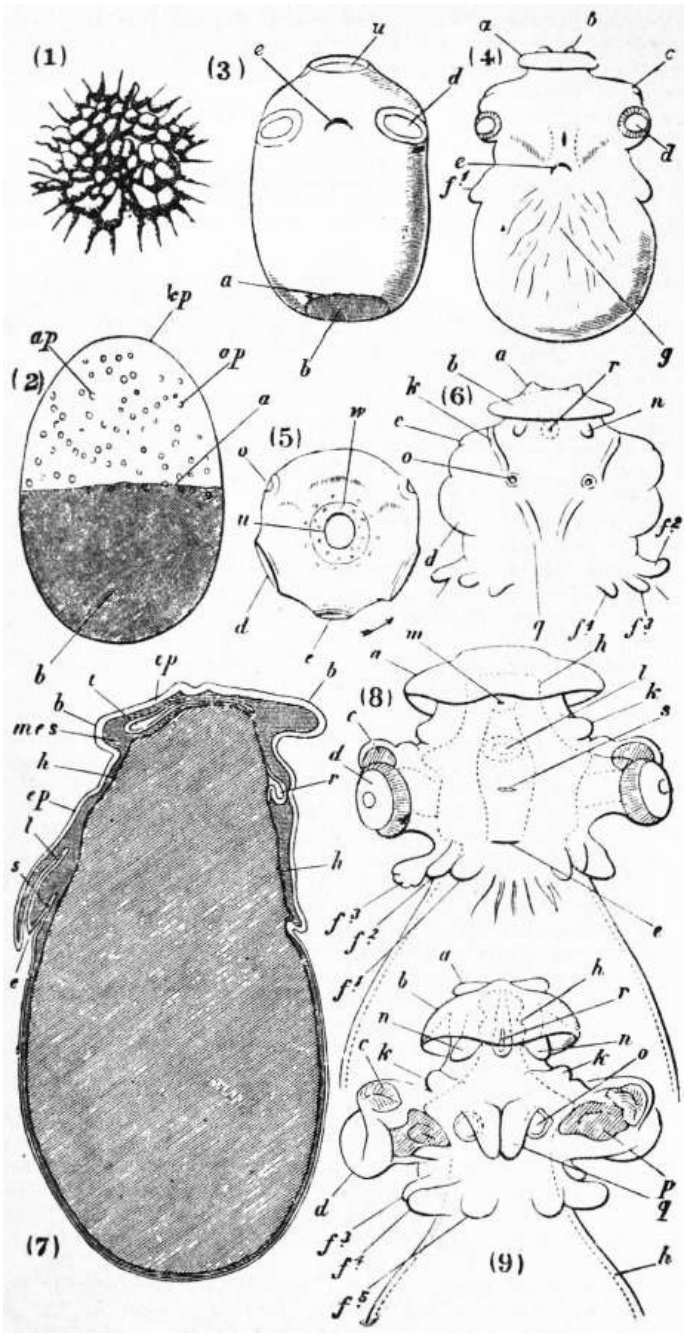


FIG. 35.—Development of *Loligo*.

1. View of the cleavage of the egg during the first formation of embryonic cells.
2. Lateral view of the egg at a little later stage. *a*, Limit to which the layer of cleavage-cells has spread over the egg; *b*, portion of the egg (shaded) as yet uncovered by cleavage-cells; *ap*, the auto-plasts; *kp*, cleavage-pole where first cells were formed.
3. Later stage, the limit (*a*) now extended so as to leave but little of the egg-surface (*b*) unenclosed. The eyes (*d*), mouth (*e*) and mantle-sac (*u*) have appeared.
4. Later stage, anterior surface, the embryo is becoming nipped off from the yolk-sac (*g*).
5. View of an embryo similar to (3) from the cleavage-pole or centro-dorsal area.

Letters in (3) to (9):—*a*, lateral fins of the mantle; *b*, mantle-skirt; *c*, supra-ocular invagination to form the "white body"; *d*, the eye; *e*, the mouth; f^1, f^2, f^3, f^4, f^5, the five paired processes of the fore-foot; g, rhythmically contractile area of the yolk-sac, which is itself a hernia-like protrusion of the median portion of the fore-foot; *h*, dotted line showing internal area occupied by yolk (food-material of the egg); *k*, first rudiment of the epipodia (paired ridges which unite to form the siphon or funnel); *l*, sac of the radula or lingual ribbon; *m*, stomach; *n*, rudiments of the gills (paired ctenidia); *o*, the otocysts—a pair of invaginations of the surface of the epipodia; *p*, the optic ganglion; *q*, the distal

6. Later stage, posterior surface.
7. Section in a median dorso-ventral and antero-posterior plane of an embryo of the same age as (4).
8. View of the anterior face of an older embryo.
9. View of the posterior face of an embryo of the same age as (8).

portion of the ridges which form the siphon, *k* being the basal portion of the same structure; *r*, the vesicle-like rudiment of the intestine formed independently of the parts connected with the mouth, *s*, *k*, *m*, and without invagination; *s*, rudiment of the salivary glands; *t* in (7), the shell-sac at an earlier stage open (see fig. 36), now closed up; *u*, the open shell-sac formed by an uprising ring-like growth of the centro-dorsal area; *w* in (5), the mantle-skirt commencing to be raised up around the area of the shell-sac. In (7) *mes* points to the middle cell-layer of the embryo, *ep* to the outer layer, and *h* to the deep layer of fusiform cells which separates everywhere the embryo from the yolk or food-material lying within it.

The external changes of form are as follows:—The mantle is the middle of the embryonic area, and in its centre is the shell-gland, which, however, behaves in a different way from that seen in other Molluscs. Its borders grow inwards and approach each other to form the shell-sac. E. Ray Lankester showed that in *Argonauta* and other Octopods the shell-sac disappears before it is closed up, but in other forms except *Spirula* it closes completely and the shell develops within it. The lateral and posterior borders of the embryo form the foot, and these borders grow out into ten or eight lobes which become the arms, and which at first, as seen in fig. 35 (8), are entirely posterior to the mouth. Development actually shows the anterior arms gradually growing round the mouth and uniting in front of it. Between the mantle and the foot are two ridges which form the funnel, and their position shows them to be the epipodia. The otocysts and eyes are formed as invaginations of ectoderm, the former behind the eyes, at the sides of the funnel. All the nerve-centres, cerebral, visceral, pedal and optic, are formed as proliferations of the ectoderm. At the sides of the optic ganglia a pair of ectodermic invaginations are formed, which in the adult become the white bodies of the eyes, surrounding the optic ganglion. These are vestiges of lateral cerebral lobes which degenerate in the course of development.

The coelomic cavity appears as a symmetrical pair of spaces in the mesoderm, right and left of the intestine, and from it grow out the genital ducts and the renal organs. The gonad develops from the wall of the coelom.

Phylogeny and Classification.—The order is divided into two sub-orders, Decapoda and Octopoda, by the presence or absence of the tentacular arms. The Decapoda are more adapted for swimming than the Octopoda, the body being usually provided with fins. In the former also there is generally an internal shell of considerable size, often calcined, while in the Octopoda only the merest vestiges of a shell remain. There can be no doubt that the Octopoda were derived from the Decapoda, although from the absence of skeletal structures fossil remains of Octopods are almost entirely unknown. *Palaeoctopus*, however, occurs in the Cretaceous, while shells of *Argonauta* do not appear before the Pliocene. The Decapoda are abundantly represented in the Secondary formations by the *Belemnitidae*, whose shell (fig. 19) consists of a straight conical phragmacone covered posteriorly by a very thick rostrum, and produced anteriorly into a thin long proöstracum which is only occasionally preserved. In certain cases remains of the arms provided with hooks, and of the ink-sac, have been recognized. The *Belemnitidae* appear first in the Upper Trias, attain their maximum development in the Jurassic rocks, and are not continued into the Tertiary period, though represented in the Eocene by a few allied forms.

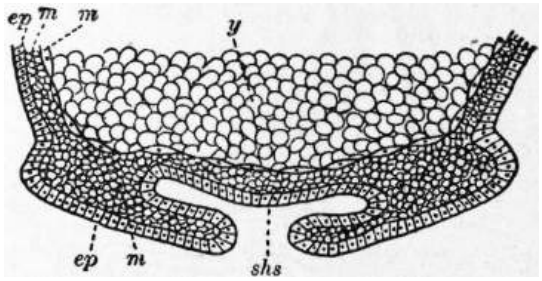


FIG. 36.—Section through aboral end of embryo of *Loligo* showing shell-sac still open. *ep*, ectoderm; *m*, mesoderm; *m′*, endoderm; *shs*, shell-sac; *y*, yolk.

There is no difficulty in deriving the typical existing Decapoda from *Belemnitidae*, and many of the extinct forms may have been directly ancestral. Chitinous “pens” like that of *Loligo*, however, begin to appear in the Jurassic and Cretaceous rocks, so that in this case as in many others the parent form and the modified form existed contemporaneously, and the latter alone has survived. The oldest shells of the *Sepia* type are from the Eocene, and it is perhaps possible that the *Sepiidae* arose separately from the Belemnites.

It is a curious fact that no fossil specimens of the genus *Spirula* have been found, but this may be due to the fact that it occurs only in deep water. At any rate there is no evidence that the shell of *Spirula* has lost a rostrum and a proöstracum; its characters must be regarded as primitive, not secondary. In the characters of the protoconch and of the commencement of the siphuncle, the shell of *Spirula* agrees with that of the Ammonoids, and in both its position is ventral, although in most Ammonoids the shell being exogastric the ventral side is the convex or external, while in *Spirula* the shell is endogastric and the siphuncle internal. The fact that the shell is not completely enclosed by the mantle is also a primitive character.

With regard to the general morphology of the Cephalopoda, it is difficult to reconcile the existence of two pairs of renal tubes as well as a pair of genital ducts in *Nautilus* with the view that the original Mollusc was unsegmented and had only one pair of coelomoducts. Considering the great specialization, however, and high degree of organization of the Cephalopods, it is evident that the earliest Nautiloid whose remains are known to us must have had a long evolutionary history behind it, and such metamerism as exists may have been developed in the course of its own history. In the other direction the evidence seems to prove that the Dibranchiata with only two renal ducts have been derived from the Tetrabranchiata.

Suborder 1. Decapoda.—Four pairs of ordinary non-retractile arms which are shorter than the body, and one pair of tentacular arms, situated between the third and fourth normal arms on each side and retractile within special pouches. Suckers pedunculated and provided with horny rings, on the tentacular arms confined usually to the distal extremities. Usually a well-developed internal shell, and lateral fins on the edges of the body. Heart in a coelomic cavity; nidamentary glands usually present.

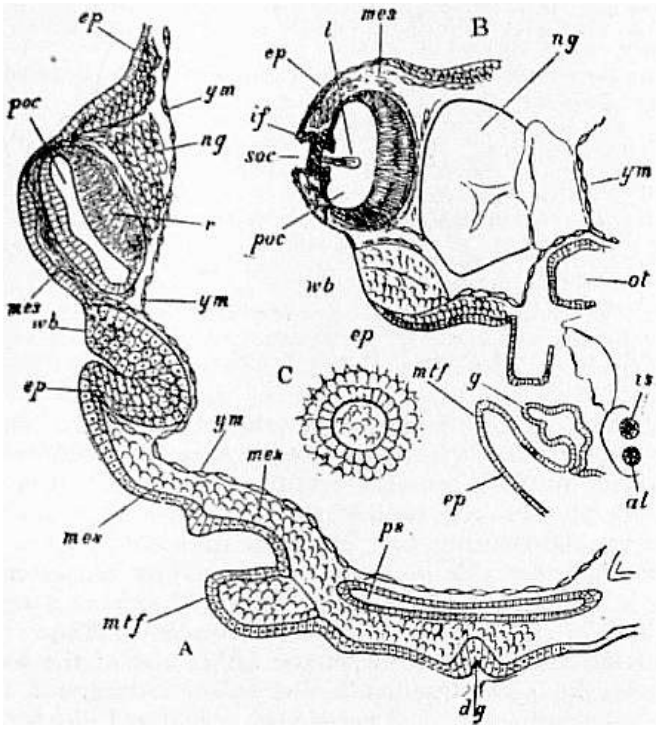


Fig. 37.—Right and left sections through embryos of *Loligo*. (After Lankester.)

A, Same stage as fig. 35 (4).
B, Same stage as fig. 35 (8); only the left side of the sections is drawn, and the food-material which occupies the space internal to the membrane *ym* is omitted.
al, Rectum.
is, Ink-sac.
ep, Outer cell-layer.
mes, Middle cell-layer.
ym, Deep cell-layer of *wb*, The “white body” of the adult ocular capsule forming as an invagination of the outer cell-layer.
mtf, Mantle-skirt.
g, Gill.
ps, Pen-sac or shell-sac, now closed.
dg, Dorsal groove.
poc. Primitive optic vesicle, now closed (see fig. 34).
l, Lens.

fusiform cells (yolk-membrane).
ng, Optic nerve-ganglion.
ot, Otocyst.
r, Retina.
soc, Second or anterior optic chamber still open.
if, Iridean folds.
C, The primitive invagination to form one of the otocysts, as seen in fig. 35 (5) and (6).

Tribe 1. *Oigopsida*.—A wide aperture in the cornea. Two oviducts in the female. In fossil genera and *Spirula*, shell has a multilocular phragmacone with a siphuncle; initial chamber globular and larger than the second chamber. The most ancient forms characterized by the small size of the rostrum and proöstracum, and large size of the phragmacone. In the living genera, except *Spirula*, the shell is a chitinous gladius.

Fam. 1. *Belemnoteuthidae*. Extinct; shell with well-developed phragmacone, and rostrum merely a calcareous envelope; siphuncular necks directed backwards as in Nautiloidea; ten equal arms provided with hooks. *Phragmoteuthis*, Trias. *Belemnoteuthis*, Jurassic and Cretaceous. *Acanthoteuthis*, Jurassic.

Fam. 2. *Aulacoceratidae*. Extinct; phragmacone with widely separated septa; rostrum well developed and claviform. *Aulacoceras*, Trias. *Atractites*, Trias and Jurassic. *Xiphoteuthis*, Lias.

Fam. 3. *Belemnitidae*. Extinct; phragmacone short with ventral siphuncle, prolonged dorsally into long proöstracum; rostrum large and cylindrical. *Belemnites*, 350 species from Jurassic and Cretaceous. *Diploconus*, Upper Jurassic.

Fam. 4. *Belopteridae*. Extinct; rostrum and phragmacone well developed, phragmacone often curved; initial chamber small. *Beloptera*, Eocene. *Bayanoteuthis*, Eocene. *Spirulirostra*, Miocene.

Fam. 5. *Spirulidae*. Dorsal and ventral sides of posterior extremity of shell uncovered by mantle; no rostrum or proöstracum; shell calcareous, coiled endogastrically and sipnunculated; fins posterior. *Spirula*, three living species known, abyssal.

Fam. 6. *Ommatostrephidae*. Shell internal and chitinous, ending aborally in a little narrow cone; tentacular arms short and thick; suckers with denticulate rings. *Ommatostrephes*, fins aboral, simple and rhomboidal, British. *Ctenopteryx*, fins pectinate, as long as the body; *Bathyteuthis*, fins terminal, rudimentary; tentacular arms, filiform; abyssal. *Rhynchoteuthis*, tentacular arms united to form a beak-shaped appendage. *Symplectoteuthis. Tracheloteuthis. Doridicus. Architeuthis*; this is the largest of Cephalopoda, reaching 60 ft. in length including arms.

Fam. 7. *Thysanoteuthidae*. Arms enlarged, bearing two rows of suckers and filaments; fins triangular, extending whole length of body. *Thysanoteuthis*, Mediterranean.

Fam. 8. *Onychoteuthidae*. Fins terminal; tentacular arms long; suckers with hooks. *Onychoteuthis*, hook-bearing suckers on tentacular arms only. *Enoploteuthis*, hook-bearing suckers on all the arms. *Veranya*, body very short, tentacular arms atrophied in the adult, Mediterranean. *Chaunoteuthis*, body elongated, tentacular arms atrophied. *Pterygioteuthis. Ancistroteuthis. Abralia. Teleoteuthis. Lepidoteuthis.*

Fam. 9. *Gonatidae*. Body elongated; fins terminal; radula with only two lateral teeth. *Gonatus*.

Fam. 10. *Cheiroteuthidae*. Tentacular arms long, not retractile; resisting apparatus well developed. *Cheiroteuthis*, suckers along the whole length of the tentacular arms. *Doratopsis*, body very long and slender with aboral spine, dorsal arms very short. *Histioteuthis*, six dorsal arms united by membrane, photogenous organs present. *Histiopsis*, membrane of dorsal arms only half-way up the arms, photogenous organs present. *Calliteuthis*, no brachial membrane, photogenous organs present. *Grimalditeuthis*, two fins on each bide, no tentacular arms.

Fam. 11. *Cranchiidae*. Eight normal arms, very short; eyes prominent; fins small and terminal. *Cranchia*, body short, purse-shaped, normal arms short, fins entirely aboral. *Loligopsis*, body elongated, conical, tentacular arms slender. *Leachia*, tentacular arms absent, funnel without a valve. *Taonius*, body elongated, normal arms, rather short, eyes pedunculated.

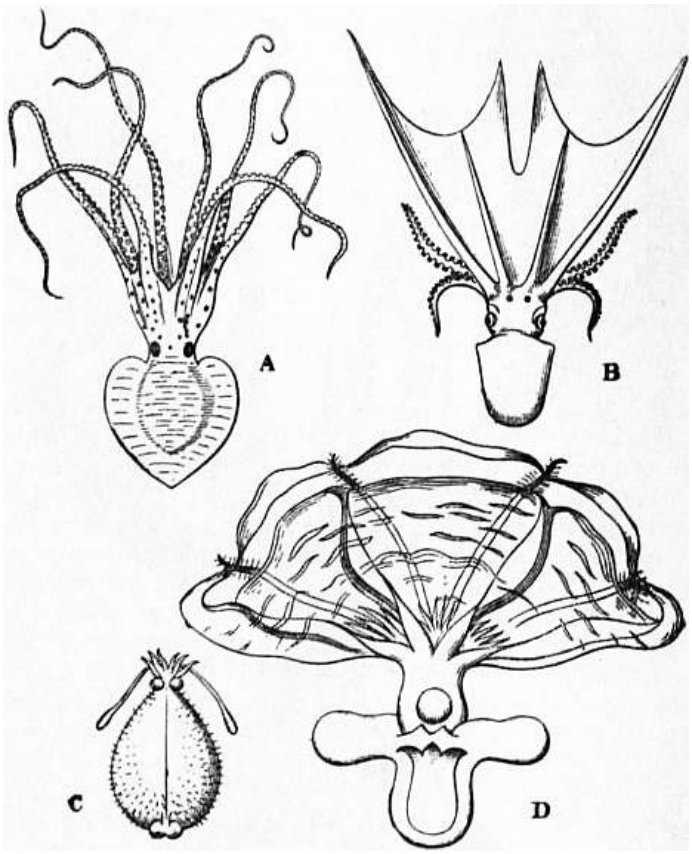


FIG. 38.—Octopodous Cephalopods.

A, *Pinnoctopus cordiformis*, Quoy and Gain (from New Zealand).
B, *Tremoctopus violaceus*, Ver. (from the Mediterranean).
C, *Cranchia scabra*, Owen (from the Atlantic Ocean; one of the Decapoda).
D, *Cirrhoteuthis Mulleri*, Esch. (from the Greenland coast).

Tribe 2. *Myopsida*.—No aperture in the cornea. Left oviduct only developed in female. Internal shell without a distinct phragmacone, calcified or simply chitinous.

Fam. 1. *Sepiidae*. Body wide and flat; fins narrow, extending the whole length of the body; shell calcareous and laminated. *Belosepia*, a rudiment of rostrum and phragmacone present in shell, Eocene. *Sepia*, shell with a rostrum, British. *Sepiella*, shell without a rostrum.

Fam. 2. *Sepiolidae*. Body short, rounded at the aboral end; fins rounded, inserted in middle of body-length; shell chitinous, small or absent. *Sepiola*, head united to mantle dorsally, British. *Rossia*, head not united to mantle, British. *Stoloteuthis* and *Inioteuthis*, without shell. *Heteroteuthis. Euprymna.*

Fam. 3. *Idiosepiidae*. Body elongated, with rudimentary terminal fins; internal shell almost lost. *Idiosepius*, 1.5 cm. long, Indian Ocean.

Fam. 4. *Sepiadariidae*. Body short; mantle united to head dorsally; no shell. *Sepiadarium*, Pacific Ocean. *Sepioloidea*, Australian.

Fam. 5. *Loliginidae*. Body elongated and conical; fins extending forward beyond the middle of body-length; shell chitinous, well developed. *Loligo*, fins triangular, aboral, British. *Sepioteuthis*, fins rounded, extending along whole of body-length. *Loliolus. Loliguncula.* The following fossil genera, known only by their gladius and ink-sac, have been placed near *Loligo*:—*Teuthopsis, Beloteuthis* and *Geoteuthis*, Lias; *Phylloteuthis*, Cretaceous; *Plesioteuthis*, Jurassic and Cretaceous.

SUBORDER 2. OCTOPODA.—Only four pairs of arms, all similar and longer than the body. Body short and rounded aborally. Suckers sessile. Heart not contained in coelom. No nidamentary glands.

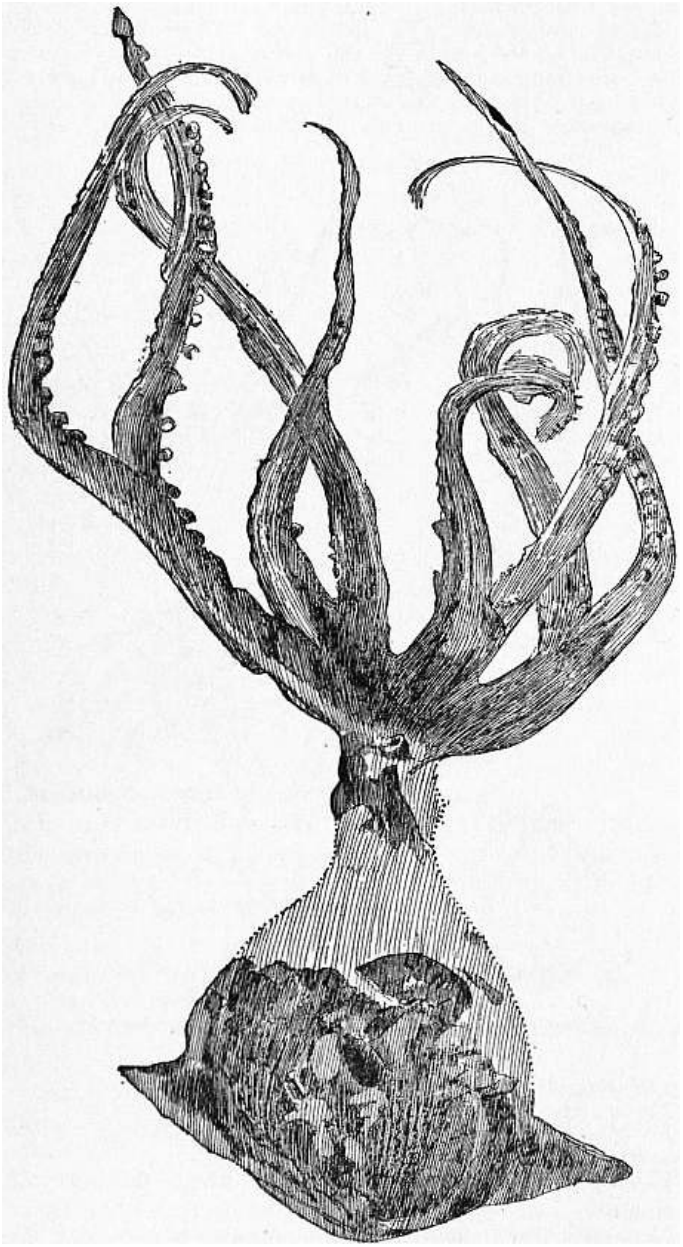


FIG. 39.—*Palaeoctopus Newboldi*, the oldest Octopod known. From the Cretaceous rocks of Lebanon. (After H. Woodward.)

Tribe I. *Leioglossa*.—No radula. Arms united by a complete membrane. Fins on sides of body.

Fam. *Cirrhoteuthidae*. Tentacular filaments on either side of the suckers. *Cirrhoteuthis*, pallial sac prominent, fins large, pelagic. *Opisthoteuthis*, body flattened, with small fins, deep-sea. *Vampyroteuthis*, four fins. *Palaeoctopus*, fossil, Cretaceous.

Tribe 2. *Trachyglossa*.—Radula present. No fins.

Fam. 1. *Amphitretidae*. Arms united by membrane; funnel attached to mantle, dividing the pallial aperture into two. *Amphitretus*, pelagic.

Fam. 2. *Alloposidae*. All arms united by membrane; mantle joined to head by dorsal band and two lateral commissures. *Alloposus*, pelagic.

Fam. 3. *Octopodidae*. Arms long and equal, without membrane; hectocotylus not autotomous. No cephalic aquiferous pores. *Octopus*, two rows of suckers on each arm, British. *Eledone*, single row of suckers on each arm. *Scaeurgus. Pinnoctopus. Cistopus. Japetella.*

Fam. 4. *Philonexidae*. Hectocotylus autotomous; arms unequal in size; aquiferous pores on head and funnel. *Tremoctopus*, two dorsal pairs of arms united by membrane. *Ocythoë*, without interbrachial membrane.

Fam. 5. *Argonautidae*. Hectocotylus autotomous; no interbrachial membrane; extremities of dorsal arms in female expanded and secreting a shell; males very small, without shell. *Argonauta*.

LITERATURE.—Use has been freely made above of the article by E. Ray Lankester, on *Mollusca*, in the 9th edition of this Encyclopedia. For the chief modern works, see Bashford Dean, “Notes on Living Nautilus,” *Amer. Nat.* xxxv., 1901; Arthur Willey, “Contribution to the Natural History of the Pearly Nautilus,” A. Willey’s *Zoological Results*, pt. vi. (1902); Foord, *Cat. Fossil*

Cephalopoda in British Museum; Alpheus Hyatt, "Fossil Cephalopods of the Museum of Comp. Zoology," *Bull. Mus. Comp. Zool.* (Cambridge, U.S., 1868); Jalta, "I Cefalopodi viventi nel golfo di Napoli," *Fauna und Flora des Golfes von Neapel*, xxiii. (1896); Joubin, "Céphalopodes de l'atlantique nord," "Céph. de la Princesse Alice," *Camp. sci. Albert I^er de Monaco*, ix. (1895), xxii. (1900); Paul Pelseneer, "Mollusca," in the *Treatise on Zoology*, edited by E. Ray Lankester.

(J. T. C.)

CEPHEUS, in Greek mythology, the father of Andromeda (*q.v.*); in astronomy, a constellation of the northern hemisphere, mentioned by Eudoxus (4th century B.C.) and Aratus (3rd century B.C.). Ptolemy catalogued 13 stars in this constellation, Tycho n, and Hevelius 51. The most interesting star in it is δ *Cephei*, a remarkable double star, the brighter component of which is a short period variable (5.37 days), with a range in magnitude of 3.7 to 4.9; it is also a spectroscopic binary.

CEPHISODOTUS, the name of the father and of the son of Praxiteles, both sculptors like himself. The former must have flourished about 400 B.C. A noted work of his was Peace bearing the infant Wealth, of which a copy exists at Munich. Peace is a Madonna-like figure of a somewhat conservative type; the child Wealth is less successful. Cephisodotus also made, like his son, a figure of Hermes carrying the child Dionysus, unless indeed ancient critics have made two works of one. He made certain statues for the city of Megalopolis, founded in 370 B.C. Of the work of the younger Cephisodotus, his grandson, we have no remains; he was a prolific sculptor of the latter part of the 4th century B.C., especially noted for portraits, of Menander, of the orator Lycurgus, and others (see J. Overbeck, *Antike Schriftquellen*, p. 255).

CERAM (*Sirang*), an island of the Dutch East Indies, in the Molucca group, lying about 3° S., and between 127° 45′ and 131° E. Its length is a little over 200 m., its greatest breadth about 50 m., and its area, including neighbouring islets, 6621 sq. m. It consists of two parts, Great Ceram and Little Ceram or Huvamohel, united by the isthmus of Taruno; and, for administrative purposes, is assigned to the residency of Amboyna, being divided into Kairatu or West Ceram, Wahai and Amahai, the northern and the southern parts of Middle Ceram, and Waru or Eastern Ceram. No central chain of mountains stretches west and east through the island, but near the north coast hills, rising 2300 to 2600 ft., slope steeply to the shore. Near the south coast, west of the Bay of Elpaputeh, a complex mass of mountains forms a colossal pyramid, with peaks rising to nearly 5000 ft. The isthmus connecting the two parts of the island is very narrow, and has a height of only 460 to 490 ft. The chief rivers flow north and south into bays, but are navigable only for a few miles during the rainy season. The rainfall is very heavy, amounting to 121 in. (mean annual) on the south coast. On the north coast the bays of Savai and Waru are accessible for small vessels. The geological structure, consisting chiefly of eruptive rocks and crystalline limestone, is similar to that of northern Amboyna. In the eastern section the prevailing rock is crystalline chalk, similar to that of Buru. Several hot springs occur, and earthquakes are not infrequent. About 4000 persons perished in the earthquake of 1899. A large part of the interior is covered with dense forests, and except along the coast the population is scanty. For the naturalist Ceram is without much interest, lacking characteristic species or abundance of specimens. The Bandanese pay occasional visits to shoot bears and deer; there are numbers of wild goats and cattle; and among birds are mentioned cassowaries, cockatoos, birds of paradise, and the swallows that furnish edible nests. A large number of fish are to be found in the various rivers; and as early as 1860 no fewer than 213 species were described. The most valuable timber tree is the iron-wood. Rice, maize, cocoa-nuts, sugar-cane and a variety of fruits are grown; and some tobacco is exported to Europe; but by far the most important production is the sago palm, which grows abundantly in the swampy districts, especially of Eastern Ceram, and furnishes a vast supply of food, not only to Ceram itself, but to other islands to the east. The Dutch have established cocoa and coffee plantations at various points. The

coast-villages are inhabited by a mixed Malay population, Buginese, Macassars, Balinese and other races of the archipelago. The interior is occupied by the aborigines, a people of Papuan stock. They are savages and head-hunters. The introduction of Christianity was hampered by the baneful influence of a secret society called the Kakian Union, to which pagans, Mahommedans and Christians indiscriminately attached themselves; and it has several times cost the Dutch authorities considerable efforts to frustrate their machinations (see *Tijdschrift van Ned. Ind.*, fifth year). The total population is estimated at 100,000, including 12,000 Christians and 16,000 Mahommedans. The chief settlements are Savai at the north and Elpaputeh at the south end of the isthmus of Taruno. There was a Dutch fort at Kambello, on the west side of Little Ceram, as early as 1646.

CERAMICS, or KERAMICS (κέραμος, earthenware), a general term for the study of the art of pottery. It is adopted for this purpose both in French (*céramique*) and in German (*Keramik*), and thus has its convenience in English as representing an international form of description for a study which owes much to the art experts of all nations, though “ceramic” and “ceramics” do not appear in English as technical terms till the middle of the 19th century.

The word “pottery” (Fr. *poterie*) in its widest sense includes all objects fashioned from clay and then hardened by fire, though there is a growing tendency to restrict the word to the commoner articles of this great class and to apply the word “porcelain” to all the finer varieties. This tendency is to be deprecated, as it is founded on a misconception; the word “porcelain” should only be applied to certain well-marked varieties of pottery. The very existence of pottery is dependent on two important natural properties of that great and widespread group of rocky or earthy substances known as clays, viz. the property of plasticity (the power of being readily kneaded or moulded while moist), and the property of being converted when fired into one of the most indestructible of ordinary things.

The clays form such an important group of mineral substances that the reader must refer to the article CLAY for an account of their occurrence, composition and properties. In this article we shall only deal with the various clays as they have affected the problems of the potter throughout the ages. The clays found on or close to the earth’s surface are so varied in composition and properties that we may see in them one of the vital factors that has determined the nature of the pottery of different countries and different peoples. They vary in plasticity, and in the hardness, colour and texture of the fired product, through an astonishingly wide range. To-day the fine, plastic, white-burning clays of the south of England are carried all over Europe and America for the fabrication of modern wares, but that is a state of affairs which has only been attained in recent times. Even down to the 18th century, the potters of every country could only use on an extensive scale the clays of their own immediate district, and the influence of this controlling factor on the pottery of bygone centuries has never yet received the attention it deserves.[1]

General Evolution of Pottery.—The primitive races of mankind, whether of remote ages or of to-day, took perforce such clay as they found on the surface of the ground, or by some river-bed, and with the rudimentary preparation of spreading it out on a stone slab if necessary and picking out any rocky fragments of appreciable size, then beating it with the hands, with stones or boards, or treading it with the feet to render it fairly uniform in consistency, proceeded to fashion it into such shapes as need or fancy dictated. Fired in an open fire, or in the most rudimentary form of potter’s kiln, such pottery may be buff, drab, brown or red—and these from imperfect firing become smoked, grey or black. How many generations of men, of any race, handed on their painfully acquired bits of knowledge before this earliest stage was passed, we can never know; but here and there, where the circumstances were favourable or the race was quick of observation, we can trace in the work of prehistoric man in many countries a gradually advancing skill based on increased technical knowledge. For ages tools and methods remained of the simplest—the fingers for shaping or building up vessels, a piece of mat or basket-work for giving initial support to a more ambitious vase,—until some original genius of the tribe finds that by starting to build up his pot on the flattened side of a boulder he can turn his support so as to bring every part in succession under his hand, and lo! the potter’s wheel is invented—not brought down from heaven by one of the gods to a favoured race, as the myths of all the older civilizations or barbarisms, Egyptian, Chaldean, Greek, Scythian, and Chinese have fabled, but born from the brain and hand of man struggling to fulfil his allotted task.

Formerly every writer on the history of pottery seemed to imagine that the very rudest pottery must have been the invention of Egyptian, Chinese or some other distinct race from which the knowledge radiated to all the other races of the prehistoric world. No conception could be more

erroneous. Since the middle of the 19th century research has established beyond doubt that wherever clay was found men became potters of a sort, just as they became hunters, carpenters, smiths, &c., by sheer force of need and slowly-gathered tradition. The not yet exploded view that Egypt or Assyria was the special cradle of this art, and that the pottery of the Greeks and Romans directly descended from such a parent stock, cannot survive in view of the incontestable evidence that pottery was made by the prehistoric peoples of what we now call Greece, Italy, Spain and other countries, long before they were aware that any other peoples lived on the earth than themselves.

For centuries this simple hand-made pottery was hardened by drying in the sun, so that it would serve for the storage of dried grain, &c., but the increasing use of fire would soon bring out the amazing fact that a baked clay vessel became as hard as stone. Then, too, came the knowledge that even in one district all the clays did not fire to the same colour, and colour decoration arose, in a rude daubing or smearing of some clay or earth (a ruddle or bole perhaps), which was found to give a bright red or buff colour on vessels shaped in a duller-coloured clay—most precious of all were little deposits of white clay which kept their purity unsullied through the fire,—and by these primitive means the races of the dawn made their wares. On this substructure all the pottery of the last four thousand years has been built, for behind all Egyptian, Greek or Chinese pottery we find the same primitive foundations.

We now reach the beginnings of recorded history, and as the great nations of the past emerge from the shadows they each develop the potter's art in an individual way. The Egyptians evolve schemes of glowing colour—brilliant glazes fired on objects, shaped in sand held together with a little clay, or actually carved from rocks or stones; the Greeks produce their marvels of plastic 704
form, and then, excited by their growing skill in metal work, turn the plastic clay into imitations of metal forms. These nations are overthrown, and the Romans spread some knowledge—only a tincture, it must be confessed—over all the lands they hold in fee; and from the Euphrates to the Atlantic, from Egypt to the Wall of Hadrian, they set alight potters' fires that have never since been extinguished. The Roman empire falls, and over Europe its pottery is forgotten along with its greater achievements; yet still pottery-making goes on in a very simple way, to be slowly revived and modified once more by the communities of monks, who, in later centuries, replace the Roman legions as the great civilizing influence in Europe. Meantime Egypt and the nearer East continued, in a debased form, the splendours of their glorious past, and glazed and painted pottery was still made by traditional methods. What part the Byzantine civilization and the Persians played during this obscure time, we are only just beginning to realize; but we now know that many interesting kinds of decorated pottery were made at Old Cairo, at Alexandria, at Damascus, in Syria, Anatolia and elsewhere (on which the later Moslem potters founded their glorious works), at a time when all over Europe crocks of simple red or drab clay, covered only with green and yellow lead-glazes, were the sole evidence of the potter's skill. What the Arab conquests destroyed, and what their breath quickened into life, we can only guess; but the fact is indisputable that with the Mahommedan conquests there came a time when the potter's art of the Occident reached its highest expression, and when methods and knowledge hitherto confined to Egypt, Syria and Persia were spread from Spain and the south of France to India—even, it may be, into China.

Meantime, in the farther East, the Chinese—the greatest race of potters the world has ever seen—were quietly gathering strength, until from their glazed, hard-fired pottery there emerged the marvellous, white translucent porcelain, one of the wonders of the medieval world.

With the dawn of the 15th century of our era, the state of affairs was practically this:—In European countries proper we find rudely fashioned and decorated wares in which we can trace the slow development of a native craft from the superposition of Roman methods on the primitive work of the peoples. The vessels were mostly intended for use and not for show; were clumsily fashioned of any local clay, and if glazed at all then only with coarse lead-glazes, coloured yellow or green; in no case above the level of workmanship of the travelling brick- or tile-maker. The finest expression of this native style is to be found in the Gothic tile pavements of France, Germany and England, where all the colours are due to the clays and there is no approach to painting. In the Moslem countries—including the greater part of Spain and Sicily, Egypt and the nearer East, probably even to the very centre of Asia—pottery was being made either of whitish clay and sand, or of a light reddish clay coated with a white facing of fine clay or of tin-enamel, on which splendid decorative patterns in vivid pigments or brilliant iridescent lustres were painted.

As early as the 12th century of our era this superior artistic pottery of the Moslem nations had already attracted the notice of Europeans as an article of luxury for the wealthy; and we may well believe the traditional accounts that Saracen potters were brought into Italy, France and Burgundy to introduce the practice of their art, while Italian potters certainly penetrated into the workshops of eastern Spain and elsewhere, and gathered new ideas. In Italy certainly, and in the south of France probably, efforts were continuously in progress to improve the native

wares by coating the vessels with a white “slip” and drawing on them rude, painted patterns in green, yellow and purplish black. The increasing intercourse with Spain, in war and peace, also introduced the use of tin-enamel after the fashion of the famous Hispano-Moresque wares, and by the end of the 14th century a knowledge of tin-enamel was widespread in Italy and paved the way to the glorious painted majolica of the 15th and 16th centuries. From Italy and Spain, France and Holland, Germany, and finally, though much later, England learnt this art, and the tin-enamelled pottery of middle and northern Europe, so largely made during the 17th and 18th centuries, was the direct offshoot of this movement of the Italian Renaissance.[2]

During the 15th and 16th centuries Chinese porcelain also began to find its way into Europe, and by the whiteness of its substance and its marvellous translucence excited the attention of the Italian majolists and alchemists. The first European imitation of this famous oriental porcelain of which we have indubitable record was made at Florence (1575-1585) by alchemists or potters working under the patronage, and, it is said, with the active collaboration of Francesco de’ Medici. This Florentine porcelain was the first of those distinctively European wares, made in avowed imitation of the Chinese, which form a connecting link between pottery and glass, for they may be considered either as pottery rendered translucent or as glass rendered opaque by shaping and firing a mixture containing a large percentage of glass with a very little clay. After the cessation of the Florentine experiments we know of no European porcelain for nearly a century, though the importation of Chinese porcelain had largely increased owing to the activity of the various “India” companies. The next European porcelain, made like the Florentine of glass and clay, was that of Rouen (1673) and St Cloud (1696); and during the 18th century artificial glassy porcelain was made in France and England largely, and in other countries experimentally. German experimenters worked in another direction, and the first porcelain made in Europe from materials similar to the Chinese was produced at Meissen by Böttger (1710-1712). During the 18th century not only was there a very large trade in imported Chinese and Japanese porcelain, but there was a great development of porcelain manufacture in Europe; and in every country factories were established, generally under royal or princely patronage, for the manufacture of artificial porcelain like the French, or genuine porcelain like the German. The English made a departure in the introduction of a porcelain distinct from either, through adding calcined ox-bones to the other ingredients; and this English bone-porcelain—a well-marked species—is now largely made in America, France, Germany and Sweden as well as in England.

By the end of the 18th century the risks and losses attendant on the manufacture of the French glassy porcelain had caused its abandonment, and a porcelain made from natural materials like the Chinese has since been generally made on the continent of Europe.

The older tin-enamelled wares—derived from the Hispano-Moresque and the Italian majolica—so largely made in France, Holland, Germany and elsewhere during the 17th and 18th centuries, met with a fate analogous to that of the French porcelain. Tin-enamelled earthenware is always a brittle substance, soon damaged in regular use; so that, when, in the middle of the 18th century, the English potter first appeared as a serious competitor with a fine white earthenware of superior durability and precision of manufacture, the old painted faience gradually disappeared between the upper millstone of European porcelain and the nether millstone of English earthenware.

The 19th century witnessed a great and steady growth in the output of porcelain and pottery of all kinds in Europe and the United States. Mechanical methods were largely called in to supplement or replace what had hitherto remained almost pure handicraft. The English methods of preparing and mixing the materials of the body and glaze, and the English device of replacing painted decoration by machine printing, to a large extent carried the day, with a great gain to the mechanical aspects of the work and in many cases with an entire extinction of its artistic spirit. Even the hand-work that still remained was largely affected by the growing dominance of machinery; and the painting, gilding and decoration of pottery and porcelain, in the first half of the 19th century, became everywhere mechanical and hackneyed. During the latter half of the 19th century another influence was fortunately at work. Side by side with the increasing mechanical perfection of the great bulk of modern pottery there grew up a school of innovators and experimentalists, who revived many of the older decorative methods that had fallen into oblivion and produced fresh and original work, in certain directions even beyond, the achievements of the past. The 20th century opened with a wider outlook among the potters of Europe and America. In every country men were striving once again to bring back to their world-old craft something of artistic taste and skill.

FIG. 1.—Potter moulding a vessel on the wheel (from a painting in a tomb at Thebes about 1800 B.C.). Compare the wheel on the left in fig. 5.

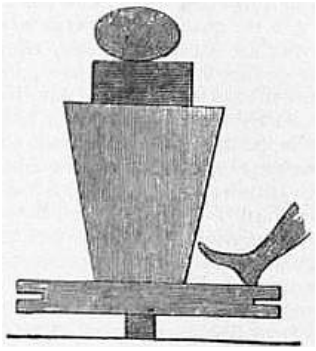


FIG. 2.—Potter's wheel of the time of the Ptolemies, moved by the foot (from a wall-relief at Philae). Compare fig. 5, the wheel on the right.

Technical Methods.—All primitive pottery, whether of ancient or of modern times, has been made by the simplest methods. The clay, dug from the earth's surface, was or is prepared by beating and kneading with the hands, feet or simple mallets of stone or wood; stones and hard particles were picked out; and the mass, well tempered with water, was used without any addition. From this clay, vessels were shaped by scooping out or cutting a solid lump or ball, by building up piece by piece and smoothing down one layer upon another or by squeezing cakes of clay on to some natural object or prepared mould or form. The potter's wheel, though very ancient, was a comparatively late invention, arrived at independently by many races of men. In its simplest form it was a heavy disk pivoted on a central point to be set going by the hand, as the workman squatted on the ground; and it may be seen to-day in India, Ceylon, China or Japan, in all its primitive simplicity (see fig. 1). This form of potter's wheel was the only one known until about the Christian era, and then, in Egypt apparently, the improvement was introduced of lengthening the spindle which carries the throwing-wheel and mounting on it near the base a much larger disk which the potter could rotate with his foot, and so have both hands free for the manipulation of the clay (fig. 2). No further advance seems to have been made before the 17th century, when the wheel was spun by means of a cord working over a pulley; and though a steam-driven wheel was introduced in the middle of the 19th century, this form remains the best for the production of fine pottery.

A prevalent misconception with regard to the potter's wheel needs correction. For anything beyond very simple shapes it is impossible to carry the work to completion on the wheel at one operation as is generally imagined. All that the potter can do while the clay is soft enough to "throw" on the wheel is to get a rough shape of even thickness. This operation completed, the piece is removed from the wheel and set aside to dry. When it is about leather-hard, it may be re-centred carefully on the wheel (the old practice), or placed in a horizontal lathe (since 16th century) and turned down to the exact shape and polished to an even, smooth surface. The Greek vase-makers were already adepts in what is often reckoned a modern, detestable practice. Many Greek vases have obviously been "thrown" in separate sections, and when these had contracted and hardened sufficiently they were luted together with slip, and the final vase-shape was smoothed and turned down on the wheel, and even polished to as fine a degree of mechanical finish as the modern potter ever attains. So too with the Chinese; many of their forms have been made in two or three portions, subsequently joined together and finished on the outside as one piece. Indeed it is remarkable how the Greeks and Chinese had discovered for themselves many devices of this kind which are generally held up to opprobrium as the debased methods of a mechanical age. Always it should be borne in mind that the shaping of pottery by "pressing" cakes of clay into moulds is much older than the potter's wheel, and has always been the method of making shapes other than those in the round. The modern method of "casting" pottery by pouring slip, a fluid mixture of clay and water, into absorbent moulds seems to have originated in England about the middle of the 18th century; and this too is a genuine potter's method which does not merit the disapproval with which it has been generally regarded by writers on the potter's art.

In all ages the work of the "thrower" or "presser" has been largely supplemented by the modeller, who alters the shape, and applies to it handles, spouts or modelled accessories at will.

Firing.—The firing of pottery has become in modern times such a specialized branch of the manufacture that the student can only be referred here to the technological works mentioned in the bibliography at the end of this article. It is, however, necessary that we should briefly describe the earlier forms of potters' kilns used by the nations whose pottery counts among the treasures of the collector and the antiquary. Here

again we now know that the primitive types of kiln used by the potters of ancient Egypt or Greece have not vanished from the earth; it is only in the civilized countries of the modern world that they have been replaced by improved and perfected devices. The potters of the North-West Provinces of India use to-day a kiln practically identical with that depicted in severest silhouette on the rock-tombs of Thebes; and the skilful Japanese remain content with a kiln very similar to the one shown in fig. 3. This Greek type of kiln was improved and enlarged by the Romans, and its use seems to have been introduced wherever pottery was made under their sway, for remains of Roman kilns have been found in many countries (see fig. 4). With the end of Roman dominance we have ample evidence that their technical methods fell into disuse, and the northern European potter of the period from the 6th to the 12th century had to build up his methods afresh, and improved kilns were invented. The general type of medieval potter's kiln is illustrated for us in the manuscript of an Italian potter of the 16th century, now in the library of the Victoria and Albert Museum[3] (fig. 5). Kilns of a different type, horizontal reverberatory kilns, were used for making the hard-fired pottery of Europe (Rhenish stoneware, &c.), as well as for Chinese porcelain and the earliest German porcelains. With the organization of pottery as a factory industry in the 18th century, improved kilns were introduced, and the type of kiln now so largely used in civilized countries is practically a vertical reverberatory furnace of circular section, from 10 to 22 ft. in diameter and of similar height, capable, therefore, of containing at one firing a quantity of pottery that would have formed the output of a medieval potter for a year. Every device that can be thought of for the better utilization of heat and its even distribution throughout the kiln or oven has been experimented with; and, though the results have been most successful from the point of view of the potter, even the most recent coal-fired ovens remain very wasteful types of apparatus, the amount of available heat being relatively small to the fuel consumption. Gas-fired kilns and ovens are now being used or experimented with in every country, and their perfection, which cannot be far distant, will improve the most vital of the potter's processes both in certainty and economy.

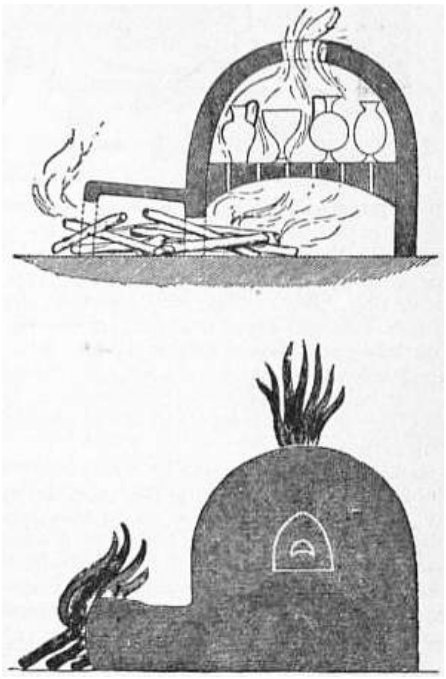


FIG. 3.—Early Greek pottery-kiln, about 700-600 B.C. (from a painted votive tablet found at Corinth, now in the Louvre). The section shows the probable construction of the kiln.

FIG. 4.—Roman kiln found at Castor. The low arch is for the insertion of the fuel; the pots rested on the perforated floor, made of clay slabs; the top of the kiln is missing,—it was probably a dome.

FIG. 5.—Two forms of Italian potter's wheels, about 1540.

Glazes.—We are never likely to known when glaze (*i.e.* a coating of fired glass) was first applied to pottery, though the present state of knowledge would incline us to the opinion that the earliest glazed objects we possess are those of ancient Egypt,[4] but the practice may have been originated independently wherever a knowledge of the elements of glass-making had spread, as all the early glazes were of the alkaline type, which must first be fused into a glass before they can be applied to pottery.

Many primitive races seem to have burnished their pottery after it was fired, in order to get a glossy surface; and in other cases the surface was rendered shining and waterproof by coating it with waxy or resinous substances which were often coloured. It is possible that the black varnish of Greek vases was obtained by such a method, and though that point is not settled, we have many types of primitive pottery, both modern and ancient, which are coated in this way. Such a coating is only a substitute for glaze in the work of peoples who do not know or have not mastered the technical secrets of true glazes. We can only consider as glazes those definite superficial layers of molten material which have been fired on the clay substance. Glazes are as varied as the various kinds of pottery, and it must never be forgotten that each kind of pottery is at its best with its appropriate glaze. The earliest known glazes (Egyptian and Assyrian) were silicates of soda and lime containing very little alumina and no lead. Such glazes are very uncertain in use, and can only be applied to pottery unusually rich in silica (*i.e.* deficient in clay). Consequently these alkaline glazes cannot be used on ordinary clay wares, and when they have been used successfully, the clay has always been coated with a surface layer of highly siliceous substance (*e.g.* the so-called Persian, Rhodian, Syrian and Egyptian pottery of the early middle ages). The fact that glazes containing lead-oxide would adhere to ordinary pottery when alkaline glazes would not was discovered at a very early period; for lead glazes were extensively used in Egypt and the nearer East in Ptolemaic times, and it is significant that, though the Romans made singularly little use of glazes of any kind, the pottery that succeeded theirs, either in western Europe or in the Byzantine empire, was generally covered with glazes rich in lead. Throughout Europe, and over the greater part of the world, leaded glazes have been continuously used and improved for all ordinary pottery, and it is only with certain special hard-fired types of ware that they have yet been successfully replaced. Chinese porcelain and all the European porcelains made by analogous methods are fired at so high a temperature that a glaze by felspar softened by lime and silica is found most suitable for them, and the hard-fired stonewares, rich in silica, are often glazed with a salt glaze, or a melted earth rich in oxide of iron.

Every kind of potter's clay (the mixture of clay, sand, flint, &c., from which the potter shapes his wares) has its own type of glaze, and from the earliest time down to our own what the potter could produce in form or glaze or colour has been largely decided for him by the clay material at his command. With any good plastic clay which cannot be fired at the highest temperature, lead glazes have always proved the most practicable. A similar clay, to which large quantities of sand are added, may be glazed by the vapours of common salt; and mixtures rich in felspar, like Chinese or European porcelain, can be glazed by melting felspathic materials upon them. Naturally those species of pottery which are the hardest fired are the most durable—the glazes of hard porcelain are more unchangeable than lead glazes, and these in their turn than alkaline glazes.

The most important types of glaze are (1) alkaline glazes (*e.g.* Egyptian, Syrian, Persian, &c.), the oldest and most uncertain; (2) lead glazes, the most widespread in use and the best for all ordinary purposes; (3) felspathic glazes, the glazes of hard-fired porcelains, generally unsuited to any other material; (4) salt glaze, produced by vapours of common salt, the special glaze of stonewares. Many intermediate glazes have been devised to meet special needs, but these remain the only important groups. Fuller details on this important subject must be sought in the technical works.

Colours.—The primitive potters of ancient and modern times have all striven to decorate their wares with colour. The simplest, and therefore the earliest, colour decoration was carried out in natural earths and clays. The clays are so varied in composition that they fire to every shade of colour from white to grey, cream, buff, red, brown, or even to a bronze which is almost black. One clay daubed or painted upon another formed the primitive palette of the potter, especially

before the invention of glaze. When glaze was used these natural clays were changed in tint, and native earths, other than clays, containing iron, manganese and cobalt, were gradually discovered and used. It is also surprising to note that some of the very earliest glazes were coloured glasses containing copper or iron (the green, turquoise and yellow glazes of the ancient Egyptians and Assyrians). Marvellous work was wrought in these few materials, but the era of the finest pottery-colour dawns with the Persian, Syrian and Egyptian work that preceded the Crusades. By this time the art of glazing pottery with a clear soda-lime glaze had been thoroughly learnt. Vases, tiles, &c., shaped in good plastic clay, were covered with a white, highly siliceous coating fit to receive glazes of this type, and giving the best possible ground for the painted colours then known. With this rudimentary technique the potters of the countries south and east of the Mediterranean produced, between the 9th and 16th centuries of our era, a type of pottery that remains ideal from the point of view of colour: for, with nothing more than the greens given by oxide of copper and iron, the turquoise of pure copper, the deep yet vivid blue of cobalt, the beautiful uncertain purple of manganese, and in certain districts the rich red of Armenian bole, they achieved colour schemes that have never been surpassed in their brilliant yet harmonious richness.

When the coating of white siliceous clay was replaced by an opaque tin-enamel as in Spain, Italy, France, Holland, &c., a necessary change in the colour schemes resulted. At first only the copper-greens and cobalt-blues could be used on such a ground; the fine manganese purple turned to brown or black and the rich iron-reds to filthy shades of yellow. We cannot wonder that the Spanish-Arab potters paid more attention to their lustre decoration, for that was the natural thing to do. How strong and fine a palette could be evolved for use on a tin-enamel ground was shown by the Italian majolists of the 15th and 16th centuries; and when the later developments of tin-enamelled pottery took place in France, Holland, Germany, &c., their colour schemes are only echoes of Italian majolica crossed with Chinese porcelain. Delft, Nevers, Moustiers and Rouen may each charm us with its individuality; Nuremberg and other south German towns may show us that they too had mastered the use of tin-enamel; yet our minds always go back to the colour schemes of Italian majolica and of the Persian and Syrian pottery that lie behind and beyond them.

The colours already spoken of were either clay colours or what are known as “under glaze” colours, because they were painted on the pottery before the glaze was fired.

The earliest glazes of the Egyptians appear not to have been white, but were coloured throughout their substance, and this use of coloured glazes as apart from painted colour was developed along with the painted decoration by the later Egyptian, Syrian and Persian potters. Green, yellow and brown glazes were almost the only artistic productions of the medieval European potters’ kilns, and their use everywhere preceded the introduction of painted pottery. The most extensive application of coloured glazes was, however, that made by the Chinese, who developed this type of colour decoration before they used painted patterns in underglaze colour. The earliest Chinese porcelains, and the hard-fired stonewares out of which their porcelain arose, were decorated in this way, and the beauty of many of the early Sung coloured glazes has never been surpassed.

With the exceedingly refractory felspathic glazes of Chinese porcelain very few underglaze colours could be used; and the prevalence of blue and white among the early specimens of Chinese porcelains is due to the fact that cobalt was almost the only substance known to the potters of the Ming dynasty which would endure the high temperature needed to melt their glazes. Consequently the Chinese were driven to invent the method of painting in coloured fusible glasses on the already fired glaze. They adopted for this purpose the coloured enamels used on metal; hence the common term “enamel decoration,” which is so generally applied to painting in those colours which are attached to the already fired glaze by refiring at a lower temperature. With the introduction of this many-coloured Chinese porcelain into Europe the same practice was eagerly followed by our European potters, and a new palette of colours and fresh styles of decoration soon arose amongst us. Painting in on-glaze colours, being executed on the fired glaze, resembles glass painting, and it generally offers a striking contrast both in technique and colour-quality to the painting executed in colours under the glaze. In the former the work can be highly finished and the most mechanical execution is possible, but the colours are neither so rich nor so brilliant as under-glaze colours, nor have they the same softness as is given by the slight spread of the under-glaze colour when the glaze is melted over it.

It must be pointed out that the colour possibilities in any method of pottery decoration are largely dependent on the temperature at which the colour needs to be fired. The clay colours are naturally more limited in range than the under-glaze colours, and these in their turn than the on-glaze colours.

When, about the middle of the 18th century, European pottery took on its modern form, of earthenware made after the English fashion, and porcelain like the French and German, the lead or felspathic glazes used brought about another revolution in the potter’s palette. The growing ideal of mechanical perfection discounted the freedom of the earlier brushwork, and printed patterns, or painting that might almost have been printed, removed the mind still farther from the richness of painted faience or majolica. It is useless to look for the glorious colour of Persian

faience, Italian majolica, or Chinese porcelain, in modern wares produced by manufacturing processes where mechanical perfection is demanded to a degree undreamt of before the 19th century. The finest modern pottery colour is only to be sought in the work of those enthusiasts and experimenters who are striving to produce work as rich and free as the best of past times.

Metals.—The noble metals, such as gold, platinum and silver, have, since the early years of the 18th century, been largely used as adjuncts to pottery decoration, especially on the fine white earthen-wares and porcelains of the last two centuries. At first the gold was applied with a kind of japanner's size and was not fired to the glaze, but for the last 150 years or so the metals have generally been fired to the surface of the glaze like enamel colours, by mixing the metal with a small proportion of flux or fusible ground glass. There can scarcely be a doubt that the ancient lustres of Persia, Syria and Spain were believed to be a form of gilding, though their decorative effect was much more beautiful than gilding has ever been. The early Chinese and Japanese gilding appears, like the European, to have been "sized" or water-gilt, not fired; and it seems probable that the use of "fired" gold was taught to the Oriental by the European in the 18th century. To-day "liquid" gold is exported to China and Japan from Europe for the use of the potter.

Primitive Pottery

We can group together that great and widely-spread class of vessels made by the primitive races of mankind, whether before the dawn of civilization or at the present day, for it is interesting to note that many modern races still make pottery by the same rude method as the Neolithic races of Europe and Asia, and with striking similarity of result. In fact, the knowledge of the methods and practices of the primitive potters of our own time furnishes the best possible guide to the methods of fabrication and ornamentation of the ancient specimens that are dug up from barrows, grave mounds, and tumuli. It is only natural that the materials and methods of such pottery are always of the simplest. The clay is used with very little preparation, and it is no unusual thing to find bits of stone, gravel, &c., embedded in the paste of such wares, though at a later stage of development they would have been removed. It must be remarked, however, that no race of potters practised the art for long without discovering that their vessels were not so liable to crack in drying, or lose their shape in firing, if fine sand or pounded "potsherds" were mixed with the clay; and when we are dealing with the work of races that have passed beyond the Stone Age and have learned the use of metals we find this custom universal.

There are three methods of shaping which seem to be common to almost every primitive race:—

1. The scooping out of a vessel from a ball of clay.
2. The building up of a form, often on a piece of basket-work or matting, gradually raising the walls higher by applying and smoothing down successive layers of clay.
3. Coiling; in which the clay is rolled out into thin ropes, and these are coiled round and round upon each other and smoothed down with the hands and with simple tools of bone, wood or metal.

The use of the potter's wheel is unknown, while it is remarkable how beautifully true and finely-fashioned much primitive pottery is. The primitive red and black vases discovered by Flinders Petrie in Egypt, and the somewhat similar vessels of prehistoric date from Spain, are remarkable instances of this. Some primitive races leave their pottery without decoration, especially when they have a fine red-burning clay to work in, but, generally speaking, primitive pottery of every race and time is elaborately decorated, but only with the simplest patterns. Such decorations consist of lines, dots or lunette-shaped depressions arranged in crosses, chevrons, zigzags or all-over repeated pattern. All this ornament is scratched or impressed into the clay before it is fired. Simplest of all is, perhaps, the pattern which has so obviously been produced by pressing a twisted thong round the neck or bowl of a vase; though the thong may have been used in the first instance merely to serve as a support while the vessel was dried. At a later stage the ornament is generally obtained by scratching with a tool, by pressing the end of a hollow stick into the clay to form rows of circles, by using a stick cut at the end into the shape of a half-moon, or other equally simple decorative device. In certain tropical countries this rudimentary pottery becomes hard enough for a certain amount of use when merely dried in the sun, but in all northern and temperate countries it must have been fired, probably in the most imperfect way, in an open fire or in such a kiln as could be formed by sinking a hole into the ground and erecting round it a screen of stones. How imperfect the firing was is shown by the ashen-grey colour due to smoke. In those countries where the ware has been more perfectly fired the pieces naturally become buff, drab, brown or red.

The primitive vessels that have been found in the grave-mounds of England and the northern countries generally have received a number of fanciful names for which there is very little warrant except in the case of the cinerary urns. These are generally the largest vessels of this

class, and as they were used to contain burnt bones there seems sufficient warrant for the supposition that they were made for this and for no other purpose.

Our knowledge of primitive pottery has been greatly improved during recent years by the labours of a number of American students connected with the United States Geological Survey, who have carefully recorded the present-day practices of those native tribes who make and use pottery in various parts of North America and Mexico; while, in the same way, Peruvian, Brazilian and other South American pottery has been as closely investigated by European observers. It should be noted that no primitive pottery reveals any trace of a knowledge of glaze, though much of it has been highly polished after firing, and in some cases a varnish has been applied which may perhaps be regarded as the earliest kind of "glazing" ever applied to pottery vessels.

LITERATURE.—On primitive pottery the following works may be specially mentioned. W. Greenwell, *British Barrows* (1877); Boyd-Dawkins, *Early Man in Britain* (1880); Mortimer, *Forty Years' Researches in British and Saxon Burial-mounds of East Yorkshire* (1905); Abercromby, "The Oldest Bronze-age Ceramic Type in Britain," *J. Anth. Inst.* vol. xxxii. (1902), 373; *Guide to Antiquities of the Bronze Age* (British Museum, 1904); Koenen, *Gefässkunde der vorrömischen, römischen und fränkischen Zeit in den Rheinländern* (1895); Wosinsky, *Der inkrustierte Keramik der Stein- und Bronze-zeit* (1904); Walters, *History of Ancient Pottery* (Greek and Roman) (1905); Holmes, *Aboriginal Pottery of the Eastern United States* (Bureau of Ethnology, Washington, 1899); also Holmes and Cushing in *Report* of Bureau of Ethnology for 1882; Wiener, *Pérou et Bolivie* (1880); Von der Steinen, *Natur-Völkerei Central Brasiliens* (1894); Hartman, *Archaeological Researches in Costa Rica* (1905); Strebel, on "Mexican Pottery" in *Publications* of Museum für Völkerkunde (Berlin, vol. 6, 1899); Werner, *British Central Africa* (1907); Füllborn, *Deutsche Ost-Afrika*, vol. ix. (1907); Macluer, "Kabyle Pottery," *Journ. Anth. Inst.* vol. xxxii. p. 245, and "Upper Egypt," *ibid*. xxxv. p. 20; Myres, "Early Pottery Fabrics of Asia Minor," *Journ. Anth. Inst.* xxxiii. p. 367; Turveren Museum, *Notes analytiques sur les collections ethnographiques du Congo*, tome ii. (1907); Cupart, *Debuts de l'art de l'ancienne Égypte* (1903).

(W. B.*)

EGYPT AND WESTERN ASIA

Egyptian Pottery.—Egypt affords us the most striking instance of the development of the potter's art. As in other countries pottery was made even in Neolithic times, for the Nile mud forms a fine plastic clay and sand is of course abundant. With these materials various kinds of pottery, often extremely well made and of good form, have been continuously produced for common domestic requirements, but such pottery was never glazed.

The wonderful glazes of the Egyptians were applied to a special preparation which can hardly be called pottery at all, it contained so little clay. Yet as early as the 1st Dynasty the Egyptians had learnt to shape little objects in this tender material and cover them with their wonderful turquoise glazes. We have therefore to study the development of two independent things: (1) the ordinary pottery of common clay left without glaze; (2) the brilliant glazed faience which appears to be special to Egypt, though it may have been the groundwork for the technique of the slip-faced painted and glazed pottery of the nearer East.

We probably do not possess any specimens of the most primitive Neolithic pottery; the oldest type known to us, the black and red ware of Ballas and Nagada (**1**), dates from the later Neolithic age, when copper was just beginning to be used. This ware is very hard and compact and the face is highly burnished. The red colour was produced by a wash of fine red clay; the black is an oxide of iron obtained by limiting the access of air in the process of baking, which was done, Professor Petrie suggests, by placing the pot's mouth down in the kiln, and leaving the ashes over the part which was to be burnt black. Both red and black colour go right through in every case. All-red and all-black vases are occasionally found, the red with geometrical decorations in white colour, and the black with incised decoration. The forms are usually very simple, but at the same time graceful, and the grace of form is more remarkable when it is remembered that none of this early pottery was made on the wheel. Pottery of almost similar technique was found in Crete in 1905 during the American excavations at Vasiliki near Hierapetra. The general appearance of the Cretan pottery is much the same as that of the Egyptian, and the duller red and black decoration (which here has a spotted or mottled appearance) was probably obtained in the same way, the black spots being due to the action of separate fragments of the baking material. This discovery is important in view of the probable early connexion of the Cretan and Egyptian culture-centres.

A very similar red and black ware, usually of thinner and harder make, and often with a brighter surface, was introduced into Egypt at a later date (XIIth Dynasty), probably by Nubian tribes who were descended from relatives of the Neolithic Egyptians. From their characteristic graves these people are called the Pan-Grave people, and their pottery is known by the same name.

Perhaps rather later in date than the early red and black wares, but by no means certainly so, the second characteristic type of primeval Egyptian pottery is a ware of buff colour with surface decorations in red. These decorations are varied in character, including ships, birds and human figures; wavy lines and geometrical designs commonly occur. The whole *facies* of this ware seems very un-Egyptian, and it has been compared with the decorated "Kabyle pottery" of modern times. To call the people who made this ware "Libyans" on the strength of this resemblance of their pottery to that of the modern Kabyles, six thousand years later, seems, however, rash. The prehistoric Egyptians were not Kabyles or Libyans, but Nilotes, and the peculiar decoration of their pottery, which seems so strangely barbaric, is in reality merely the most ancient handiwork of the Egyptian painter, and marks the first stage in the development of pictorial art on the banks of the Nile (**2**). Other types of pottery (**3**), in colour chiefly buff or brown, were also in use at this period; the most noticeable form is a cylindrical vase with a wavy or rope band round it just below the lip, which developed out of a necked vase with a wavy handle on either side. This cylindrical type outlived the red and black and the red and buff decorated styles (which are purely Neolithic and predynastic) and continued in use in the early dynastic period, well into the Copper age. The other unglazed pottery of the first three dynasties is not very remarkable for beauty of form or colour, and is indeed of the roughest description (**4**), but under the IVth Dynasty we find beautiful wheel-made bowls, vases and vase-stands of a fine red polished ware (**4**). This fine ware continued in use at least as late as the XVIIIth Dynasty, though the forms of course differed from age to age. Under the XIIth Dynasty, and during the Middle Kingdom generally, either this or a coarser unpolished red ware was in use. The forms of this period are very characteristic (**5**); the vases are usually footless, and have a peculiar globular or drop-like shape—some small ones seem almost spherical. At this period the foreign "Pan-Grave" black and red pottery was also in use (see above).

The art of making a pottery consisting of a siliceous sandy body coated with a vitreous copper glaze seems to have been known unexpectedly early, possibly even as early as the period immediately preceding the Ist Dynasty (4000 B.C.). Under the XIIth Dynasty pottery made of this characteristic Egyptian faience seems to have come into general use, and it continued in use down to the days of the Romans, and is the ancestor of the glazed wares of the Arabs and their modern successors (**6**). The oldest Egyptian glazed ware is found usually in the shape of beads, plaques, &c.—rarely in the form of pottery vessels. The colour is usually a light blue, which may turn either white or green; but beads of the grey-black manganese colour are found, and on the light blue vases of King Aha (who is probably one of the historical originals of the legendary "Mena" or Menes) in the British Museum (No. 38,010) we have the king's name traced in the manganese glaze on (or rather in) the blue-white glaze of the vase itself, for the second glaze is inlaid. This style of decoration in manganese black or purple on copper-blue continued till the end of the "New Empire" shortly before the XXVIth (Saite) Dynasty. It was not usual actually to inlay the decoration before the time of the XVIIIth Dynasty. The light blue glaze was used well into the time of the XIIth Dynasty (British Museum, No. 36,346), but was then displaced by a new tint, a brilliant turquoise blue, on which the black decoration shows up in sharper contrast than before. This blue, and a somewhat duller, greyer or greener tint was used at the time for small figures, beads and vases, as well as for the glaze of scarabs, which, however, were usually of stone-schist or steatite —not faience. The characteristically Egyptian technique of glazed stone begins about this period, and not only steatite or schist was employed (on account of its softness), but a remarkably brilliant effect was obtained by glazing hard shining white quartzite with the wonderfully delicate XIIth Dynasty blue. A fragment of a statuette plinth of this beautiful material was obtained during the excavation of the XIth Dynasty temple at Deir el-Bahri in 1904 (British Museum, No. 40,948). Vessels of diorite and other hard stones are also found coated with the blue glaze. A good specimen of the finest XIIth Dynasty blue-glazed faience is the small vase of King Senwosri I. (2400 B.C.) in the Cairo Museum (No. 3666) (**6**). The blue-glazed hippopotami of this period, with the reeds and water-plants in purplish black upon their bodies to indicate their habitat, are well known. Fine specimens of these are in the collection of the Rev. Wm. MacGregor at Tamworth (**8**).

The blue glaze of the XIIth Dynasty deepened in colour under the XIIIth, to which the fine blue bowls with designs (in the manganese black) of fish and lotus plants belong (**8**) (British Museum, Nos. 4790, &c.). The finest specimens of XVIIIth Dynasty blue ware have come from Deir el-Bahri, in the neighbourhood of which place there may have been a factory for the manufacture of votive bowls, cups, beads, &c., of this fine faience, for dedication by pilgrims in the temple of Hathor (good collection in British Museum). Towards the end of this dynasty polychrome glazes came into fashion; white, light and dark blue, violet, purple, red, bright yellow, apple-green and other tints were used, not only for smaller objects of faience, such as rings, scarabs, kohl-pots, &c., but also for vases, *e.g.* No. 3965 of the Cairo Museum (Amenophis III. wine-bottle), the ground colour of which is white with a decoration of flower wreaths in blue, yellow and red, with an inscription in delicate blue (**6**). This polychrome faience was also now used for the *ushabti* figures which were placed in the tombs; hitherto they had been made

exclusively of stone or wood, never of glazed stone or pottery; henceforward they were made exclusively of faience, but the polychrome glazes (*e.g.* British Museum, Nos. 34,180, 34,185) were soon abandoned, and the plain blue and black of the ordinary vases was adopted. The *ushabtis* of King Seti I. (British Museum, No. 22,818, &c.) (**9**) are fine specimens of this type. Under the XXth Dynasty the blue paled and became weak in quality, but the priest-king family of the XXIst used for their *ushabtis* a most brilliant blue glaze, an extraordinary colour which at once distinguishes the faience of this period from that of all others (**9**). The same brilliant glaze was used for vases of various kinds as well. The polychrome ware had developed into a style of inlaying with glazed faience, which we see at Tel el-Amarna under the XVIIIth Dynasty (1400 B.C.) (**10**), and at Tel el-Yahūdīya under the XXth (1200 B.C.), used for wall decoration. After this time polychrome ceramic decoration seems to have died out in Egypt, but was retained in Asia (see below).

The technical skill of the New Empire potters is shown by such a remarkable object as the gigantic *Uas*-sceptre of blue glazed faience, now in the Victoria and Albert Museum (**12, 8**). This is the largest known piece of Egyptian glazed faience; really large vases of faience are not found. Faience vases were very commonly built up or carved out of a ball of the dried material, perhaps held together by some mucilaginous substance —it seems impossible that such a substance could ever have been fashioned on the wheel. Sometimes even small vases were made of separately moulded pieces united by a glassy material (**6**). Under the XXIInd Dynasty small glazed vases with figures of deities or animals in relief became common; these were made in moulds (**6**). In the matter of form the faience pottery of the New Empire follows the lead of the new earthenware types. Forms had altered considerably from those of the XIIth Dynasty. In place of the simple flowing lines of that period, we now find egg-shaped bodies with cylindrical necks, with or without handles, great *amphorae* with almost pointed bases, sometimes with the handles perched upon the shoulders of the vase; flat-tipped, squat jugs; little handleless vases somewhat resembling the modern *kulla*, "*mit mehrfach eingezogenem Bauch*" (V.B.), and the common flat flask-like type known as the "pilgrim bottle" (**6, 13, 14, 15**).

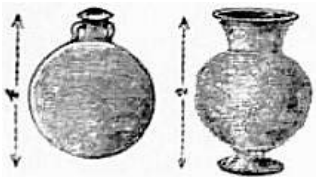


FIG. 6.—Egyptian pottery made of fine blue paste.

Owing to the extended foreign relations of Egypt at this time, imported vases from Greece and Asia, including Mycenaean *Bugelkannen* and Cypriote black "base ring" jugs, have been found in the tombs and deposits of this age (**14**). Imitations of foreign forms, especially the *Bugelkannen*, are found[5] chiefly in faience (British Museum, 22,731, is an imitation of a Minoan jug from Crete). The faience forms of the XVIIIth and XXIInd Dynasties include also the *kulla* shape, the pilgrim bottle, miniature *amphorae*, &c. (see fig. 6), and miscellaneous forms not found in common pottery, imitating metal and stone vases, *e.g.* the blue-green ribbed pots of the XXIInd Dynasty, imitating bronze originals, and the *alabastron* of the XVIIIth; these last go back to the XIIth Dynasty. Very pretty cups in the shape of lotus flowers (see fig. 7) are to be seen in most museums; they are of the XIXth Dynasty, and mostly came from Tuna (**6, 8**).

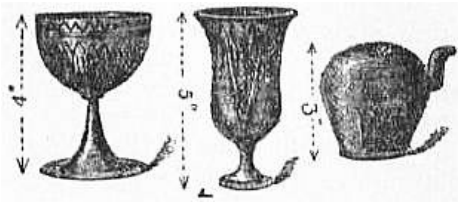


FIG. 7.—Egyptian blue-glazed pottery.

The continuance of the old red polished ware of the IVth Dynasty during the Middle Kingdom to the time of the XVIIIth Dynasty has already been mentioned. Characteristic of the latter period of this ware are long jugs with attenuated body and single handle, which, because they have been found with Mycenaean objects in Cyprus, have been considered to be of foreign, probably of Syrian origin. They may, however, be Egyptian. Vases of the same ware in the shape of men and animals are not uncommon (**17**). Another ware of this period has a highly polished yellow face, sometimes becoming ruddy, and passing off into a pinkish red; in this ware the pilgrim bottles are common. An unpolished, brittle, and thin yellow ware was also used largely for wine-vases. The rougher, commoner red and brown ware at this period became decorated with designs, chiefly of lily wreaths, &c., in paint of various colours (**13**). This new development hid the ugly colour of the common pottery and was a cheaply obtained imitation of the expensive, polychrome glazed ware of the period (see fig. 8). This painted pottery continued in use until about the time of the XXIInd Dynasty. From this time onwards, till the Ptolemaic period, the commonest pottery was a red ware, usually covered with a white slip. Under the XXVIth Dynasty a finer homogeneous white ware occurs, usually for vases with a rude representation of the face of the god Bes on their bodies.

The XXVIth Dynasty marks a new period of development in the history of Egyptian faience. The old deep blue colour had gradually deteriorated into an ugly green (British Museum, No. 8962), which was replaced by the Saite potters with a

new light blue of very delicate tint, imitated, in accordance with the archaistic spirit of the time, from the old light blue of the earliest Dynasties. The glaze itself is very thin and "sugary" in texture. The old decoration of the blue with designs and inscriptions in manganese-black is abandoned; on the *ushabtis* the inscriptions are now incised. Side by side with this light blue glaze was used an unglazed faience, a sort of composition paste with the colour going right through.[6] It has more variety of colour than the glazed faience, light green and a dark indigo blue being found as well as the Saite light blue. Sometimes it is of a very soft, almost chalky consistency. It was used for vases, but more generally for small figures and scarabs (**6**). The commonest vase-form of this period is the pilgrim bottle, now made with the neck in the form of a lily flower, and with inscriptions on the sides wishing good luck in the New Year to the possessor. These flasks appear to have been common New Year's gifts.

FIG. 8.—Egyptian pottery with painted ornament and sham marbling.

Under the Sebennyte kings of the XXXth Dynasty a further new development of glaze began, of a more radical character than ever before. The colour deepened, and the glaze itself became much more glassy, and was thickly laid on. The new glaze was partly translucent, and differed very greatly from the old opaque glaze. It first appeared on *ushabtis* at the end of the Saite period. A curious effect was obtained by glazing the head-dress, the inscription &c., of the *ushabtis* in dark blue, and then covering the whole with translucent light blue glaze. This method was regularly used during the succeeding Ptolemaic and Roman periods, when the new style of glaze came into general use. A yellowish green effect was obtained by glazing parts of the body of the vases in yellow and covering this with the translucent blue glaze. This method was used to touch up the salient portions of the designs in relief, imitated from foreign originals, a style which now became usual on vases. The usual decoration is mixed Egyptian and classical, the latter generally predominating. A large range of colours was employed; purple, dark blue, blue-green, grass-green, and yellow glazes all being found. The glaze is very thickly laid on, and is often "crazed" (**6, 8**). A remarkable instance of this Romano-Egyptian faience is the head of the god Bes in the British Museum (No. 35,028). A hard, light blue, opaque glaze like that of the XXVIth Dynasty is occasionally, but rarely, met with in the case of vases (British Museum, Nos. 37,407, 37,408).

We know something of the common wares in use during this period from the study of the *ostraka*, fragments of pottery on which dated tax-receipts, notes, and so forth were written. From the *ostraka* we see that during the Ptolemaic period the commonest pottery was made of red ware covered with white slip, which has already been mentioned. At the beginning of the Roman period we find at Elephantine a peculiar light pink ware with a brownish pink face, and elsewhere a smooth dark brown ware. About the 3rd century A.D. horizontally ribbed or fluted pots, usually of a coarse brown ware, came into general use. These were often large-sized *amphorae*, with very attenuated necks and long handles (see fig. 9). During the Byzantine (Coptic) period most of the pottery in use was ribbed, and usually pitched inside to hold water, as the ware was loose in texture and porous.

During the Coptic period, a lighter ware was also in use, decorated with designs of various kinds in white, brown or red paint on the dull red or buff body. In Nubia a peculiar development of this ware is characteristic of the later period (Brit. Mus. No. 30,712).

A polished red ware of Roman origin (imitation Arretine or "Samian") was commonly used as well.

The heavily glazed blue faience continued in use until replaced in the early Arab period by the well-known yellow and brown lead-glazed pottery, of which fragments are found in the mounds of Fostat (Old Cairo).

FIG. 9.—Egyptian pottery under the Ptolemies, showing Greek influence in the shapes.

Western Asia.—Palestine. The most ancient Palestinian pottery is the rough "Amorite" ware from Lachish (Tel el-Hesi) which sometimes has wavy handles like the prehistoric Egyptian (**18**). Later we find actual Mycenaean pottery in Philistia (**19**), an interesting testimony to the truth of the legend which brings the Philistines from Crete; the fourth and fifth cities of Lachish (1200-1000 B.C.) show us the first ordinary Phoenician or Israelite pottery—buff or red lamps and bowls, the latter with the handles sometimes painted in bistre, and vases showing strong Egyptian influence; while pottery from Cyprus and elsewhere is found as in Egypt.

The only remarkable later development of Palestinian pottery is the Phoenician imitation of

Egyptian faience of the Saite period, of which the characteristics are well known. Some of this may actually have been made in Egypt.

The course of the potter's art in Mesopotamia and Persia appears to have run on lines of development parallel with the art in Egypt, for the country between the Tigris and the Euphrates is rich in good clays, and, wherever the invention of glass arose, its application to pottery decoration was certainly developed at an early period in Egypt and in Mesopotamia.

Two characteristic uses of clay wares must, however, be pointed out, though they have nothing to do with vase-making.

1. The Babylonian and Assyrian use of clay shaped into tablets, cylinders and prisms, to produce an imperishable record of the literature of the time. The cylinders and prisms were thrown on the potter's wheel and are consequently hollow; the circular form was then sliced down, and the surface was impressed with cuneiform inscriptions, the prism, tablet or cylinder being subsequently dried and fired.

2. The architectural use of glazed bricks and slabs. While the Egyptians remained content for the most part with the application of their brilliant alkaline glazes to small and delicately-finished objects, the Babylonians and Assyrians developed an architecture decorated with glazed and coloured brickwork. The bricks were of very open texture, and the ornamental pattern or figure subjects were obtained by a strong outline in dark-coloured clay which formed a kind of *cloison* or boundary, the shallow cells between being filled in with coloured clays—yellow, red or white—or with coloured glazes of turquoise, green or blue, yellow and purplish brown. These glazes are obviously like the Egyptian, but they are more coarsely prepared and are always full of bubbles and consequently more or less opaque. Yet the severe simplicity of the method, the splendid colour effect, strong yet sumptuous, entitles these productions to a very high rank among all the world's work in clay and glaze. The "Frieze of the Archers" now in the Louvre may be mentioned as one of the finest productions of its kind, and the Louvre and British Museum possess the finest collections of this early architectural use of glazed and coloured clay. (See also MURAL DECORATION)

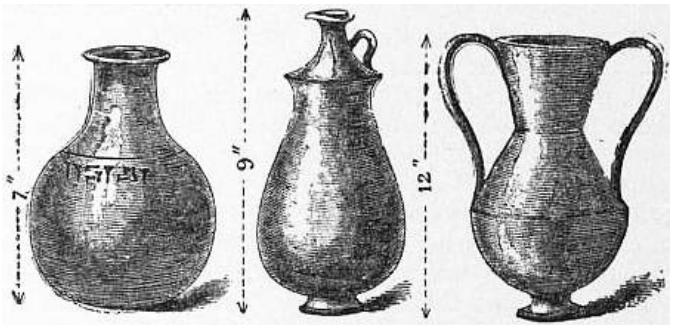


FIG. 10.—Assyrian biscuit pottery.

Coming to ordinary pottery we find that in early times well-formed vases made of good clay, unglazed and unpainted, were made. Small figures of deities made of the same clay are often found. It is practically the same terra-cotta as that of the inscribed tablets. None of the forms are particularly distinctive (see fig. 10). The excavations of the French in Persia have brought to light at Moussian in Susiana an extremely interesting painted ware, which belongs to a very early period. The decoration is usually geometrical. The technique seems to be analogous to the Mycenaean-Greek (*Firnismalerei*), and the whole effect is very like that of the Greek, Late Mycenaean or Dipylon pottery. The ware is buff in colour and fine in texture, with a polished surface. The decoration is sometimes in polychrome, but usually in the grey-brown iron-glaze (?) alone. This pottery degenerates later and finally disappears (**20**).

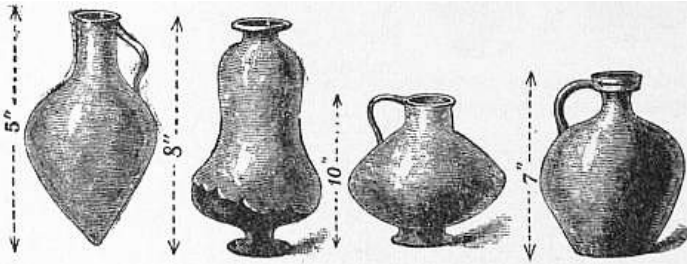


FIG. 11.—Assyrian glazed and enamelled pottery.

During the Sargonide period in Assyria (7th century B.C.) we find a polychrome faience (colours usually white and brown) obviously of Egyptian origin. It was used, not for vases, but architectonically for friezes, ornamental bosses, &c. Its origin may be found in Egypt under the

XVIIIth Dynasty, when Egyptian influence extended to the Tigris, and Babylonia had regular diplomatic relations with Egypt In Asia this polychrome decoration in glazes continued to be used long after it had ceased to be made in the country of its origin; the enamelled brick decoration of Persepolis is the descendant of the glazed inlay decorations of Tel el-Amarna, Tel el-Yahudiya and Kuyunjik. In the Sargonide period blue glazed vases occur (see fig. 11) which are probably of Egyptian origin or are Phoenician imitations of Egyptian faience.

Characteristic of the Parthian period is a coarse green glazed pottery of which the slipper-shaped coffins, of the time were made (British Museum, Nos. 1645-1647) (**21**). This glaze possibly contains a small amount of lead; in appearance it is not unlike the contemporary translucent blue glaze of Egypt. The Egyptian glaze certainly spread into western Asia, and we find the last specimens of it in the tiles from the destroyed city of Rhagae in Persia, which may be as late as the 13th century A.D. The lead glazes, unknown in Egypt till the late Roman period, may be of Asiatic origin, though this important point is by no means clear.

References.—(1) Petrie-Quibell, *Ballas and Nagada* (date erroneous); (2) Jacques de Morgan, *L' Âge de la pierre et des métaux*; (3) Petrie, *Diospolis Parva*, frontispiece (also for "sequence-dates" of pottery); (4) Garstang, *Mahâsna and Bêt Khallâf*, pls. xxix.—xxxii.; (5) Petrie, *Illahûn*, pl. xii. (corr. by V. Bissing in (14)); (6) V. Bissing, *Catalogue générale du musée de Caire*, "Die Fayencegefässe"; (7) Petrie, *Abydos*, ii., frontispiece; (8) Henry Wallis, *Egyptian Ceramic Art* (Macgregor Collection); (9) *Guide to Third and Fourth Egyptian Rooms, British Museum*, p. 252 ff.; (10) Petrie, *Tel-el-Amarna*; (11) *Guide to Third and Fourth Egyptian Rooms*, p. 261; (12) Petrie, *Nagâda*, pl. xxviii.; (13) Petrie, *Illahûn*, pls. xx., xxi.; (14) V. Bissing, *Strena Helbigiana*, p. 20 ff.; (15) Garstang, *El Arábah*, pls. xviii.-xxi., xxviii., xxix.; (16) Hall, *Oldest Civilization of Greece*, p. 143 ff. ibid. figs. 29, 30, 69; (17) *Guide to Third and Fourth Egyptian Rooms*, pl. viii.; (18) Petrie, *Tell-el-Hesy*, pl. v.; (19) Welch, *Ann. Brit. Sch. Ath.* vi.; (20) de Morgan, *Délégation en Perse*, viii. (1905); (21) *Brit. Mus.: Guide to Babylonian and Assyrian Room*.

(H. R. H.)

Greek, Etruscan and Roman

Greek. *Study of Greek Vases.*—It is not so many years since an account of Greek pottery would naturally have followed chronologically the history of Egyptian pottery with little overlapping; but recent discoveries have reversed all such ideas, and, while up to the end of the 19th century the earliest remains to be traced on Greek soil could be assigned at the furthest to the period 2500-2000 B.C., it is now possible not only to show that at that period technical processes were highly developed, but even to trace a continuous development of Greek pottery from the Neolithic age. This result has been mainly brought about by Dr Arthur Evans's researches at Cnossus in Crete, but traces of similar phenomena are not wanting in other parts of Greece. Whether the race which produced this pottery can strictly be called Greek may be open to question, but at all events the ware is the independent product of a people inhabiting in prehistoric times the region afterwards known as Greece; its connexion with the pottery of the historic period can now be clearly traced, and in its advanced technical character and the genuinely artistic appearance of its decoration even this early ware proclaims itself as inspired by a similar genius.

The study of Greek vases has thus received an additional impetus from the light that it throws on the early civilization of the country, and its value for the student of ethnology. But it has always appealed strongly to the archaeologist and in some degree also to the artist or connoisseur, to the former from its importance as a contribution to the history of Greek art, mythology and antiquities, to the latter from its beauty of form and decoration. Attention was first redirected to the painted vases at the end of the 17th century, though for a long time they served as little more than an adjunct to the cabinet of the amateur or a pleasing souvenir for the traveller; but even during the 18th century it dawned on the minds of students that they were of more than merely artistic importance, and attention was devoted to the elucidation of their subjects, and attempts made to arrive at a chronological classification. Two facts must, however, be borne in mind: firstly, that down to the middle of the 19th century the great majority of painted vases had been found only in Italy; secondly, that these vases were mostly of the later and more florid styles, which, if artistically advanced, are now known to represent a decadent phase of Greek art.

From the former cause arose the notion that these vases were the product not of Greek but of Etruscan artists, and so the term "Etruscan vase" arose and passed into the languages of Europe, surviving even at this day in popular speech in spite of a century of refutation. Meanwhile, the study of the subjects depicted on the vases passed through the successive stages of allegorical, historical and mystical interpretation, until a century and more of painstaking study led to the more rational principles of modern archaeologists.

Sites and Discoveries.—The sites on which Greek vases have been found cover the whole area of the

Mediterranean and beyond, from the Crimea to Spain, and from Marseilles to Egypt. By far the great majority, at all events of the finer specimens, have been extracted from the tombs of Vulci and other sites in Etruria; those of the later period or decadence have been found in large numbers on various sites in southern Italy, such as Capua, Curnae and Nola in Campania, Anzi in Lucania, and Ruvo in Apulia. In the western Mediterranean, Sicily has also been a fruitful field for this pottery, early varieties being found at Syracuse, later ones at Gela, Girgenti and elsewhere. Painted vases have also come to light in Sardinia and in North Africa, especially in the Cyrenaica, where the finds mostly belong to the 4th century B.C. In Greece proper the most prolific site has been Athens, where the finds extend from the Dipylon vases of the 8th century B.C. down to the decadent productions of the 4th century; one group, that of the white funeral *lekythoi*, is almost peculiar to Athens. Next to this city, Corinth has been most productive, especially in pottery of the archaic period and of local manufacture. Large quantities of pottery of all periods have been yielded by Thebes, Tanagra and other sites in Boeotia, and remains of the "Mycenaean" period at Mycenae, Argos and elsewhere. But on the whole painted pottery is rare in other parts of the mainland. Among the western islands of the archipelago, Aegina and Euboea have proved fruitful in vases of all periods; Thera, Melos and others of the Cyclades are remarkable for pottery of the prehistoric period with rudely painted designs; and above all Crete is now famous for the wondrous series of painted and ornamented pottery of pre-Mycenacan date, which can be traced back even to the Neolithic period, and the discovery of which has entirely revolutionized the preconceived theories on the appearance of painted pottery in Greece. This has been found in the recent excavations at Cnossus, Palaeokastro and elsewhere. In Asia Minor there have been some important finds on the mainland, but only along the coast; some of the islands, more especially Samos and Rhodes, have been more fruitful in this respect. At Kertch and elsewhere in the Crimea, large numbers of fine but somewhat florid vases of the 5th and 4th centuries B.C. have come to light. Cyprus has long been known as a rich field for pottery of all periods, from the Mycenaean onwards, the later varieties being marked by strong local quasi-oriental characteristics, with little development from the more primitive types (figs. 12 and 13). The principal sites are Salamis, Amathus, Marion (Poli) and Curium. Lastly, in the Egyptian delta two sites, Naucratis and Daphnae, have yielded results of considerable importance for the history of early Greek vase-painting.

FIG. 12.—Jug from Cyprus of Oriental style, 10 in. high

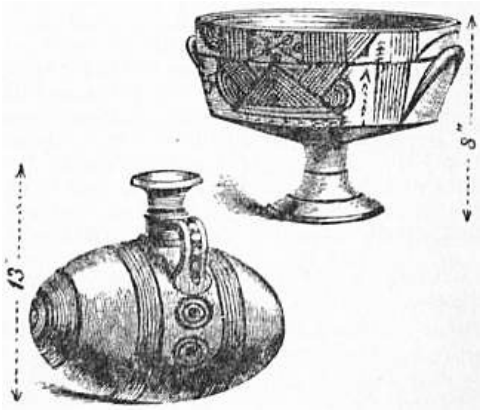


FIG. 13.—Pottery from Cyprus with geometrical ornament.

The great majority of these vases have been found in tombs; but some important discoveries have been made on the sites of temples and sanctuaries, as on the Acropolis of Athens, or at Naucratis. In such cases the vases are seldom complete, having been broken up and cast away into rubbish-heaps, where the fragments have remained undisturbed. The tombs vary greatly in form, those of Greece being usually small rock-graves or shafts, those of Italy often fine and elaborate chambers with architectural details, and the manner in which the vases are found in these tombs varies greatly. Plain unornamented pottery is almost universal, and may be considered to have formed the "tomb-furniture" proper—the painted vases being as in daily life merely ornamental adjuncts.

Shapes and Uses of Greek Vases.—The enormous number of painted vases now collected in museums is in itself sufficient evidence of the important part they must have played in the daily life, of the Greeks, and the care which was bestowed on their decoration shows the high estimation in which they were held. It is, however, remarkable that, with the exception of general allusions to pottery and its use in daily life, there are singularly few passages in classical literature which throw light on the purposes for which these vases were used. Where any are described at full length there is always evidence that metal vases are intended. Athenaeus and the lexicographers have indeed put on record a long list of names of shapes, but it is only in a few cases that we can be certain what forms they describe, or whether any of the typical forms of existing vases can be identified with the literary descriptions.

We have then two questions to consider in this section: firstly, the uses to which painted vases were put by the Greeks; secondly, the classical names of the various forms of plain and painted

pottery which have come down to us.

As we have seen, the majority of painted vases have been discovered in tombs, which at first sight seems to suggest that they were made principally for sepulchral purposes; but that they also had their uses in daily life as much as plain pottery or earthenware cannot be doubted. They stand, in fact, in the same relation to the commoner wares of their day as china or porcelain does with us, being largely ornamental only, but used by wealthy people or on special occasions for the purposes of daily life, as for instance at banquets or in religious ceremonies.

Vases were used as measures, as in the case of a small one-handled cup in the British Museum (see fig. 15), found at Cerigo (*Cythera*) and inscribed with the word ἡμικοτύλιον or "half-kotyle," equivalent to about one-fourth of a pint. Another vase found at Athens is supposed to represent the official χοῖνιξ or quart, having a capacity of 0.96 litre; it is inscribed δημόσιον or "official measure," and bears the official stamp of the state. Conversely many names of vases, such as the *amphora* or the *kotyle*, were adopted to indicate measures of capacity for liquid or dry commodities. Earthenware vessels were used for storing both liquids and food, for the preparation of foods and liquids, and for the various uses of the table and the toilet. That the painted ware was used at banquets or on great occasions we learn from scenes depicted on the vases themselves, in which vases painted with subjects appear in use. In connexion with athletics, they were given as prizes, as in the case of the Panathenaic *amphorae*, a class of vases given for victories in the games held at Athens at the Panathenaic festivals, where, however, they do not represent prizes so much as marks of honour corresponding to modern racing cups. Vases were also used as toys for children, as is proved by the discovery of many diminutive specimens, chiefly jugs, in the tombs of children at Athens, on which are depicted children playing at various games. They also served a purely decorative use as domestic ornaments, being placed on columns or shelves; or, in the case of flat cups and plaques, suspended on the wall. Many of the later Greek and Italian painted vases are very carelessly decorated on the one side, which was obviously not intended to be seen.

We come now to the use of vases for religious purposes, dedicatory, sacrificial or funerary. Of all these uses, especially the last, there is ample evidence. That vases were often placed in temples or shrines as votive offerings is clear from the frequent mention in literature of the dedication of metal vases, and it can hardly be doubted that painted pottery served the same purpose for those who could only afford the humbler material. Of late years much light has been thrown upon this subject by excavations, notably on the Acropolis of Athens, at Corinth, and at Naucratis in the Egyptian delta, where numerous fragments have been found bearing inscriptions which attest their use for such purposes. It was a well-known Greek custom to clear out the temples from time to time and form rubbish-heaps (*favissae*) of the disused vases and statuettes, which were broken in pieces as useless, but it is to this very fact that we owe their preservation. At Naucratis many of the fragments bear incised inscriptions, such as Ἀπόλλωνός εἰμι, "I am Apollo's" (possibly a memorandum of the priest's, to mark consecrated property), or ὁ δεῖνά με ἀνέθηκε τῇ Ἀφροδίτῃ, "So-and-so dedicated me to Aphrodite." Fig. 14 gives another example with a dedication to Apollo. At Penteskouphia, near Corinth, a large series of painted tablets (πίνακες), dating from 600 to 550 B.C., with representations of Poseidon and dedicatory inscriptions to that deity, were found in 1879. Votive offerings in this latter form were common at all periods, and tablets painted with figures and hung on trees or walls are often depicted on the vases, usually in connexion with scenes representing sacrifices or offerings.

There is no doubt that vases (though not necessarily painted ones) must have played a considerable part in the religious ceremonies of the Greeks. We read of them in connexion with the Athenian festival of the Anthesteria, and that of the gardens of Adonis. They were also used in sacrifices, as shown on an early black-figured cup in the British Museum and on a vase at Naples with a sacrifice to Dionysus. In scenes of libation the use of the jug and bowl (*phiale*) is invariable.

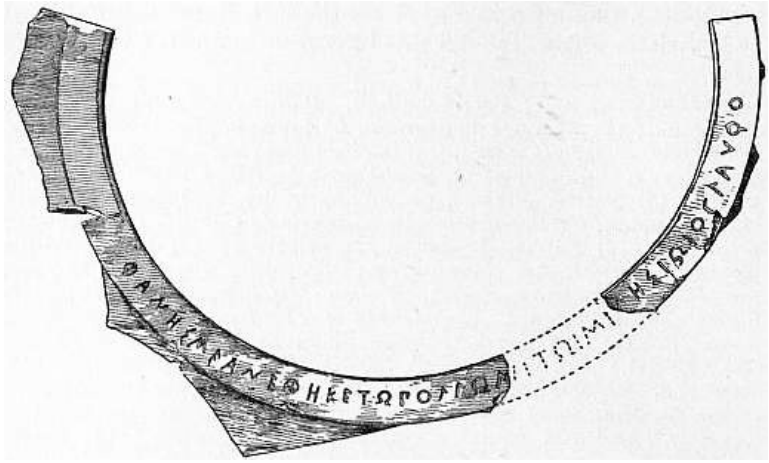


FIG. 14.—Part of vase from Naucratis with dedication to Apollo.

But their most important use, and that to which their preservation is mainly due, was in connexion with funeral ceremonies. They were not only employed at the burial, but were placed both outside the tombs to receive offerings, and inside them either to hold the ashes of the dead or as “tomb-furniture,” in accordance with Greek religious beliefs in regard to the future life. Several classes of vases are marked out by their subjects as exclusively devoted to this purpose, such as the large jars found in the Dipylon cemetery at Athens, which were placed outside the tombs, the white Athenian *lekythoi* of the 5th and 4th centuries B.C., and the large *krateres* and other vases of the 4th century B.C. found in the tombs of Apulia and other parts of southern Italy. Their use as cinerary urns was perhaps more restricted, at all events as regards the painted vases, though the custom is well known and is referred to in literature from Homer downwards. In “Mycenaean” times coffers (λάρνακες) of clay were used for this purpose, especially in Crete, where fine painted examples have been found; but of Greek pottery of the best periods there are but isolated instances.

The diagrams in fig. 15 show the principal shapes characteristic of Greek pottery in all but the earliest periods, when the variety of form was as yet too great to permit of more than the vaguest nomenclature; each form has its conventional name appended. These shapes may be classified under the following heads: (1) Vases in which food or liquids were preserved; (2) vases in which liquids were mixed or food cooked; (3) those by means of which liquids were poured out or food distributed; (4) drinking-cups; (5) other vases for the use of the table or toilet. Thus we have the *pithos* and *amphora* for storing wine, the *krater* for mixing it, the *psykter* for cooling it, the *kyathos* for ladling it out, and the *oinochoe* or *prochoos* for pouring it out; the *hydria* was used for fetching water from the well. The names and forms of drinking-cups are innumerable, the principal being the *kylix*, *kotyle*, *kantharos*, *rhyton* (drinking-horn) and *phiale* (libation bowl). The *pyxis* was used by women at their toilet, and the *lekythos*, *alabastron* and *askos* for oil and unguents.

Technical Processes.—Though the Greeks succeeded in making pottery of a very high order from the point of view of form and decoration, the technical processes remained throughout of the most elementary—for glaze was not used at all, the colour was of the simplest, and the temperature at which the ware was fired was not high enough to introduce any serious difficulties. As we should expect, it is possible to trace a gradual improvement in the technical processes in the direction of greater precision and refinement, for no vase-painter of the best period could have achieved his decorative triumphs on wares so coarse in substance and so rough in finish as those that satisfied his predecessors. As in every other case technical and artistic refinement went hand in hand. In the earliest times the clay was used with very little preparation; at all events before the introduction of the potter’s wheel the finish is not to be compared with that of the early races in Egypt. As the practice developed no doubt, specially good clays were found in certain districts, and these became centres of manufacture or the clays were carried to other established centres. The primitive wares usually exhibit the natural buff, yellow, grey or brownish colours of other elementary pottery, and the surface is somewhat rough and possesses no gloss. Thenceforward it becomes appreciably warmer in tone as it becomes finer in texture, until it reaches its perfection in the glowing orange, inclining to red, of the best Attic vases of the 5th century B.C. In the vases of the later Italian centres the colour again reverts to a paler hue.

The clay for the potter was doubtless prepared by a system of sedimentation, so as to get rid of all coarse particles. It was mixed with water and decanted into a series of vats so that ultimately fine clay of two or three grades was obtained. Both red and whitish clays were used, and the best potters gradually discovered that mixtures of different clays gave the best results. The clay for the Athenian vases was obtained from Cape Kolias in Attica; and as it did not burn to a very warm tone, ruddle or red ochre (*rubrica*) was added to it to produce the lovely deep orange glow that distinguishes the best vases. Corinth, Cnidus, Samos and other places were also famous for their clays, and at the first named tablets have been found bearing representations of the digging of clay for pottery.

FIG. 15.—Shapes of Greek Vases.

The improved manipulation of the clays, and the increasing knowledge that the colour of a clay could be modified by admixture of other substances such as ruddle and ochre, really paved the way for what is known as the glaze of the Greek painted vases. This delicate gloss, so thin as to defy analysis, has been commonly called glaze, but it cannot be a glaze in the sense of a separate coating of finely-ground glass superimposed upon the clay. In all probability, as the Greek potter used finer and finer clays and so was enabled to perfect his shapes, he found that after a vase had been "thrown" he could get a closer texture on it by dipping it in a slip of still finer clay material and then smoothing it down and polishing it on the wheel when sufficiently dry. But the mixtures he would use for such a purpose—of very siliceous clay and ochre—would, when they were burnt in the Greek kiln, not only fire to a beautifully bright colour, but also to a glossy surface, especially where the flames had freely played about them; and it is more in accordance with our knowledge to believe that the exquisitely thin gloss of the finest Greek red vases was produced in this way, for it seems impossible that it can have been a coating of any special glaze.

In any case we may state broadly that the body of Greek vases is always fine in grain, fired hard enough to give forth a dull metallic sound when it is struck, but seldom fired above a temperature of about 900° C., which a modern potter would consider very low. When broken the inside is generally found to be duller in colour, and is often yellow or grey, even where the external surface is red. The material is exceedingly porous, and allows water to ooze through it (another proof that it was not glazed). Numerous analyses of the material of Greek vases have been published, but they tell us nothing of the secrets of the Greek potter. The results of a great number of these analyses may be summed up as follows: silica, 52-60 parts; alumina, 13-19 parts; lime, 5-10 parts; magnesia, 1-3 parts; oxide of iron, 12-19 parts. Analyses of a thousand ordinary simple red burning clays would give a similar result. It is to the glory of the Greek potter that with such ordinary materials, by the exercise of selection, patience and skill, he achieved the fine artistic results we see. He did as much as can be done with natural clay materials, but the glory of painted colour and glaze, like the later Persian or Chinese, was not for him.

Manufacture of Vases.—The earliest Greek pottery is, like all primitive pottery, hand-made. The introduction of the potter's wheel into Greece was the subject of various ancient traditions, but we now know that it can be easily traced by a study of the primitive pottery of Crete, Cyprus or Troy. In Cyprus, for instance, the Bronze age tombs of 2500-1500 B.C. contain only hand-made pottery, but in the next period (1500-1000 B.C.) we find hand-made and coarse vases side by side with a more developed kind of painted pottery—the "Mycenaean"—obviously made on the wheel. It seems probable, therefore, that the wheel was introduced into Greece about 1500 B.C.; it was certainly known to Homer, as a familiar allusion shows (*Il.* xviii. 600). It was still a low circular table turned with the hand, not the foot; representations of its use are seen on several vases of the archaic period (fig. 16), and they further prove that the vase was replaced on the wheel for the subsequent processes of painting, polishing and adding separately modelled parts, as well as for the original shaping or "throwing."

The method of shaping the vase on the wheel, which is the same as that still in use, need not be described in detail; the feet, necks, mouths and handles were modelled separately or shaped in moulds, and attached while the clay was moist, as is also indicated on a vase. Large and coarse vases, such as wine casks (πίθοι), were always modelled by hand on a kind of hooped mould (κάνναβος).

FIG. 16.—Votive tablet from Corinth; a potter applying painted bands while the vessel revolves on the wheel.

Parts of vases were modelled by hand at all periods by way of decoration. Even in the geometrical period we find horses modelled in the round on the covers of vases and later on handles enriched with moulded figures of serpents twining round them. Such embellishments are frequently, if not always, deliberate imitations of metal forms, but the plastic principle is one which obtained in Greek pottery from the very first, as for instance in the primitive pottery of Troy, in which the vases are often modelled in human or animal forms; and the same principle is involved in the common practice of speaking of the "neck," "shoulder" or "foot" of a vessel. In the best period the practice of adding moulded ornaments or of modelling vases in natural forms took a subsidiary place, but examples occur from time to time, as in the beautiful *rhyta* or drinking-horns of the red-figure period (Plate II., fig. 58), or in smaller details such as are seen in handles enriched with heads in relief, a favourite practice of the potter Nicosthenes. In the 4th-century vases of southern Italy the handles are often much ornamented in this fashion, as in the large *krateres*, where they are adorned with masks in relief.

The system of moulding whole vases or ornamenting them with designs in relief taken from moulds really belongs to the decadence of the art, when imitations of metal were superseding the painted pottery. Even then it is rare to find whole vases produced from a mould, except in the case of those in the form of human figures or animals (Plate II., figs. 57 and 58), which almost come under the heading of terra-cotta figures, except for the fact that they are usually painted in the manner of the vases. But in southern Italy the tendency to imitate metal led to the popularity of ornaments made separately from moulds and attached or let in to vases otherwise plain. Vases of this period, with reeded bodies, must also have been made from moulds, as were a series of *phialae* or libation-bowls associated with Cales in Campania (Plate II., fig. 56), which are known to be direct imitations of metal.

All or nearly all of these vases are covered with a plain black glaze or varnish, and painted decoration is rare except in the case of those moulded in special forms or of a certain class made in Apulia with opaque colouring laid on the varnish. Some of these plain black vases of the 4th century are ornamented with *stamped* patterns made with a metal punch impressed in the moist clay. This decoration is confined to simple patterns.

After the vases had been made on the wheel they were dried in the sun and lightly baked, after which they were ready for varnishing and painting; it is also probable that the gloss was brought out by a process of polishing, the surface of the clay being smoothed with a piece of wood or hard leather. On a vase in Berlin a boy is seen applying a tool of some kind to an unfinished cup, probably for this purpose; the cup, being shown in red on the vase, has evidently not been varnished. Many vases are varnished black all over the exterior (whether decorated with designs or not) with the exception of the foot and lip.

The process of baking was regarded as one of the most critical in the potter's art. It was not indeed universal, as we read of sun-dried vessels for utilitarian purposes, but all the vases that have come down to us have been baked. The amount of heat required was regulated by the character of the ware, but was not very high. Many examples exist of discoloured vases which have been subjected to too much or too little heat, the varnish having acquired a greenish or reddish hue. Or again the red gloss is sometimes turned to an ashen-grey colour, the black remaining unimpaired. Other accidents were liable to occur in the baking, such as cracking under too great heat, or the damaging of the shape by vases knocking against one another and so being dented in or crushed. The form of the oven was of the simplest (fig. 17). No furnaces have been found in Greece, and only one or two in Italy, but we have a variety of evidence from vase-paintings. They were fed by fires from beneath, and the vases were inserted with a long shovel. They were heated with charcoal or wood fuel, and

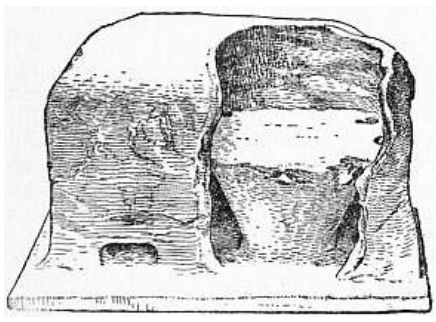


FIG. 17.—Model of Kiln found in Essex.

there are representations of men poking or raking the fires with long-handled implements. One vase-painting gives a bird's-eye view, in horizontal section, of the interior of an oven full of jugs of various forms. Others have more complete presentations of potteries, with men engaged in the different processes of vase manufacture, modelling, painting or supplying the kilns with newly-made wares.

The Painting of Vases.—We may distinguish three principal classes of painted pottery, of Which two admit of subdivision.

1. Primitive Greek vases with simple painted ornaments, chiefly linear and geometrical, laid directly on the clay with the brush. The colour employed is usually a yellowish or brownish red passing into black. The execution varies, but is often extremely coarse.

2. Greek vases painted with figures. These may be subdivided as follows:—

(*a*) Vases with figures in shining black on a red glossy ground.

(*b*) Vases with figures left in the glossy red on a ground of shining black.

3. Vases with polychrome decoration.

(*a*) Vases of various dates with designs in outline or washes in various colours on white ground (these range from the 6th to the 4th century B.C.).

(*b*) Vases of various dates with designs in opaque colour laid over a ground of shining black (ranging from the primitive period to the 3rd century B.C.).

Of these the second group is by far the largest and most important, including the majority of the finest specimens of Greek vase-painting, and the following account will deal mainly with the technical processes by which the most successful results were obtained. In both the classes (*a*) and (*b*) the colouring is almost confined to a contrasting of the glossy red ground and shining black.

This black varnish (?) is particularly deep and lustrous, but varies under different circumstances according to differences of locality, of manufacture or accidents of production. It is seen in its greatest perfection in the "Nolan" *amphorae* of the earlier red-figure period, at its worst in the Etruscan and Italian imitations of Greek vases. The gradations of quality may be partly due to the action of heat, *i.e.* stoving at a higher or lower temperature. It also varies in thickness. At present no certainty has been attained as to its composition—Brongniart's oft-quoted analysis cannot be accepted —nor has any acid been found to have an effect upon it, though the chemical action of the earth sometimes causes it to disappear.

The method of its use forms the chief distinction between the black-figured and red-figured vases, but there is a class of the former which approaches near in treatment to the latter, the whole vase being covered with black except a framed panel which is left red to receive the figures. It is obvious that the transition to merely leaving the figures red is but a slight one. But in all black-figured vases the main principle is that the figures are painted in black silhouette on the red ground, the outlines being first roughly indicated by a pointed instrument making a faint line. The surface within these outlines being filled in with black, details of anatomy, dress, &c., were brought out by incising inner lines with a pointed tool. After a second baking or perhaps stoving had taken place, the designs were further enriched by the application of opaque purple and white pigments, which follow certain conventional principles in their respective use. After a third baking at a lower heat still to fix these colours the vase was complete.

In the red-figured vases the shining black is used as a background. But before it is applied the outlines of the figures are indicated not by incised lines, but by drawing a thick line of black round their contours. Recent researches have attempted to show that the instrument with which this was achieved may have been a feather brush or pen, by which the lines were drawn separately, not concurrently. The other tools used for painting would be an ordinary metal or reed pen and a camel's-hair brush, or at any rate something analogous. Thus the outlines of the figures were clearly marked, and the process is one of drawing rather than painting, but it was in draughtsmanship that the best vase-painters excelled. The next stage was to mark the inner details by very fine black lines or by masses of black for surfaces such as the hair; white and purple were also employed, but more sparingly than on the earlier vases. The main processes always remain the same down to the termination of vase-painting, though the tendency to polychromy, which came in about the end of the 5th century B.C., effected some modifications. The blacking of the whole exterior surface—a purely mechanical process—took place after the figures had been completed and protected from accidents by the thick black border of which we have spoken.

(From a photo supplied by the Director of the Sèvres Museum)

FIG. 18.—Fragment of unfinished red-figured vase.

A fragment of an unfinished vase preserved in the Sèvres Museum gives a very clear idea of the process just described, the figures being completed, but the back ground not yet applied (fig. 18). There is also another vase in existence which gives the interior of a vase-painter's studio, in which three artists are at work with their brushes, their paint-pots by their side.

In the class of vases (3 (*a*)), with polychrome figures on a white ground, the essential feature is the white slip or *engobe* with which the naturally pale clay is covered. In the archaic vases of the 7th and 6th centuries B.C., especially in the Ionian centres, as at Rhodes, Naucratis and Cyrene, this slip is frequently employed, but with this, difference, that the figures are painted in the ordinary black-figure method, the only additional colour being purple laid on the black. We first find polychrome decoration, whether in wash or outline, in a small class of fragments from Naucratis, of the 6th century B.C., which technically are of a very advanced character. The colours used either for outline or wash include purple, brown, yellow, crimson and rose-colour, but some, if not all, of these colours were not fired.

In the 5th century this practice was revived at Athens, chiefly in the class of *lekythoi* or oil-flasks devoted exclusively to sepulchral uses. Here the vases, after leaving the wheel and being fitted with handles, &c., were covered with a coating of white clay. A second coating of black was applied to the parts not required for decoration, and the white was then finely polished, acquiring a dull gloss, and finally fired at a low temperature. The decoration was achieved as follows: a preliminary sketch was made with fine grey lines, ignoring draperies, &c., and not always followed when the colours were laid on. This was done when the first lines were dry, the colour being applied with a fine brush in monochrome—black, yellow or red—following the lines of the sketch. For the drapery and other details polychrome washes were employed, laid on with a large brush. All varieties of red from rose to brown are found, also violet, yellow, blue, black and green. Hair is treated either in outline or by means of washes.

Finally, we have to deal with the class of vases (3 (*b*)) in which opaque pigments are laid over the surface of the shining black with which the whole vase is coated. This method is met with at three distinct periods in the history of vase-painting, separated by long distances of time.

We first find it in the earlier Cretan or Kamares ware, where it seems to have been introduced not long after the close of the Neolithic period, about 2500 B.C., and where it holds its own for about a thousand years against the contrasted method of "dark on light" painting, till it was finally ousted by the latter at the height of "Mycenaean" civilization in Crete. The colouring is very varied, orange, brown, pink and white being the principal tints employed.

The process appears again at the end of the 5th century in a small class of Attic vases, which have been regarded as a sort of transition between the black-figured and red-figured. White and orange-red are here employed, sometimes with accessory details in purple and black and incised lines, so that the technique is virtually black-figured, though the appearance of the vases is often red-figured. Lastly, it appears in southern Italy as a final effort of vase-painting to flicker into life again about the end of the 3rd century. Some of these vases were made in Campania, where the method resembles that of the Attic class just described, others in Apulia, probably at Gnathia. The latter have feeble conventional decoration in purple and white with details in yellow, confined to one side of the vases, and are also distinguished by the use of ornaments in relief. They were also occasionally made in Greece proper.

Remarkably few colours were used by the Greek vase painters, especially in the best periods. The deep purple used for accessory details was produced from iron oxide, but the red used for lines on the white *lekythoi* is an ochre (μίλτος, *rubrica*). The white also used for accessories is an earth or clay; in the slip coating of the white ground vases it assumes the consistency of pipe-clay. Yellow, where used for details on the later vases, is an ochre, and blue and green are produced from artificial compounds containing copper. A number of the colours, such as blue, rose and green, used by the polychrome painters, are obviously artificial pigments which have not been fired. When gilding was employed it was laid on over a raised ground of clay finely modelled with a small tool or brush, and was attached by varnish, not by fire.

Potters and Inscriptions.—The potters who made these vases were mostly—at least at Athens in the 6th and 5th centuries, B.C.—μέτοικοι, or resident aliens, as their names in many cases imply. We have an Amasis (an Egyptian name), a Brygus (a Scythian), a Lydus and a Scythes. The dialect of many of the inscriptions on Attic vases seems to show foreign influence, though in other cases peculiarities may be merely due to the use of a vernacular. They formed a gild or fraternity, and in each pottery there was probably more or less division of labour, the more simple processes being the work of slaves. This seems to be implied in the vase-paintings representing the interior of potteries. Others again "specialized" in different shapes, and were known as χυτροπλάθοι, ληκυθοποιοί, and so on.

Over a hundred names of artists are known, found on some five hundred vases. They go back to about 700 B.C., the earliest names being found on Corinthian and Boeotian vases; but the majority of the signatures are found on Attic black- and red-figured wares. Some, such as Andocides, made vases in which the two methods are combined. The best known is Nicosthenes, whose signature occurs eighty times. The ordinary forms of signature are four—(1) ὁ δεῖνα ἐποίησεν ; (2) ὁ δεῖνα ἔγραχεν; (3) ὁ δεῖνα ἔγραχε καὶ ἐποίησεν; (4) Α ἔγραψε. Β ἐποίησεν. Where

ἐποίησε alone occurs (as in a signature of Euxitheus), it probably refers to the master of the pottery who designed the vase and superintended its production; in other cases the share of the actual artist is clearly indicated. Some artists, such as Duris and Makron, sign ἔγραψε alone; in all cases, the form of signature affords us a useful guide to their style.

Space forbids the discussion of other inscriptions found on vases, which include those descriptive of subjects or persons, ejaculations uttered by the figures, convivial exclamations, or the καλός names discussed below; all these are painted on the designs themselves. There is also another class of *graffiti* inscriptions, which includes those incised by the owners with their names and memoranda scratched under the foot, probably made by the potter or his workmen relating to the number of vases in a batch or "set" and their price.

Vitreous and Lead-glazed Wares.—In Greek tombs a class of pottery is often found which approximates, more in appearance to porcelain, but, though often spoken of by that name, it is not porcelain at all, but is analogous to the Egyptian glazed faience, of which it is in point of fact an imitation. It is distinguished by the white gritty material of which it is made, largely composed of sand, and forming what is sometimes known as "frit" from its semi-vitreous consistency. The surface is covered with a glaze, usually of a pale blue or cream colour, but other colours such as a manganese-purple or brown are sometimes found. Some of the earliest examples of this ware have been found in Mycenaean tombs at Enkomi in Cyprus, in the form of vases moulded in the shape of human or animal heads. These exhibit a remarkably advanced skill in modelling, and are more like Greek work of the 6th century B.C. Apart from the technique they have nothing in common with the Egyptian importations so often found in Mycenaean tombs.

In a subsequent period (8th-7th century B.C.) Egyptian objects in faience became a common import into Greek cities, such as those of Rhodes, and to a less degree in Sardinia and southern Italy, through the commercial medium of the Phoenicians. Flasks of faience occur in the Polledrara tomb at Vulci (610-600 B.C.) and similar vases with a pale green glaze at Tharros in Sardinia in tombs of the same date. In Rhodes, small flasks and jars are found ornamented with friezes of men and animals in relief, or imitating in colour and design the glass vessels of the Phoenicians. It also seems probable that the Greeks of Rhodes and other centres attempted the imitation of this ware (see fig. 19), for we find faience *aryballi* or globular oil-flasks modelled in the form of helmeted heads or animals, which are purely Greek in style.

FIG. 19.—Enamelled pottery from tombs in Rhodes, made under Egyptian influence.

In the Hellenistic period the fashion was revived at Alexandria, and under the Ptolemies large jugs of blue-enamelled faience with figures in relief and bearing the names of reigning sovereigns were made and exported to the Cyrenaica and to southern Italy. Two of these are in the British Museum (Egyptian department). The same collection includes a very beautiful glazed vase in the form of Eros riding on a duck, found in a tomb at Tanagra, but undoubtedly of Alexandrine make, and a head of a Ptolemaic queen, with a surface of bright blue glaze.

Subsequently in the 1st century B.C., this so-called porcelain ware was replaced by a variety of ware characterized by a brilliantly coloured glaze coating, in which the presence of lead is often indicated. This ware was principally made at three centres; at Tarsus in Asia Minor, at Alexandria and at Lezoux in central Gaul. But it was probably also made in western Asia Minor and in Italy. It is not confined to vases, being also employed for lamps and small figures; the vases are usually of small size, in shapes imitated from metal (Plate II., fig. 59). The colour of the glaze varies from a deep green to bright yellow, and the inside of a vessel is often of a different tint from the exterior. Many of these vases are decorated with figures or designs in relief, others are quite plain. The colours of these glazes are of course due to the addition of oxide of copper and oxide of iron to a lead glaze, and they are strictly analogous to the green and yellow glazes of medieval Europe.[7]

HISTORICAL ACCOUNT OF GREEK VASE-PAINTING.—It has been indicated in the section dealing with technical processes that Greek vases may be classified under four headings according to the character of the decoration, and this classification may with a slight modification be adopted as a chronological one, the history of the art falling under four main heads, under which it will be convenient to describe its development from the earliest specimens of painted pottery down to the period when it was finally replaced by other methods of decoration.

These four classes and their main characteristics may be summarized as follows:—

I. *Vases of the Primitive Period* from about 2500 or 2000 to 600 B.C., including both the Cretan-Mycenaean epoch and the early ages of historical Greece. In the former the pottery is either decorated in polychrome on a shining black ground or conversely in shining black on a buff ground; in the latter, the decoration is in brown or black (usually dull, not shiny) on an unglazed ground varying from white to pale red. In the former again the decoration is marked

by its naturalistic treatment of plant and animal forms; in the latter the ornaments are chiefly linear, floral or figures of animals; human figures and mythological scenes being very rare.

II. *Black-figured Vases* from about 600-500 B.C.; figures painted in shining black on a glossy ground varying from cream colour to bright orange red, with engraved lines and white and purple for details; subjects mainly from mythology and legend.

III. *Red-figured Vases*, from 520 to 400 B.C.; figures drawn in outline on red clay and the background wholly filled in with shining black, inner details indicated by painted lines or dashes of purple and white, scenes from daily life or mythology. With these are included the vases with polychrome figures on white ground. In these, which are exclusively made at Athens, the perfection of vase-painting is reached between 480 and 450 B.C.

IV. *Vases of the Decadence*, from 400 to 200 B.C.; mostly from southern Italy, technique as in Class III., but the drawing is free and often careless, and the general effect gaudy; subjects funereal, theatrical and fanciful. At the end of this period vases are largely replaced by plain shining black pottery modelled in various forms, or with decorations in relief, all these being imitations of the metal vases which began to take the place of painted wares in the estimation of the Hellenistic world.

Annual of the British School at Athens.
FIG. 20.—Minoan or “Kamares” ware, from Crete.

FIG. 21.—Primitive black pottery from the Troad.

I. *Vases of the Primitive Period*.—It has been noted in the introductory section that it is possible to trace the development of pottery in Greece as far back as the Neolithic period, owing chiefly to the light recently thrown on the subject by the excavations in Crete. These have yielded large quantities of painted pottery of high technical merit, usually with decoration in polychrome or white on a dark ground, in what is known as the Kamares ware, covering the period 2500-1500 B.C. (fig. 20). This was gradually superseded by painting in dark shining pigments on a light glossy ground during the later Minoan period (1500-1000 B.C.), forming what is known as the “Mycenaean” style. The subjects, though chiefly confined to floral ornaments or aquatic plants and creatures, are marvellously naturalistic yet decorative in their treatment, often rivalling in this respect the pottery of the Far East. In the latter part of this period this class of pottery was spread all over the Mediterranean, and large quantities have been found in Greece, especially at Mycenae, in Rhodes and other Greek islands, and in Cyprus, where a series of vases with animals, monsters, and even human figures shows what is probably the latest development of the pure Minoan or Mycenaean style.

Outside Crete the earliest Greek pottery has been found in Cyprus and at Troy, with simple incised or painted patterns on a black polished ground, the vases being all hand-made, and often treated in a plastic fashion with rude modelling of human or animal forms (figs. 21, 22); these cover the period 2500-2000 B.C. Early painted pottery, parallel with the Kamares ware, has been found in Thera and in the important cemeteries of Phylakopi in Melos. But until the general spread of Mycenaean civilization and art in the latter half of the second millennium there is no site except Crete where a continuous and successful development can be studied.

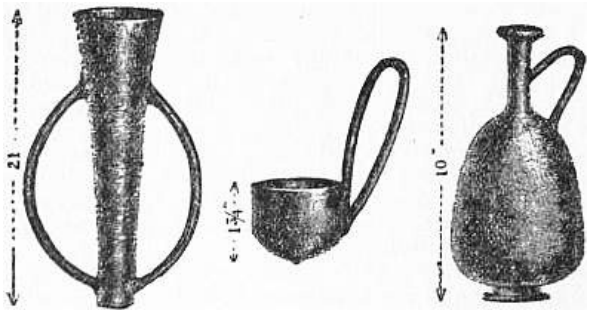


FIG. 22.—Primitive red pottery from the Troad.

FIG. 23.—Vase with bands of animals, Oriental in style, (British Museum.)

About the time which is represented in Greek tradition by the Dorian invasion (1100 B.C.) the then decadent Mycenaean civilization was replaced by a new one much more backward in development, making pottery of a far simpler and more conventional type, the decoration being largely confined to geometrical patterns to the exclusion of motives derived from plant forms. This is usually known as the geometrical style, and the pottery covers the period from about 1000 to 700 B.C. It is found all over the mainland and islands of Greece, and exhibits a certain development towards a more advanced stage. The patterns include the chevron, the triangle, the key or maeander, and the circle, in various combinations, painted in dull black on a brown ground. In most places the art advanced no further, but in Boeotia, and still more at Athens, we can trace the gradual growth of decorative skill, first in the introduction of animals, and then in the appearance of the human figure. In the Athenian cemetery outside the Dipylon gate a series of colossal vases has come to light, on which are painted such subjects as sea-fights and funeral processions. The human figures are exceedingly rude and conventional, painted almost entirely in silhouette, but there is a distinct striving after artistic effect in the composition and arrangement. In Boeotia the vases do not advance beyond the animal stage, and many exhibit a tendency to decadence in their carelessness, as contrasted with the painstaking helplessness of the Athenian artists.

In Ionia and the islands of the Aegean such as Rhodes, the art of vase-painting from the first carried on the Mycenaean tradition, and was distinguished by its naturalism and originality, and by the bold and diverse effects produced by variety of colour or novelty of subject. The ornamentation is at first elementary, consisting of friezes of animals, especially lions, deer and goats (figs. 23 and 24). These figures stand out sharply in black against the creamy buff ground which is characteristic of nearly all Ionic pottery, and details are brought out by means of engraved lines, patches of purplish iron pigment, or by drawing parts of the figures, especially the heads, in outline on the clay ground. Another feature is the general use of small ornaments such as rosettes and crosses in great variety of form to cover the background and avoid the vacant spaces which the Greek artist abhorred. The system of decoration has been thought to owe much to Assyrian textile fabrics.

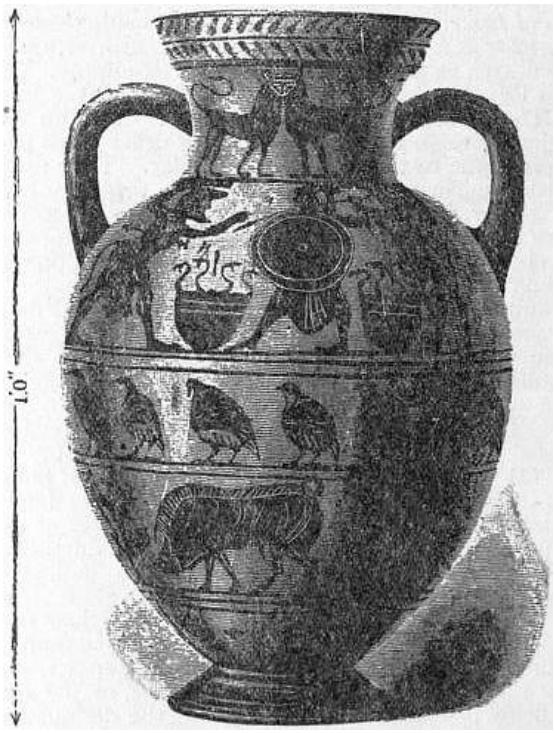


FIG. 24.—Ionic amphora, with contest between Heracles and Hera, and bands of birds and animals; black, with incised lines.

One of the best though most advanced examples of early Ionic pottery is a *pinax* or plate from Rhodes in the British Museum, on which is represented the combat of Menelaus and Hector over the body of Euphorbus (fig. 25); their names are inscribed over the figures, and this is almost the earliest known instance of a mythological subject, the date of the painting being not later than 600 B.C. To a slightly later date belongs another remarkable group of cups with figures on a white ground, probably made at Cyrene in North Africa. Of these the most famous has a painting in the interior, of Arcesilaus II., king of Cyrene from 580 to 550 B.C., weighing goods for export in a ship. Others have mythological subjects, such as Zeus, Atlas and Prometheus, Cadmus and Pelops.

But these vases, though still retaining the older technique, really belong to the second class, that of black-figured vases, and they belong to a time when in all Ionian centres this method was being superseded by the new technique which Corinth had introduced and Athens perfected, to the consideration of which we must return.

FIG. 25.—Early inscribed pinax from Rhodes, with contest of Menelaus and Hector over the body of Euphorbus.

For some 150 years Corinth almost monopolized the industry of pottery on the west of the Aegean. Large numbers of examples have been found in or near the city itself, many bearing

inscriptions in the peculiar local alphabet. They show a continuous progress from the simplest ornamentation to fully-developed black-figured wares. In the earliest (Plate I. fig. 52) oriental influence is very marked, the surface being so covered with the figures and patterns that the background disappears and the designs are at times almost unintelligible. The general effect is thus that of a rich oriental tapestry, and the subjects are largely chosen from the fantastic and monstrous creations of Assyrian art, such as the sphinx and gryphon. The vases are mostly small, the ground varies from cream to yellow, and the figures are painted in black and purple.

Both in Ionia and at Corinth during the early part of the 6th century the same tendencies are seen to be at work, tending to a unification of styles under the growing influence of Athens. In Ionia (see above) figure subjects become more common, and the technique approaches gradually nearer to the black-figure method. Similarly at Corinth the ground ornaments diminish and disappear, the friezes of animals are restricted to the borders of the designs, and human figures are introduced, first singly, then in friezes or groups, and finally engaged in some definite action such as combats or hunting scenes. In the last stages Greek myths and legends are freely employed. A new development, traditionally associated with the painter Eumarus of Athens, was the distinguishing of female figures by the use of white for flesh tints. A somewhat similar development was in progress at Athens, though represented by comparatively few vases. Here the adoption of Corinthian and Ionian technical improvements evolved by the middle of the 6th century the fully developed black-figure style which by degrees supplanted or assimilated all other schools.

II. *Black-figured Vases.*—At the head of this new development stands the famous Francois vase at Florence, found at Chiusi in 1844 (Plate I. fig. 53). Its shape is that of a *krater* or mixing-bowl, and it bears the signatures of its maker and decorator in the form “Ergotimos made me, Klitias painted me.” It might be described as a Greek mythology in miniature, with its numerous subjects and groups of figures all from legendary sources such as the stories of Peleus, Theseus and Meleager, or the return of Hephaestus to heaven. All the figures have their names inscribed.

The general technique of the black-figured vases has already been described. It may be noted as a chronological guide that the use of purple for details is much commoner in the earlier vases, white in the later, but towards the end of the century when the new fashion of red figures was gaining ground, both colours were almost entirely dropped. The drawing of the figures is, as might be expected, somewhat stiff and conventional, though it advanced considerably in freedom before the style went out of fashion. Many vases, otherwise carefully and delicately executed, are marred by an excess of mannerism and affectation, as in the works of the artists Amasis and Exekias (Plate I. fig. 54). The treatment of drapery is a good indication of date, ranging from flat masses of colour to oblique flowing lines of angular falling folds.

The shapes most commonly employed by the Athenian potters of this period are the *amphora, hydria, kylix, oinochoe* and *lekythos,* the first-named being the most popular. A special class of *amphorae* is formed by the Panathenaic vases, which were given as prizes in the Athenian games, and were adorned with a figure of the patron goddess Athena on one side and a representation of the contest in which they were won on the other (fig. 26). They usually bear the inscription τῶν Ἀθηνῆθεν ἄθλων εἰμί “I am (a prize) from the games at Athens.” Some of these can be dated by the names of Athenian archons which they bear, as late as the 4th century, the old method of painting in black figures with a stiff conventional pose for the goddess being retained for religious reasons.

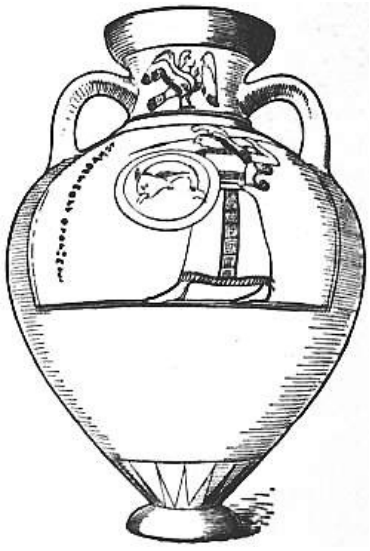


Fig. 26.—Panathenaic amphora.

The chief interest of the black-figured vases is really derived from their subjects, which range over every conceivable field, the proportion of myth and legend to scenes from daily life being much greater than in the succeeding period. They include groups of Olympian and other deities, and the various scenes in which they take part, such as the battle of the gods and giants, or the birth of Athena (treated in a very conventional manner, as on a fine *amphora* in the British Museum); Dionysus and his attendant satyrs and maenads, the labours and exploits of Heracles and other heroes, subjects taken from the tale of Troy and other less familiar legends; and scenes from daily life, battle scenes, athletics, the chase and so on. The same classification of course holds good for the later periods of vase-painting, with some exceptions. The proportion of genre-scenes subsequently becomes greater, and some myths disappear, others rise into prominence, new deities such as Eros (Love), and Nikē (Victory) appear for the first time, and, generally speaking, the later subjects are characterized by a sentimentality or

tendency to emotion which is entirely foreign to the conventional stereotyped compositions of the 6th century artist.

A remarkable feature of the subjects on black-figured vases is that a stereotyped form of composition is invariably adopted at least for the principal figures, but minor variations are generally to be found, as, for instance, in the number of bystanders; and it is almost an impossibility to find any two vase-paintings which are exact duplicates. The form of the composition, was partly determined by the field available for the design; when this took the form of a long frieze the space was filled up with a series of spectators or the repetition of typical groups, but when the design is on a framed panel or confined by ornamental borders the method of treatment is adapted from that of a sculptured metope, and the figures limited to two or three. In many cases it is difficult to decide, in the absence of inscriptions, whether or no a scene has mythological signification; the mythological types are over and over again adopted for scenes of ordinary life, even to the divine attributes or poses of certain figures.

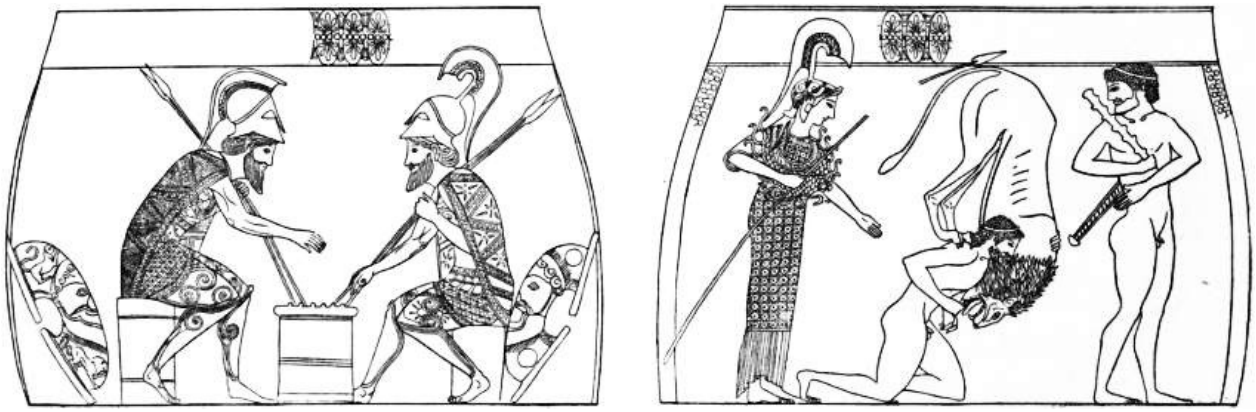


FIG. 27.

Vase by Andocides. Black figures on obverse.

Vase by Andocides. Red figures on reverse.

Among the artists of the period who have left their names on the vases, besides those already mentioned, the most conspicuous is Nicosthenes, a potter of some originality, from whose hand we have over seventy examples, a few being in the red-figure method. He is supposed to have introduced at Athens a revival of the Ionic fashion of painting on a cream-coloured ground instead of on red, of which some very effective examples have been preserved. He was always a potter rather than a painter, and most of his vases are remarkable for their forms—introducing plastic imitations of metal vases—rather than for their painted decoration. Most of the artists of this period, as in the succeeding one, have left their signatures on cups (*kylikes*), but this form did not receive so much attention from the painter as at a later period, and many of these examples bear only inscriptions and no painted decoration.

III. *Red-figured Vases.*—The sudden reversal of technical method involved in the change from black figures on a red ground to red figures on black is not at first sight easy of explanation. Some artists, like Nicosthenes and Andocides, used both methods, sometimes on the same vase, and there is no doubt that the two went on for some years concurrently. As, however, no intermediate stage is possible, there is no question of development or transition. The new style was in fact a bold and ingenious innovation. It may possibly have been suggested by a small class of vases in which the figures are painted in the black-figure *method*, but have the converse appearance, that is to say they are painted in a thick red pigment on a ground of shining black. It may therefore have occurred to the artist that he could obtain the same effect merely by leaving the figures unpainted on the red clay and surrounding them with the black. The change, must, however, be closely associated with the career of the artist Andocides, who not only produced vases in each method, but also several in which the two are combined (fig. 27). In two or three cases the subject is actually the same on each side, almost every detail being repeated, except that the colouring is reversed.

The date at which the change took place was formerly placed well on in the 5th century, on account of the great advance in drawing which most of the red-figured vases show, as compared with the black. They were thus regarded as contemporary with the painter Polygnotus, if not with Pheidias. But the excavations on the Acropolis of Athens yielded so many fragments in the advanced red-figured style which must be earlier than 480 B.C., that it has become necessary to find an earlier date for its appearance. This is now usually placed at about 520 B.C., overlapping with the preceding period.

The red-figure period is usually subdivided into four, marking the chief stages of development, and known respectively as the “severe,” “strong,” “fine,” and “late fine” periods. Their principal characteristics and representative painters may be briefly enumerated.

In the *severe* period there is no marked advance on the black-figured vases as regards style. The figures are still more or less stiff and conventional, and some vases even show signs of an analogous decadence. The real development is partly technical, partly in the introduction of new subjects. Although the change of style probably had its actual origin in the *amphora*, as treated by Andocides, the new developments are best seen in the *kylix*, a form of vase which now sprang into popularity and called forth the chief efforts of the principal artists. Its curved surface gave ample scope for skilful effects of drawing and decorative arrangement, and the earlier painters devoted all their attention to perfecting it as a work of decorative art. For other shapes, such as the *hydria*, and *lekythos*, the old method was for a time preferred.

The most typical artist of the period was Epictetus, and other famous cup-painters were Pamphaeus, Cachrylion and Phintias. The earliest cups are decorated in a quite simple fashion like those of the black-figure period, often with a single figure each side between two large “symbolical” eyes, and a single figure in a circle in the interior. To the latter the artist at first devoted his chief efforts, though even here his scope was at first limited. But although he had not yet attained to skill in composition, he did discover that the circular space was well adapted for exhibiting his newly-acquired abilities as a draughtsman and for disposing figures in ingeniously conceived attitudes. In all cases the object was to fill the space as far as possible, a characteristic of all the best Greek art. By degrees more attention was paid to the designs on the exterior, and the single figures were replaced by groups, but regular compositions in the form of friezes telling some story were not introduced until quite the end of this period. Epictetus was throughout his career a thoroughly “archaic” artist, but a considerable advance was made by Cachrylion, who stands on the verge of the succeeding stage.

Fig. 28.—Cup by Euphronius.

The *strong* period centres round the name of Euphronius, the author of a really great artistic movement. His capacity for inventing new subjects or new poses—or otherwise overcoming technical and artistic difficulties—marks a great advance on all previous achievements, and he seems to represent the stage of development traditionally associated with the painter Cimon of Cleonae, the inventor of foreshortening and other novelties. Thus figures were no longer represented exclusively in profile, as in the black-figured vases which had made no advance beyond the conventions of Egyptian art. Ten vases signed by him are in existence (though it is not certain that all were actually painted by him), most of them having mythological subjects (fig. 28).

Of his contemporaries, Duris, Hieron and Brygus take foremost rank, all three being, like Euphronius, essentially cup-painters, though they use other forms at times. For decorative effect and beauty of composition their vases have never been surpassed. As an example we may quote a *kotyle* or beaker in the British Museum signed by Hieron, with a group of Eleusinian deities. The larger vases of this period are more rarely signed, but many of them rival the cups

in execution, though the subjects are characterized by greater simplicity and largeness of style.

In *the fine* style (460-440 B.C.) breadth of effect and dignity are aimed at, and although cup-painting had passed its zenith, and signed specimens become rarer, yet, considering the red-figured vases as a whole, this period exhibits the perfection of technique and drawing. In many of the larger vases the scenes are of a pictorial character, landscape being introduced, with figures ranged at different levels, and herein we may see a reflection of the style of the painter Polygnotus. One of the finest cups in this style is in the Berlin Museum, it is signed by the artists Erginus and Aristophanes, and the subject is the battle of the gods and giants. To the end of the period belongs a beautiful *hydria* in the British Museum by the painter Meidias with subjects from Greek legend in two friezes (fig. 29). Generally speaking, there is a reaction in favour of mythological subjects.

FIG. 29.—Hydria by Meidias in the style of Polygnotus.

In the *late fine* style, which begins about 440 B.C., the pictorial effect is preserved, but with perfected skill in drawing the compositions deteriorate greatly in merit, and become at once over-refined and careless. The figures are crowded together without meaning or interest. The fashion also arose of enhancing the designs by means of accessory colours—almost unknown in the previous stages—such as white laid on in masses, blue and green, and even with gilding. Athletic and mythological subjects yield place to scenes from the life of women and children or meaningless groups of figures (fig. 30).

A good example of this style is an *amphora* from Rhodes with the subject of Peleus wooing Thetis, in which polychrome colouring and gilding are introduced. There are also many imposing and elaborate specimens found (and perhaps made) in the colonies of the Crimea and the Cyrenaica; in particular one signed by Xenophantus with the Persian king hunting, and another representing the contest of Athena and Poseidon for the soil of Attica, both from the Crimea.

Contemporary with the red-figure method is one in which the figures are painted on a white slip or *engobe* resembling pipe-clay, with which the whole surface was covered; the figures are drawn in outline in red or black, and partly filled in with washes of colour, chiefly red, purplish red, or brown, but sometimes also with blue or green. This style seems to have been popular about the middle of the 5th century B.C. and was employed for the funeral *lekythoi* which came into fashion at Athens about that time. These vases, which form a class by themselves, were made specially for funeral ceremonies and were painted with subjects relating to the tomb, such as the laying-out of the corpse on the bier, the ferrying of the dead over the Styx by Charon, or (most frequently) mourners bringing offerings to the tomb (fig. 31). They continued to be made well on into the 4th century, but the later examples are very degenerate and careless.

Of other forms, especially the *kylix* and the *pyxis* (toilet-box), some exceedingly beautiful specimens have come down to us, which show a delicacy of drawing and firmness of touch never

surpassed, although the lines were probably only drawn with a brush. The technique of these vases may reflect the methods of the painter Polygnotus and his contemporaries, who used a limited number of colours on a white ground. Among them no finer specimen exists than the cup in the British Museum with Aphrodite riding on a goose; the design is entirely in brown outlines, and the drawing, if slightly archaic, full of grace and refinement.

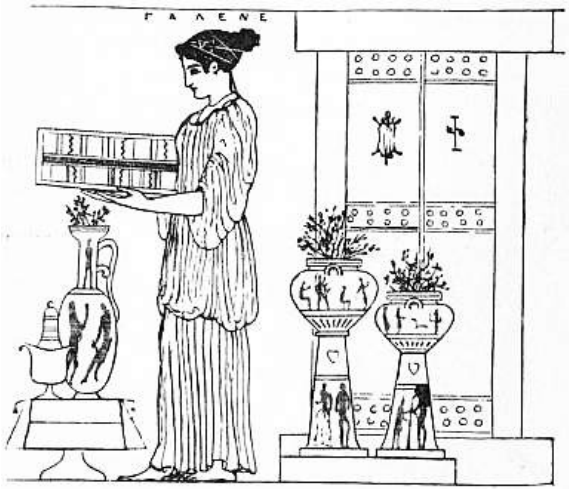


FIG. 30.—Painting from a small toilet-box or pyxis, showing painted vases used to decorate a lady's room. On the left is a gilt pyxis with a tall lid, and an oenochoe on a low table; on the right two tall vases (lebes) on a plinth. All except the pyxis are decorated with painted figures, and contain flowers.

In the subjects on red-figured vases we do not find the same variety of choice as on the black-figured, but on the other hand there is infinitely greater freedom of treatment. The stereotyped form of composition is almost entirely discarded, and each painter forms his own conception of his subject. The class of slim *amphorae*, known as "Nolan" from the place where they were mostly found, are distinguished by having the design limited to one or at most two figures on each side, often on a large scale; these vases are also famous for the marvellous brilliance of their shining black (fig. 32).

Towards the middle of the 5th century the patriotism of the Athenian artist finds expression in the growing importance which he attaches to local legends, especially those of Theseus, the typical Attic hero. He seems to have been regarded as the typical Athenian athlete or *ephebus*, and his contests as analogous to episodes of the gymnasium. Hence the grouping on some vases of scenes from his labours are like so many groups of athletes (fig. 33), and hence, too, a general tendency of the red-figured vases, especially the cups, to become a sort of glorification of the Attic *ephebus*, the representations of whom in all sorts of occupations are out of all proportion to other subjects.

FIG. 31.—Funeral lekythos showing vases placed inside tomb.

We find evidence of this, too, in another form. Many vases, especially the cups of the "severe" and "strong" periods, bear names of persons inscribed on the designs with the word καλός, "fair" or "noble," attached; sometimes merely, "the boy is fair." The exact meaning of this practice has been much discussed, but evidence seems to show that the persons celebrated must have been quite young at the time, and were probably youths famous for their beauty or athletic prowess. Some of the names are those of historical characters, such as Hipparchus, Miltiades or Alcibiades, and, though they cannot always be identified with these celebrated personages, enough evidence has been obtained to be of great value for the chronology of the vases, Further, the practice of the vase-painter of adopting his own particular favourite name or set of names has enabled us to increase our knowledge of the characteristics of individual artists by identifying unsigned vases with the work of particular schools.

IV. *Vases of the Decadence.*—For all practical purposes the red-figure style at Athens came to an end with the fall of the city in 404 B.C. Painted vases did not then altogether cease to be made, as the

Panathenaic prize vases and the funeral *lekythoi* testify, but at the same time a rapid decadence set in. The whole tendency of the 4th century B.C. in Greece was one of decentralization, and the art of vase-painting was no exception, for we find that there must have been a general migration of craftsmen from Athens, not only to the Crimea and to North Africa, but also to southern Italy, which now becomes the chief centre of vase production. Here there were many rich and flourishing Greek colonies or Grecianized towns, such as Tarentum, Paestum and Capua, ready to welcome the new art as an addition to their many luxuries. In the character of the vases of this period we see their tendencies reflected, especially in their splendid or showy aspect; the only aim being size and gaudy colouring.

FIG. 32.—"Nolan" amphora by Euxitheus (c. 450 B.C.), figure of Briseis; the other side has Achilles.

The general method of painting remains that of the Athenian red-figure vases, but with entire loss of simplicity or refinement, either in the ornamentation, the choice of colours, or the drawing of the figures. Large masses of white are invariably employed, especially for the flesh of women or of Eros, the universally present god of Love, and for architectural details. Yellow is introduced for details of hair or features, and in attempts at shading, nor is a dull iron-purple uncommon. The reverses of the vases, when they have subjects, are devoid of all accessory colouring, and the figures are drawn with the greatest carelessness, as if not intended to be seen. There is throughout a lavish use of ornamental patterns such as palmettes, wreaths of leaves, or ornaments strewn over the field (a reversion to an old practice).

The drawing, having now become entirely free, errs in the opposite extreme; the forms are soft and the male figures often effeminate. The fanciful and richly-embroidered draperies of the figures and the frequent architectural settings seem to indicate that theatrical representations exercised much influence on the vase-painters. The great painters of the 4th century may also have contributed their share of inspiration, but rather perhaps in the subjects chosen than in regard to style; though the effect of many scenes on the larger vases is decidedly pictorial, they are chiefly remarkable for their emotional and dramatic themes.

The influence of the stage is twofold, for tragedy as well as comedy plays its part. Many subjects are taken directly, others indirectly, from the plays of Euripides, such as the *Medea*, *Hecuba* (Plate II. fig. 60), or *Hercules Furens*, and the arrangement of the scenes is essentially theatrical. The influence of comedy is seen in subjects derived from the *phlyakes*, a kind of farce or burlesque popular in southern Italy, and here again the setting is adapted from the stage, some vases having parodies of myths, others comic scenes of daily life.

Many vases of this period, especially those of large size, were expressly designed for funeral purposes. Some of these bear representations of the underworld, with groups of figures undergoing punishment. On others shrines or tombs are depicted—sometimes containing effigies of the deceased, at which the relatives make offerings—as on the Athenian *lekythoi*. But by far the greater portion of the subjects are taken from daily life, many of these being of a purely fanciful and meaningless character like the designs on Sèvres or Meissen china; the commonest type is that of a young man and a woman exchanging presents, the presence of Eros implying that they are scenes of courtship.

The vases of this period are usually grouped in three or four different types, corresponding to the ancient districts of Lucania, Campania and Apulia, each with its special features of technique, drawing and subjects. In Lucanian vases the drawing is bold and restrained, more akin to that of the Attic vases; in Campania a fondness for polychromy is combined with careless execution. In Apulia a tendency to magnificence exemplified in the great funeral and theatrical vases is followed by a period of decadence characterized by small vases of fantastic form with purely decorative subjects. Besides these we have the school of Paestum, represented by two artists who have left their names on their vases, Assteas and Python. A well-known example of the work of the former is a *krater* in Madrid with Heracles destroying his children, a theatrical and quasi-grotesque composition, and there is a fine example of Python's work in a *krater* in the British Museum, with Alkmena, the mother of Heracles, placed on the funeral pyre by her

husband Amphitryon, and rain-nymphs quenching the flames (Plate I. fig. 55).

FIG. 33.—Cup with exploits of Theseus.

About the end of the 3rd century B.C. the manufacture of painted vases would seem to have been rapidly dying out in Italy, as had long been the case elsewhere, and their place is taken by unpainted vases modelled in the form of animals and human figures, or ornamented with stamped and moulded reliefs. These in their turn gave way to the Arretine and so-called "Samian" red wares of the Roman period. In all these wares we see a tendency to the imitation of metal vases, which, with the growth of luxury in the Hellenistic age, had entirely replaced painted pottery both for use and ornament; the pottery of the period is reduced to a subordinate and utilitarian position, merely supplying the demands of those in the humbler spheres of life.

Collections.—The majority of the painted vases now in existence are to be found in the various public museums and collections of Europe, of which the largest and most important are the British Museum, the Louvre and the Berlin Museum. Next to these come the collections at Athens, Naples, Munich, Vienna, Rome and St Petersburg; isolated specimens of importance are to be found in other museums, as at Florence, Madrid or the Bibliothèque Nationale at Paris. Most of the great private collections of the two preceding centuries have now been dispersed. In recent years the Boston Museum has raised America to a level with Europe in this respect; and the Metropolitan Museum at New York contains a vast collection of Cypriote pottery.

LITERATURE.—Important original articles are to be found in various archaeological journals such as *American Journal of Archaeology* (1885, &c); *Annual of the British School at Athens* (1894, &c.); *Athenische Mitteilungen* (1876, &c.); *Bulletin de correspondance hellénique* (1877, &c.); *Comptes rendus de la commission impériale archéologique* (St Petersburg, 1859-1888); *Gazette archéologique* (Paris, 1875-1889); *Jahrbuch des kaiserlichen deutschen archäologischen Instituts, Berlin* (1886, &c.); *Journal of Hellenic Studies* (1880, &c.); *Monumenti antichi* (Milan, 1890, &c.); *Monuments grecs* (Paris, 1872-1898); *Monuments Piot* (Paris, 1894, &c.); *Revue archéologique* (Paris, 1844, &c.). The older works have been recently superseded by important publications embodying the latest views such as Hartwig, *Die griechischen Meisterschalen des strengen rotfigurigen Stils* (1893); Louvre, *Catalogue des vases antiques de terre cuite*, by E. Pottier (1896, &c.); S. Reinach, *Répertoire des vases peints* (Paris, 1899-1900); H. B. Walters, *History of Ancient Pottery* (Greek, Etruscan and Roman), 1905, with an excellent bibliographical list; also art. "Hischylos" in *J.H.S.* xxix. (1909) p. 103.

ETRUSCAN POTTERY.—Parallel with the development of the art of pottery in Greece runs the course of the art in Etruria, though with far inferior results; in its later stages it is actually no more than a feeble imitation of the Greek. The period of time which we must consider extends from the Bronze age (1000 B.C. or earlier) down to the 3rd century B.C., when Etruscan civilization was merged into Roman.

The earliest civilization traced in Italy is not, strictly speaking, Etruscan, but may perhaps be more accurately styled “Umbrian.” It is usually referred to as the “Terramare” period from the remains discovered in that district in the basin of the Po. These people were lake-dwellers, barely removed from the Neolithic stage of culture, and their pottery was of the rudest kind, hand-made and roughly baked. Cups and pots have been found sometimes with simple decoration in the form of knobs or bosses, and many have a crescent-shaped handle serving as a support for the thumb.

The next period, the earliest which can be spoken of as “Etruscan,” is known as the “Villanova” period, from a site of that name near Bologna, or as the period of pit-tombs (*a pozzo*), from the form of the graves in which the pottery has been found (see Villanova). It begins with the 9th century B.C. and lasts for about two hundred years. The pit-tombs usually contain large cinerary urns or *ossuaria* (containing the ashes of the dead), fashioned by hand from a badly-levigated volcanic clay known as *impasto Italico*. These vessels were irregularly baked in an open fire, and the colour of the surface varies from red-brown to greyish black. They appear to have been covered with a polished slip, intended to give the vases a metallic appearance. The shape of the urns is peculiar, but uniform; they have a small handle at the widest part and a cover in the form of an inverted bowl with handle (Plate III. fig. 63). Their ornamentation consists of incised or stamped geometrical ornaments formed in the moist clay in bands round the neck and body; more rarely patterns painted in white are found. Common pottery is also found showing little advance on that of the Terramare period except in variety of decoration. The technique and ornament are the same as in the case of the urns. They correspond in development, though not in date, to the early pottery of Troy and Cyprus, as well as to the primitive pottery of other races, but one marked difference is the general fondness of the Italian potter for vases with handles.

Sometimes the cinerary urns take the form of huts (*tuguria*), though these are more often found in the neighbourhood of Rome. One of the best examples is in the British Museum; it still contains ashes which were inserted through a little door secured by a cord passing through rings. The ornamentation suggests the rude carpentry of a primitive hut, the cover or roof being vaulted with raised ridges to represent the beams. The surface is polished, and other specimens are occasionally painted with patterns in white.

In the next stage a change is seen in the form of the tombs, the pit being replaced by a trench; this is accordingly known as the “trench-tomb” or *a fossa* period, and extends from the 8th century B.C. to the beginning of the 6th. Importations of Greek pottery now first make their appearance. The character of the local pottery actually remains for some time the same as that of the preceding period, but it improves in technique. By degrees an improvement in the forms is also noted, and new varieties of ornamentation are introduced; there is, however, no evidence that the wheel was used.

Two entirely new classes of pottery are found at Cervetri (Caere) belonging to the 7th century. One consists of large jars (πίθοι) of red ware, the lower part being moulded in ribs, while the upper has bands of design stamped round it in groups or friezes. These designs were either produced from single stamps or rolled out from cylinders like those used in Babylonia. The subjects are usually quasi-oriental in character, and it is not certain that this ware was made in Etruria, especially as similar vases have been found in Rhodes and Sicily; either it was imported, or it was a local imitation of Greek models.

The other class is similar as regards the shapes and the nature of the clay, but is distinguished by having painted subjects in white outlines on a red glossy ground. The clay, a kind of *impasto Italico*, was first hardened by baking, and then a mixture of wax, resin and iron oxide was applied and polished; on this the pigments, a mixture of chalk and earth, were laid. The subjects are from Greek mythology or are at least Greek in character, but the technique is purely Etruscan, and the drawing is crude and un-Greek in the extreme.

The fourth period shows a close continuity with the third; but the difference is defined firstly by the appearance of a new type of tomb in the form of a chamber (*a camera*), secondly, by the all-pervading influence of oriental art, and to a less extent of that of the Greeks. The period extends from about 650 to 550 B.C., and is further marked by the general introduction of the wheel into Etruria and by the appearance of inscriptions in an alphabet derived from western Greece. In the earlier tombs the typical local pottery is of hand-made *impasto Italico* resembling that of the previous periods; in the later we find what is known as *bucchero* ware—the national pottery of Etruria—which is made on the wheel and baked in a furnace, and shows a marked tendency to imitate metal.

To this period also belongs the famous Polledrara tomb or Grotto d’lside at Vulci, the contents of which are now in the British Museum and include some remarkable specimens of pottery. It dates from about 620-610 B.C. The most remarkable of the vases is a *hydria*, of reddish-brown clay covered with a lustrous black slip on which have been painted designs in red, blue and a

yellowish white. The colours have unfortunately now almost disappeared, and it is doubtful if they had been fired. The principal subject is from the story of Theseus and Ariadne. This tomb also contained a large wheel-made *pithos* of red *impasto* ware with designs painted in polychrome. In the Regulini-Galassi tomb at Cervetri (about 650 B.C.) large cauldrons of red glossy ware were found, with gryphons' heads projecting all round, to which chains were attached. A similar cauldron from Falerii on a high open-work stand is now in the British Museum.

We now come to the *bucchero* ware, which is characteristic of the later portion of this period, though the earliest examples go back to the end of the 7th century. Its main feature is the black paste of which it is composed, covered with a more or less shining black slip. Modern experiments seem to indicate that the clay was smoked or fumigated in a closed chamber after baking, becoming thereby blackened throughout, and the surface was then polished with wax and resin. Analyses of the ware have proved that it contains carbon and that it had been lightly fired. The oldest *bucchero* vases are small and hand-made, sometimes with incised geometrical patterns engraved with a sharp tool like metal-work. Oriental influence then appears in a series of chalice-shaped cups found at Cervetri with friezes of animals. From about 560 B.C. onwards the vases are all wheel-made, with ornaments in relief either stamped from a cylinder or composed of separate medallions attached to the vase. The subjects range from animals or monsters to winged deities or suppliants making offerings (fig. 34); in other cases we find meaningless groups of figures or plant forms. These types are found chiefly in southern Etruria, but at Chiusi (*Clusium*) a more elaborate variety found favour from about 500 to 300 B.C. The shapes are very varied and the ornament covers the vase from top to bottom, the covers of the vases being also frequently modelled in various forms. The figures are stamped from moulds, incised designs being added to fill up the spaces. The range of subjects is much widened, including scenes from Greek mythology and oriental types combining Egyptian and Assyrian motives, which must have been introduced by the Phoenicians.

FIG. 34.—Etruscan oinochoe, of black bucchero ware, with figures in relief. (British Museum.)

Thus the technique of the *bucchero* wares is purely native, but the decoration is entirely dependent on foreign types whether Greek or oriental, and throughout the whole series the tendency to imitate metal-work is to be observed in every detail, both in the forms and in the methods of decoration. Some are mere counterparts of existing work in bronze.

The last variety of peculiarly Etruscan pottery which calls for notice is the Canopic jar, so called from its resemblance to the κάνωποι in which the Egyptians placed the bowels of their mummies. They are rude representations of the human figure, the head forming the cover, and in the tombs were placed on round chairs of wood, bronze or terra-cotta. An example of such a jar on a bronze-plated chair may be seen in the Etruscan Room of the British Museum (Plate III. fig. 65). Their origin has been traced to the funeral masks found in the earliest Etruscan tombs. From these a gradual transition may be observed from the mask (1) placed on the corpse, (2) on the cinerary urn, (3) the head modelled in the round and combined with the vase, and (4) at last the complete human figure. The earliest of these jars are found in the "pit-tombs" of the 8th century B.C., and the latest and most developed types belong to the 5th century B.C.

The skill shown by the Etruscans in metal-work and gem-engraving never extended to their pottery, which is always purely imitative, especially when they attempted painted vases after the Greek fashion. The kinds already described are all more or less plastic in character and imitative of metal, except in the case of the Cervetri and Polledrara finds, which have little in common with anything Greek, and exhibit a quite undeveloped art. But towards the end of the 6th century B.C., when Greek vases were coming into the country in large numbers, attempts were made to imitate the black-figure style, especially of a particular class of Ionian vases. Imitations of these are to be found in most museums and may be readily recognized as Etruscan from peculiarities of style, drawing and subject, as well as their inferior technique (fig. 35).

FIG. 35.—Etruscan Amphora imitating Greek style; parting scene of Alcestis and Admetus, with Etruscan inscriptions.

At a later date (4th-3rd century B.C.) they began to copy red-figured vases with similarly unsuccessful results. With the exception of a small class of a somewhat ambitious character made at Falerii (Civita Castellana), of which there is a good example in the British Museum with the subject of the infant Heracles strangling the serpents, they are all marked by their inferior material and finish and their bizarre decoration. The style is often repulsive and disagreeable, as well as ineffective, and the grim Etruscan deities, such as Charun, are generally introduced. Some of these vases have painted inscriptions in the Etruscan alphabet. The latest specimens positively degenerate into barbarism.

Painted vases of native manufacture are also found in the extreme south of Italy and have been attributed to the indigenous races of the Peucetians and Messapians; their decoration is partly geometrical, partly in conventional plant forms, and is the result of natural development rather than of imitation of Greek types. Some of the shapes are characteristic, especially a large four-handled *krater*. They cover the period 600-450 B.C., after which they were ousted by the Graeco-Italian productions we have already described.

ROMAN POTTERY.—Roman vases are far inferior to Greek; the shapes are less artistic, and the decoration, though sometimes not without merits of its own, owes most of its success to the imitation or adaptation of motives learnt from earlier Grecian, Egyptian or Syrian potters. They required only the skill of the potter for their completion, and, being made by processes largely mechanical, they are altogether on a lower scale of artistic production.

It has been noted that during a certain period—namely, the 3rd and 2nd centuries B.C.—ceramic art had reached the same stage of evolution all round the Mediterranean, painted pottery had been ousted by metal-work, and such vases as continued to be made were practically imitations of metal both in Greece and Italy. These latter we must regard as representing ordinary household pottery, or as supplying to those who could not afford to adorn their houses and temples with costly works in metal, a humble but fairly efficient substitute. There is a terra-cotta bowl of the 2nd century B.C. in the British Museum which is an exact replica of a chased silver bowl with reliefs in the same collection, and may serve as an illustration of this condition of things (Plate II. fig. 56).

These imitations of metal were largely made in southern Italy, a district which enjoyed close artistic relations with Etruria, and we have already seen that the same principle had long been in vogue among the Etruscans. Hence it is not surprising that an important centre of pottery manufacture should have sprung up in Etruria, in the and century B.C., which for many years set the fashion to the whole Roman world. But before discussing such products it may be as well to say something on the technical character, shapes and uses of Roman pottery in general.

Technical Processes.—Roman pottery regarded in its purely technical aspect is in some ways better known to us than the Greek, chiefly owing to extensive discoveries of kilns and potters' apparatus in western Europe. It may be classified under two heads, of which only the second will concern us for the most part as yielding by far the greater amount of material and interest: (1) the plain, dull earthenware used for domestic purposes, and (2) the fine, red shining wares, usually known to archaeologists as *terra sigillata*, clay suited to receive stamps (*sigilla*) or impressions.

For both classes all kinds of clay were used, varying somewhat in different regions, and ranging in colour when fired from black to grey, drab, yellow, brown and red. The clays varied greatly in quality; most of the pottery made in southern Gaul was fashioned from the ferruginous red clay of the Allier district, but at St-Remy-en-Rollat and in that neighbourhood a white clay was used. In Italy we find a carefully levigated red clay in use, great care being devoted to its preparation and admixture. But apart from decoration and style there is a great similarity in the general appearance of the Italian and provincial pottery made under Roman influence, and it is often very difficult to decide whether the vases were manufactured where they had been found or were imported from some famous centre of manufacture. The secret of the glossy red surface

seems to have been common property and found its way from Italy to Gaul, Spain and Germany, and perhaps even to Britain.

The manner in which this glossy red surface was produced has been a much-disputed question, some, as for instance Artis, the excavator of the Castor potteries in Northamptonshire, claiming that it was a natural result obtained in the baking, after polishing of the surface, by means of specially contrived kilns. But it is now generally agreed that it was artificial. It is true that the Roman lamps and many of the commoner wares have a gloss produced by polishing only, varying in colour and brightness with the proportion of iron oxide in the clay and the degree of heat at which the pieces were fired. But the surface finish of the finer or *terra sigillata* wares is something quite distinct, and reaches a high and wonderfully uniform perfection.

It is possible that the technical secret of the potters of the Roman world was only a development from the practice of the Greeks, but it does seem as if the finer Roman wares were coated with a brilliant glossy coating so thin as to defy analysis, yet so persistent as to leave no doubt of its existence as a definite glossy coat. Repeated attempts have been made to determine its nature by analysis, but chemists ought to have known better, for the coating is so thin that it is impossible to remove it without detaching much more body than glaze. Examination shows it to be much more than a surface polish or than the gloss of the finest Greek vases, and we shall have to wait for a final determination of its nature until some one who is at once a chemist and a potter can reconstruct it synthetically. Whatever its nature and method of production, it is certain that the glaze itself was a transparent film which heightened the natural red colour of the clay, until in the finest specimens it has something of the quality of red coral.

In the manufacture of vases the Romans used the same processes as the Greeks. They were all made on the wheel, except those of abnormal size, such as the large casks (*dolia*), which were built up on a frame. Specimens of potters' wheels have been found at Arezzo and Nancy, made of terra-cotta, with a pierced centre for the pivot, and bearing small cylinders of lead round the circumference to give a purchase for the hand and to aid the momentum of the wheel. For the ornamental vases with reliefs an additional process was necessary, and the decoration was in nearly all cases produced from moulds. The process in this case was a threefold one: first the stamps had to be made bearing the designs; these were then pressed upon the inside of a clay mould which had been previously made on the wheel to the size and shape required; finally, the clay was impressed in the mould and the vase was thus produced, decoration and all. Handles being of rare occurrence in Roman pottery, the vases were thus practically complete, requiring only the addition of rim and foot. The stamps were made in various materials, and had a handle at the back (Plate III. fig. 64). The moulds were of lighter clay than the vases, and were lightly fired when completed, so as to absorb the moisture from the pressed-in clay. Large numbers of these moulds are in existence (Plate III. fig. 61), and the British Museum possesses a fine series from Arezzo. Those discovered in various parts of Gaul have afforded valuable evidence as to the sites of the various pottery centres, as their presence obviously denoted a place of manufacture, and the value of this evidence is increased when they bear potters' names.

Remains of kilns for baking Roman pottery[8] are very numerous in western Europe, especially in Gaul, where the best examples are at Lezoux near Clermont, at Châtelet in Haute-Marne, and near Agen in Lot-el-Gäronne. In Germany good remains have come to light at Heiligenberg in Baden, al Heddernheim near Frankfort, Rheinzabern near Carlsruhe, and Westerndorf in Bavaria. In England the best kilns are those discovered by Artis in 1821-1827 at Castor in Northamptonshire (see fig. 4).

Shapes.—As is the case with Greek vases, a long list of names of shapes may be collected from Latin literature, and the same difficulties as to identification arise in the majority of cases. They may, however, be classified in the same manner; as vases for storing liquids, for mixing or pouring wine, for use at the table, and so on. In addition Varro and other writers have preserved a number of archaic and obscure names chiefly applied to the vases used in sacrifices.

The principal vases for storing liquid or solid food were:—The *dolium*, a large cask or barrel of earthenware; the *amphora*, a jar holding about six gallons; and the *cadus*, a jar about half as large as the *amphora*. The *dolium* had no foot, and was usually buried in the earth; it was also used for purposes of burial. The *amphora* corresponds to the Greek wine-jar of that name, and had, like its prototype, a pointed base. Many examples were found at Pompeii stamped with the names of consuls (cf. Hor. *Od.* in. 21. I), or with painted inscriptions relating to their contents. The *cadus* is mentioned by Horace and Martial.

Of smaller vases for holding liquids, such as jugs, bottles and flasks, the principal were the *urceus*, answering to the Greek οἰνοχόη, the *ampulla*, a kind of flask with globular body, and the *lagena*, a narrow-necked flask or bottle. Of drinking-cups the Romans had almost as large a variety as the Greeks, and the great majority of the ornamented vases preserved to the present day were devoted to this purpose. The generic name for a cup was *poculum*, but the Romans borrowed many of the Greek names, such as *cantharus* and *scyphus*. The *calix* appears to have answered in popularity, though not in form, to the Greek *kylix*, and is probably the name by which the ornamented bowls were usually known. The names for a dish are *lanx*, *patina* and *catinum*. Another common form is the *olla* (Greek χύτρα), which served many purposes, being

used for a cooking-pot, for a jar in which money was kept, or for a cinerary urn. The form of vase identified with this name has a spherical or elliptical body with short neck and wide mouth. Of sacrificial vases the principal was the *patera* or libation-bowl, corresponding to the Greek φιάλη.

Arretine Ware.—The Latin writers, and in particular Pliny, mention numerous places in Italy, Asia Minor and elsewhere, which were famous for the production of pottery in Roman times. Pliny mentions with special commendation the "Samian Ware," the reputation of which, he says, was maintained by Arretium (Arezzo). Samian pottery is also alluded to by other writers, and hence the term was adopted in modern times as descriptive of the typical Roman red wares with reliefs, whether found in Italy, Germany, Gaul or Britain. But it was only accepted with diffidence as a convenient name, and as early as 1840 discoveries at Arezzo made it possible to distinguish the vases found there as a local product, now known as "Arretine" ware. The name "Samian" has, however, adhered to the provincial wares and at the present day is often used even by archaeologists. But recent researches have shown that nearly all the provincial wares can be traced to Gaulish or German potteries, and, since it is implied by Pliny that "Samian" pottery is older than "Arretine," the name may now be fairly rejected altogether, as we have rejected the name "Etruscan" for Greek pottery. The Romans probably used it as a generic term, just as we speak of "china," and the real Samian ware is to be seen in the later Greek pottery, with reliefs, of the 3rd century B.C.

There were, as Pliny and other writers imply, many pottery centres in Italy, at Rhegium, Cumae, Mutina and elsewhere, as well as at Saguntum in Spain, but all were surpassed in excellence by Arretium. In more modern times its pottery came under notice even in the middle ages, and discoveries were made in the time of Leo X (about 1500) and again in the 18th century. The Arretine ware may be regarded as *the* Roman pottery *par excellence*, and its popularity extended from about 150 B.C. down to the end of the 1st century of the Empire, reaching its height in the 1st century B.C., after which it rapidly degenerated, and its place was taken by the wares of the provinces. Its general characteristics may be summed up as follows:—(1) The fine local red clay, carefully levigated and baked very hard to a rich coral red or a colour like sealing-wax; (2) the fine red glaze, which has already been discussed; (3) the great variety of forms employed, showing the marked influence of metal-work; (4) the almost invariable presence of stamps with potters' names. The majority of the specimens have been found at Arezzo itself, but there was a branch of the industry at Puteoli, producing pottery almost equal in merit, and it was also exported to central and eastern Europe and Spain.

The earliest examples are of black glossy ware, but the red appears to have been introduced by 100 B.C., when the first potters' stamps appear. These are usually quadrangular in form, though other shapes are found, and are impressed in the midst of the design on the ornamented vases, or on plain wares on the bottom of the interior. The number of potters' names is very large, though some appear to have been more prolific than others, and to have employed a large number of slaves, whose names appear with their masters' on the stamps. The best known is Marcus Perennius, whose wares take highest rank for their artistic merit, the designs being copied from good Greek models. He employed seventeen slaves, of whom the best known is Tigranes, the stamps usually appearing as M·PEREN and TIGRAN. The slave-name of Bargates is found on one of his finest vases, in the Boston Museum, the subject being the fall of Phaethon. We may suppose that the stamps for the figures were designed by the masters, but that the vases were actually moulded by the slaves. Other important artists are Calidius Strigo, who had twenty slaves; P. Cornelius, who had no less than forty; Aulus Titius, who signs himself A·TITI·FIGVL·ARRET; the Annii and the Tetii; and L. Rasinius Pisanus, a degenerate potter of the Flavian period, who imitated Gaulish wares.

The forms of the vases are all, without exception, borrowed from metal shapes and are of marked simplicity (see fig. 37, Nos. 1, 8, 9, 11). They are mostly of small size and devoid of handles, but a notable exception is a bell-shaped *krater* or mixing-bowl, of which there is a very fine example in the British Museum, found at Capua and decorated with the four seasons (Plate III. fig. 62). For the decoration and subjects the potters undoubtedly drew their inspiration from the "new-Attic" reliefs of the Hellenistic period, of which the *krater* just cited is an example. So, too, are such subjects as the dancing maenads or priestesses with wicker head-dresses, or the Dionysiac scenes which are found, for instance, on the vases of Perennius. Others again are distinguished by a free use of conventional ornament, figures when they occur being merely decorative. There is throughout a remarkable variety both in the ornamentation and in the methods of composition.

Provincial Wares.—The Arretine ware, as has been noted, steadily degenerated during the 1st century of the Empire, and the manufacture of ornamental pottery appears to have entirely died out in Italy by the time of Trajan. Its place was taken by the pottery of the provinces, especially by that of Gaul, where the transference of artistic traditions led to the rise of new industrial centres in the country bordering on the Rhone and the Rhine.

As to the general characteristics of the provincial wares, that is, of the ornamented wares or *terra sigillata*, the clay is fine and close-grained, harder than the Arretine, and when broken shows a light red fracture; the surface is smooth and lustrous, of a brighter yet darker red colour (*i.e.* less like coral) than that of Arretine ware, but the tone varies with the degree of heat used. The most important feature is the fine glaze with which it is coated, similar in composition to that of the Arretine; it is exceedingly thin and transparent, and laid equally over the whole surface, only slightly brightening the color of the clay. The ornament is invariably coarser than that of Arretine ware, by which, however, it is indirectly inspired.

The vases are usually of small dimensions, consisting of various types of bowls, cups and dishes, of which two or three forms are preferred almost to the exclusion of the rest, and they frequently bear the stamp of the potter impressed on the inside or outside. Although this ware is found all over the Roman world, by far the greater portion comes from Gaul, Germany or Britain, and evidence points to two—and only two—districts as the principal centres of manufacture: the valleys of the Loire and the Rhine and their immediate neighbourhood. In the 1st century A.D. Gaulish pottery was largely exported into Italy, and isolated finds of it occur in Spain and other parts.

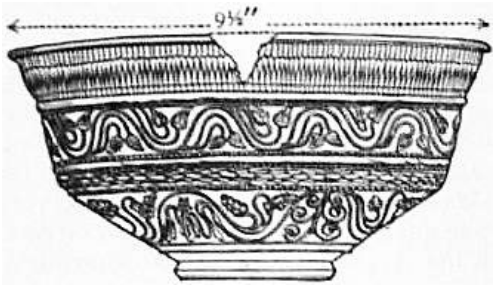


FIG. 36.—Bowl of Gaulish ware, with moulded patterns in slight relief.

The recent researches of Dr Dragendorff and M. Déchelette have shown that a chronological sequence of the pottery may be clearly traced, both in the shapes employed and in the method of decoration; and, further, that it is possible—at least as regards Gaul—to associate certain potters' names and certain types of figures, though found in many places, with two centres in particular, Graufesenque near Rodez (department of Aveyron) in the district occupied by the Ruteni, and Lezoux near Clermont (department of Puy-de-Dôme) in the country of the Arverni. The periods during which these potteries flourished are consecutive, or rather overlapping, but not contemporaneous, the former being practically coincident with the 1st century A.D., the latter with the 2nd and 3rd down to about A.D. 260, when the manufacture of *terra sigillata* practically came to an end in Gaul.

There were also certain smaller potteries, some of which mark a transition between the Italian and provincial wares, in the north of Italy and on the Rhine and upper Loire, *e.g.* St Remy-en-Rollat, and others of later date, as at Banassac and Montans in the latter district, but none of these produced pottery of special merit or importance. The early Rhenish wares are, strictly speaking, of a semi-Celtic or Teutonic character, while the later German *terra sigillata*, for which the principal centres were Rheinzabern near Carlsruhe and Westerndorf in Bavaria, are of similar character but inferior to the 2nd-century pottery of Lezoux. A mould from Rheinzabern is illustrated, Plate IV. fig. 66.

The ornamented vases produced in these potteries are, as we have said, almost confined to two or three varieties, which follow one another chronologically. A shape favoured at first is the *krater*, which has been mentioned as one of the characteristic Arretine forms; but this enjoyed but a short term of popularity. Early in the 1st century we find a typical form of bowl in use, which, following the numeration of Dr Dragendorff's treatise, is usually spoken of as No. 29. This is characterized by its moulded rim engraved with finely incised hatchings, and by the division of the body by a moulding into two separate friezes for the designs (fig. 36). Its ornament is at first purely decorative, consisting of scrolls and wreaths, then small animals and birds are introduced, and finally figure subjects arranged in rectangular panels or circular medallions. About the middle of the century a second variety of bowl (known as No. 30; see fig. 37) was introduced; this is cylindrical in form, and, being found both at Graufesenque and Lezoux, may be regarded as transitional in character. In the latter half of this century a new form arises (No. 37; fig. 37), a more or less hemispherical bowl which holds the field exclusively on all sites down to the termination of the potteries. In this form and in No. 30 a new system of decoration is introduced, the upper edge being left quite plain. The panels and medallions at first prevail, but are then succeeded by arcading or inverted semicircles enclosing figures, and finally after the end of the 1st century (and on form 37 only) we find the whole surface covered with a single composition of figures unconfined by borders or frames of any kind, but in a continuous frieze; this is known as the "free" style (Plate IV. fig. 69).

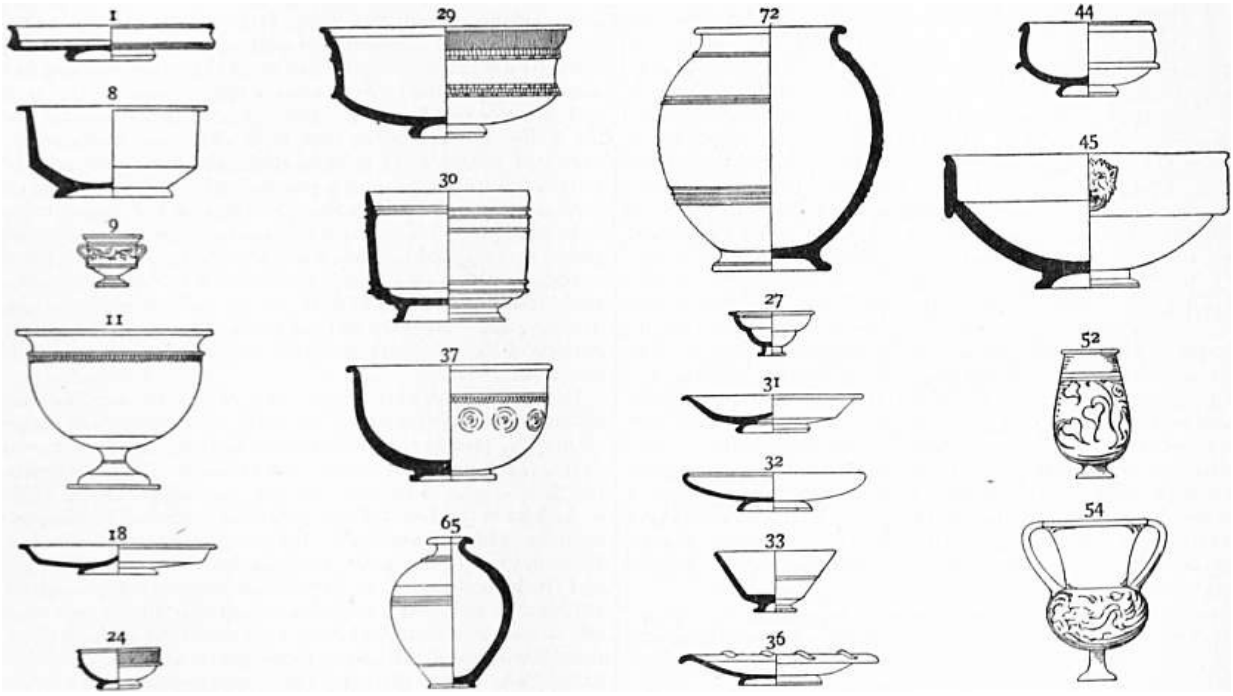


FIG. 37.—Shapes used in Roman Pottery. 1-11, Arretine; 18-65, Gaulish and German.

As regards the figure subjects, it may be generally laid down that the conceptions are good, but the execution poor. Many are obvious imitations of well-known types or works of art, and the absence of Gaulish subjects is remarkable. They include representations of gods and heroes, warriors and gladiators, hunters and animals, the two latter classes being pre-eminently popular.

The potters' names at Graufesenque are nearly all of a common Roman type, such as Bassus, Primus, Vitalis; those at Lezoux are Gaulish in form, such as Advocisus, Butrio, Illixo or Laxtrucisa. This seems to imply that Roman influence was still strong in the earlier centre which drew its inspiration more directly from Arretium. But even the purely Roman names are sometimes converted into Gaulish forms, as *Masclus* for Masculus, or *Tornos* for Turnus. The stamps are quadrangular in form, depressed in the surface of the vase with the letters in relief; on the plain wares they are usually in the centre of the interior, but on the ornamented vases are impressed on the exterior among the figures. The usual formula is OF (for *officina*) or M (for *manu*) with the name in the genitive, or F, FE or FEC for *fecit* with the nominative.

Besides the ordinary *terra sigillata* with figures produced in moulds we find other methods of decoration employed. In the south of France, about Arles and Orange, vases were made with medallions separately moulded and attached round the body; these have a great variety of subjects, both mythological and gladiatorial or theatrical, or even portraits of emperors. There is a remarkable specimen in the British Museum with a scene from the tragedy of the *Cycnus*, on which Heracles and Ares are represented, with seated deities in the background (Plate IV. fig. 67). The date of these reliefs is the 3rd century after Christ.

Of the same date is a somewhat similar ware made at Lezoux. Here each figure is attached separately to the vase, and the background is filled in with foliage produced by the method known as *en barbotine* (slip-painting), of which we shall speak presently. The effect of these vases, which are mostly large jars or *ollae* (Plate IV. fig. 70), is often very decorative, and there is a fine specimen in the British Museum from Felixstowe, on which the modelling is really admirable. Other good examples have been found in various parts of Britain.

The "slip-decoration" process is practically unknown in Italy, but it is found early in the 1st century of our era in Germany, and appears to have originated in the Rhine district. It is not confined to the red ware, but in the early German examples is applied on a dull grey or black background. On the continent its use is almost limited to simple decorative patterns of scrolls or foliage, but in Britain it was largely adopted, as in the well-known Castor ware made on the site of that name (*Durobrivae*) in Northamptonshire. Many of the vases found or made here have gladiatorial combats, hunting-scenes, or chariots executed by this method (fig. 38). The decoration was applied in the form of a thick viscous slip, usually of the same colour as the clay, but reduced to this consistency with water, and was laid on by means of a narrow tube or run from the edge of a

FIG. 38.—Jar of Castor ware, with reliefs of a stag pursued by a hound, executed in semi-fluid slip.

spatula. The Castor ware appears to date from the 3rd and 4th centuries A.D. 6 in. high.

Painted wares are at all times rare, but were occasionally produced in Gaul, Germany and Britain. A notable class of such ware seems to have been produced in the Rhine district, represented by small jars covered with a glossy black coating, on which are painted in thick white slip inscriptions of a convivial character, such as BIBE, REPLE, DA VINUM, or VIVAS (Plate IV. fig. 68). A very effective ware, obviously imitating cut glass, by means of sharply incised patterns, was made at Lezoux in both the red and black varieties.

LITERATURE.—Dragendorff in *Bonner Jahrbücher*, xcvi. 37 ff.; Déchelette, *Vases céramiques de la Gaule romaine* (1904); Walters, *Ancient Pottery*, ii. chaps, xxi.-xxiii.; *British Museum Catalogue of Roman Pottery* (1908).

(H. B. WA.)

PERSIAN, SYRIAN, EGYPTIAN AND TURKISH POTTERY[9]

Formerly, in all general accounts of the potter's art, it was the custom to pass over the period between the fall of the Roman empire and the appearance of the beautiful Persian and Syrian pottery of the early middle ages, as if the intervening centuries had produced nothing worthy of note. Even yet the successive steps by which this beautiful art arose are largely matters of inference and deduction, but it must be borne in mind that while the Greeks and Romans made singularly little use of glaze and painted colour, the Egyptians and the inhabitants of Syria and Mesopotamia had long been noted for their skill in this direction. In discussing the pottery of these peoples we have already pointed out at what a very early period they had developed the production of rich and beautiful coloured glazes—the Egyptians as a jewel-like decoration of small pieces made in a very sandy paste, or actually carved from stone, and the Assyrians, on a bolder scale, in their glazed and coloured brickwork. Though the Egyptian and Syrian empires were overthrown, the peoples of these countries remained; and, as we are now aware, carried on their traditional craft, though in a less splendid way. There is abundant evidence that pottery was made in the Egypt of Roman times and later with rich turquoise blue and yellow glazes, though the potters had learned to produce this glaze on a material containing more clay and less sand than that used in earlier days. We know also that they had learned that the addition of lead oxide to a glaze enabled such glaze to be applied on vessels formed from clay which was sufficiently plastic to be shaped on the wheel. This knowledge was not confined to Egypt, but appears to have been spread over Syria and parts of Asia Minor; and throughout the Byzantine empire many forms of pottery were made which were clearly the starting-points of much of the fine pottery produced in Europe in later times. We find, for instance, side by side, a manufacture of bowls, dishes and vases of very simple shape, yet made of two distinct materials: (1) a whitish sandy body on which turquoise blue, green or even white glaze, consisting mainly of silicates of soda and lime, was used either without ornament or with simple painted patterns in black or cobalt blue under the glaze; (2) similar vessels made of a lightish red clay, also rather sandy and porous, coated with a white slip (pipeclay or impure kaolin) covered with a yellowish lead glaze. These vessels were decorated in a variety of ways: (1) *Graffiati*; patterns cut or scratched through the coating of white slip while it was still soft, down to the red ground, so that when the vessel was glazed it displayed a pattern in dark upon a light ground. (2) Yellow and red ochre and copper scales were rudely "dabbed" over the white slip surface, so that when the vessel was glazed it presented a marbled or mottled appearance with touches of red, yellow, brown or green, on a yellowish-white ground. (See the section on *Egyptian pottery* above.) (3) Oxides of copper or iron were added to the lead glaze, and the resulting green or yellow glazes were applied to plain vases or to vessels decorated with moulded reliefs. In all these methods we see the continuation of old tradition in simpler forms, but we shall also see that these, in their turn, became the starting-point of much of the medieval pottery of Europe, particularly of Italy and the other southern countries.

In the same way, a little farther east, the Persians of Sassanian times seem to have preserved some of the traditions of the potters of Assyria, just as they inherited their skill; and the Assyrian device of raising strong brown outlines round a design to control the flow of coloured glazes, which is exemplified in the Frieze of Archers in the Louvre, was carried on by them, for it appears unchanged in the tiles of the Mosque of Mahommed I. built at Brusa in the 15th century. The intercourse between the Persian and Byzantine empires at this time must have led to a general diffusion of technical knowledge among the pottery centres of the various countries round the eastern end of the Mediterranean, though our knowledge is too fragmentary to furnish sufficient data for any definite placing of the progress made. Our information is mainly derived from the examination of the rubbish mounds at Fostat, or Old Cairo, in Egypt, by Dr Fouquet, and by eager inquirers like Henry Wallis. Fostat was built in A.D. 640 by Amr and destroyed in the 12th century; partially rebuilt, it was given over to pillage in 1252 by a Mameluke sultan, and all that remains is the Old Cairo of to-day, the rest of the site being

covered with accumulated rubbish heaps. In the same way Rhagae or Rai, one of the ancient capitals of Persia, the site of which lies a few miles east of Teheran, was destroyed about 1220 by Jenghiz Khan. Like Fostat it was partially rebuilt, but was destroyed again in the following century, so that its existence practically ceased in the 14th century. Rhagae was once an important centre of the ceramic industry, but this was transferred to the neighbouring town of Veramin, in the 13th century. Excavations have also been made on the site of Rakka, near Aleppo, in Syria, and from all these sources, and a few others of minor importance, much interesting light has been thrown on the development of the potter's art in these countries during the period between the 4th and 12th centuries. Yet, until systematic excavations have been made in Persia, Anatolia, Syria and the Delta, on the same scale as those which have proved so valuable in Greece, Crete, Cyprus and the valley of the Nile, we cannot hope to possess sound chronological data of the developments of the arts in these countries. Meantime the exact share which should be allotted to each district for its discoveries will remain ground of contention for scholars of conflicting schools, though there can be little doubt that Egypt and the southern part of Syria played a more important part than has generally been supposed in the development of the potter's art at this period.

Persian Pottery.—The most important pottery of the nearer East, whether considered on its own merits or from the influence it has exercised on the pottery of later times, is that so highly valued by collectors under the distinctive name of Persian; though much that passes under that name may not have been made in Persia. From the 10th to the 16th centuries the craftsmen of Persia were perfect masters of decorative design and colour; and, as potters, they possessed a sense of the forms proper to clay, such as none of the great races of antiquity ever exhibited. The shapes of Greek pottery speak more strongly of metal than of clay, but the best Persian work exhibits a feeling for the material that has rarely been equalled. The shapes are not only true clay-shapes but they are designed so as best to exhibit the qualities of the glaze and colour with which they were to be decorated. Certainly from the 12th to the 16th centuries the pottery of the Persians must rank among the greatest achievements of the potter's art. The ware was shaped from various mixtures such as we have already spoken of—but whether its body was a mixture of white clay with a large proportion of sand, or some inferior clay that burnt to a yellowish or red tint, and was surfaced with a fine white coating of siliceous slip, or with a mixture of soda-glass, clay and oxide of tin, which made it whiter still—the one aim was to produce a white pottery. On this white ground—with a coarsish absorbent surface—beautiful patterns, in conventional floral or animal forms, were deftly painted in cobalt-blues, manganese-purples, copper-greens and turquoise, with mixtures for intermediate tints; while a strong brownish-black outline colour was compounded by mixing the oxides of iron and manganese, to be turned into a fine, still black by the addition of a trace of cobalt and later of oxide of chromium. Over this freely painted colour, often used in broad flat masses, a singularly limpid alkaline glaze, generally of considerable thickness, was fired until it just fused; and the resultant effect is of the most rich and brilliant colour relieved on a ground of slightly toned white. Judging from fragments which have been found at Rai, and which can scarcely therefore be later than the 13th century, we find the characteristic Persian style of ornament already developed; dumpy little figures kneeling, standing or riding on grass between cypress trees, or animals and birds similarly disposed, with conventional borders and bands of Cufic inscriptions. Another well-known type of pattern consists of highly conventionalized floral ornament which often runs to a beautiful tracery of "arabesque" lines. The drawing is generally finely outlined with brown or black (a survival of the ancient Assyrian practice), and in the earliest pieces the flat washes of colour are laid in only in cobalt-blue, turquoise or green from copper, and shades of purple and brown from manganese. From the 16th century onwards Chinese influence is strongly felt both in the designs and in the colour schemes, particularly in the wares painted with patterns in blue only (fig. 39), which sometimes carry the imitation of Chinese porcelain so far as to bear forged Chinese marks. Finally, Shah Abbas I. (1587-1629) is said to have brought a number of Chinese artificers, among them many potters, to Ispahan, and we find that Chinese porcelain was largely painted at King-tê-Chên, with blue decorations in the Persian taste, so that we cannot be surprised at the growth of a hybrid Perso-Chinese style of decoration. From this period, however, Persian pottery deteriorated both in its technical and artistic aspects. Crudely moulded figures in fairly high relief, coloured with an opaque yellow and green as well as with transparent blue and turquoise, began to make their appearance, especially on the famous Persian tiles; and in the 18th century the brown and black outlines of the drawing (a most valuable decorative resource) vanish, and we get brighter and more glittering, yet poorer colours, including a rose-red enamel fired over the glaze, evidently imitated from the Chinese *famille-rose* porcelains of the 18th century.

Fig. 39.—Persian Plate painted in blues only. (Victoria and Albert Museum.)

The finest work appears to have been produced from the 11th to the 14th centuries; yet so imperfect is our knowledge of what is truly Persian, Syrian or Egyptian, that we are forced to accept many conventional names that have perhaps little but custom to recommend them. There is, for instance, an important class of pottery known, until recently, only from a few remarkably handsome vases, and once called “Siculo-Arab” because these few examples had been mostly found in Sicily. This ware is characterized by its fine quality and its distinguished ornament—leaf-shaped panels with arabesques; interlacing patterns; striped and dotted bands; friezes of animals or birds amidst flowers and foliage, inscriptions, &c.; all strongly and firmly drawn in black or brown outlines and washed in with a very pure cobalt-blue or with turquoise. In spite of the resemblance of these pieces to the oldest Persian wares, we know that bowls, dishes, vases and spoilt pieces of the same kind have been dug up on the site of Rakka near Aleppo; similar ware has been found at Fostat, together with evidences of local manufacture, and occasional pieces have been brought from Persia; so that probably this distinguished ware was made at Rakka in Syria between the 9th and the 13th centuries, and was afterwards made by Syrian potters both in Persia and Egypt.

Other Persian Wares.—We have already spoken of the prevalent use of coloured glazes in all the countries of the nearer East—from Egypt to Persia—from remote times, either as the sole colour decoration or in conjunction with modelled or painted ornament. The fragments from Rai and Fostat include rich turquoise glazes (derived from the ancient Egyptian), deep and light-green glazes containing lead and copper, imitations of ancient Chinese céladon-green, a brownish-purple glaze, a coffee-brown glaze and a deep cobalt-blue glaze.[10] All these may be 728
found either on plain vases, or on vessels with modelled ornament; or covering delicate floral or arabesque patterns painted in white slip or incised in the paste. Sometimes, even at this early period, there are traces of applied gold-leaf attached, but not fired, to the glaze.

At a very early period, too, we find those beautiful bowls, dishes and vases decorated with geometrical or arabesque patterns in a singularly still underglaze black, and covered with the blue turquoise or green copper glazes. This characteristic and beautiful ware is common to Persia, Syria and Egypt in Saracen times, and it was soon prized in Europe, as is shown by the famous fragment found by the late Mr Drury Fortnum built into the outer walls of S. Cecilia in Pisa, where it was apparently placed in the 12th century.[11]

At a later date a shining black glaze made its appearance, and in the 13th century pale and lapis-lazuli blues, while there is a comparatively modern sage-green glaze found only on pieces bearing patterns modelled in low relief.

Persian Porcelain.—This beautiful and somewhat mysterious ware—often called “Gombroon” ware—apparently made its appearance in the 13th century, though the bulk of the known examples are not earlier than the 17th or 18th century. The ware is quite translucent and is of soft and delicate texture. Unlike Chinese porcelain, it was made from a mixture of pipe-clay and glass, and was glazed with a soft lead glaze; so that a fragment of it would melt to an opaque glass in an ordinary porcelain oven. It is principally met with in the form of dishes, bowls (often mounted on feet) and saucers. The pieces are generally very thin and are either perfectly plain or bear flutings or simple wavy patterns incised in the paste. Most characteristic and beautiful is the decoration by means of delicate perforations either straight or lozenge-shaped. In the

finest pieces the perforations are filled with glaze, and then they form a decoration analogous to the well-known “rice-grain” decoration of the Chinese. Occasional pieces are found decorated with colour, either a delicate green, producing an effect like pale bright céladon, or the well-known Persian blue ground; and this is sometimes decorated with lustre patterns. Nowhere can this rare and delicately beautiful ware be so well studied as in the Victoria and Albert Museum.

Lustred Ware.—The decoration of pottery with iridescent metallic films is one of the most astonishing and beautiful inventions ever made by the potter. Hitherto we have seen only coloured clays, coloured glazes, or colours fired under the glaze, but we are now brought face to face with a colour effect produced by refiring the finished glazed pieces, at a lower temperature, with pigments painted upon the glaze (fig. 40; see also Plate V. 13th-century Persian lustre). How such a practice originated is probably an idle speculation, but it may have come through repeated attempts to decorate pottery with gold. If gold was painted under the glazes of these ancient vases, it would probably vanish and leave no trace; but gold, alloyed with much silver, applied over the finished glaze and refired, in the attempt to make it adhere, may have given the first films of iridescent colour. We know certainly that before the 13th century the elements of the process had been mastered, and that the potters of the nearer East had learnt that by mixing some compound of silver (doubtless the sulphide) with clay, and painting the mixture on the finished vase, which was refired in such a way that the pieces were only raised to a dull red heat and were then exposed to the vapours of the wood-fuel, glowing lustrous patterns were left on the ware that looked like metal—but metal shot over with all the hues of the rainbow, golden, rosy, purple and green. Numerous fragments of this lustred pottery had been disinterred from the site at Rhagae, and it was therefore assumed that the beautiful process was of Persian origin, particularly as most of the examples then known bore designs of distinctly Persian style. We are now inclined to think that the process really arose in Egypt or in Syria, and was carried eastward to Persia, just as it was afterwards carried westward to Spain. In support of this view there is the written record of the Persian traveller Nasiri Khosrau, who visited Old Cairo in the 11th century (1035-1042). He was apparently familiar with the pottery of his own country, and notes all the novel forms that he found in the bazaars of Old Cairo, which was both a great trading emporium for the traffic of East and West, and a pottery centre of note. He mentions, specially, certain translucent bowls of earthenware decorated with colours resembling a stuff called “bougalemoun,” “the tints changing according to the position which one gives to the vase.” Such a description could only apply to “lustred” pottery, and it would seem as if this process must have been known in Egypt or Syria before it was practised in Persia (see Plate V., 13th-century Syro-Persian). In any case the secret was soon carried to Persia, for we have ample evidence that it was practised at Rhagae in the next century.

Fig. 40.—Persian Ewer, white ground, with pattern in brown copper lustre; the upper part has a blue ground. The mounting is gilt bronze, Italian 16th-century work. (British Museum.)

The earliest dated example of Persian lustred ware is a star-shaped tile of the year A.D. 1217 (A.H. 614), decorated with spotted hares, heraldically confronted, in a ground of lustre relieved by dots and curls, and surrounded by an inscribed border. A vase in the Godman collection bears the date A.D. 1231 (A.H. 629), and some of the well-known “star and cross” tiles from Veramin belong to the year A.D. 1262. The early Persian lustre is chiefly known to us through the tiles with which the walls of mosques and public buildings were decorated; the more ephemeral vases, bowls and dishes have survived in smaller numbers and very rarely in perfect condition.

Common motives of decoration were animals and birds (sometimes showing Chinese influence), the hare and the deer being favourites; roughly drawn sack-like figures of men and women, mounted or on foot (probably heroes of Persian legend), conventional foliage and arabesques. The designs are usually reserved in a lustred ground, which is relieved by small scrolls, curls and dots etched in the lustre (as though the glazed piece had been covered all over with the lustre mixture and the ornament scratched out of this when it was dry), and showing beneath the ivory-white tin-enamel with which the early wares are generally coated. The lustre itself when viewed directly may look like some golden or deep chocolate-brown colour, but as the piece is turned to catch a side-light this deep colour is seen to bear a thin iridescent film, which glows with golden, green, purple or ruby-red metallic *reflets*. On the earliest examples the decoration is often entirely in lustre, but later, lustre is often used to eke out a pattern painted with masses of pale cobalt-blue or turquoise under the glaze. Similar tiles with rather more elaborate ornament bear 14th-century dates, and another variety has parts of the decoration, more particularly the large letters of the inscriptions, raised in low relief and heightened with blue. Yet another class, belonging to the 14th century, has a fine dark-blue alkaline glaze, with designs in low relief, picked out with scrolls and arabesques in white enamel or bold floral sprays in leaf-gold. Lustre is frequently found applied to the rich cobalt-blue ground, and there are still existing a few magnificent vases which show the artistic possibilities of this scheme of decoration. It should be noted that when the pieces are in the round, the pattern is usually painted in lustre and not reserved in a lustre ground as on the flat tiles. In the later examples the tin-enamel was replaced entirely by white slip, and the lustre decoration continued in use until the end of the reign of Shah Abbas I. (1587-1629). To the last period belong many charming bowls, narghilis, cups and dishes in a brown lustre, with ruby *reflets*, on a white or a deep blue ground; this ware is pure white in substance and generally translucent, and the pieces are occasionally signed (see *Persian porcelain* above).

Damascus Ware.—This time-honoured name (for "Damas Ware" was often mentioned in medieval inventories, and appears to have included many varieties of oriental pottery which were highly prized in Italy, France and England in the middle ages)[12] forms rather a puzzle nowadays for the archaeologist, for many diverse wares have been included under this title, some of which were not made at Damascus. Yet Damascus is one of the oldest cities in the world, and has seen unnumbered dynasties come and go around its desert-fringed oasis. An important centre of caravan traffic, a nexus of palpitating life from east and west, north and south, we cannot wonder if it developed a special pottery of its own, tinged with something of a cosmopolitan spirit. Formerly the Damascus wares were treated as a variety of the Persian pottery we have just described, but the best examples of the class now known under this name exhibit a mingling of various influences such as we might expect, and have well-marked affinities both with the Persian wares and those brilliant productions now commonly recognized as Syrian and Turkish, while even far-off echoes of Chinese decorative mannerisms are not wanting. The characteristic Damascus ware of the collector is marked by its quality; the ground is of very clear white, the colours are pure and brilliant, and the vessels, whether dishes or vases, are soundly made. The decoration, which is purely floral or conventional, recalls the more formal Persian style, but the colours recall those of the Turkish pottery with one remarkable substitution. The piled-up red-clay pigment of the latter is absent, but where it would inevitably occur in the design of a Turkish piece its place is taken by a purple made from manganese, which is often thin and rather washy in quality. Fine examples of this famous ware are to be seen in the British Museum and in the Louvre; its characteristic style of pattern is well shown in the 16th-century Damascus piece reproduced in Plate V. Another splendid example is the lamp from the Mosque of Omar at Jerusalem, also in the British Museum (fig. 41); and this has generally been classed with the Damascus wares, though its colouring and its technique belong rather to Lower Syria or to Egypt. This magnificent piece bears a dated inscription, "In the year 956 in the month *Jemazi-l-oola*. The painter is the poor and humble Mustafa." This is reckoned as June A.D. 1549. It may be remarked that our difficulties of identification are increased by the fact that, under Arab rule, Syrian and Persian potters were at work in Damascus, in Old Cairo and elsewhere. Among the Fostat fragments classified by Dr Fouquet are many bearing the signatures of Syrian workmen. In the 15th and 16th centuries, too, imitations of Chinese blue-and-white porcelain became common throughout

FIG. 41.—Lamp from the Mosque of Omar.

the nearer East, and quantities of fragments have been found at Fostat, Ephesus and elsewhere.

Turkish Pottery.—This beautiful and striking ware, formerly called Persian, and till lately Rhodian because Rhodes was a known centre of manufacture, seems to have been fabricated in all the countries overrun by the Ottoman Turks in the 13th century, so that the name "Turkish," in spite of some opposition, is now generally applied to it. (See fig. 42; and the 16th-century Rhodian or Turkish pieces, Plate V.) It has a fine white body of the usual sandy texture, covered, as a rule, with a wash of pure white slip; it is painted in strong brilliant colours, chiefly blue, turquoise, green, and a peculiar red pigment which is heaped up in palpable relief—the whole of the ornament being outlined with black or dark green. The ware was glazed with an alkaline glaze of great depth, so that the colours soften and sometimes run, producing one of the most brilliant and attractive of all the oriental wares. In certain districts the white ground was not used, but over it a slip of the red colour (Armenian bole), varying in strength from bright red to pale salmon, was laid over the piece, reserving the pattern only in the white slip, which consequently lies lower than the red ground. Other examples are known where the ground has been covered with lavender, blue, sage, apple and turquoise greens, chocolate or coffee-brown, and the sumptuous effect of the whole was often increased by the application of gold-leaf over the fired glaze. The decorative motives are distinguished from those of the Persian wares by a breadth and boldness which are in keeping with the brilliant, and not always harmonious, colouring. They include, it is true, the Persian arabesque, the floral scroll with feathery leaf, the thistle-bloom and the cypress tree, but the naturalistic treatment which permits immediate recognition of the favourite Turkish flowers such as the tulip, hyacinth, carnation, fritillary, cornflower and lily (some of which were imported into Europe by the Turks), is as original and distinctive as the arrangement of the different elements of the design is artistic and charming. Other styles of design include formal patterns and diapers, rarely human and animal figures, and occasionally armorial devices and ships. Tiles of this ware were extensively used for lining the walls of public buildings, replacing the carpets and textile hangings which their designs so freely imitated. Of domestic articles, dishes are the most numerous, though vases, ewers, sprinklers, jugs, tankard-shaped flower-holders, covered bowls and mosque lamps are also plentiful. The tiles are found in all parts of the Turkish empire, though they were probably made at certain centres, such as Nicaea (which gave its name to the ware in the 16th century and no doubt supplied many of the mosques in Constantinople), Kutaia, Demitoka, Lindus and other centres in Rhodes and Damascus. Individual wares cannot be distinguished, except in some measure those of Damascus and Kutaia. A small jug in the Godman Collection has an Armenian inscription stating that it was made by "Abraham of Kutaia" in the 16th century. A few fine bowls and vases, painted in a beautiful blue with Persian arabesques and rosette scrolls, recalling Chinese porcelains of the Ming dynasty, but of very characteristic appearance, are also attributed to this place; and later, in the 18th and up to the end of the 19th century, an inferior ware was largely manufactured here. This late ware usually takes the form of small objects—plates, cups, jugs, egg-shaped ornaments, &c.—with a thin, well-potted, white body and slight patterns of radiating leaves, scale diapers, &c., in blue, black and yellow. Turkish pottery was at its best in the 16th and the early part of the 17th century, and though good tile work of later date exists, the general pottery deteriorated before the 18th century. An inferior ware of poor colour is still produced in Turkey, Persia and Syria, and some attempt has been made of late to revive the old lustre decoration, but the results are not likely to be mistaken for those of old times.

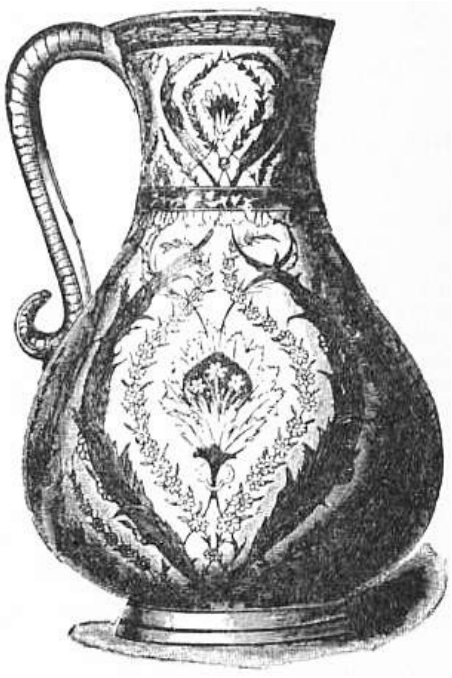


FIG. 42.—Rhodian Jug.

Collections.—The Victoria and Albert Museum contains the finest collection of the medieval pottery of the nearer East—the British Museum collection, though much smaller, has some magnificent examples. The Cluny Museum in Paris has a never-to-be-forgotten collection of Turkish pottery, especially plates and dishes. The museums of the Louvre and of Sèvres have also many beautiful examples. Berlin, Frankfort and other German towns have collections, but much smaller in extent. Private collectors in England and France own many fine specimens, and mention may be made particularly of those owned by Mr Ducane Godman and Mr George Salting.

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1900); Karabacek, “Zur muslimischen Keramik,” in *Monatsschrift fur den Orient* (1884); Lane-Poole, *Art of the Saracens in Egypt* (1886); Migeon, *Manuel de l’art musulman*, vol. ii. (1907); Sarre, *Persische Keramik*; and *Jahrbuch der koniglichen preussichen Kunstsammlung* (1905), part ii.; H. Wallis, *The Godman Collection* (1) *Lustred Vases* (London, 1891); (2) *The Tenth Century Lustred Wall-tiles* (1894); *Notes on some Early Persian Lustre Vases* (1885); *Egyptian Ceramic Art* (1898).

(R. L. H.; W. B.*)

Hispano-Moresque Pottery

With the doings of the Moslem potters of the countries round the eastern Mediterranean fresh in our minds, it is interesting to follow the westward trend of the Moslem conquests, and see how in their wake there also sprung up in Spain a ware of high distinction and beauty. The Iberian peninsula had been the scene of pottery-making from prehistoric times—a red unglazed ware was made before the dawn of civilization as finely finished as that found in the Nile valley by Flinders Petrie (see Egypt: *Art and Archaeology*), and the Romans had one of their great provincial pottery centres at Saguntum; but it was only when a great part of Spain lay under Mussulman rule that artistic and distinctive pottery was produced. What is by no means clear is how it came to pass that when the traditional methods, learnt by the Arabs in Egypt and Syria, were carried westward they should have undergone such a radical change. Oxide of tin, the opacifying and whitening material in glazes *par excellence*, was certainly known and used in the East from at least the 6th century B.C.; the ancient wares are coated with a covering of white tin-enamel to hide the buff or reddish-coloured clay, and it was similarly used elsewhere; but its use was sporadic and not general in those countries, where we find instead a consistent development of the pottery made with a white slip-coating and a clear alkaline glaze. Perhaps it was that at this period tin was almost as costly as gold, and it was only when potters with an oriental training brought their skill to Spain, where tin abounded, that the relative cheapness of the material led them to employ it, so far as is known, exclusively. (There is a wide distinction between the tin-enamelled and the slip-faced wares, glazed with an alkaline glaze. In the latter, the more oriental type, the slip-coating is of fine white clay and sand, and this is finished with a transparent alkaline glaze containing little or no lead: in the former there is no need of a coating of slip, for the addition of oxide of tin to a glaze rich in lead gives a dense coating of white enamel, opaque enough to disguise the color of the clay beneath.) Such colours as were used for painted patterns were painted over this enamel coating before it was fired, so that they became perfectly incorporated with it, and then this ground furnished a splendid medium for the development of those thin iridescent metallic films that we call “lustres.” The knowledge of this lustre process had been brought from the East also, where it was used on another ground, and with the growing use of lustre pigments containing copper as well as silver—until the red, strongly metallic copper lustre almost ousted the quieter silver lustres—we get the simple technique of one of the most distinctive kinds of pottery known.

Fig. 43.—Hispano-Moorish Plate, painted in blue and copper lustre.

Briefly, the wares were “thrown” upon the wheel or “pressed” on modelled forms—handles, ribs and dots of clay, or strongly incised patterns were often added by hand—and they were

then fired a first time. A coating of the tin-enamel (rich in lead as well as tin) was applied, and on this coating designs were painted in cobalt and manganese; sometimes these colours were only used as masses to break up the background. Then the second firing took place and the piece came from the firing all shining and white, except where the blue or brownish purple had been painted (see fig. 43). The lustre pigments, a mixture of sulphide of copper or sulphide of silver, or both with red ochre or other earth, was then painted over the glazed surface with vinegar as a medium. The repainted piece was fired a third time to a dull red heat, and smoked with the smoke from the wood used in firing, and when cold the loosely adherent ochre and metallic ash left were washed off, leaving the iridescent films in all their beauty.

The technical practices of the Spanish potters and the composition of the lustre pigments are given in Cocks's account of the processes followed at Muel (Aragon) in 1585. The Manises receipt of 1785 gives:—copper 3 oz., red ochre 12 oz., silver 1 peseta piece, sulphur 3 oz., vinegar 1 qt. and the ashes scraped off the pots after lustring 36 oz.[13] Interesting documents have recently been published concerning the works executed by the "Saracen," John of Valencia, at Poitiers in 1384, and it is certain, from the list of materials supplied to him, that he made there tiles that were enamelled and lustred.

The earliest record of lustred pottery in Spain is the geographer Edrisi's mention of the manufacture of "golden ware" then carried on at Calatayud in Aragon in 1154. Ibn Sa'id (1214-1286) speaks of the glass and the golden pottery made at Murcia (city), Almeria and Malaga. From the 4th century the notices which have come down to us divide themselves into two main groups relating to the industry (a) at Malaga; (b) at various localities, but especially Manises in Valencia.

Malaga—Malaga was situated within the Moorish kingdom of Granada, which formed, from 1235 until the late 15th century, the last remnant of Moorish dominion in Spain. Here under the art-loving Nasride dynasty, Mussulman arts and learning flourished to an unprecedented degree. In 1337 Ahmed ben-Yahya al-Omarí enumerates, among the craft productions of Malaga, its golden pottery, the like of which he declares is not to be met with elsewhere. The Moroccan traveller Ibn Batuta mentions (1350) the Malagan golden pottery, as does Ibn al-Hatib (1313-1374) of Granada, in his description of Malaga. The principal monument of the period is the royal palace of Granada, begun in 1273, and finished during the 14th century, from which period most of its ornamentation dates. Two vases were discovered there, of which the existing one, known as the "Alhambra vase," is admittedly the most imposing product of Hispano-Moresque ceramic art extant. Its amphora-shaped body (4 ft. 5 in. high) is encircled by a band of Arabic inscription, above which are depicted gazelles reserved in cream and golden lustre upon a blue field; the rest of the body and the prominent handles are covered with compartments of arabesques and inscriptions in the same colours; and panels on the neck, divided by mouldings and decorated with strap-work and arabesques. Vases similar in shape and technique, with ornament of Cufic characters and arabesques in horizontal rows, are to be found in the museums at St Petersburg, Palermo and Stockholm. As to the exact date of these, experts are not agreed. Though presenting all the characteristics of the 14th-century Hispano-Moresque ornament, it seems probable that they were produced at the same period as the large lustred wall-tile formerly in the Fortuny (now in the Osma) collection, an inscription upon which is by some held to refer to Yusuf III. of Granada (1409-1418), not to Yusuf I. (1333-1354). Another remarkable example is a dish (Sarre collection, Berlin), which, it is claimed, bears upon its back, in Arabic, the word Malaga; it is ornamented with eight segmental compartments filled alternately with strap-work designs and arabesques in lustre. Malaga was reconquered by Ferdinand and Isabella in 1487, and after this its industry probably decayed, as it is not mentioned by Lucio Marineo in 1539 among the localities where ceramics then flourished.

Valencia.—The emirate of Valencia was reconquered by Aragon in 1238. The history of its lustred ware is known from 1383, when Eximenes (whose evidence has been erroneously held to date from 1499) mentions the golden ware (*Obra dorada*) of Manises. Valencian pottery of this kind was an offshoot of the Malagan industry, as in documents lately published (ranging from 1405 to 1517) it is repeatedly designated Malaga ware (*Obra de Malaga*). Its decorative qualities became famous throughout the whole of Europe and North Africa. The ware was chiefly manufactured at Manises by the Moorish retainers of the Buyl or Boil family, lords of Manises, who levied dues upon the output of the kilns, and occasionally arranged for its sale. It is distinguished as regards its ornamentation from the pottery of Malaga by the adoption of a more natural rendering of plant form motives and by the use of armory. The ware consists of drug pots, deep dishes, large and small plates, aquamaniles, vases, &c. Some dozen varieties of ornament were employed during the 15th and early 16th centuries, including mock arabic inscriptions, various flower or foliage patterns taken from the vine, bryony, &c., and gadroons. The centres of dishes frequently bear the arms of a king or queen of Aragon, of the Buyls of Manises, or other Valencian or Italian families for whom they were made. Great dexterity is shown in the execution of minute and complicated schemes of ornament and in the richness of the colour schemes; golden lustre of various hues, with blue and manganese, form the simple

combinations, but the ruby, violet or opalescent lustre combine to produce with the colours a wonderful decorative effect. From 1500 the use of blue and manganese was gradually discontinued and the ornament quickly became nondescript, but the brilliancy of the lustre pigment nevertheless obtained a wide popularity for the ware, as is attested by Marineo (1539), Viciana (1564) and Escolano (1610). After the expulsion of the Moriscoes (1609) the industry was carried on by those who had escaped deportation or by Spaniards who had learnt the craft; generally speaking their productions can be summed up in the word “decadence.” In the course of the 15th century the manufacture of lustred pottery was carried on at various other small towns near Valencia; in 1484 it was produced at Mislata, Paterna and Gesarte. It is known to have flourished at Calatayud in 1507, and at Muel, also in Aragon, in 1589. In the Valencia district much pottery for ordinary use, ornamented with blue on white, was also produced.

Majorca.—Scaliger, in 1557, states that Chinese porcelain was imitated in the Balearic Isles, and that the Italians called these imitations “majolica,” changing the letter in the name of the islands (then called Majorica) where they originated. The truth would appear to be that Valencian wares, being exported in Balearic vessels that called at Majorca on the voyage to Italy, acquired a reputed Mallorcan origin. There is extant a potter’s petition praying for permission to establish himself in Majorca (1560), in which he states that “Manises ware,” &c., had to be imported, as it was not made there.

Collections.—In England, the Victoria and Albert and the British Museums have fine collections of this ware. At Paris the Cluny Museum collection, and the Louvre; the museum at Sevres contains many fine typical pieces. Another good collection is that of the archaeological museum at Madrid. The Berlin and the Hamburg museums, the Metropolitan Art Museum at New York and the Boston Museum of Fine Arts also contain good specimens. The private collections of England, France and Italy are rich in these wares, among the finest being those of Mr F.D. Godman (Horsham), and of Don G.J. de Osma (Madrid).

Literature.—A. Van de Put, *Hispano-Moresque Ware of the 15th Century* (1904); F. Sarre, “Die spanisch-maurischen Lusterfayencen des Mittelalters,” &c. (in *Jahrbuch der kgl. preuss. Kunstsammlungen*, xxiv. (1903); G.J. de Osma, “Apuntes sobre cerámica morisca: textos y documentos valencianos,” No. 1, 1906, and “Los Letreros ornamentales en la ceramica morisca del siglo xv.” (in the review *Cultura Española*, No. ii, 1906; J. Font y Gumá, *Rajolas valencianas y catalanas* (1905); J. Tramoyeres Blasco, “Cerámica valenciana del siglo xvii.” (in the *Almanaque, para 1908, del periodico Las Provincias de Valencia*; J. Gestoso y Pérez, Historia de los barros vidriados sevillanos (1904); also J.C. Davillier, *Histoire des faiences hispano-moresques à reflets metalliques* (1861).

(A. v. de P.)

Medieval And Later Italian Pottery[14]

Little is known of the potter’s art in Italy after the fall of the Roman empire till the 13th century. The traditions of the Roman potters appear to have been gradually lost, leaving behind only sufficient skill to make rude crocks for domestic use and to coat them, if required, with a crude yellowish lead glaze sometimes stained to a vivid green with copper oxide. Applied ornament of roughly modelled clay and scratched designs were the chief embellishments of such wares, which were of the same class as the medieval pottery of Great Britain and the north of Europe. In the 12th and 13th centuries, however, contact with Asia Minor, Syria, Egypt and Spain, where ceramic skill had been highly developed in fresh directions, as we have seen, introduced into Italy as well as the rest of Europe those superior wares characterized by a white surface decorated with bright colours under a brilliant transparent glaze, and glorified by metallic lustres. The Italian potters did not long remain unaffected by these influences, but though Persian, Syrian and Egyptian pottery must have been fairly plentiful in the households of the wealthy, it was the distinctively Hispano-Moresque wares from which the potters of Italy drew the inspiration for a new ware of their own. The technique of a siliceous slip-coating with colour painted on that and covered with a transparent alkaline glaze, was only sparingly used, and then not very successfully; it is only the introduction of the tin-enamel that was turned to fruitful account and led to the production of the magnificent Italian majolica of the 15th and 16th centuries. In the same way the practice of lustre decoration might have been learnt from the Orient, but its late appearance on Italian wares (16th century) and its evident relationship to the lustres of Spain, rather than to the earlier lustres of Egypt, Syria and Persia, are further evidence that though oriental decorative motives gave the Italians certain early types of design, it is the Hispano-Moresque potters from whom the Italians learnt the art they were afterwards to develop so splendidly in a new direction.[15]

All the Italian pottery above the level of common crocks may be conveniently grouped into four classes.

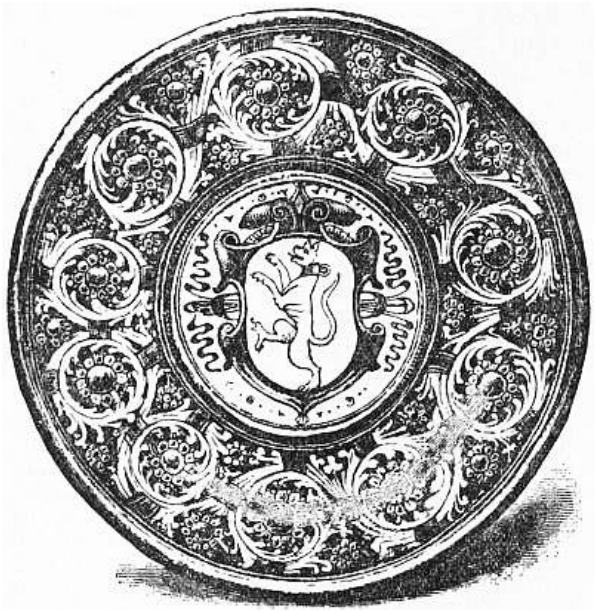


FIG. 44.—Italian Graffiato Plate, 16th century. (South Kensington Museum.)

1. The native wares, made of coarse and often dark-red clay, coated with a white clay slip (a kind of pipe-clay) and covered with a crude lead glaze, either yellow or green. The idea of rendering this ware ornamental, and fitting it for more than vulgar use, led to a great development of the *graffiato* process; where, while the vessel, with its white clay coating was firm yet soft enough, patterns were scratched or engraved through the white slip to the red body beneath. This decorative method has been already mentioned several times, for it was practised during the early middle ages in all the countries from India to Italy, and the Byzantine potters were adepts in its use. Nor has its practice ever ceased in Italy, for through all the times when painted majolica was the ware of the wealthy, this earlier and humbler pottery was used by those who could not afford the former; and the gaily-coloured later wares of this kind have a fine decorative quality of their own. From the depth beneath the present soil at which fragments of this ware have been disinterred, it is obvious that the method was widely practised in early times, and no simpler glazed wares are known except those covered all over with green, yellow or brown glazes. Early examples have been found all over northern Italy—in Faenza, Florence, Pisa, &c., and particularly in Padua, where it seems to have been extensively made. Pavia was another centre of its manufacture, even to the end of the 17th century, and Citta di Castello must have been noted for it in the 16th century, for Piccolpasso describes this ware as “alla Castellana” (see fig. 44). Apparently in the latter half of the 15th century a sudden advance takes place in the colouring of this *graffiato* ware. Instead of the simple glazes, of uniform colour, of the earlier productions, underglaze colours—green, purple, blue and a brown of the tint of burnt sienna which passes into a glossy black where it is thick—were applied in bold splashes under the straw-coloured glaze, producing a rich and decorative effect by very simple means. As fine examples of this kind we may mention the dish with the mandoline players, and one with cupids disporting themselves in a tree, in the Victoria and Albert Museum; the tazza, supported by three modelled lions, in the Louvre; and the dish, with figures of the Virgin and two saints, in the museum at Padua. The ware has often been called, quite erroneously, *mezza-majolica*. It had nothing to do with majolica, being the natural development of a much older process; and its manufacture was carried on all through the period of majolica manufacture and has never ceased.

2. *Mezza-Majolica*—This name is accurately applied to certain Italian wares that made their appearance in the 12th century or even earlier, when rude patterns—a clumsy star, a rude crossing of strokes or some equally elementary work—are found painted on a thin white ground covering a drab body. The pieces, generally pitchers of ungainly forms, are uncouth in the extreme; the body has been shaped in local clay and then thinly coated by dipping it into a white slip, which seems at first to have been of white clay only, though oxide of tin and lead were added to it even in the 12th century. The colours used for the rude painting were oxide of copper and oxide of manganese, and the final glaze, which is generally thin and often imperfectly fused, seems to have been based on the alkaline glazes of the nearer East. The specimens so assiduously recovered by Professor Aragnani, some of which, or similar wares, are to be found in the Louvre, the British and the Victoria and Albert museums, are typical of the rude work out of which, by a fuller knowledge of Spanish methods, the painted majolica grew.

3. *Majolica*—For the last three centuries the word majolica has been used to signify an Italian ware with a fine but comparatively soft buff body, coated with an opaque tin-enamel of varying degrees of whiteness and purity, on which a painted decoration was laid and fired. In the later pictorial wares, a fine coating of transparent alkaline glaze was fired over the painting to soften

the colours—really to varnish them. The word itself appears to have been derived from the name of the island Majorca, and was originally applied by the Italians to the lustred wares of Spain which were largely imported into Italy, probably arriving in ships that called at or hailed from Majorca, as we do not believe that the ware was actually made in that island. That the secret of the tin-glaze, which is the essential feature of Italian majolica, was known in Italy in the 13th century is practically proved; and there is both literary and archaeological proof of its use there in the 14th. Mention of it is made in the *Margarita Preciosa* published at Pola by Pierre Le Bon in 1336, and the well-known jug, bearing the arms of Astorgio I., discovered under the Manfredi palace at Faenza, must have been made shortly after 1393. Its development marched side by side with that of the mezza-majolica, until it practically superseded the latter for painted wares in the 15th century; but the earliest examples have little more than an archaeological interest, and it was only after the last decade of the *quattrocento* or the first of the *cinquecento* that it blossomed into an artistic creation. In its prime the production of majolica was confined to a very small part of Italy. Bologna on the north, Perugia to the south, Siena on the west, and the Adriatic to the east, roughly enclose the district in which lie Faenza, Forli, Rimini, Pesaro, Cafaggiolo, Urbino, Castel Durante, Gubbio, Perugia and Siena. Towards the middle of the 16th century Venice on the one hand, and in the 17th and 18th centuries the Ligurian factories at Genoa, Albissola and Savona, made majolica of the later decadent styles, while, at the end of the 17th and in the early part of the 18th centuries, the southern town of Castelli, near Naples, produced a ware which closes the period of artistic majolica.

PLATE I

FIG. 52.—CORINTHIAN JAR.

FIG. 53.—FRANÇOIS VASE.
(From Furtwängler and Reichhold, *Griechische Vasenmalerei*, by permission of F. Bruckmann.)

FIG. 54.—BLACK-FIGURED AMPHORA BY EXEKIAS.

FIG. 55.—VASE FROM SOUTHERN ITALY.
Signed by Python.

PLATE II

FIG. 56.—BOWL MADE AT CALES IN IMITATION OF METAL.
(2ND CENT. B.C.)

FIG. 57.—VASE OF 5TH CENT. B.C., MODELLED IN FORM OF HEAD.

FIG. 58.—VASE OF 6TH CENT. B.C., IN FORM OF HELMETED HEAD.

FIG. 59.—FLASK OF VITREOUS GLAZED WARE. (ROMAN PERIOD.)

FIG. 60.—AMPHORA OF APULIAN STYLE, WITH SCENE FROM EURIPIDES' "HECUBA."

PLATE III

FIG. 61.—MOULD FOR ARRETINE BOWL.

FIG. 62.—JAR OF ARRETINE WARE FROM CAPUA.

FIG. 63.—EARLY ETRUSCAN JAR.
(VILLANOVA PERIOD.)

FIG. 64.—STAMP FOR ORNAMENTING ARRETINE VASE.

FIG. 65.—ETRUSCAN "CANOPIC" JAR PLACED IN BRONZE CHAIR.

PLATE IV

FIG. 66.—MOULD FOR BOWL OF GERMAN WARE. (2ND CENT. AFTER CHRIST.)

FIG. 67.—MEDALLION FROM VASE MADE IN S. FRANCE, WITH SCENE FROM TRAGEDY. (3RD CENT. AFTER CHRIST.)

FIG. 68.—JAR OF RHENISH WARE WITH INSCRIPTION. (3RD CENT. AFTER CHRIST.)

FIG. 69.—BOWL OF GAULISH (LEZOUX) WARE WITH FIGURES IN "FREE" STYLE. (2ND CENT. AFTER CHRIST.)

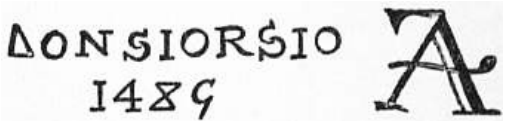
FIG. 70.—JAR OF LATER LEZOUX WARE. (3RD CENT. AFTER CHRIST.)

4. *Lustred Majolica*—This brilliant species of Italian pottery (to which alone Piccolpasso applied the name majolica) seems to have been mainly produced at Deruta and Gubbio, though experiments were made at Cafaggiolo and probably at Faenza and Siena. Considering how much the Italian majolist owed to the Spanish-Moorish potter, it is remarkable that this beautiful method of decoration should have made so tardy an appearance, for the earliest specimens do not appear to be much earlier than the end of the 15th century, and the process was apparently abandoned by the middle of the 16th. The lustre wares of Deruta, probably the earliest made in Italy, have strongly-marked affinities with their Spanish prototypes; the earlier examples are hardly to be distinguished from Spanish wares, and to the last the ware remained technically like the earlier ware, though with perfectly Italian decorative treatment. Yet the best examples of Deruta silver lustre have a quality of tone that has never been surpassed; a colour resembling a wash of very transparent umber bearing a delicate nacreous film of the most tender iridescence. The Gubbio lustre is best known to us through the works of Maestro Giorgio, whose

distinctive lustre is a magnificent ruby-red unlike any other. In all probability the lustre process was so quickly abandoned on the fine painted majolica, because the increasing efforts to make a "picture" were discounted by so uncertain a process. When one of the later majolica painters had spent weeks on the decoration of some vase or dish, with an elaborate composition of carefully drawn figures, it was not likely that he would care to expose it to any risks that could be avoided. The risks of the lustre process were inordinately great—Piccolpasso says, "Frequently only six pieces were good out of a hundred"—so that its use was relegated only to inferior wares, and then the process was relinquished and forgotten until its rediscovery in the second half of the 19th century.

The history of the development of these noble wares is by no means clear, nor is it always certain what part was played by each town in the successive inventions of technical methods, decoration and colouring, so that it is better, in such a general sketch as this, to treat the subject in its broadest features only. In the earlier painted wares the only colours used were manganese-purple and a transparent copper-green as on the mezza-majolica, but early in the 15th century cobalt-blue was added to the palette, and, later on, the strong yellow antimoniate of lead, mixed with iron. The decorations at this period were largely influenced by the wares imported from Persia, Syria, Egypt and Spain, specimens of which were so prized as to be used for the decoration of church fronts and the façades of public buildings. The lustre of the Saracenic wares was not yet understood, but its place was taken first by manganese and afterwards by yellow. The designs were chiefly conventional flower-patterns in the Persian or Moorish style, arabesques, and floral scrolls, the ground being filled at times with those tiny spirals, scrolls and dots to which the Eastern potters were so partial. Figures, human and animal, were introduced either among the formal ornament or only sundered from it by panels, of which the outlines often followed the contours of the central design (see the early 15th-century Faenza piece, Plate VI.). The figures were, in fact, drawn to conform to the outline of the vessel, and not the vessel made to display the figure-subject as in the majolica of the succeeding century. The earliest dated example of this period is the pavement laid down in the Caracciolo chapel in the church of San Giovanni a Carbonara, in Naples, about 1440. Specimens of these tiles may be seen in the British Museum, and from their style it has been suggested that they were made by some Spanish potters brought over to Naples by Queen Joanna, who was of the royal house of Aragon. To this period also have been referred the large ovoid jars made to contain drugs or confections, and decorated with bold scrolls of formal oak leaves enclosing spirited figures of men or animals, or heraldic devices. These are characterized by a rich blue colour generally piled up in palpable relief and sometimes verging on black; the outlines are usually in manganese, and transparent green is used for details and occasionally even as a ground colour. This ware has been definitely assigned to Florence on what seem very inadequate grounds, and it is better to speak of it simply as Tuscan. Then, essentially Italian ornament began to assert itself, and it redounds to the credit of the Italian majolist that he soon freed himself from repeating the styles of the wares from which he obtained his methods, and produced a distinctive type of ornament of his own. He revelled in patterns with bold floral scrolls, or those based on peacocks' feathers (see fig. 45), and then he advanced to concentric bands of painted ornament, borrowed from classic art yet breathing the true spirit of the Renaissance; while cable borders, chequer and scale patterns, bands of stiff radiating leaves, festoons of fruit and flowers, zigzags and pyramidal scrolls occupied nearly the whole surface or framed an armorial or emblematic central subject. Figure-subjects occur with increasing frequency as the century advanced; Madonnas and other sacred subjects, portraits, and, occasionally, groups of figures after the early Italian masters, or scenes borrowed from the first illustrated editions of the classics, gradually encroach on the conventional borders and occupy more and more of the surface of the piece. The provenance of these 15th-century pieces still remains uncertain—Faenza, Forli, Florence, Siena and other places offering rival claims,—but there is no doubt that from the earliest times Faenza was the most fertile centre of their manufacture, and almost all the motives of the *quattrocento* wares are found on fragments discovered there or on examples that can be traced to Faventine

FIG. 45.—Early Faenza plate, with peacock-feather design, in blues, yellow and orange-red. (Victoria and Albert Museum.)



Early Faenza Potter's mark.

Late Faenza Potter's mark.

factories.

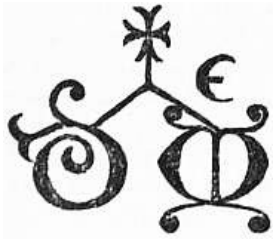
It is customary to treat the enamelled terra-cottas of Luca della Robbia, the great Florentine sculptor (1399-1482), and his followers, Andrea and Giovanni della Robbia and other members of the family, as belonging rather to the domain of sculpture than of pottery, and this is right, for there is nothing certainly known of the work of this great sculptor which connects it with painted majolica. The old theory that Luca invented the tin-glaze is long since exploded; what he did was to use coloured glazes made with a basis of tin-enamel on his boldly modelled terra-cottas—a very different thing,—and it is by no means certain that he was the first to do even that. The Victoria and Albert Museum is extraordinarily rich in della Robbia ware of every kind; and one may see there these beautifully modelled figures in high relief covered with pure white tin-enamel, set in a background of slatey blue or rich manganese purple and framed in wreaths of flowers and fruit which are coloured with blue, green, purple and sometimes yellow. There are altar vases too, of classic shape with low relief ornament, covered with the same peculiar blue glaze; these are sometimes furnished with modelled fruit and flowers; and finally there is the rare set of roundels painted on the flat with figure-subjects typifying the months; but the attribution of these remains doubtful, and their method is not that of painted majolica.

A remarkable development took place at the beginning of the 16th century, and in the forty succeeding years the highest perfection of manipulative skill, both in potting and painting, was attained. Artistically regarded, the elaborate and detailed methods of painting then adopted are too much allied to fresco-painting to be considered as fit treatment for enamelled clay; but this view was certainly not accepted at the time, nor is it subscribed to by many modern collectors; yet, regarded as decorated pottery, the 15th-century majolica, simpler and more conventional in design and treatment, is eminently preferable. The ruling families of northern Italy, who now took the industry under their personal patronage, clearly inclined to the opposite view and spared no expense to provide subjects for their pot-painters. During the first two decades the 734
influence of Faenza was paramount, and though the encroachments of purely pictorial motives are clearly indicated on the wares, room was still found for ornamental patterns. The broad rims of the dishes were covered with beautiful arabesque designs, frequently including grotesque figures, masks, dolphins and cherubs (see the Faenza Casa Pirota piece, 1525, Plate VI.). Sometimes reserved in the white on a dark blue ground and shaded with light blue and yellow, sometimes traced in dark blue on a paler grey-blue glaze (called *berettino*) or painted in darker tints on a ground of orange or full yellow, the Faventine arabesques form a conspicuous feature of the early wares of this century. Honeysuckle patterns and interlaced lines drawn in pure white on a toned tin-enamel (white on white or *sopra-bianco* decoration) commonly appear on the sides of the deep wells of the dishes, while in the centre is a single figure, a coat of arms, or a small figure-subject. A similar treatment, without the *sopra-bianco*, was accorded to the fruit-dishes, shallow bowls on low feet, &c., with moulded gadroons or scalloped sides, which are generally attributed to Faenza or Castel Durante. The workshops of Siena were also noted for delicately painted grotesques and arabesques, with a rich brownish-yellow or deep black ground. At Gubbio, too, the “grotesque” decoration was practised with marked success. Other developments of this style are the “*a candelieri*” designs, in which grotesques were symmetrically arranged round some central subject, such as a candelabrum or vase, and “*a trofei*” in which trophies of arms, musical instruments, and other objects were symmetrically disposed, or arranged in studied disarray throughout the design; these patterns are generally associated with the wares of Castel Durante and Deruta. Lovers’ gifts, dishes in which the whole space is occupied by a portrait bust of a girl or man, with the name and a complimentary adjective inscribed on a ribbon in the background, were common to Faenza, Castel Durante and many other factories. Elaborate figure-subjects also were attempted early in the century at Faenza and with no little success, as may be seen from a dish in the British Museum, which is entirely occupied by the scene of the death of the Virgin, after a print by Martin Schöngauer, delicately painted in shades of blue, and dated about 1500.

In the early Faventine school the outlines of the figures are almost always traced in blue, even when they are laid on the grey-blue *berettino* ground, and blue was the prevailing colour of the shading and details. In the third decade of the century the style affected at Urbino superseded that of Faenza. The majolica painter’s palette was now complete; in addition to the primitive blue, manganese-purple, transparent green and yellow, we find black, white, orange, greens of varying shades, brown, and a great number of intermediate tints obtained by mixing the standard colours. All the colours of the majolica of the best periods were painted on the tin-enamel before the final glazing, and were capable of standing the full heat of the fire. Such a thing as painting in enamels on the finished ware and refiring them at a lower heat was unknown before the end of the 17th or beginning of the 18th century. A true red colour seems to have been beyond the power of most of the Italian majolists, and was only attained at Faenza, and with less complete success at Cafaggiolo; the famous red of the Turkish pottery behaves very indifferently on tin-enamel.

In the Urbino style, which now became general, the ware was

given over entirely to pictorial subjects, scenes from history or romance, scriptural and mythological, copied from the compositions of the Italian painters and usually set in a background of Italian landscape. Guidobaldo II., duke of Urbino, spared no pains to develop this phase of the art; the cartoons of Raphael, engraved by Marc Antonio and others, were placed at the disposal of the pot-painters, as well as the paintings of Michelangelo, Giulio Romano, Battista Franco, Rosso Rossi, Perugino, Parmeggiano and many more, and these, together with engravings by Agostino Venetiano, Marco Dente, Enea Vico and others, were copied, with more or less fidelity, on the majolica. Some of the painters, as, for instance, Xanto Avelli, were eclectic in their tastes and made up their subjects by taking a figure here or there from various pictures. Thus of three figures on a plate in the British Museum, painted with the Dream of Astyages, one is borrowed from Raphael and another from Mantegna. These "*istoriati*" wares reached their zenith at Urbino between the years 1530 and 1560, when the workshops of the Fontana family were in full activity; but their popularity was very general, and skilful painters at many other towns produced specimens that it is hard to distinguish from those of Urbino. Baldasara Manara was a prolific painter in this style at Faenza; Pesaro and Castel Durante were little behind Urbino in the skill of their artists, the Lanfranchi family in the former town having a well-deserved reputation, while the founders of the Fontana factories learnt their art in the latter; and a few pieces of considerable merit bear the name of Rimini as their place of origin.



Urbino Potter's mark.

There will always remain a large number of specimens of majolica which cannot be assigned with certainty to any particular factory, partly because the same style of painting was in vogue at many places at the same time, and partly because of the itinerant propensities of many of the painters, whose signed works prove that they moved from place to place to practise their art. There are, however, a few prominent artists whose touch is sufficiently well known from the examples that bear their signatures to enable us to classify a considerable proportion of the finest pieces. First of these is Niccola Pellipario, the founder of the Fontana family, who moved from Castel Durante to Urbino in 1519, and worked at the latter place in the factory of his son, Guido Fontana. There is little doubt that he was the painter of the famous service in the Correr Museum at Venice, which marks the transition from the style of Faenza to that of Urbino, and his free figure-drawing, the oval faces with strongly marked classical features, the peculiarly drawn knees, the careful landscapes and the characteristic balls of cloud are easily recognized in quite a number of pieces in the British Museum (see the Gonzago Este piece, Plate VI.). His pupil, who frequently signed his name in full, Xanto Avelli da Rovigo, was one of the foremost Urbino painters, and his work is characterized by bold colouring and fine figure-drawing, with a marked fondness for yellowish flesh tints. But Niccola's grandson, Orazio Fontana (see example, Plate VI.), was perhaps the most celebrated exponent of the pure Urbino style, and his free drawing and soft harmonious colouring, in which a brilliant blue is usually conspicuous, are unequalled by any other majolica painter of the period.

Certain characteristic wares of Faenza have already been noted. Those with the grey-blue (*berettino*) glaze were principally made at the factory called Casa Pirota, though inferior imitations were also produced at Padua, and a blue glaze of paler tint was largely used at Venice. Dolphins are a frequent motive in the arabesque ornaments of the same Faventine workshop, and many of the wares are marked with a circle divided by a cross and containing a dot in one of the quarters. A capital P crossed with a line or paraph is another Faventine mark, and a somewhat similar monogram, with an S added to the upper part, is found in the wares of Cafaggiolo. It has already been stated that a red colour is peculiar to Faenza and in an inferior and browner tint to Cafaggiolo; it was used, according to Piccolpasso, at the factory of Vergiliotto in the former place. At Cafaggiolo, the factory of the Medici family, many fine pieces were painted, mostly in the Faventine style; a deep blue, heavily applied and showing the marks of the brush, was freely used in backgrounds, and delicate running leaf scrolls in paler blue and reminiscent of Persian style often appear on the Cafaggiolo wares (see example, Plate VI). Not a little can be learnt from the ornament on the reverse sides of the dishes and plates; those of Faenza and Siena are richly decorated with scale patterns and concentric bands; those of Cafaggiolo and Venice are either left blank or have one or two rings of yellow. A few pre-eminently beautiful dishes, with central figure subjects of miniature-like finish in delicate landscapes with poplar trees in a peculiar mannered style, are probably the work

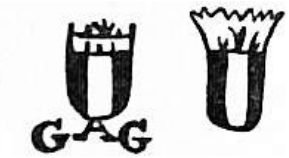
Venetian Majolica
Potter's mark.

Later Cafaggiolo
Potter's mark.

of M. Benedetto of Siena. Borders of arabesques with black or deep orange ground belong to the same factory and were perhaps decorated by the same hand. The dishes covered, except for a few small medallions, with interlaced oak branches ("*a cerquate*" decoration), are no doubt the productions of Castel Durante; and a certain class of large dishes with figure subjects in blue on a toned blue glaze, and sometimes with formal ornaments in relief, are of undisputed Venetian origin.

Another phase of majolica decoration began about the middle of the 16th century and synchronized with the decline of the pictorial style. The figure subjects were relegated to central panels or entirely replaced by small medallions, and the rest of the surface covered with fantastic figures among floral scrolls, inspired by Raphael's grotesques painted on the walls of the Loggie in the Vatican. The prevailing tone of this ornament was yellow or orange, and the tin-enamel ground, which is always more or less impure in colour on Italian pottery, was washed over with a pure milk-white, known as *bianco di Ferrara* or *bianco allatato*, said to have been invented by Alphonso I., duke of Ferrara, who took an active interest in his private factory founded at Ferrara, and managed by potters from Faenza and Urbino.

Turin Potter's mark.



Savona Potter's marks.

The new style flourished at Urbino, Pesaro and Ferrara; at the first-named particularly in the workshops of the Patanazzi family, and lasted far into the 17th century. But the majolica was now in full decline, partly through the falling off of princely patronage, and partly, perhaps, owing to a reaction in favour of Chinese porcelain, which was becoming more plentiful and better known in Europe. The manufacture, however, never entirely ceased, and revivals of the old style were attempted at the end of the 17th century by Ferdinando Maria Campori of Siena, who copied Raphael's and Michelangelo's compositions, and by the families of Gentile and Grue at Naples and Castelli. The majolica of Castelli is distinguished by the lightness of the ware, good technique, and harmonious but pale and rather weak colouring; it continued into the 18th century. A coarse and inferior ware was made at Padua and Monte Lupo; and the factories of Faenza were still active, producing, among other kinds, a pure white ware with moulded scallops and gadroons. The industry continued to flourish in Venice and the north. Black ware with gilt decoration was a Venetian product of the 17th century, and at Savona and Genoa blue painted ware in imitation of Chinese blue and white porcelain made its appearance. In the 18th century a new departure was made in the introduction of enamel painting over the glaze, a method borrowed from porcelain; but this process was common to all the faience factories of Europe at the time, and though it was widely practised in Italy no special distinction was attained in any particular factory. In our own days imitations of the 16th century wares continue to be made in the factories of Ginori, Cantigalli and others, not excepting the lustred majolica of Gubbio and Deruta; but, compared with the old pieces, the modern copies are heavy to handle, stiff in drawing, suspiciously wanting in the quality of the colours and the purity of the final glaze which distinguish the work of the best period.

FIG. 46—Early majolica plate, in blue and yellow lustre only, made at Pesaro or Deruta, *c.* 1500. The motto on the scroll may be Englished as follows: "He who steers well his ship will enter the harbour."

(Louvre.)

Lustred Wares.—The lustred wares of Deruta have marked characteristics, and, though differing in actual treatment from the Hispano-Moresque, their appearance is eloquent in favour of such a derivation. The most characteristic examples are large dishes and plateaux, thickly made and with the enamel on the upper face only, the back having a lead glaze. They are often decorated (see fig. 46) with a single figure or bust in the centre (with or without an inscribed ribbon), which is usually set against a dark blue background which covers only half the field, while in the other half is a formal flower, and in the borders are radiating panels with palmettes alternating with scale pattern, or some other formal design. The whole style is archaic, the designs being heavily outlined in blue and washed over with a greenish yellow lustre, with beautiful opalescent *reflets* recalling mother of pearl. The lustre varies from this *madreperla* tint to a brassy metallic yellow, and parts of the ornament are sometimes modelled in low relief. In spite of its archaic appearance, the Deruta lustred wares are scarcely older than the 16th century, and the style was continued as late as the second half of that century. Deruta pottery was not always lustred, and some of the pieces signed by the painter El Frate, who flourished between 1541 and 1554, are without the lustre pigment, though showing the heavy blue outlines of the lustred wares. The lustred majolica of Gubbio owes its celebrity almost entirely to the work of one man, Maestro Giorgio Andreoli, who came thither from Pavia, with his brothers Salimbene and Giovanni, and obtained citizenship in 1498. His earliest efforts were in the direction of sculpture, and some of his reliefs in the style of della Robbia are still in existence; indeed the earliest dated piece of lustred majolica attributed to him is a plaque of 1501, with the figure of St Sebastian in relief, in the Victoria and Albert Museum. It is not known whence he learnt the secret of the beautiful transparent ruby lustre peculiar to Gubbio. A red or rosy lustre is found in both Persian and Hispano-Moresque wares, and no doubt the process was learnt from some Moslem potter and developed by Giorgio to unusual perfection. Golden, yellow, brown and opalescent lustres were also freely used at Gubbio, the ruby being only sparingly applied. Finished painted pieces were sent from other factories to receive the addition of lustre at Gubbio, but these can almost always be distinguished from the true Gubbio wares, in which the lustre is an integral part of the decoration. Apart from the lustred enrichment, the majolica of Gubbio has few distinctive qualities, for its styles were various and almost all borrowed (see fig 47). The archaic taste of Deruta, the arabesques and grotesques of Faenza and Castel Durante, and in a lesser degree the “*istoriato*” style of Urbino, reigned in turn. Perhaps the most characteristic paintings of Maestro Giorgio are the central medallions of cups and deep dishes enclosing a single figure of a child or a cupid in *grisaille*. Giorgio’s larger figure compositions, if indeed his signature in lustre may be taken to imply that he painted the designs as well as lustred them, show great inequality, some rising to a very high standard—as the dish with “the Three Graces” in the Victoria and Albert Museum, and the “Bath of Nymphs” in the Wallace collection—while in others the figure drawing is quite inferior. The arabesques and grotesques on the Gubbio wares are usually of great merit. There are a few known pieces of unlustred Gubbio wares with figure subjects, painted chiefly in blue and in the style of the early Faventine artists. After 1517, when we may assume that the lustre process was thoroughly mastered, the Gubbio wares were usually signed with the initials or full name of Maestro Giorgio, and a few rapidly executed scrolls in lustre completed the decorations of the reverse of the plates and dishes. The master’s latest signed work is dated 1541, and he died in 1552. It is probable that his brother Salimbene assisted him, and Piccolpasso names his son Vincentio as possessor of the lustre secret. Possibly the latter was the painter who signed his wares with the initial N, but this conjecture rests solely on the ingenious, but unsupported notion that N is a monogram of the first three letters of the name Vincentio. Other initials, M, D, R, also occur on Gubbio plates, and the latest dated example of the ware is signed by one “Mastro Prestino” in 1557, but it has little to recommend it save that it is enriched with the Gubbio lustres, which after this time entirely disappear.

FIG. 47.—Gubbio plate, with portrait in ruby lustre and blue outline. (Victoria and Albert Museum.)

Gubbio Potters' marks.

The old majolica shapes are briefly as follows:—among the earliest are small bowls (*scodette*), often with flattened sides; jugs (*boccali*) with large lip-spouts, and mouths pinched into trefoil form; large dishes with gradually shelving sides (*bacili*), or with flat broad rims and deep centres; akin to these are the plateaux with a raised flat disk in the centre; small dishes with broad flat rims and deep though narrow central walls (*tondini*), suitable for handing a wine-glass or sweetmeats; flat trencher-shaped plates (*piatti* or *taglieri*); saucer-shaped dishes on low feet and sometimes with moulded sides (*tazze* or *fruttieri*) suitable for holding fruit. Among the vase forms ovoid shapes with short necks and a pair of flat handles are common in the Tuscan wares of the 15th century; the jars for confectionery, drugs, or syrups were often of the cylindrical form with graceful concave sides known as the "*albarello*," in shape of Eastern origin, and in name perhaps derived from the Persian *el barani* (a vase for drugs, &c.); other vase forms with spouts and handles were used for the same purpose; ornamental vases after classical designs (*vasi a bronzi antichi*); and in the best Urbino period a great variety of fanciful forms—ewers, vases, cisterns, shells, salt-cellars, ink-pots, &c., with applied masks and serpentine handles, were made in the exuberant taste of the time. A complex piece of furniture for the bedside of ladies in childbirth (*vaso puerperale*) consisted of a bowl with a foot surmounted by a flat trencher on which fitted an inverted drinking-bowl (*ongaresca*); and above this again a salt-cellar with cover. Many of these shapes were suited to daily use, but the richly decorated majolica was designed to adorn the walls, the *credenze*, table-centres and cabinets of the rich. This alone could have been the destination of the large dishes (*piatti di pompa*) with rim pieces for suspension, and the smaller dishes (*coppe amatorii*) with portraits of young men and girls and lovers' symbols; and it is inconceivable that the costly lustred wares of Gubbio or the fine *madreperla* dishes of Deruta were designed for anything but decorative use. The ware was in fact an article produced for the wealthy in the century of Italy's glory, and under no other conditions could such magnificent and expensive pieces have been made.

Technical Methods.—This is a convenient place to give an account of the methods used by the early medieval potters—(1) because they represent what had been learnt from Roman times to the 16th century, and indeed to the introduction of modern methods, (2) because, besides all that a potter could derive from an examination of the wares, we have ample written accounts of the methods and processes followed by the Italian majolist. Mr Solon has recently published an epitome of the account given in Biringuccio's *La Pyrotechnica* (Venice, 1540), and there is the memorable MS. of Piccolpasso, a potter of Castel Durante, now in the library of the Victoria and Albert Museum, which, besides giving an account of the processes, contains illustrations of kilns, mills, decorative motives, &c.[16]

1. The potter's clay was prepared from mixtures of various kinds prepared by (a) beating and picking out coarse particles, (b) mixing with water, (c) passing through a sieve, (d) drying again into plastic clay ready for the working potter. The essential point about the potter's clay of the best tin-enamelled wares, whether Spanish, Italian, French or Dutch, is that the clays are those known geologically as "marls," which contain a large percentage of carbonate of lime. Such

clays always fire to a pinky red or buff colour, and give a ware that is strong and yet light in substance, and on no other kind of clay does the tin-enamel display its full perfection (see Deck's *La Faience*). The analyses of certain tin-enamelled wares are useful as showing the essential constitution of the best pottery bodies for such purposes.

	Delia Robbia.	Majolica.	Delft. Faience.	French
Silica	49.65	48.00	49.07	48.65
Alumina	15.50	17.59	16.19	17.05
Lime	22.40	20.12	18.01	19.43
Magnesia	0.17	1.17	0.82	0.27
Oxide of iron	3.70	3.75	2.82	4.33
Carbonic Acid, water, &c.	8.58	9.46	13.09	10.27

2. *Shaping*.—The vessels were either "thrown" on the potter's wheel (which had remained practically unaltered from Egyptian times), or they were formed by "pressing" thin cakes of clay into moulds, made of a composition of plaster (*gesso*), bone-ash and marble dust. In the latter way all shapes that were not circular were made, as well as those with heavy bosses or gadroons imitated from embossed metal forms. It is interesting, though not surprising, to note that for the fine later wares, the roughly thrown vases, when sufficiently dry, were recentred on the wheel or were placed in a joiner's lathe and smoothed to a clean and accurate surface. The Greek potters did the same, and this practice must always be followed where fine painting or gilding is afterwards to be applied. In the later florid vases of the Urbino style the piece was built up of thrown parts and moulded parts (handles, masks, spouts, &c.), luted together with slip when they were dry enough to be safely handled, and then retouched by the modeller or vase-maker, a method followed to this day for elaborate pieces of pottery or porcelain.

PLATE V

Rhodian or Turkish: 16th century.

Syro-Persian: 13th century.

Rhodian or Turkish: 16th century.

Damascus: 16th century.

Rhodian or Turkish: 16th century.

Persian, lustre and underglaze colour: 13th century.

3. *The Glaze.*—The white enamel which formed at first both the glaze and the ground for painting upon—*bianco*, as it was called—was prepared in a complicated way. A clear potash glass (*marzacotto*) was made by melting together clean siliceous sand (*rena*) and the potash salt left as the lees of wine (*feccia*). This corresponds to the alkaline glaze of the Egyptians with the substitution of potash for soda. Such a glaze alone would have been useless to the Italian potter, and accordingly the *bianco* was made by melting together thirty parts of *marzacotto* and twelve parts of lead and tin ashes. The white enamel as used was therefore a mixed silicate of lead and potash rendered opaque with oxide of tin.

4. Pigments (*colori*) were compounded from metallic oxides or earths; the yellow, from antimoniate of lead, which was mixed with oxide of iron to give orange; the green, from oxide of copper (the turquoise tint given to the Egyptian and Syrian glazes by oxide of copper is impossible with a glaze of lead and tin); and the greens were made by mixing oxide of copper with oxide of antimony or oxide of iron; blue, from oxide of cobalt, used in the form of a blue glass (*smalto*, or *zaffara*); brownish-purple, from manganese; black, from mixtures of the other colours; and the rare red, or reddish brown, of Faenza and Cafaggiolo was probably the same Armenian bole that was used so magnificently by the makers of the Turkish pottery, but on the white enamel ground this colour was most treacherous and uncertain. It must be remembered that many of these colours owe their tint to the lead used in their composition, or to the grounds containing oxides of lead and tin on which they were painted. Piccolpasso describes the preparation and composition of the various colours used in his day.

5. *Coperta*, or transparent glaze. In the later majolica a thin coating of soft rich glaze was applied over the fired painting to give a smooth bright surface. This *coperta* was a soft lead glass consisting of silica (sand), 20 parts; oxide of lead, 17 parts; potash, 12 parts; and common salt, 8 parts; fused together and then finely ground in water.

6. *Methods of Glazing and Decorating.*—In the mezza-majolica and the early majolica it is probable that the clay vessel was dipped in the white bath to give it an envelope (*invetriatura*) before it was fired at all; but it must soon have become apparent that it was much better to fire first the shaped vessel until it was about as hard and brittle as a clay tobacco-pipe, and then coat it with the white enamel, by dipping it into a bath or pouring the fluid material upon it. This was the practice described by Piccolpasso. A coating of white enamel, the thickness of glove leather, having been obtained, the piece was carefully taken by the painter, who first etched in the outline on the absorbent powdery ground, and then shaded the figures, landscapes, &c., in blue or in a mixture of blue and yellow, adding the other colours as gradated washes. The vase was then fired a second time to a heat greater than the first, so that the enamel was melted on the vessel and the colours sunk into the enamel at one and the same operation. This method of painting on the unbaked enamel demanded a bold direct treatment—for alteration or retouching was impossible—and much of the vigour of the earlier designs is due to this fact. As the ware became more refined in its treatment it was felt that this method did not yield a sufficiently brilliant surface, and so the painted and fired piece was coated with a film of *coperta* and fired again at a slightly lower temperature to make it smoother and more glossy. Still pursued by the idea of rivalling the triumphs of pictorial art, the majolist carried his methods a step farther. The white enamel coating was fired before painting, giving a glossy surface on which the painter

could draw or wipe out, and so could execute outlining, tinting, or shading of the utmost delicacy. A film of *coperta* was then washed over the painting, and the piece was fired a third time in the cooler parts of the kiln. In some instances it is not easy even for an experienced potter to decide which method has been pursued, owing to the softening of the colours. Generally we should expect that the later and more pictorial pieces had been painted on a ground of fired white enamel, and we may be absolutely certain when delicate white patterns have been "picked out" in a coloured ground.

Where lustre decoration has been added to a piece of majolica it indicates, as elsewhere, the use of a special process, and a final firing at a lower heat. The lustre pigments were the same as those used on the earlier lustred wares, and these were painted over an otherwise finished piece. To obtain the lustre effect these were placed in a special kiln, so contrived that when the pots were just visibly red the smoke of the burning fuel (rosemary or gorse) was allowed to play upon them long enough to drive the metallic films (silver or copper) into the already-fired glaze.[17]

Collections.—The Victoria and Albert Museum contains perhaps the most widely representative collection in the world, especially as at the present time the pieces of the Salting and Pierpont Morgan collections are on exhibition there. The British Museum collection is valuable, being rich in "signed" pieces of the first quality. The Wallace collection and the Ashmolean Museum at Oxford (Fortnum collection, &c.) are also valuable and contain some remarkable examples. The Cluny Museum, the Louvre and the museum at Sèvres have fine collections; while noteworthy pieces are to be found in the Ceramic Museum at Limoges. In Germany the museum at Brunswick contains one of the largest collections known, but many inferior and doubtful examples. Berlin, Munich, Vienna and St Petersburg have noteworthy collections. In Italy, the Bargello at Florence and the museums of Venice, Milan, Turin, Faenza, Pesaro, Urbino, Rome and Naples all have collections, whilst interesting examples of local manufactures are to be found in many of the smaller Italian towns. The American museums, especially those in New York, Boston and Philadelphia, have some fine examples.

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(R. L. H.; W. B.*)

FRENCH POTTERY FROM THE 15TH TO THE 19TH CENTURY

The pottery of medieval France needs little attention here, for it was, in the main, similar to that which was made generally in Europe—rudely shaped vessels of ordinary clay often decorated with modelled ornament and glazed with yellow or brown lead glaze, or, if coated with white slip, decorated with bright green glazes, and towards the end of the 15th century with greyish blue. The later specimens of this simple ware—pronouncedly Gothic in feeling—were often extremely decorative. Avignon, Beauvais and Savigny are the best-known centres of this truly national manufacture, and, as we might expect in French work, the reliefs are often sharp and well designed. Evidence accumulates that from time to time the princes and great nobles imported Spanish or Italian workmen to make special tiles for the decoration of their

palaces or chapels. The duke of Burgundy brought Jehan de Moustiers and Jehan-le-Voleur, "*ouvriers en quarrieaux peints et jolis*," in 1391, to paint tiles for his palaces at Hesdin and Arras in the north, and we have already referred to the tile-work in the Spanish fashion made at Poitiers by John of Valencia, the "Saracen," in 1384 for Duke Jean de Berry.[18] Other instances might be multiplied but that this foreign work left little or no traces on contemporary French pottery. Even at a later date, when Francis I. brought Girolamo della Robbia from Italy to decorate his "Petit Château de Madrid" in 1529, or when Masseot Abaquesne, about 1542, manufactured at Rouen the painted tile pavements for the château of Ecouen, the cathedral of Langres, and other places, nothing came of the imported methods; the works were executed and left no traces on the general pottery of the country. During the 16th century, however, two remarkable kinds of pottery were made in France of distinctive quality, and both eminently French—the Henri-Deux ware and the pottery of Bernard Palissy and his imitators.

Henri-Deux, *Oiron* or *St Porchaire* ware, for all these names have in turn been applied to the enigmatic and wonderful pottery, specimens of which are now valued at more than their weight in gold, was once believed to have been made by the librarian Bernard, and his assistant Charpentier, for their patroness Helène de Hangest about 1529 at her château at Oiron, near Thouars.[19] A few years ago this theory was discarded in favour of one which assigned them to some unknown potter of St Porchaire in the same region;[20] but even of this theory there is insufficient proof, and we are left in doubt both as to the maker and the place of origin. All we know is that the ware dates from the reign of Henry II., and that it was probably made somewhere near Oiron, as most of the specimens have been found in that district. The work is *sui generis*, for it had no direct ancestry, neither did it leave any mark on contemporary French pottery. Sixty-five pieces of the ware (see fig. 48) are known to be in museums and private collections; the Louvre and the Victoria and Albert Museum have the best collections of their kinds, but the Rothschilds still hold the greater number of examples. The ware is fashioned in a simple whitish pipeclay, and ornamented with interlacing strap-work patterns, typical of the period, inlaid in yellow, buff or dark-brown clay. The forms are generally graceful, but some examples are over-elaborate and overloaded with modelled ornament. The pieces were designed to serve as candlesticks, salt-cellars, tazzas, ewers, holy-water pots and dishes. After the vessels had been "thrown" and "turned" to a perfect shape, metal tools, such as were used by the bookbinders and casemakers of that day, were pressed into the clay, so as to form sunk cells of ornamental tooling. These cells were carefully filled with finely-prepared slips of other clays, that would burn yellow, buff or dark-brown; and when the whole was dry the piece was carefully smoothed again, and moulded reliefs were attached, or touches of colour were applied. After being fired the ware was glazed, apparently with the ordinary lead glaze of the time carefully prepared and fired again. At a later period the ornament was not inlaid in this elaborate manner, but was simply painted, as indeed it might all have been so far as decorative effect is concerned.

Fig. 48.—Tazza of Oiron pottery. (Louvre.)

Oiron Potter's mark.

Palissy Ware.—Bernard Palissy was a genius of original talent, but, at the hands of his literary admirers, he has gained a legendary rank as one of the great potters of the world which his pottery does not warrant. He is supposed to have spent sixteen years in the search for the white enamel which was being used all the time in Italy and Spain—probably he was searching for the mystery of Chinese porcelain—and when he settled down to make the "Palissy ware," he did nothing more than carry to perfection the methods of the village pot-makers of his own district. On a hard-fired red clay he disposed groups of moulded plants, shells, fish and reptiles, painted them with crude green, brown and yellow colours, and glazed the whole with a well-prepared lead glaze. His style soon had numerous imitators, like A. Cléricy and B. de Blémont, who executed works quite as good as those of their master; but their works also vanished and left no permanent impression on the general trend of French pottery.

Meantime Italian, and, it may be, Spanish potters strayed over the French border and attempted to introduce the manufacture of their tin-enamelled wares; for we know of the works

of Gambin and Tardessir of Faenza, established at Lyons about 1556; of Sigalon at Nîmes in 1548; of Jehan Ferro at Nantes about 1580, and other sporadic efforts. The needed impetus came, however, when the Mantuan duke, Louis de Gonzague, became duke of Nevers in 1565; and we find Italian majolists, working under princely patronage, planting their decadent art in the centre of France. The first efforts met with little success until, with the appearance of the Conrades from Savona, who were domiciled in Nevers in 1602, we get the genuine ware of Nevers. Naturally the first productions, whether of the Conrades or their predecessors, were in the style of the debased majolica of Savona, but the body and glaze of the ware is harder, the colours are not so rich, and the execution is less spirited. The first departure from Italian traditions is seen in the ware of the so-called “Persian style” of Nevers—probably adopted from contemporary work in Limoges enamels on metal—where conventional and fanciful designs of flowers and foliage, birds, animals or figures were thickly raised in white enamel on a ground of bright, intense cobalt-blue glaze. After the middle of the 17th century the Italian style of design appears to have been entirely replaced by pseudo-oriental patterns painted in blue or in polychrome, but really imitated from the “Delft” copies of Chinese and Japanese porcelain. When Rouen and Moustiers became famous for their distinctive wares Nevers copied their designs also, and on a gradually descending scale the manufacture continued to the end of the 18th century, when France was flooded with the rude *Faiences patriotiques* from this centre.

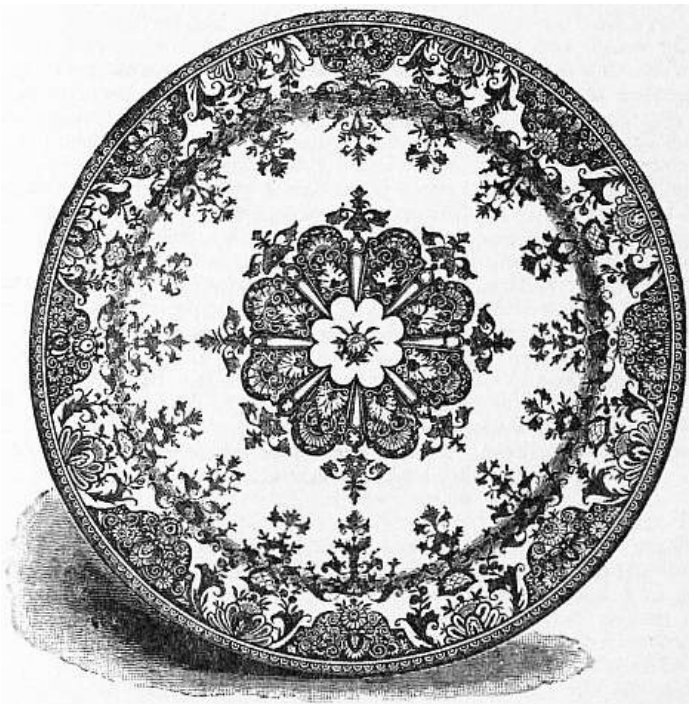


Fig. 49.—Dish of Rouen enamelled pottery, painted in blues and deep red.

Nevers Potters’ marks.

The genuine French tin-enamelled ware, freed from the traces of Italian influence, first developed itself at Rouen under the famous Poterats in the later part of the 17th century. A new scheme of ornamentation was gradually evolved in the daintily-designed scalloped and radiating patterns adapted from oriental fabrics, lace and needlework, and from the ornamental devices of contemporary printers. These designs, having been skilfully drawn on the pieces, were filled in with bright blue, strong yellow, light green, or a bright bricky-red in palpable relief, applied as flat washes or in fine lines; and the result was a gay and sparkling ware much superior in decorative value to the later Italian majolicas (see fig. 49). So successful was this Rouen ware that rival factories were quickly started at Saint Cloud, Sinceny, Quimper, Lille, and other places in the north. Saint Cloud and Lille made fine pottery of this class at the end of the 17th and in the early 18th century. It was imitated at Nevers, the potters’ marks shown being those of J. Bourdu and H. Borne. In the south of France, Pierre Clérissy established the industry at Moustiers in 1686, and, though the early Moustiers ware bears a strong resemblance to the debased Italian majolica of the time, the Moustiers painters soon left that behind, and on a glaze of inimitable whiteness and softness they deftly pencilled blue patterns based on the engravings of designs after Berain, Marot and Toro. At a later date Olerys, who had been to Alcora to introduce the French faience into Spain, returned to Moustiers and introduced a pale polychrome style very inferior to that of Rouen. These pieces are covered with patterns outlined in blue and filled in with yellow, pale green and light purple. Olerys is also said to have introduced the grotesque style of Moustiers, founded on the caricatures of Callot. Other factories were started from Moustiers, such as those at Apt, Ardus and Montauban, and even at Narbonne, Bordeaux and

Clermont-Ferrand; just as the northern factories had sprung from Rouen.

We have already seen at Nevers the introduction of patterns in the Chinese style, and the same course was increasingly followed at all the French factories during the 18th century. At Strassburg a fresh impetus was given in this direction when, about 1721, Charles Hannong introduced the practice of painting his white tin-enamelled ware with the on-glaze colours used by the porcelain painters. This process enabled the French potter to produce many colours unobtainable by his older process, and moreover helped him to make his wares look more like the coveted porcelain, then becoming the rage all over Europe. This new departure marks the end of the best period of French faience, but so successfully did it meet the demands of the time that it gradually displaced the old method of decoration where the colours were painted on the raw glaze and fired along with it. Factories sprang up for the manufacture of this new ware in the first half of the 18th century at Niederviller, Lunéville and Sceaux, and it was quickly adopted by the older factories at Rouen, Sinceny, Marseilles, &c. With its general adoption the old French faience, developed from the Italian stock, departed, to make way for a tin-enamelled imitation of *famille-rose* porcelain. But this last style was not of long life. The wealthy classes were no longer patrons of pottery but of porcelain, and when, after 1786, the newly perfected English earthenware was thrown upon the French market, the French faience-makers had to give up their works, or adopt the manufacture of this neater and, for domestic purposes, more suitable form of pottery. This change, together with the disturbances of revolutionary times, brought artistic pottery in France to a standstill, and we shall treat of its revival during the last forty or fifty years in a subsequent section.

Collections.—The Victoria and Albert Museum and the British Museum contain typical examples; but not such collections as are to be seen in the Cluny Museum, the Louvre, the museum at Sèvres, or the French provincial museums at Rouen, Limoges, Marseilles, Lille, St Omer, &c.

Literature.—Deck, *La Faience* (Paris, 1887); Gasnault and Garnier, *French Pottery* (Victoria and Albert Museum Handbooks, 1884); Le Breton, *Le Musée céramique de Rouen* (Rouen, 1883); Milet, (?) *Historique de la faience et de la porcelaine de Rouen* (Rouen, 1898); Pottier, *Histoire de la faience de Rouen* (Amiens, 1870); L'Abbé H. Requin, *Histoire de la faience artistique de Moustiers*, tome I^er (Paris, 1903); M.L. Solon, *The Old French Faience* (London, 1903)—the best survey of the whole subject, with a very full bibliography. The various volumes of the *Gazette des beaux-arts* contain many valuable original articles.

(W. B.*)

German, Dutch and Scandinavian Pottery

In northern Europe until the time of the Renaissance the making of tiles is the only branch of the potter's craft of artistic rank. The pavement tiles of Germany of the Gothic period, examples of which have been found in the valley of the Rhine from Constance to Cologne, often bear designs of foliage or grotesque animals full of character and spirit. Their decoration is effected either by impression with a stamp of wood or clay, or by "pressing" the tile in a mould to produce a design in relief. The surface is sometimes protected by a lead glaze—green, brown or yellow—but is generally left unglazed.

Glazed tiles with relief ornament were also made as early as the 14th century for the construction of stoves, such as have continued in use in Germany to the present day. About 1500 a development took place in the combination of glazes of different colours on a single tile. In the middle of the 16th century Renaissance ornament appears in place of Gothic canopies and tracery, and blue and white enamels begin to be used in combination with lead glazes of other colours. Figures in the costume of the period, or shields of arms, in round-arched niches are a favourite motive alike in the stove tiles and in the wares of similar technique known as *Hafnergefässe*, which have been wrongly attributed to Hirsvogel of Nuremberg. These were made not only in that city but also in Silesia and at Salzburg, Steyr, and elsewhere in Upper Austria; their manufacture continued into the 18th century.

Imitations of Italian majolica with polychrome painting on a white enamelled ground were first made in southern Germany about 1525, and it is with these wares that the name of Hirsvogel should really be associated. The same style survived for more than a century and a half in the stoves and pottery made by the Pfau family at Winterthur in Switzerland, from the end of the 16th century onwards. An interesting development is exhibited by certain rare productions, of Silesian origin, dating from about 1550, with decorations in coloured enamels which are prevented from flowing together by a strong outline incised in the clay.

Stoneware.—The most important feature of the history of German pottery is the development of stoneware along the valley of the Rhine. This ware is of a highly refractory white or grey body of intense hardness, glazed by the introduction of salt into the kiln when the highest temperature was reached. It was exported in large quantities through the markets of Cologne

and Aachen (Aix-la-Chapelle) to England, France and other parts of northern Europe. The frequent occurrence in its decoration of the arms of foreign cities and princes shows that the German potters were alive to the requirements of foreign customers.

The oldest centre of this manufacture seems to have been at Siegburg near Coblenz, where the white stoneware peculiar to the neighbourhood, made from local clay, must have been made and exported in considerable quantities at least as early as the 15th century; plain beer-jugs of that date with cylindrical neck and slightly swelling body have been unearthed in London and the eastern counties of England. In the 16th century an artistic development took place, and the potters were formed into an exclusive gild under stringent regulations. The manufacture lasted till the sack of the town by the Swedes in 1632, subsequent attempts to re-establish it being unsuccessful. This ware, of a creamy white colour, generally thinly glazed and only rarely coloured by staining with cobalt blue, is decorated by impression with small stamps or by the application of reliefs pressed from separate moulds. The motives include sacred and classical figure subjects, portraits of contemporary sovereigns, and armorial bearings, with accessory foliage in which a survival of Gothic feeling is often perceptible. Characteristic forms are the high tankard (*Schnelle*) and the ewer with long spout (*Schnabelkrug*), but the fancy of the potter also found expression in various quaint or extravagant forms.

At Raeren in the duchy of Limburg this industry attained importance about 1550, and was continued for over seventy years; 1539 is the earliest date known to occur on this ware. The pieces were of two kinds, brown-glazed and grey; the latter usually decorated with blue. The favourite form is a baluster-shaped jug with heraldic designs or a frieze of figures round the middle. The subjects are from Scripture history or contemporary peasant life as interpreted by Hans Sebald Beham and the German and French “Little Masters.” Examples are known bearing dates and names or initials of mould-cutters, among them Ian Emens and Baldem Mennicken; but it must not always be inferred that a piece is as old as the date introduced in its decoration, for the same set of moulds might be used for many years.

Another important centre in the 16th century was at Frechen near Cologne. Round-bellied jugs known as *Bartmänner*, from the bearded mask applied in front of the neck, covered with a brown glaze, which in later examples is often coagulated into thick spots, were first made here towards the end of the 15th century, and continued to be the staple product well into the 17th. The jugs of this type, known as Greybeards or Bellarmines, which were exported in profusion to England, Scandinavia and the Low Countries, were mostly made here. At Cologne itself there were also factories, probably before the 16th century, the later productions of which resemble those of Frechen.

During the 17th and 18th centuries the busiest stoneware centre was the district surrounding Höhr-Grenzhausen in Nassau known as the Kannebäckerländchen, where artistic ware was being made before 1600. Soon after that date manganese purple was first used in the decoration in addition to cobalt blue, and henceforward colour in combination with impressed and incised ornament tended more and more to supersede decoration in relief. Figure subjects gave place to rosettes, foliage on wavy stems, and geometrical patterns. Vessels of large size and fantastic shape appear beside the standard forms of the earlier factories. In the 18th century the forms of beer-vessels became stereotyped in the globular jug with cylindrical neck and the cylindrical tankard, while tea and coffee pots, inkstands and other vessels, hitherto unknown, began to be made. A stoneware manufacture dating back to the middle ages existed at Creussen in Bavaria. The productions of this district during the 17th and 18th centuries consist of tankards of squat shape, jugs and jars, of a dark red body, covered with a lustrous dark brown glaze, frequently painted after the first firing in brilliant enamel colours with figures of the Apostles, the electors of the Empire, or other oft-repeated motives. Imitations of the wares of Raeren and Grenzhausen were made at Bouffioulx near Charleroi; other minor centres of the manufacture were at Meckenheim near Cologne and Bunzlau in Silesia.

As in England, so in Holland (by Ary de Milde and certain Delft potters) and in Germany, attempts were made with some success, early in the 18th century, to imitate the Chinese red stoneware, known as *boccaros*. The early efforts of Böttger, the discoverer of the secret of true porcelain, at Meissen, belong to this category. His red ware is of such hardness that it was cut and polished on the lapidary’s wheel. For some time after the manufacture of red ware at Meissen had ceased, a glazed brown ware of less hard body with gilt or silver decoration was made at Bayreuth. The products of other minor factories of this class cannot now be identified.

Mention may be made of the lead-glazed peasant pottery, such as the bowls produced at Marburg with quaint symbolical devices modelled in relief and applied. Slip-covered wares with *graffiato* decoration, apparently of indigenous growth and not inspired by foreign examples, were made well on into the 19th century near Crefeld and elsewhere in Germany, at Langnau in Switzerland, and by German emigrants in Pennsylvania. In Holland a peculiar green-glazed ware was made in the 18th century with pierced geometrical decoration recalling the Dutch carved woodwork of the period.

Delft.—One of the most remarkable phenomena in the history of pottery is the appearance about 1600, in a highly developed state, of the manufacture of a tin-enamelled earthenware at Delft. It was introduced in that town by Herman Pietersz of Haarlem, but whence he learned his art is unknown. The faience-makers (*plateelbackers*) were one of the eight crafts of Delft which formed the Gild of St Luke founded in 1611. About 1650 a great development took place, and till the latter years of the 18th century, when its faience was ousted by the more serviceable wares of the English potteries, Delft remained the most important centre of ceramic industry in northern Europe. The ware is of fine buff-coloured clay, dipped after the first firing in a white tin-enamel, which formed the ground for painted decoration; after painting, this was covered with a transparent lead glaze and fired a second time, so that in its technique it belongs to the same class as the painted Italian majolica and the old French faience. At its best it is rightly ranked among the greatest achievements of the potter's art.

Characteristic of the first period are dishes and plaques in blue monochrome with somewhat overcrowded scenes of popular life in the style of the engravings of Goltzius. Imitations of the oriental porcelain imported by the Dutch East India Company were introduced about 1650 by Aelbregt de Keizer and continued for some time among the finest productions. At the same time the earlier tradition was developed in the finely painted landscapes and portraits of Abraham de Kooge and Frederick van Frytom. Other potters of the best period were Lambartus van Eenhorn and Louwys Fictoor, makers of the large reeded vases with Chinese floral designs in polychrome, Augestyn Reygens, Adriaen Pynacker, and Lucas van Dale; to the last are attributed the pieces with yellow decoration on an olive-green enamel ground. The rare examples with polychrome decoration on a black ground in imitation of Chinese lacquer are the work of Fictoor and Pynacker. With the 18th century came a largely increased demand and a consequent deterioration in artistic quality. The rise of the German porcelain factories had its effect in the introduction of overglaze painting fired in a muffle kiln, typified by the work of the Dextras, father and son. This innovation, by which the Delft potters attempted to compete with European porcelain, contributed to the ruin of their art by eliminating the skilled touch required for painting on the unfired enamel. The ware frequently, but not invariably, bears a mark derived from the sign of the factory (the rose, the peacock, the three bells, &c.), or the name or initials of its proprietor.

A small faience factory was started by Jan van Kerkhoff about 1755 at Arnhem; its productions were of good quality, chiefly in the rococo style, marked with a cock.

The exportation of the Delft ware to Germany occasioned the rise of numerous factories in that country for making faience in imitation of the Dutch. Among these may be named Hanau (founded about 1670), Frankfort and Cassel. Others, such as Kiel and Stralsund, drew their inspiration from the productions of Marseilles and Strassburg (*q.v.*). At Nuremberg a factory was founded in 1712, which was but little affected by extraneous influences; among its characteristic productions are dishes with sunk decoration in the form of a star, and jugs with long necks and pear-shaped bodies, often spirally fluted. Similar wares were made at Bayreuth. The Dutch and French styles were carried by German potters into Scandinavia; factories were established at Copenhagen in 1722, at Rörstrand and Marieberg near Stockholm in 1728 and 1758, and at Herrebøe in Norway about 1759.

At the close of the 18th century the influence of imported English earthenware was strongly felt. In Holland workshops were established for painting the English cream-coloured ware with subjects suited to the Dutch taste; and in Germany cream-coloured wares and *steingut* in imitation of Wedgwood's productions were manufactured at Cassel, Proskau and elsewhere. The "Delft" ware of Holland during the 17th century was a beautiful decorative ware, in which the Dutch painters caught successfully the spirit, and often the very colour value, of Chinese blue and white porcelain. Its fame spread over the whole of Europe, and its styles were readily imitated by the potters of all other countries who made a similar ware. Even the polychrome Delft, though not nearly so beautiful as the "blue and white," is strongly decorative, and one sees in the polychrome faience of northern France and of Germany more than a trace of its influence. When this ware was supplanted by English earthenware it was a clear instance of a ware that was technically superior displacing a more artistic product.

PLATE VI.

Calaggiolo: 16th century.

Faenza. Casa Pirota, 1525.

Urbino. Decorated by Orario Fontana.

Urbino. 1525 (?). A plate of the famous Gonzaga Este service.

Faenza: early 15th century.

Collections.—For German wares the German museums are naturally best. The museums at Munich and Nuremberg contain splendid collections of the tin-enamelled and peasant wares of South Germany. Cologne has a wonderful collection of the Rhenish stoneware, and Berlin and Hamburg have good general collections. Copenhagen and Stockholm are especially good for

Scandinavian wares, and Zürich for Swiss. There are also good collections of German stoneware in the Victoria and Albert and the British museums, and in the Cluny Museum, the Louvre, and the museum at Sèvres; but there are no notable collections of the German tin-enamelled wares out of Germany. The wares of Delft may be best studied in the museums at the Hague and Amsterdam. There is an interesting collection at the factory of Thooft and Labouchère in Delft. The principal museums in England, France and Germany all have fair to good collections of this renowned ware.

LITERATURE.—For tiles and peasant pottery, see Forrer, *Geschichte der europäischen Fliesen-Keramik* (Strassburg, 1900; chapters on the Netherlands and Germany); Walcher von Molthein, *Bunte Hafnerkeramik der Renaissance in Österreich ob der Enns und Salzburg* (Vienna, 1906); Hafner, *Das Hafnerhandwerk und die alten Öfen in Winterthur* (Winterthur, 1876-1877); Barber, *Tulip-ware of the Pennsylvania German Potters* (Philadelphia, 1903). For stoneware, see Solon, *The Ancient Art Stoneware of the Low Countries and Germany* (London, 1892); Van Bastelaer, *Les Grès wallons* (Mons, 1885). For Böttger's red ware, see Berling, *Das Meissner Porzellan* (Leipzig, 1900), chap. iii. For Dutch faience, see Havard, *Histoire de la faïence de Delft* (Paris, 1878), and article by same author on "La Faïence d'Arnhem" in *Gazette des beaux-arts*, 2nd series, vol. xx. (1879). For German faience, see von Falke, *Majolika* (Berlin, 1896), and articles by Stieda, "Deutsche Fayencefabriken des 18. Jahrhunderts," in *Keramische Monatshefte*, vols. ii. and iii. For Scandinavian pottery, see Nyrop, *Danske Fajence og Porcellainsmaerker* (Copenhagen, 1881); Stråle, *Rörstrand et Marieberg* (Stockholm, 1872); Grosch, *Herrebøe-Fayencer* (Christiania, 1901). Excellent accounts of most branches of the subjects are given by Brinckmann, *Das hamburgische Museum fur Kunst und Gewerbe* (Hamburg, 1894).

(B. RA.)

LATER WARES OF SPAIN AND PORTUGAL

We shall only deal at length here with those important kinds of pottery that have exerted real influence on the historical development of the art. Offshoots from the main stem that have developed little or no individuality can only be briefly mentioned. When the characteristic Spanish-Moorish lustre wares ceased to be desired by the wealthy they rapidly sank into insignificance, though as a decorative peasant pottery their manufacture never really ceased and has been revived again in our day. The course of pottery importation was changed and the now fashionable Italian majolica was brought into Spain in the 16th and 17th centuries, as Hispano-Moresque wares had followed the opposite course two centuries earlier. Besides the influence which these imported wares had on the Spanish potters, a number of wandering Italian majolists found their way into Spain, so that we find the use of painted colour, particularly blue, yellow, orange, green and purple, making its appearance at various centres, around Valencia, at Triana near Seville, &c., but the most important manufacture was at Talavera in the centre of the peninsula. The best of this ware recalls the late Italian majolica of Savona, and the influence of Chinese porcelain designs, probably filtered through to the Spanish potters by the then popular enamelled Delft wares, is very apparent. The potteries of Talavera are mentioned as early as 1560, and they continued at work, with varying fortunes, down to the end of the 18th century. Many and varied wares were produced, including tiles as well as pottery; the most common pottery pieces are dishes, bowls, vases, *tinajas*, holy-water vessels, drug-pots, and hanging flower vases, together with moulded and painted snails, owls, dogs, oranges, almonds, walnuts, and every kind of fruit. Apart from the poorer colour the baroque style of ornament also rendered the ware much inferior to that of Italy or of France. The popular Talavera wares were imitated elsewhere in Spain, and a number of factories existed at Toledo in the 17th century, but their wares are very inferior. In the 18th century, besides debased imitations of this ware, some coarse but striking pottery was made at Puente del Arzobispo near Toledo.

An interesting offshoot from the Talavera potteries is to be found in the tin-enamelled wares made at Puebla, Mexico, from the early 17th century. It is said that Spanish potters were settled at this place by the Dominicans soon after 1600; and the making of a debased form of Spanish majolica continued there for nearly two centuries. See Barber's "Tin-Enamelled Pottery," *Bulletin of the Philadelphia Museum*, 1907. During the 18th century determined efforts were made by King Charles III. and by the famous Count Aranda to improve the Spanish pottery wares, as well as to introduce the manufacture of porcelain. The efforts of the king led to the foundation of the porcelain works at Buen Retiro near Madrid, which will be mentioned later, and considerable success also attended the revival of strong copper lustre, like that of the late Hispano-Moresque wares; but the finest tin-enamelled wares were those made at Alcora in the important factory founded by Count Aranda in 1726, which continued in operation down to the French wars. For his purposes the count brought from Moustiers, then one of the famous French pottery centres (see above), Joseph Olerys, a well-known pot-painter. He went to Alcora as chief draughtsman and designer, having charge of a number of Spanish potters and painters. Olerys introduced the Moustiers style of decoration, and the glaze and body of the Alcora wares of the best period recall the fine quality of Moustiers faience. It is only fair to add that Olerys in

his turn learnt the use of various delicate yellow and green colours from the Spaniards, and when he returned to France in 1737, having acquitted himself most honourably, he introduced this new style of delicate polychrome decoration at Moustiers. The mixture of motives and ideas that animated the duke and his potters may be seen by the following list of wares produced about 1750. Vases of different shapes; small teapots; teapots and covers, Chinese fashion; teapots and covers, Dutch fashion; cruets, Chinese style; entrée dishes; salt-cellars, Chinese style; *escudillas* (bowls) of Constantinople; *barquillos* (sauce-bowls), Chinese style; cups, plates, and saucers of different kinds with good painted borders in imitation of lace-work, and finally fruit-stands, salad-bowls and dishes, trays and refrigerators. Later in the century the manufacture of porcelain was introduced here, as well as white earthenware made in imitation of the productions of Wedgwood, and the tin-enamelled wares flickered out in Spain as they did elsewhere.

The manufacture of a kind of debased majolica was also practised in Portugal from the 16th century down to our own times; but the ware never attained to any distinction and is little known outside that country. The best-known specimens were made at Rato, near Lisbon, where a factory was founded in 1767 under the patronage of the court.

Mention must be made of the unglazed native pottery of Spain and Portugal, for wine-jars, water-jars and bottles, cooking pots, and other domestic utensils are still made in these countries for ordinary domestic use, in traditional forms and by methods of the most primitive kind. Many of these vessels, especially the *tinajas* (wine-jars) and water-coolers, are based on ancient, classical or Arab forms, and in every country market-place it is still common to see groups of vessels, in unglazed pottery of fine shape and finish, exposed for sale—a very different state of things from what obtains in France, Germany, and particularly in England, where the primitive methods of the peasant are being imitated by those who ought to know better. From the 16th to the 18th century a special kind of unglazed pottery vessels known as *buccaros* was extensively made both in Spain and Portugal. The body of the ware is unglazed, whitish, black or red, according to the special kind of clay. The curious point about this ware is that, if we may believe contemporary documents, the vessels were delicately scented, like a ware imported from Mexico; and the soft vessels are said to have been eaten—a custom common enough in certain parts of Central and Southern America. (See M.L. Solon, *The Noble Buccaros*, 1896.)

(W. B.*)

English Pottery from the 16th to the 18th Century[21]

Fig. 50.—Saxon cinerary urns; the stamped patterns are shown.

The course of pottery manufacture in England followed, generally rather in the rear, that of France, Germany and other northern countries. Before the coming of the Romans much pottery of the late Stone age and the Bronze age was made in Britain. The Romans introduced their more advanced technique, and, besides importing Italian and Gaulish pottery, they founded numerous centres of pottery manufacture, as at Upchurch, Castor, Uriconium, &c. With the departure of the Roman legions their simple, yet comparatively advanced, pottery vanished, and Saxon and early Norman times have left us little but

Fig. 51.—Common forms of medieval pottery; the upper part of the slender jug is covered with a green vitreous lead glaze; the other is unglazed with stripes of red ochre.

wares resembling those of the Germanic and Frankish productions (fig. 50). The early middle ages passed without much improvement, and, though rare specimens—like the ewer in the form of a mounted knight in Salisbury Museum—proved that glazed wares were made in this country, the general run of our medieval pottery vessels never soared above the skill of the travelling brick or tile maker.[22] The monastic tile-makers, with their strong, Gothic tile pavements, produced artistic work of a very high order; but the patrons of the common potter remained content with his rudely made and simply glazed pitchers, flagons, dishes and mugs (see fig. 51). Even in the 16th century the excellence of English pewter probably acted as a barrier to the introduction of finer pottery, and it was only the importation of foreign wares—Italian, German, Dutch and French—that stirred up our native clay-workers to the possibilities of their art. In early Tudor times there was some importation of Italian majolica as well as of the Hispano-Moresque pieces, and the religious wars as well as the constant intercourse with the Low Countries brought over to the eastern counties not only the stonewares of the Rhineland and the "Delft" wares of Holland, but also emigrant potters from those countries who tried to practise their native crafts amongst us. The Civil War appears to have been unable to check this new spirit, for we have the evidence of dated examples to show that various immigrants went on quietly practising their trade along the Thames side, in what were then the outskirts of London, and probably in the eastern counties and Kent as well. It seems probable that the earliest influence was an Italian one, but before this was firmly domiciled it was supplanted by that of the Dutch and Germans. The first wares of an improved kind that were made in England are so closely related to the German stonewares and the "Delft" wares that it is often difficult to determine whether actual specimens are of English or foreign origin. The first, and in some senses the greatest, of English potters was John Dwight, an educated man, who had held the office of secretary to three successive bishops of Chester, and who obtained a patent in 1671 for the manufacture of certain improved kinds of pottery. We have no knowledge where Dwight acquired his skill in the potter's art, for when he obtained his patent he was residing at Wigan (Lancashire), far removed from the districts where foreign potters had settled. About 1672-1673 Dwight set up a factory at Fulham, where he resided till his death in 1703. He was always an eager experimenter, and from his diaries it seems certain that he was searching after the, then, mysterious Chinese porcelain. We have no grounds for believing that he ever attained success in this search, for his known productions may be grouped into two main classes: (1) Hard-fired red stoneware—mostly small vessels, teapots, mugs, &c., in imitation of the Chinese buccaros.[23] (2) Whitish, grey, or drab salt-glazed stoneware made in imitation of, and often not to be distinguished from, the wares of the Rhineland. But Dwight produced a considerable number of modelled portrait-busts, statuettes, &c., all in stoneware of various tints, which entitle him to a place in the very first rank of potters. The portrait-bust of Prince Rupert (British Museum), the statuettes of Meleager (British Museum), of Jupiter (Liverpool), &c., are worthy of a sculptor of the Italian Renaissance, while the recumbent effigy of Lydia Dwight (Victoria and Albert Museum) is one of the most beautiful works ever executed by an English potter.

Meantime the manufacture of tin-enamelled pottery, in the style of "Delft," was prosecuted with increasing industry in London on the south side of the river, and particularly at Lambeth. By the end of the 17th century the same imitation "Delft" wares were made at Bristol and Liverpool, continuing until, in the closing years of the 18th century, tin-enamelled earthenware was abandoned in favour of the perfected English cream-colour. There is a strong family likeness in all this English "Delft," whether made at Lambeth, Bristol or Liverpool. The body of the ware is harder and denser than in the tin-enamelled wares of the continent, and is not so suitable for its special purpose, as it is generally deficient in lime. The decoration is usually painted in cobalt blue of good tone, though inferior in softness and richness of tint to that of the best Delft pieces; polychrome painting was not so common, and it differs from that of the Dutchmen in the greater prevalence of a pale yellow colour and the general absence of any good red like that found on the polychrome wares of Delft, Rouen, Sic.

German stoneware also received a well-merited share of attention long before the time of Dwight, and it is often impossible to distinguish the grey and brown ale-jugs, greybeards, &c., presumably of English manufacture in the 17th and early 18th centuries, from their German prototypes. Fulham remained an important centre of this manufacture, and a fine brown stoneware was largely made at Nottingham as early as 1700; in each case the manufacture continues in neighbouring districts to this day.

The development of a native English pottery took place in North Staffordshire. A growing community of peasant potters, who manufactured some strongly decorative English wares by very simple means, was established here from the middle of the 17th century. Rudely fashioned dishes, jugs, bottles, &c., were shaped in the local red-burning brick clays, and, while the pieces were still soft, simple but effective decorative patterns were drawn upon them in diluted white clay (slip), trailed on through a quill or from a narrow-spouted vessel. This ancient and world-wide process (for it was used by the Ptolemaic Egyptian, the Roman and the Byzantine potters) has furnished the peasant potters of every European country with characteristic wares, but

nowhere was it used with greater skill than in England. The English slip-decorated wares are often spoken of as “Toft ware,” because Thomas Toft, living in what is now Hanley (Staffordshire) boldly signed and dated many of his pieces (1670, &c.); but similar wares were made at Wrotham in Kent, in Derbyshire, Wales and elsewhere. The repute of the Staffordshire district must have spread by the time of the Revolution, for soon after 1690 John Philip Elers, a Dutchman of good family, settled there and began to make a superior pottery to any previously made in the district. Elers is generally described as a great inventor who brought all kinds of knowledge into the district, but the only wares he is known to have made were singularly like those of Dwight, and, quite recently, records of a lawsuit in which Dwight charged Elers and some other Staffordshire potters with suborning his workmen and infringing his patents have been brought to light. It is certain that, from the time of Elers, the Staffordshire potters made great advances in the fabrication of their wares, and during the 18th century they evolved two distinctively English kinds of pottery, (1) the white and drab salt-glaze, (2) English earthenware.

Staffordshire Salt-glaze.—It is uncertain when and how the Staffordshire potters learnt that a highly siliceous pottery could be glazed by throwing common salt into the kiln at the height of the firing, for the practice had originated in the Rhineland more than a century before. Many writers have maintained that the practice was introduced by Elers, but this is uncertain. Early in the 18th century a fine, white, thin, salt-glazed ware was made in Staffordshire, in many quaint and fanciful forms largely influenced by Chinese porcelain—still an object of wonder and mystery. Teapots, coffee-pots, tea-caddies, plates, dishes, bowls, candlesticks, mugs and bottles were made in great variety, and at its best the ware is a dainty and elegant one, so that a brisk trade was developed in the district, and, for the first time, a distinctively English pottery was exported to the continent and to the American colonies.

English Earthenware.—The manufacture of tin-enamelled pottery scarcely obtained a foothold in Staffordshire, but the invention of the white salt-glazed ware paved the way for one of the greatest revolutions in the potter’s art that the world has ever seen. This was nothing less than the abandonment of the ordinary red or buff clays with a coating of white slip or of tin-enamel, and the substitution of a ware white throughout its substance, prepared by mixing selected white-burning clays and finely-ground flint (silica).[24] The change has generally been associated with Wedgwood, most famous of English potters, but he really only perfected, along with his contemporaries, the Warburtons, Turners and others, the work of half a century’s experiment and discovery. The ware compared most favourably, from the point of view of serviceableness, neatness and mechanical finish, with all that had gone before it, and as the tin-enamelled wares had almost everywhere in Europe sunk to the position of domestic crockery—for the Chinese, German, French and English porcelains had displaced it with the wealthy—this better-fashioned and more durable English ware gave it its final death-blow. English earthenware in its various forms was to be met with all over Europe, from London to Moscow, and from Cadiz to Stockholm; and, aided by emigrant English potters, the continental nations soon began a similar manufacture for themselves. Everywhere this great change was encouraged by the growing fondness for mechanical perfection, and it is not without a sigh that a lover of pottery can witness the gradual disappearance of the painted tin-enamelled wares—degenerate survivals though they were of Italian majolica, French faience and Dutch “Delft”—before the unconquerable advance of another form of pottery which in its inception was based on technical rather than artistic qualities, especially as nearly a century passed before the new material was turned to artistic account.

By general consent the name of Josiah Wedgwood has been pre-eminently associated with this great change, and with good reason, for though he had many contemporaries who equalled or even excelled him in certain kinds of pottery, no other potter ever approached him in the range of his products and the varied applications to which he turned the exercise of his remarkable talents.[25] True, he soon abandoned the simple Staffordshire wares, coloured with mottled glazes or clay-slips, to which the names of Astbury or Whieldon are commonly attached, but the varied productions of his factory united the best work of a district fruitful in new kinds of pottery, with something especial to Wedgwood himself. Thus he adopted and improved the green and yellow glazes which had come down from medieval times (see the cauliflower ware piece, Plate X.), and gave a new direction to their use in his green-glazed dessert services, candlesticks, &c. He carried on the manufacture of hard-fired red-clay teapots, mugs, coffee-pots, cream-jugs, &c., introduced by Elers; and, along with his fellow-potters, he invented drab, grey, brown and other colours in similarly hard-fired unglazed bodies. He neither invented nor alone perfected the Staffordshire cream-coloured earthenware, but he made it so well that his “Queen’s ware” was the best of its class. He undoubtedly invented the Jasper ware, in which on grounds of unglazed blue, green, black, &c., white figures and ornamental motives, adapted from the antique by Flaxman, Webber and other sculptors, were applied; and he even attempted to reproduce the painted vases of the Greek decadence in dry colours painted over a hard black body.

Wedgwood’s “Jasper ware,” his most original production (see Plate X.), differed both in nature and composition from all the species of pottery that had preceded it. In an attempt to obtain the

qualities of the finest porcelain biscuit, Wedgwood discovered, after years of experiment, that by mixing together a plastic white clay and “cawk” or barytes he could obtain a “body” which might be “thrown” on the wheel or “pressed” in moulds, and which, while it fired to a white and sub-translucent pottery, was capable of being coloured, by the usual metallic oxides, to various shades of blue, green, yellow, lilac and black. The ware resembled “biscuit” porcelain in that it needed no glaze to render it impervious to water, and it thus marked the culmination of those “dry” or unglazed wares that had been so largely made in China, Japan and Europe, where the quality resides in the fired clay material without any adventitious aid from a glaze. The general practice was to make the body of the vessel of a coloured material and to ornament this with applied figures or ornamental reliefs, in “white” of the same kind, “pressed” from intaglio moulds and then applied by wetting the surface and squeezing—leaving the fire to unite the vessel and its applied ornament into one piece. Sometimes the ornament was in a coloured clay applied on a white body, and we get in the same way black on red, buff on red or black, and red or black on buff and drab bodies. The variety of bodies produced by Wedgwood and his followers in this way is exceedingly great, and is only to be equalled by the diversity of their application, for the pieces made include plaques, vases, plates, dishes, jardinières, bulb-pots, teapots, cups and saucers, inkstands, scent-bottles, buttons, buckles, and, in a word, every kind of thing that could be made in clay. Many of the applied designs, whether of figures or ornament, were very beautiful in a way, being copied or adapted from Greek and Roman gems, vases, &c. At their best they are marvellous for the precision and delicacy of their execution, and it is impossible to imagine that anything better could have been done in this style. So perfectly did they represent the taste of their period that attempts were made at Sèvres, Meissen, Berlin and Buen Retiro to produce something of the same kind in porcelain; but none of these can be compared with the works of Wedgwood, or his great contemporary Turner (see Plate X.), in beauty of colour or perfection of workmanship.

It is obvious nowadays that much of this work was inspired by mistaken motives; that it was founded on an imperfect view of ancient art; and that it was marred by its mechanical ideals; but it must be remembered that it was in perfect harmony with the spirit of the times, and that 744
while it emphasizes for us the pseudo-classic taste of the late 18th century, it marks an advance in the technical skill of the potter, which is simply astounding. The co-ordination of labour, which had gone further with the Greek and the Italian potter than is generally supposed, was now brought to a climax. Mechanical appliances were introduced for the performance of many portions of the potter’s work that had hitherto been indifferently performed by rude and exhausting manual toil; and while the application of mechanism was pushed too far—so that in the first half of the 19th century we find the most inartistic pottery the world has ever seen—we must regard this even more as a cyclic movement of human feeling than as the work of any individual, or group of men. The late 18th century marks the period when pottery was no longer produced, as Italian majolica, the Henri-Deux ware, the Palissy wares, the best faience of Nevers, Rouen, Moustiers, Delft or Nuremberg had been, for the noble or the wealthy, but when it was largely in demand by the poorer classes, anxious in their turn to have a useful ware which should imitate the more costly porcelain used by the great. France, Germany, Sweden, Russia, and later the United States, all followed in the wake of the English potters, and the printing-press was applied in all countries to produce elaborate engraved patterns in blue, brown, green, &c., in order to get an effective-looking ware in harmony with the spirit of the times, and at the same time cheaper in price than the simple painted patterns of the vanquished tin-enamel.

Collections.—The British and the Victoria and Albert Museums naturally contain the most representative collections of English pottery. The museums at Liverpool, Bristol, Burslem, Hanley and Nottingham, also have good collections, while Birmingham, Manchester and Stoke-upon-Trent may be mentioned. The Guildhall Museum, London, is rich in early wares found or made in London and its vicinity. Continental collections of English pottery are meagre in the extreme and badly described, even in the ceramic museums at Sèvres and Limoges. The collection at Dresden is interesting, as it was purchased from the collection made by Enoch Wood, a Staffordshire potter. In America, the Boston Museum of Fine Arts, the Metropolitan Museum of New York, and the Pennsylvania Academy of Fine Arts at Philadelphia, contain interesting examples of wares exported to America in the late 18th and early 19th centuries.

Literature.—The earliest compilations, such as Jewitt’s *Ceramic Art in Great Britain* (1878), and *Life of Josiah Wedgwood* (1865); Chaffers, *Marks and Monograms* (1863; 9th edition revised, 1900); Meteyard’s *Life of Wedgwood* (1865-1866), and Shaw’s *History of the Staffordshire Potteries* (1829; reissued London, 1900), must always be of interest as original sources of information; but the later works, such as Church, *English Earthenware* (1884; new edition, 1906); *Josiah Wedgwood* (1894, reissue 1903 and 1907); Solon, *Art of the Old English Potter* (1883; 2nd ed., 1885); Hobson, *Catalogue of English Pottery in the British Museum* (1903); Burton, *English Earthenware and Stoneware* (1904), are the best authorities.

(W. B.*)

Chinese Pottery and Porcelain[26]

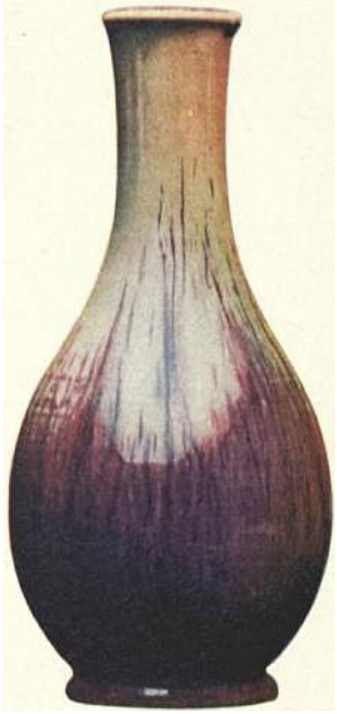
In China, as in every other country where pottery-making has been practised for centuries, we find a natural progression from primitive pottery akin in shape, decoration and manufacture to the pottery of other primitive races the world over. We find too the early use of bricks, tiles, &c., as in Egypt and Assyria; and then the usual succession of domestic utensils, funeral vases, and vessels for religious ceremonials. There is nothing to show that the potter's wheel made its appearance in China earlier than elsewhere, and the Chinese potters have used the simple methods of carving and "pressing" from moulds which preceded the use of the potter's wheel, even more than other nations. In books of the Chow dynasty (1122-249 B.C.) the difference between the processes of "throwing" and of "pressing" from moulds is clearly described,[27] and it is instructive to note that many early as well as late forms of Chinese pottery are remarkably like their works in bronze. In the same way there is no definite date to which we can refer the introduction of glazed pottery. The earliest specimens of glazed ware known are referred by the Chinese to the times of the Han dynasty (206 B.C.-A.D. 220), a date much later than that of the earliest glazed wares of Egypt and Assyria. Remembering the intercourse between China and the West, at times historically remote, it is not impossible that the idea of coating a vessel of clay with a glaze was carried into China from Chaldaea or Assyria. In any case the Chinese developed the potter's art on their own lines, for we have ample evidence that from very early times they fired their pottery to a much higher temperature than was common in the west of Asia, and so discovered types of glaze and of pottery that remained for centuries a mystery elsewhere. The glazed wares of the Han dynasty already mentioned are quite unlike any contemporary pottery produced in Syria, Egypt or Europe, for the body of the ware is so hard that it can scarcely be scratched by a knife, and the dark-greenish glaze has become iridescent by age as though it contained oxide of lead. The easily-fired friable wares of Assyria, Egypt and Greece seem to have had no attraction for the Chinese, and the glazes on their hard-fired wares were naturally different from those already described. The Chinese appear to have been the first potters in the world to discover that at a sufficiently high temperature pottery can be glazed with powdered felspathic rock mixed with lime. At first these glazes were used on any ordinary refractory clay which might burn red, drab or buff; but in this technique lay the germ of Chinese porcelain, the most advanced form of pottery the world has yet seen. It is necessary to consider the pottery that preceded porcelain, for not only was it the matrix out of which porcelain grew, but in certain districts of China, where the necessary materials for porcelain are not found, similar wares have been manufactured without intermission to the present time. Naturally, in progress of time, the technique of this pottery has been greatly improved, both by developments in the preparation and mixture of the clays, the shaping and modelling of the wares, the introduction of coloured enamels or glazes, and the like. Dr Bushell, who is our great authority on the Chinese arts and handicrafts, rightly seizes on two outstanding types of Chinese pottery other than porcelain which have exercised considerable influence on the doings of European potters.

1: *Yi-Hsing-Yao*.[28]—This is the pottery, generally of unglazed fawn, red or brown stoneware, made at Yi-hsing-hsien in the province of Kiang-su. Articles of every kind are made in these fine-coloured clays, but the general forms are dainty and skilfully finished pieces, such as small teapots, cups, saucers, dishes, trays, water-bottles and wine cups. This ware was largely manufactured under the Ming dynasty (A.D. 1368-1643) and later.[29] It was imported into Europe by the Portuguese, who applied to it the name *boccaro*, formerly given only to a scented terra-cotta brought from Mexico and Peru.[30] This pottery and Chinese porcelain were wide asunder as the poles in nature as well as origin, but the potters of northern Europe regarded every kind of pottery coming from the Far East as a species of porcelain, and the manufacture of red teapots, mugs, bowls, cups, &c., in imitation of the Yi-Hsing-Yao was widespread during the late 17th and early 18th centuries under the name of red porcelain. Dwight, Elers and Böttger are notable names in this connexion.

2. *Kuang-Yao*.—The name given by the Chinese to the pottery made in the province of Kwang-tung. There are several centres of manufacture in this extensive province, but for the purposes of this article it is sufficient to state that the best-known of these wares are dense, hard-fired and glazed stonewares, which are always dark-coloured grey, red, brown or blackish. They are usually glazed with thick, variegated or opalescent glazes, grey, blue, green, yellow or red, but flecked, veined and streaked with other tints. The wares are so like the productions of the Sung dynasty (A.D. 960-1279) that modern pieces are often confounded with the more precious productions of that epoch. One of the first lessons to be learnt by the student of Chinese pottery is that, with great reverence for their own antiquities, the Chinese of every period have endeavoured to reproduce the famous wares of their ancestors, and often with such skill as to deceive the most expert. Even when the manufacture of porcelain was at its highest in King-tê-chên, the potters in other parts of China carried on the production of glazed or unglazed pottery in coloured clays, and, further, the directors of the imperial factory from time to time strove to reproduce the most archaic wares that could be found in the Empire.

Chinese. Sang de Bœuf.

Chinese. Turquoise glaze “crackled.”



Chinese. Flambé.

Purple Soufflé. Coral red. Peach blow. Pigeon’s blood. Lemon yellow. Apple green.

Porcelain.—By this word we distinguish broadly all those pieces of pottery in which the body of the ware is vitrified and translucent, and also, broadly speaking, in which the material is white throughout, unless minute quantities of metallic oxides have been definitely added to colour it. It is impossible to draw any hard and fast line between porcelain and stoneware, for both may be thoroughly vitrified and translucent in thin pieces—but generally the stonewares are drab, red or brown in the colour of the fired clay, and they seldom exhibit the precious quality of translucence. If the body of a piece of pottery is not even vitrified, however hard it may be, it is terra-cotta or earthenware. The Chinese, accustomed from a very early period to fire their pottery to a high temperature, produced vitrified stonewares before any other nation. Moreover, they glazed these stonewares with fusible mineral substances, and from that stage the natural refinements of methods must necessarily have produced porcelain. In regions where beds of primary clay were found, the body of the ware would burn whiter than elsewhere, and a mixture of limestone or marble with the felspathic rock would give a glaze of greater purity and brilliance and one that was more readily fusible and Would spread better over the whole piece. How many centuries were needed before a ware white enough and translucent enough to be now classed as porcelain was produced we cannot know; but the process was certainly one of gradual evolution. Some Chinese writers in their zeal for ancient things have ascribed to remote periods the production of wares of this class. Where authentic specimens are not to be found it is necessary to proceed with caution, and literary evidence alone cannot be deemed sufficient to settle such a difficult point. The balance of opinion at the present time is that something worthy of the name of porcelain was made during the Tang dynasty (A.D. 618-907), but we have no pieces earlier than the Sung dynasty (A.D. 960-1259), and the majority of these are perhaps more fitly described as stoneware than as porcelain.

Under the Sung dynasty China enjoyed great material prosperity, and all the arts were cultivated assiduously. Pottery of distinguished merit was made in many districts, and much of it has been classified as porcelain because the body is whitish and vitrified, though it is much inferior in finish and in translucence to the perfect white porcelain of later times. It is necessary to realize, too, that we have no record of any pottery with painted decoration until perhaps the very end of the 13th century; such ornament as was used consists entirely of designs incised or modelled in the clay. But the principal decoration is to be found in the varied coloured glazes with which the wares, whether stoneware or porcelain, were covered. The glaze is never clear and white as at later times; it is generally uneven, imperfectly fused and presents all the marks of an imperfect technique. The nearest approach to white is found in an opalescent grey which shades off to greenish and bluish tints. The glazes of this period which are most highly valued are the *céladons*, a family of cool bluish or yellowish greens of indescribable depth and softness. Besides the *céladons* which are the most uniform in tints of the Sung glazes, we get many shades of palish lavender, brownish yellow and brownish black, but these are all subtly or boldly mottled, splashed, clouded or veined with strange tones of red, blue, purple, opalescent grey and black. The most famous of these now very rare Sung wares were the stonewares of Chunchow, remarkable for their rich and varied glazes, the black variegated glazed wares of Fu-kien province, “hare’s fur cups” and “partridge cups” of collectors, and the four principal wares that may be called porcelain, viz.—the *Ju-Yao*, made at Ju-chow in Honan; the *Kuan-Yao* (Kuan = “official” or “imperial”), made first at Pien-chow and afterwards at Hang-chow; the *Ko-Yao*, made at Liu-t’ien; and the *Ting-Yao*, made at Tung-chow in Chih-li.

This was the period when Chinese porcelain became known beyond its native country, for the first mention of porcelain outside China appears in the writings of a Mahommedan traveller, Sulaiman, who visited China in the 9th century and wrote: “They have in China a very fine clay with which they make vases which are as transparent as glass; water is seen through them”;[31] and its first appearance in the west is always given as A.D. 1171 (or 1188), when Saladin sent a present of forty pieces to the sultan of Damascus. From this time onwards an export trade was developed, particularly in the *céladon* wares of Lung-chüan, a city in the south-west of the province of Chehkiang. This famous ware, the “green porcelain” of the Chinese, probably made as an imitation of jade, exists mostly in the form of thick heavy dishes, bowls and jars, bearing incised or fluted patterns, and coated with a remarkable thick green glaze of indescribable softness of tone. Though the body of the ware is white when it is broken through, any parts not covered by the glaze have a reddish-brown colour due to the unrefined paste, and when the ware was reproduced in later times this reddish-brown tint had to be imitated artificially. The ware was highly prized both in China and Japan, in the islands of the East Indies, and in all Mahommedan countries. In Persia it was largely used, and specimens of it have been recovered during the last century from the east coast of Africa and as far west as Morocco. “Archbishop Warham’s cup” at New College, Oxford, which is the first specimen of Chinese porcelain to reach England that we can now produce, is a *céladon* bowl with a silver-gilt mount of the time of Henry VIII.[32]

The Sung dynasty was overthrown by the Tatars under Kublai Khan (grandson of Jenghiz Khan), and the power remained in Tatar hands until 1368, when the great native dynasty of the Mings was established. During this period (Yuan dynasty), roughly a century, one can say little of ceramic progress, for the wares of the period are singularly like those of Sung times. But two important changes took place which had a marked influence on the subsequent development of Chinese porcelain—(1) the concentration of the industry at King-tê-chên, which was consummated in the early years of the Ming dynasty; (2) the introduction of painted decoration under a white transparent glaze, the idea of which (and perhaps the necessary cobalt mineral) was brought from Persia.

King-tê-chên was already a pottery centre when its factories were rebuilt in 1369 by Hung-Wu, the founder of the Ming dynasty, who made it the imperial factory, so that the best porcelain workers were attracted thither, and in the other old centres the industry was abandoned or some earlier manufacture was continued, as in the southern province of Kiang-su. In the province of Fu-kien a distinct kind of porcelain manufacture has also continued. We have already mentioned the black glazed cups, “hare’s fur,” &c., made in this province in Sung times, and, while King-tê-chên was to be the scene of the developments of the coloured and painted porcelains, Te-hwa in Fu-kien perfected the manufacture of the famous and beautiful white porcelain in bowls, dishes, cups and statuettes, best known under its French title of *blanc de Chine*.

The earliest painted Chinese porcelains, which are referred to the beginning of the Ming period, though some of them may be older, speak strongly of ideas imported from the west of Asia. The pieces are massive both in form and substance, and the ornament, consisting of figures mounted or on foot, animals, bands of diaper or foliage, or pendant necklaces, is strongly silhouetted by a raised outline recalling the decorative methods of the Assyrian brickwork. The technical methods also recall the methods of western Asia, for the ware was

fired before it was glazed, and then yellow, turquoise, green or purple glazes, similar in nature to the glazes of Egypt, Syria and Persia, and quite unlike the Chinese Sung glazes, were filled into the outlined spaces and melted at a lower temperature. The Grandidier collection in the Louvre, the Franks collection at the British Museum, the Victoria and Albert Museum, as well as all the great private collections of Chinese porcelain, contain samples of this primitive and archaic-looking ware.

The great stream of porcelain decoration was, however, to take an entirely different direction. The Persian pottery with its brilliant painted decorations in blue, green and purple on a pure white ground, exercised its natural fascination over men as keen in colour-sense as the Chinese potters. With the concentration of the industry at King-tê-chên, and the rapid improvement in technical skill and knowledge that followed, the production of a fine porcelain with a transparent white glaze was perfected. Of all the colours used by the Persian pot-painter the only one that would endure the fierce fire of the Chinese porcelain was the blue obtained by using the ores of cobalt, and with this colour, and a wonderful blood-red obtained from copper, the foundation of Chinese painted porcelain was laid. It would be idle to try and fix any specific date for this important development, which took more than a generation to perfect, but it is reasonably accurate to say that the blue and white painted porcelains were unknown in the 13th century and were fully developed at the beginning of the 15th century. Chinese collectors prize most highly the blue and white of the reign of Suen-tê (A.D. 1426-1435), of Chêng-hwa (1465-1487), and next of Yung-lo (1403-1424). It is interesting to note that the colour used during these reigns is spoken of as “Mahommedan” blue, so that it was evidently brought from some country to the west. This 15th-century blue and white porcelain is admittedly the finest of its class, and though the Chinese never abandon an old method and have continued to make blue and white porcelain, often of very good quality, the later wares, fine as they may be, rarely equal these.

The under-glaze red, an invention of the Chinese, has already been mentioned, and this most difficult of all ceramic colours was largely used during the same period. At first it appears as a general ground colour for the outside of bowls and cups, then vessels were made in special forms (persimmon fruit, &c.) to display its qualities, finally it was used either alone or in conjunction with blue in painted designs under a white glaze of exceptional quality. A Chinese connoisseur of the 15th century describes one of his pieces as being decorated with “three red fishes on a white ground, pure as driven snow; the fish boldly outlined and red as fresh blood, all with colour so brilliant as to dazzle the eye.”

Other characteristic wares which made their appearance in Ming times are the marvellous “eggshell” porcelains, called by the Chinese “bodyless” from their extreme thinness. As early as the reign of Yung-lo (1403-1424) these delicate wares were in high repute, and their manufacture has been continued ever since with varying skill and success. In spite of their extreme thinness the specimens have designs of dragons in the midst of clouds and waves, inscriptions, &c., engraved in the paste before firing. In the fine white specimens the design is so delicate that it is barely visible until the vessel is filled with liquid or held to the light. Others were covered with a coloured glaze which serves to accentuate the design, and the most prized of these are the yellow pieces made during the reign of Hung-Chi (1488-1505) and Chêng-tê (1506-1521).

Another wonderful variety of Chinese porcelains which made its appearance at this period is the well-known perforated ware, commonly spoken of, from the shape of the perforations, as “grain of rice” porcelain, though the Chinese have exhibited consummate skill in the manufacture of perforated pieces of all kinds. Sometimes the perforations are left clear, but in the rice-grain pattern the incisions are generally filled up with the melted glaze so that they become like so many windows in the walls of the piece. We have already seen that the Persian potters used a similar method of decoration in the 16th century, but we are unable to say at present whether the device originated in China or in Persia. Its use in both countries is only an additional proof of the intercourse between eastern and western Asia.

It is only toward the end of the 16th century that we find the first examples of porcelain decorated with colours fired over the glaze. It seems probable that the practice grew out of the use of enamels on metal, which had spread from Byzantium to China, and which the Chinese developed with remarkable skill. It is important to remember that the very nature of the glaze of Chinese porcelain, necessitating such a high temperature to melt it, severely restricted the under-glaze palette to cobalt-blue and the glorious but uncertain copper-red. To obtain the rich polychromatic schemes of the potters of the West some other means must be found, and so the device was adopted of taking a finished piece of blue and white and decorating it further by very fusible colours painted over the fired glaze and then attached to it by refiring at a lower temperature equal only to that used by the enameller on metals. At first the on-glaze or enamel colours were applied as thin washes, as in the Ming (*San ts’ ai*) three-colour decoration of green, purple, and yellow. Then we get the Ming (*Wan-li Wu ts’ ai*) five-colour scheme, in which

the same three colours are combined with an over-glaze red and all are painted over a skeleton pattern in under-glaze blue. This development, as its name implies, only took place in the reign of Wan-li (1573-1620).

At this time King-tê-chên must have produced a very large quantity of porcelain. The requirements of the court were enormous, for in 1583 one of the supervising censors, remonstrating with the emperor, declared that one year's demands comprised over 96,000 pieces; and Dr Bushell writes: "The colossal production of the reign of Wan-li is shown by the abundance of porcelain of this time to be found in Pekin at the present day, where a garden of any pretensions must have a large collection of bowls or cisterns for goldfish, and street-hawkers may be seen with sweetmeats upheld by dishes a yard in diameter, or ladling syrup out of large bowls, and there is hardly a butcher's shop without a cracked Wan-li jar standing on the counter to hold scraps of meat."

Such profuse orders may be accountable for the fact that the wares of this reign are inferior both in material and workmanship to the wares of the preceding and also of later periods, but the influence of the growing export trade doubtless told in the same direction. For several centuries the native Chinese porcelain had been exported to all the neighbouring countries, and through Persia and Cairo to the West. No long time elapsed before the Chinese adopted forms, colours and decorations for these export wares, not in accordance with Chinese usage, but presumably more suited to the tastes of the foreigner. Hence the Persian and Syrian style of the painted blue decoration of the 15th and 16th century wares found in other Asiatic countries. Now, for the first time, there came a direct European demand, and cargoes of ware were brought to Europe by the Portuguese and afterwards by the Dutch, which were increasingly decorated in fashions foreign to Chinese taste. The production of these export wares slowly modified the taste of the Chinese themselves and paved the way for the new styles of the late 17th and early 18th centuries.

The political troubles which marked the downfall of the Ming dynasty definitely separated the first great period of Chinese porcelain from its second and culminating period. The works at King-tê-chên were destroyed more than once in the 17th century, but in spite of these difficulties the potters must have remained, for the reigns of K'ang-hi (1662-1722), Yung-chêng (1722-1735), and K'ien-lung (1736-1795) covered a century and a half, within which the high-water mark of artistic production was reached and passed. It is only possible here to sketch in broadest outline the course of this Renaissance, which has formed the subject of many learned works.

It is characteristic of the Chinese mind that during this period, when a spirit of eager experiment was abroad, the productions of their ancient kilns should receive no less attention than the new methods of decoration in on-glaze colours, while at the same time many of the discoveries of the later Ming days were carried on to perfection. The first remarkable productions of the reign of K'ang-hi, the famous green and blood-red *Lang-yao* glazes, were made in the attempt to produce glazes like those of old times. With the more carefully prepared 747
body and glaze the results are strikingly different and, as we think, superior, for it is difficult to believe that any example of the "sacrificial" red of the reign of Suen-tê can have been as glorious as the red *Lang-Yao*, the crown of all that group of glazes known from their general colour as *sang de boeuf* (see example, Plate VII.). In the same way the traditional blue and white of the Ming period was continued with the greatest skill, and, if the blue pigment be not so pure as that of the 15th century, the decorative effect of the blue and white of the reign of K'ang-hi (see example, Plate VIII.) has never been equalled in Europe. The subjects of the blue and white pieces of this period are very varied, including religious, ceremonial, battle and hunting subjects, homely scenes such as ladies and children amusing themselves in gardens, or animals, birds, dragons and other fabulous monsters disporting themselves in clouds or waves. The so-called "hawthorn ginger jars" form a class by themselves in the opinion of modern collectors (see the plum-blossom jar, Plate VIII.), a specimen being sold at the Louis Huth sale (1906) for £5900. The fertility of the painters was remarkable, and a collection of the blue and white of this reign offers a fine feast of ceramic colour from the harmonious relation between the tones of the white and the blue, especially when it is seen *en masse*, as in the famous Dresden collection.[33]

The practice of painting the ground of a piece in blue so that the pattern was reserved in white (even artfully heightened by the use of slip) dates from Ming times, but the grounds of powder-blue appear to have originated at this time. The cobalt-pigment was not applied by a brush, but was blown on through a tube, one end of which was covered with fine muslin, in a rain of minute drops. This ground was either carried over the whole piece so as to give the effect of a vibrating blue glaze—in which case it was generally covered with conventional designs pencilled in ground-up gold-leaf over the glaze—or panels were reserved in white on which floral designs were afterwards painted in on-glaze colours.

In the same way the decoration in underglaze red was revived or re-introduced, and probably the finest pieces of this ware, as of so many others in our great European collections, date only

from the beginning of the 18th century. Eggshell wares and pierced or reticulated pieces were made to great perfection, and the coloured glazes in light green, turquoise, purple and black (see Plate VII.) reached their height. The early glazes of this type appeared in Sung times (see above), but on the finely prepared K'ang-hi wares much more striking and brilliant colour effects were obtained. As in old times, for the production of some of these glazes a departure was made from the general Chinese methods. The vessels were first fired to the "biscuit" state, and then soft alkaline glazes coloured with copper or manganese were fired over them at a much lower temperature so as to give the "peacock-blue," "kingfisher-green" and "aubergine-purple" glazes. Many varieties of single-coloured glazes were made by covering a white glazed piece with on-glaze colour, and in this way new shades of coloured glaze, such as the coral-reds (Plate VII.), were obtained. The various brown or bronze-coloured grounds, so well known in the so-called "Batavian" porcelain, were obtained by coating the piece with a slip of some ochreous clay under the usual white glaze. Even these methods do not exhaust the fertile resources of the potters of this period, for they carried on concurrently the style of decoration in overglaze colours, first in the schemes characterized by the predominance of a vivid green enamel (*famille verte*; see Plate VIII.), and finally, in the 18th century, in the schemes in which rose, pink and purple colours predominate (*famille rose*; see Plate VIII.). It is probable that these latter colours, which owe their tint to gold, were introduced into China from Europe, but the Chinese employed them whole-heartedly, until in fact they largely ousted all the earlier types of colour decoration.

During the reign of Yung-Chêng (1723-1735) the diverse styles seem to have been finally struggling for mastery. Yung-Cheng was an ardent collector of ancient Chinese porcelains, and he sent to King-tê-chên specimens of the most ancient wares, whether of pottery or porcelain, to be reproduced, while at the same time he and his court patronized the wares in foreign styles and colours (Japanese and European.)

The struggle continued practically to the end of the 18th century, but in spite of certain brilliant inventions, such as the "iron-rust" and "tea-dust" glazes of the reign of K'ien-lung in harmony with old Chinese effects, what we must regard as the inferior decorative style triumphed, and we see the gradual disappearance of the ancient methods in favour of (1) wares of a beautiful white body decorated only with on-glaze colours, principally those of the *famille rose*, and (2) a very large production of inferior wares, made in European shapes and decorated with on-glaze painting and gilding to suit the European taste of the 18th century.

This "armorial" china, so much of which was once foolishly ascribed to Lowestoft, has little to commend it. The material is seldom of the best quality, and the Chinese rendering of European arms and crests, or stiff copies of European engravings surrounded by quasi-oriental borders of diaper, &c., does nothing to recommend it. A great deal of this ware, though manufactured at King-tê-chên, was decorated at Canton, and the school of pottery decorators founded there by reason of this export trade also produced a certain number of pieces in pure Chinese taste, especially some of the ruby-backed plates and dishes and the small cups and saucers decorated with deftly-painted designs of cocks, peonies, &c.

It must be pointed out that the great change implied in the replacement of patterns painted in blue under the glaze by those painted in colours over the glaze profoundly influenced the style of painting. In the earlier wares the treatment is bold and vigorous as becomes true pottery colour, and the softening of the colour by the melting glaze adds to the artistic charm of the result. Painting on a fired glaze is like painting on glass—fine lines, delicate drawing, and skilful stippling or cross-hatching are just as natural in this method as they are impossible or uncertain in the other. Naturalism of rendering takes the place of conventional decorative treatment, and elaborate minuteness of finish supplants the broad freedom of direct brushwork. During the 18th century the same leaven was at work on the porcelains of China and of Europe, the East influenced the West, and the West in its turn bore down the East. If Chinese porcelain remained superior to its European counterfeits, it was because the Chinaman was still the better potter and had a longer tradition of decorative art behind him.

There is little to be said of Chinese porcelain during the 19th century. The European demand was practically killed by the growth of porcelain works at home, and the imperial patronage, so great a factor in the production of artistic wares, was fitful and uncertain. Tao-Kwang (1821-1850) gave some attention to porcelain, and the pieces made for him and marked "*Shen-te-t'ang*" are valued by collectors. The so-called Peking bowls of his reign (made of course at King-tê-chên) are also of repute. But the political difficulties of China left little leisure for the cultivation of the arts; the successive wars with France and England served only to scatter the splendid wares of the past (see the Musée Chinoise at Fontainebleau), and during the reign of the next emperor Hien-fêng (1851-1861) the T'aipings overran the province of Kiang-si and destroyed King-tê-chên and its factories. Since then the town has been rebuilt and is once again producing Chinese porcelain. Tempted doubtless by the high prices now paid in Europe and America for examples of the Chinese porcelains of the 18th century, modern copies of the single-coloured, *sang de boeuf*, *flambé* and other glazes are being made, while the highly prized

“hawthorn” jars and black-ground vases are receiving the same undesirable attention.

Materials and, Manufacture of Chinese Porcelain.—For many centuries after its first appearance Chinese porcelain differed from every other known species of pottery both in its material and its manufacture. While the pottery of all other countries was generally made of coloured clays mixed only with sand or broken “shards” and fired at a comparatively low temperature, Chinese porcelain was compounded from the purest white clays, sand and fusible rock; it was glazed with fusible rock, and it was so hard fired that the entire mass became vitrified and translucent. The germ of the manufacture lay in the discovery of large masses of primary clay (kaolin) mixed with finely-ground felspathic rock (petuntse), both of which were carefully washed, levigated and purified. The body of Chinese porcelain varied from time to time within wide limits, but, broadly speaking, it always consists of purified kaolin, petuntse and quartz (sand), mixed in various proportions, sometimes with additional ingredients, according to the quality of ware desired. For the glaze the purest and cleanest portions of the felspathic rock (petuntse) were selected and mixed with lime—all being ground to fine powder. The lime causes the glaze to melt at a lower temperature than would be necessary for petuntse alone. The lime also gives the Chinese glazes their luscious softness of aspect and the faint greenish or bluish tone, while it enabled them to receive the later decorations in piled-up enamels, impossible on the harder European porcelain glazes of the 18th century. The finely-prepared glaze was applied to the clay vessels, before they had been fired, either by dipping, by painting, or by insufflation; and then glaze and body were fired together at a very high temperature. For certain glazes—turquoise, purple, &c.—which were not of the felspathic type, the vessels were first fired to the “biscuit” state, and the glazes were then applied and fired at a much lower temperature—the usual practice of the potters of other countries. When painted wares in blue and red were first introduced, the necessary pigments were painted on the pieces before firing, the glaze was applied over them, and then all was finished at one and the same firing. With the later enamel colours the piece was first fired as above described, and the fusible colours were then painted on the glaze, which was of course like glass. A second firing at a lower temperature fused these on-glaze colours to the ware. For information on Chinese materials and methods the reader is referred to the letters of Père d’Entrecolles in the collection of Jesuit letters known as *Lettres édifiantes et curieuses*. The English reader will find reliable translations of the essential parts in Bushell’s *Oriental Ceramic Art*, Dillon’s *Porcelain*, and Burton’s *History of Porcelain*. Later information will be found in Brongniart’s *Traité des arts céramiques*, especially in the 3rd edition, 1877; and in an article by G. Vogt, *Bulletin de la Société d’encouragement pour l’industrie nationale*, April 1900, pp. 530-612.

Collections.—The Franks collection in the British Museum; the Victoria and Albert Museum, where the famous collection of Mr George Salting has for years been displayed, together with the collections belonging to the museum. Paris, the Grandidier collection at the Louvre; the collection at the Musée Guimet; the Sèvres Museum. Fontainebleau, the Musée Chinoise. Dresden, the Porcelain Collection—the oldest in Europe. Boston, the Museum of Fine Arts. New York, the Metropolitan Museum containing the Garland and other collections. Washington, the Hippisley collection; as well as magnificent private collections, at the head of which is that of the late W.T. Walters of Baltimore.

Literature.—The older European works on Chinese porcelain have been superseded by the later books. The following list contains the best recent books:—S.W. Bushell, *Oriental Ceramic Art* (New York, 1897; text separately 1899); *Chinese Porcelain before the present Dynasty* (Pekin, 1886); *Chinese Art*, vol. ii., Victoria and Albert Museum Handbooks (1906); Brongniart, *Traité des arts céramiques* (3rd edition, with valuable supplements by Salvétat, 1877); Dillon, *Porcelain* (1900); Sir A.W. Franks, *Catalogue of Oriental Pottery and Porcelain* (1878); Grandidier, *La Céramique chinoise* (1894); Griggs, *Examples of Armorial China* (1887); Hippisley, *Ceramic Arts in China* (Smithsonian Institute, Washington, 1890); Hirth, *Ancient Chinese Porcelain* (Leipzig, 1888); Julien, *Histoire et fabrication de la porcelaine chinoise* (Paris, 1856); Meyer, *Lung-chuan Yao, oder alter Seladon Porzellan* (Berlin, 1889); Monkhouse, *History of Chinese Porcelain* (1901); O. du Sartel, *La Porcelaine de Chine* (Paris, 1881); Burton, *Porcelain* (1906); Bushell and Laffan, *The Garland Collection in the Metropolitan Museum of New York* (1907).

(W. B.*)

European Porcelain to the end of the 18th Century

Europe can claim no share in the discovery of porcelain, the white and translucent pottery *par excellence*, for when the first specimens of Chinese porcelain were brought to Europe, perhaps as early as the 11th or 12th century, they excited the greatest wonder and admiration. Cairo was at this time the great mart for the exchange of the products of East and West, and from this centre porcelains were sent into Europe. Nasir i Khosrau, the Persian traveller, who visited Old Cairo in a.d. 1035-1042, was evidently acquainted with Chinese porcelain, and he also speaks of a translucent ware made at Fostat (Old Cairo) which may well have been the progenitor of the glassy porcelains of Persia, as well as of those made in Italy during the 15th and 16th centuries.

In A.D. 1171 the famous Saladin sent from Cairo a present of forty pieces of Chinese porcelain to the sultan of Babylon; and from that time onwards we have frequent records of pieces of this exotic pottery finding their way into the treasuries of European princes. With the renewed attention paid to the potter's art in Europe after the 14th century, it was but natural that efforts should be made to imitate a material so mysterious and beautiful. But knowledge of Chinese materials and methods was *nil*, and for a further two centuries all that Europe manufactured in the shape of translucent pottery was the artificial porcelain made with glass, which can only be looked upon as a substitute for true porcelain. In Italy during the 16th century, and in France during the century from 1670 to 1770 roughly, this artificial porcelain was made and developed. At Meissen in Saxony the famous Böttger made a true porcelain from materials analogous to the Chinese about 1710-1712, and this manufacture was pursued in Germany, Austria and elsewhere in Europe (even in France, the home of the artificial glassy porcelain, after 1770), so that by the end of the 18th century, when Chinese porcelain had reached and passed its zenith, the manufacture of a similar material was well established in Europe, and the glassy porcelains had been generally abandoned. The only country which offered any departure from this general rule was England. The earliest English porcelains were derived from the French, and, like them, owed their translucence to the use of glass. Efforts were made at Plymouth and at Bristol (1758-1781) to introduce the manufacture of porcelain, like the Chinese and its German counterparts, but these failed and the English potters finally invented a third kind of porcelain, in which calcined ox-bones were added to the clay and ground rock to give a white translucent porcelain capable of receiving any form of decoration. This distinctively English porcelain, perfected about 1800, is not only the principal kind made in England in our own times, but its manufacture has been adopted, to some extent in France, Germany and Sweden, as well as in the United States.

It is impossible to describe these various efforts of European potters without a certain amount of overlapping, for during the 18th century all the three kinds of European porcelain were struggling for supremacy. It is advisable, therefore, to keep clearly in mind which kind of porcelain is in question, for many problems of manufacture and decoration are absolutely determined by the nature of the materials.

If we could trust to documentary evidence alone, the earliest European porcelains were made at Venice in 1470, and again in 1519; while we also read of its manufacture at Ferrara in 1561.[34] Unfortunately, documentary evidence alone is not conclusive, and the first European porcelain, known from actual specimens as well as by documentary evidence, was that made at Florence in the laboratory of Francesco de' Medici, between 1575 and 1585. Specimens of this rare porcelain are to be found only in great museums and private collections, where they rank among our chief ceramic treasures. They show clearly that the Florentine potters never fully mastered their difficult material, for the ware is always imperfect and compares indifferently in whiteness and translucence with fine porcelain, while the glaze is neither smoothly melted nor free from defects. Obviously the effect of Chinese blue and white porcelain was aimed at, the decorations, reminiscent of the style of the Persian pot-painters, being executed in cobalt blue alone. These rare and interesting pieces bear distinctive marks; for at their period the use of painters' marks or monograms had become fairly general on artistic pottery in Europe. One of the best known marks is the "palle" or balls of the arms of the Medici family, bearing the letters "F M M E D II." for "Franciscus Medici Magnus Etruriae Dux II."; while other pieces have a rude representation of the Great Dome of Florence and the letter "F."

Florentine Potter's mark.

PLATE VIII.

Chinese. K’ang-hsi period.

Chinese. Black ground. K’ang-hsi period.

Chinese (*Famille Verte*). K’ang-hsi period.

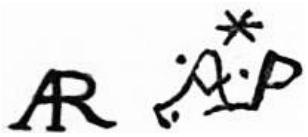
Chinese (*Famille Rose*). Ch’ien-lung period.

Chinese. Plum-blossom jar. K’ang-hsi period.

Fortunately, too, besides the few specimens of Florentine porcelain that have survived to our day a manuscript has been found in the Magliabechian Library at Florence which states that the paste was composed of 24 parts of sand, 16 of a glass (powdered rock crystal 10 and soda 8), and 12 parts white earth of Faenza. To 12 parts of this mixture 3 parts of the kaolinic clay of Vicenza were to be added, and the pieces glazed with a lead glaze, or sometimes with the tin-enamel of the Italian faience maker. We are in the presence, therefore, of a material unlike Chinese porcelain in every respect, the Florentine porcelain being the first of a long line of European porcelains the artistic qualities of which were obtained by mixing a large quantity of glass with a small quantity of clay, so that they may almost be regarded as a species of glazed and painted glass. The technical methods used in their manufacture and decoration, however, were those of the potter and not of the glass maker.

With the death of Francesco de’ Medici in 1587 it seems probable that this wonderful innovation came to an untimely end, and we hear no more of porcelain in Italy for more than a

century. During this century (1587-1687) there can be no doubt that efforts were made all over Europe to discover the secret of porcelain manufacture; but the first reliable date we can point to is 1673, when Louis Poterat, a faience maker of Rouen, obtained a privilege from the French king for the manufacture of porcelain in that town. The Rouen porcelain in turn ceased with the death of Poterat in 1696. Authentic specimens are extant in the shape of salt-cellars, mustard pots and some few vases, the latter of considerable size. The pieces are usually decorated in blue with patterns in the Rouen style and were evidently painted by an expert faience painter. In composition, the porcelain of Rouen, like that of Florence, was of the artificial or glassy type, and shortly afterwards a similar ware made its appearance at the faience works of St Cloud near Paris, and at various works in the city of Paris. Well-known pieces, bearing the marks here shown, formerly supposed to be the earliest specimens of French porcelain and the work of Poterat at Rouen, are probably experimental pieces made in Paris after the date of Poterat's discovery, as they differ in important particulars from his ware.



Paris Potters' marks.

Once firmly established in France, this manufacture, under the patronage of the French court or of some great French noble, rapidly assumed a position of importance. The works at St Cloud received letters-patent from Louis XIV. in 1696, and the manufacture was continued there down to 1773. The appearance of the St Cloud porcelain is very characteristic, for though the paste has a yellowish tinge it is of fine quality with a clear and brilliant glaze. The first efforts appear to have consisted in frank imitations of the much-prized Oriental wares, and white pieces decorated only with branches of flowering plum in relief, or pieces modelled with imbricated or scale pattern or with delicate flutings, were made. The earliest colour decoration was naturally in under-glaze blue, and while quasi-oriental designs were largely used, the commonest feature is the prevalence of painted borders like those used on the faience of Rouen and St Cloud. At a later date decoration in over-glaze colours and gilding was also employed, and though the ware never reached to such a pitch of excellence as that of the Royal Manufactory at Sèvres, the St Cloud porcelain is one of the most distinctive French porcelains of the 18th century.

St Cloud Potters' marks.

German Porcelains.—While the glassy porcelains of France were being developed at St Cloud, success of a more permanent order was reached in Germany. Augustus the Strong, elector of Saxony (1670-1733), had formed an extensive collection of Chinese and Japanese porcelains, still to be seen in the Dresden Museum, and he had established experimental pottery works, bringing skilled potters from Holland and elsewhere. His chief investigators appear to have been Tschirnhaus and Böttger, both alchemists, and it was the glory of the latter to be the first European to produce a porcelain like the Chinese, both in the nature of its materials, and in the appearance of its paste and glaze. It may be surmised that Böttger was guided toward this momentous discovery by information brought from China, though such an idea is always stoutly denied by German authorities, who, with pardonable pride, claim that Böttger at the age of twenty-four succeeded where all other European experimenters had failed. He was certainly working at the problems offered by the exotic wares of China, for his first production was an extremely hard redstone-ware—often erroneously called "Böttger's red porcelain"—resembling the Chinese "boccaros" or red teapots of the Yi-hsing potteries. He had been anticipated in this direction by Dwight of Fulham, but the red pottery of Böttger was so intensely fired that it became dense enough to be cut and polished by the lapidary as if it were a piece of jasper or carnelian. It was first offered for sale at the Leipzig fair of 1710, and for many years it enjoyed great popularity, as well as the undesirable honour of wide imitation. At the same time (1710) Böttger exhibited a few crude specimens of greyish-white porcelain. Imperfect pieces were on sale in 1713, and by 1716 its manufacture was definitely established, though the pieces were still far from perfect. Böttger died in 1719, having had the rare fortune, in his short and eventful life, to establish in Europe the manufacture of true porcelain.

The life of Böttger reads like a page of romance, and the story of the subsequent development of porcelain manufacture throughout the German empire is hardly less romantic. When the importance of Böttger's discovery was recognized, he and his workmen were removed from Dresden to the Albrechtsburg, a fortress situated at Meissen some 16 m. away, so that the manufacture could be conducted with the greatest secrecy. All concerned were practically state prisoners, and this extreme rigour doubtless defeated the end in view, for workmen escaped from time to time, and professing, more or less truthfully, a knowledge of the manufacture, found patrons among the German princes all eager to gain reputation as experimenters in the new art of porcelain. Some of these wandering "Arcanists," like Ringler and Hunger, and the men who learnt from them, travelled all over the empire, and the following list of dates will show how porcelain factories sprang up from the parent factory at Meissen:—

Meissen	1710	St Petersburg	1744
Vienna	1718	Berlin	1750

Ansbach	1718	Nymphenburg	1758
Bayreuth	1720	Ludwigsburg	1758

Meissen.—Although the factory which was founded at Meissen as a result of Böttger's discovery remained on its old site until 1863, the porcelain made there has been commonly known as Dresden porcelain; probably because Dresden was the seat of the Saxon court, and the enterprise was conducted at the expense of the electors of Saxony. So jealously were the secrets of this factory guarded that when Napoleon, the master of Europe, sent Brongniart to investigate the methods in use at Meissen in 1812, the elector of Saxony had to release Steinauer, the director, from his oath of secrecy before he would explain the processes. Meissen porcelain, therefore, affords us the best example by which we may follow the changes of fashion and taste that governed the styles of porcelain decoration in Europe during the 18th century. The early Meissen porcelain was made from the kaolin found at Aue, near Schneeberg, and while there is no mention of any other material, we may be sure that clay and felspathic rock, analogous to the Chinese *kaolin* and *petuntse*, were obtained from the same quarries, and were used together. Until after the death of Böttger in 1719 it cannot be said that the venture was more than a *succès d'estime*. The specimens preserved in the Dresden Museum show that the pieces were generally thick in substance and clumsy in shape, being often made from the moulds that had been designed for Böttger's red-stoneware. Naturally enough these early examples were inspired by Chinese models, both in shape and decoration. As at St Cloud, white pieces with modelled decoration were common. Unlike the contemporary French glassy porcelains, the decorations in under-glaze blue were very imperfect, the blue colour being much 750
run and blistered; and when attempts were made at decoration in enamel colours (*i.e.* colours fired on the finished glaze) the result was unsatisfactory, as, owing to the refractory nature of the hard felspathic material, these colours frequently scaled off. The later success of the Meissen factory must be attributed to Herold or Höroldt (who joined the staff in 1720 as a colour maker and painter), and to Kandler, a sculptor, who came to the works in 1731. In the hands of these two men the forms and decorations, still largely based on Chinese and Japanese models, assumed a definitely European style, while the composition of the body and the glaze, and the application of colours and gold, were brought to perfection. Herold was appointed director of the works a few years after 1720, and retained that post until 1765, while Kandler was chief modeller from 1731 to 1775. The years from 1730 (when the work definitely emerged from its experimental stage) to 1775 (when Kandler died) mark the most distinctive period of the Meissen porcelain. In the estimation of collectors also the Meissen porcelain of this period is the most valuable, and genuine examples of *Alt-Meissen* command high prices in the sale rooms, especially in Germany. This appreciation was quite as apparent in the 18th century, for by 1740 Meissen porcelain had won the greatest renown in Europe, and was actually exported by way of Constantinople over the Mahommedan countries of the Nearer East. It is frequently described by contemporary writers as being far superior to the porcelain of China, and so great was its vogue between 1740 and 1750 that as many as 700 workmen—a large number for those days—were employed, and the industry brought large profits as well as great reputation to the Saxon court. Each year saw some fresh departure from the original inspiration of the work, some fresh innovation of European style in design. After 1730 the rude reproductions of Chinese forms and decorations in white or blue and white were replaced by imitations of the Imari porcelains, especially those decorated in the style of Kakiemon. Here Meissen was running a race with Chantilly in setting the fashion for the dainty decorations in red and green and gold which spread in time to all the porcelain factories of Europe. Gradually European *motifs* became predominant. The simple oriental forms were replaced by distinctively European shapes with architectural mouldings, handles and feet. Instead of the dainty Japanese patterns, we perceive the gradual introduction of "Rococo" scroll-work (as interpreted by the Germans) to form a framework or border for miniature-like paintings of landscapes, ruins, figure-subjects, hunting scenes, &c., executed in the limited palette of on-glaze colours then available. Further evidence of the departure from oriental influence is to be found in the numerous "armorial" services produced between 1730 and 1740; and at the same period we find the first appearance of a style of decoration that has persisted to our own times, as a means of passing off pieces with small flaws in body or glaze, by hiding them among sprays of naturalistic flowers, with an occasional fly or some other winged creature thrown with seeming artlessness over the surface of the piece. This idea, though it seems to have been first used at Meissen, was so useful to the potter that it became general, and a device originally adopted to cover faults of manufacture was elevated into a distinct style of decoration by later European factories (*e.g.* Strassburg, Niederviller, &c.).

The talents of Kandler were applied in ambitious but unsatisfactory attempts to produce life-sized figures of the twelve apostles, an equestrian statue of Augustus the Strong of heroic proportions, and many models of animals intended for the decoration of the Japanese palace at Dresden. Many of these latter are to be seen in the Dresden Museum, and create an unfavourable impression of the taste of their period. The fame of Kandler is better perpetuated (see example, Plate IX.) by the little statuettes and groups of figures and animals that flowed in

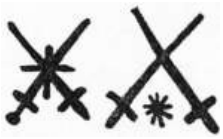
a steady stream from his facile hand; for though these figures have prettiness rather than grace, and *flair* rather than style, they are instinct with the spirit of the middle 18th century, and were eagerly imitated or boldly copied at every factory in Europe. Only in the *biscuit* porcelain figures of Sèvres, and in some few of the portrait figures of Derby, do we find anything artistically superior. These Meissen statuettes look their best when they are simply in white; many are grotesque and ugly, and the colour decorations are usually in very poor taste, the harsh, shining colours contrasting unpleasantly with the pronounced white of the porcelain.

Mention must be made of the use of modelled flowers at Meissen. Originating in the simple application of modelled branches of prunus, &c. in imitation of the white porcelains of Fu-kien, the method developed until we get not only the characteristic "May-flower" decoration (see example, Plate IX.), but also independent sprays and bouquets modelled in porcelain and coloured with the utmost mechanical precision. It is not quite clear whether this production of porcelain flowers was first perfected at Meissen or at Vincennes,[35] but it was largely practised at both places.

Toward the end of this period, vases, candelabra, mirror-frames and clock cases were modelled in the most *outré* rococo forms with applied scrolls, shells and flowers. These pieces had their modelled details picked out in gold and colours, while the success of the French styles of decoration is still further shown by the copies of Watteau figures and groups on the more important vases, dishes and plates. Frederick the Great made sad havoc with the prosperity of Meissen during the Seven Years' War. He looted the factory both in 1759 and 1761, and is said on the latter occasion to have carried away to Berlin both models, working moulds and many workmen. This misfortune marks the end of the most distinctive Meissen porcelain, for after this time Sèvres became the most important porcelain factory in Europe, and the later productions of Meissen were, for the most part, German versions of the styles initiated at the French royal factory. From 1764 to 1774 Dietrich, a painter, was at the head of affairs, while a Frenchman named Acier succeeded Kandler. They introduced the neo-classical style, which was spreading like a blight all over Europe, and this departure was perfected under the directorship of Count Marcolini (1774-1814), when Meissen, fallen from its high estate, was content to follow the lead of Sèvres.

After the Marcolini period there is nothing to be said of Meissen. The old productions of the factory had become valuable, and the custom of reproducing them, marks included, was adopted. Such a practice was not likely to lead to further progress, and, though the factory was removed from its old site in the Albrechtsburg in 1863, it cannot be said to have added anything to the progress of European porcelain during the 19th century.

During the initiatory period the "Dresden" pieces bore the monogram "A.R." interlaced (Augustus Rex), and between 1712 and 1716 pieces intended for sale and not for the use of the court were marked with the sign of Aesculapius (a snake twining round a staff). From about 1720 two crossed swords, painted in blue under the glaze, with or without accompanying stars, crosses, &c., formed the general mark, but the mark has been so often used on other porcelains that, in itself, it is of slight value as a means of identification.



"Dresden" Potter's mark.

Vienna.—The first mention of the manufacture of porcelain in Vienna occurs in 1718, when a Dutchman, Claude du Paquier, was granted a patent. He had secured two runaways from Meissen, Stölzel and Hunger, yet little progress was made until after 1744, when the factory was bought by the empress Maria Theresa. At first the traditional styles of Meissen were continued, but the characteristic Viennese porcelain was produced after 1785. In this ware figure-painting, rich ground colours and elaborate gilding are associated in an unmistakeable manner. Leithner, who was chemist and colour maker at this period, succeeded in producing a more extensive and brilliant palette of colours than was in use at any other European porcelain factory in the last quarter of the 18th century; and the gilding was rich and elaborate. Apart from its technical merits the ware has nothing to recommend it, for the styles of decoration showed pronounced neo-classical influence, and lacked the saving merits of the French work in the same style. The works was closed in 1864, on account of the heavy expenses, and collectors should be reminded that many spurious imitations, the product of small Viennese factories, are to be found on the market.

Berlin.—The first Berlin porcelain was made by W. Casper Wegeli, aided by workmen from other German factories, as early as 1750. This business was unsuccessful and came to an end in 1757, but its productions are highly prized on account of their rarity. Success only came when Frederick the Great brought workmen, moulds and materials from Meissen in 1761, and, becoming proprietor of the works in 1763, founded the Royal Berlin Porcelain Manufactory. Though Meissen workmen and methods had been imported, and the Meissen style governed the earliest productions, Frederick's well-known *penchant* for

Wegeli's mark.

French art was doubtless responsible for the fact that the rococo style of decoration was more determinedly followed here than elsewhere in Germany. The colour schemes of this ware are unusually simple, pieces being seldom decorated in more than three colours, while a rose-coloured enamel, a favourite colour with the great Frederick, is quite characteristic. The Royal Berlin Factory passed under a cloud in the troubled condition of the Prussian monarchy during the early years of the 19th century, and down to 1870 it was content to follow in the wake of Sèvres like most of the other European factories. Since about the year 1880, however, it has developed into the most scientific of European porcelain works, and it was here that Seger manufactured his special porcelain, made to reproduce the qualities of the finest Japanese wares. In spite of this scientific success it must be remarked that the late Berlin porcelain is artistically disappointing, being too exuberant for our taste and recalling anything rather than porcelain in its treatment.

Minor German Factories.—It is unnecessary to describe the productions of all the German porcelain works of the 18th century, for not only is there a strong family likeness, but all the works aimed at producing pieces comparable with those of Meissen, Vienna or Berlin. In every case the industry was established under the patronage or at the direct charge of princes or great nobles, anxious to emulate the success of the elector of Saxony or the king of Prussia, and generally the enterprise came to an end with the death of a patron or from his unwillingness to sustain the continued drains upon his purse.

The factory at Höchst was started about 1720 by wanderers from Meissen, but it was only carried to a successful issue through the patronage of the archbishop-elector of Mainz after 1746. The general style of Höchst is a palpable imitation of the contemporary wares of Meissen, but this factory was noted for its excellent figures and groups, especially those modelled by Melchior (1770-1780). He modelled, at Höchst, more than three hundred figures, as well as many portrait medallions. The works came to an untimely end during the French invasion of 1794.

Frankenthal had a porcelain factory (founded by the Hannongs of Strassburg) in 1756, and patronized by Karl Theodor, elector palatine from 1762 to 1795, when the French invasion put an end to its activities. Melchior, the sculptor, came here from Höchst after 1780, and elaborate pieces in the current styles of Sèvres and Dresden were made.

Nymphenburg, near Munich, had a factory which was made a royal factory in 1758 by Max Joseph III. of Bavaria. The ware was of fine quality, but without special distinction. Melchior came on here about 1800, remaining till his death in 1825; his Nymphenburg figures are as highly esteemed as those he modelled at Höchst and Frankenthal. In the early years of the 19th century elaborate painting became the rule here, as at the other royal factories, and copies were made on porcelain of some of the famous paintings in the Munich galleries. The works is still in existence, in the hands of a private company, who unfortunately sell many reproductions of the 18th-century wares.

Ludwigsburg, some 9 m. from Stuttgart, had a porcelain factory from 1758 to 1824, liberally subsidized by the dukes of Württemberg. Highly-finished painting was the rule at this factory, and because the ware bore a crown as one of its marks, it has rather foolishly been called “Kronenberg” porcelain.

Fürstenberg was the factory patronized by the dukes of Brunswick. Experiments were made as early as 1746, but little ware was produced before 1770. Fürstenberg set itself to imitate all the best-known styles of the day, and its only distinctive productions are its “biscuit” statuettes and medallions. The factory remained in operation until 1888, but as the moulds were then sold by auction, imitations of the old pieces are now common.

Other 18th-century German factories were those of Fulda, Bayreuth, Cassel, Ansbach, Kloster-Veilsdorf, Wallendorf and Limbach.

Mention must also be made of the work of certain famous decorators, like Bottengruber and Preussler, who decorated both German and oriental pieces; while Busch, the canon of Hildesheim, produced effects like fine engraving by etching the glaze with a diamond and rubbing black colour into the lines.

While France and Germany were each developing their own particular type of porcelain, it was only natural that the kings and princes of other countries should strive to emulate them in the manufacture of this still rare and highly esteemed form of pottery. Naturally, perhaps, the countries to the north and east seem to have been influenced most by German methods, whilst those to the south and west followed the French example.

Holland.—The earliest Dutch factories were started as early as 1704, first at Weesp near Amsterdam, and afterwards at Oude Loosdrecht. The mark of this factory occurs as M: O.L., or M.o.L. After 1782 the works was removed to Nieuwe Amstel, but the “Amstel” porcelain came to an end with the French invasion. The ware resembled the German both in material and decoration. The best porcelain made in Holland was produced at a factory at the Hague, founded some time after 1775. There is a choice collection of this ware in the Gemeente Museum at the

Hague. No porcelain appears to have been made in Holland after about 1810 until 1890 or later.

Denmark.—It has been stated that porcelain of the German type was made in Copenhagen as early as 1731, but there is no definite record of the production of true porcelain until about 1772, when potters, modellers and painters from some of the German works founded the enterprise which was taken over by King Christian VII. in 1779 and converted into a royal factory. Fostered by the king's patronage, fine porcelain of pronouncedly German style was largely made down to the end of the 18th century. The collection in the castle of Rosenburg contains many examples of the work of this period. In the early years of the 19th century the Empire style of decoration was adopted, and the artistic influence of Sèvres became paramount. Large sums of money were continually required from the crown to maintain the establishment until, in 1867, it was sold into private hands to get rid of an encumbrance. The subsequent new-birth of the existing royal Copenhagen porcelain works must be noted in the next section.

Sweden.—The history of Swedish porcelain in the 18th century is connected with the factories at Rörstrand and Marieberg, both in the environs of Stockholm. Tentative experiments were made at both these places before 1760, but these came to an end by the close of the 18th century, though the Rörstrand works was reopened some fifty years ago and will be subsequently referred to. The Swedish porcelains were of two kinds, one a true felspathic porcelain like the German, and the other a glassy porcelain resembling that made at Mennecy in France. It is interesting to note that the decorative styles in both cases are distinctly French in character.

Russia.—Peter the Great is said to have projected a porcelain factory at the suggestion of his ally Augustus the Third of Saxony, but the scheme was not carried into execution until the days of the empress Elizabeth. Catherine II. subsidized the work in prodigal fashion, but although she brought over French artists, the Russian porcelain more closely resembles its German than its French prototype. In the early years of the 19th century the imperial Russian factory followed the example of Sèvres in producing costly dinner services and extravagant vases of large dimensions.

Small independent factories were started in the neighbourhood of Moscow: one by an Englishman named Gardner about 1780, and another by A. Popoff. Besides producing ordinary table ware these Moscow factories sent forth a considerable number of statuettes, the most interesting being those representing Russian peasant types.

Hungary.—The one Hungarian porcelain factory of note is that at Herend, which was founded about 1830 by Moritz Fischer. At this factory copies of oriental porcelain were made that have deceived many collectors, though the pieces are usually impressed with the word "Herend" in the paste.

Switzerland.—Little porcelain has been produced in Switzerland, and considering the geographical position of the country it seems natural that porcelain of the German type should have been made at Zurich and of the French type at Nyon on the lake of Geneva, but these productions are of no particular importance.

French Porcelains.—The beginnings of French porcelain at Rouen and St Cloud have already been mentioned, as they preceded Böttger's discovery of true porcelain; but as nothing was known in France of the methods and materials used by the German porcelain makers, the artificial or glassy porcelain held sway in France through the greater part of the 18th century. The next important factory after St Cloud was that founded at Chantilly about 1725 under the patronage of the Prince de Condé, an enthusiastic collector of Chinese and Japanese porcelains. One distinctive feature of the Chantilly porcelain is its imitation of the Japanese Imari wares of the 17th century, especially those bearing delicate patterns in the Kakiemon style. This imitation was not confined to the decoration alone, but great efforts were made to reproduce the delicious tender whiteness of the original ware, by covering the body of the soft porcelain with a coating of the tin-enamel used by the French faience makers. Similar imitation of the Kakiemon style of decoration became the rage all over Europe, and was largely followed at Meissen and in England as well as in France; but no European imitations equalled those of the famous Chantilly ware.

Lille and Chantilly Potters' marks.

Other porcelain factories were started at Mennecy-Villeroy and at Lille, but the most important French factory was that founded at Vincennes about 1740, not only because of the many beautiful pieces produced there, but also because the works was taken under the direct patronage of the king in 1753 and was transferred to Sèvres in 1756, becoming ultimately the most important porcelain factory in Europe.

Fortunately we have documentary information of the exact composition of the artificial porcelain (*pâte tendre*) of Sèvres, and a brief account of its manufacture will serve to explain how all the glassy porcelains of Europe were made. The potter commenced by preparing a glass

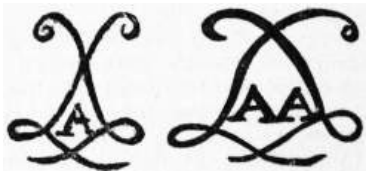
or frit, melting together pure sand, alum, sea-salt, gypsum, soda and nitre. The clear portions of this frit were powdered and washed with boiling water, and the working clay was compounded by adding to such powdered frit a small quantity of chalky clay or marl and sometimes pure chalk as well. This mixture was ground in water until the fluid was as fine as cream, and it was then boiled to a thick paste which was so little plastic in itself that black soap or parchment size was added to it to give it enough plasticity for the workman to be able to shape it. Vases and other pieces were made from this paste by pressing cakes of it in plaster moulds of considerable thickness. After pressing, the pieces were dried and were then either turned on a lathe or rubbed down with sand-paper to reduce them to sufficient thinness; while handles, spouts or other ornaments in relief were applied with a lute of slip, as is customary with every other species of pottery. The fragile objects were then fired into what is known as the "biscuit" condition; the most difficult part of the whole process. During this firing the pieces frequently went out of shape because of the excessive shrinkage of the material and its tendency to soften as it approached the melting point of the frit. Consequently an elaborate system of "propping" the pieces had to be resorted to, and even then a very large proportion became deformed. When the porcelain was drawn from the oven after the first firing, the supports were removed and the pieces were rubbed with sand to clean the surface, and were then coated with glaze by sprinkling with a brush; the glaze being a fusible glass very rich in lead. The glaze coat was melted by refiring the piece at a lower temperature; and it was frequently necessary to repeat this process several times in order to get a perfectly even and brilliant result. The difficulties of such a process were enormous, and it was only by the financial support of wealthy patrons, or of the state, that such a method of manufacture was ever carried on for any length of time. At its best the material is an exceedingly beautiful one, lending itself especially to decoration in on-glaze colours, and the pieces produced at Vincennes and at Sèvres, between 1745 and 1770 or thereabouts, form a distinct class by themselves. Skilful chemists like Hellot and Macquer were employed to direct the operations, and many beautiful ground colours, such as the famous *gros-bleu, bleu de roi, rose Pompadour*, pea-green and apple-green were invented.

Sèvres Porcelains.—The forms of the Sèvres porcelain are exceedingly varied. Many of the older shapes were designed by Duplessis, the king's silversmith, and, as is perhaps natural, are more proper to metal than to pottery; but the French glassy porcelain is such an artificial material in every respect that such a point should not be strained too far. Owing to the want of plasticity in the paste the pieces were always made in moulds of plaster of Paris, while in many cases they were moulded in separate parts and these united together with metal screws or mounted in bands of chased ormolu. Table services made for actual use were usually painted on a plain white ground with the full palette of on-glaze colours (or enamels) and much rich gilding. The decorative pieces such as vases, candelabra, jardinières, &c., were decorated in a much more sumptuous fashion by covering the greater part of the piece with a ground of one of the rich enamel colours previously mentioned, reserving only panels in white on which delicate miniature-like decorations of the most varied kind were subsequently painted and fired (see fig. 52; and examples of Sèvres, Plate IX.). Such collections as the Wallace at Hertford House, or the Jones Bequest in the Victoria and Albert Museum, show at once the variety and perfection to which the work attained.

FIG. 52.—Sèvres vase, *pâte tendre*; green body and gilt imitation mounting. (Victoria and Albert Museum.)

This Sèvres porcelain is entirely devoid of the broad decorative treatment and rich full colour of any of the great kinds of fine pottery or porcelain. Artistically considered, it has no place beside the triumphs of the Chinese or Persian potters, or of the Italian majolists. Its shapes are too formal, and are not sufficiently imbued with a sense of the qualities of the material. The ground colours defy every natural tendency of pottery colour for they are even, flawless and mechanical, with none of the palpitating richness that comes so naturally from the potter's processes. The paintings, whether of flowers, birds or figure-subjects, are extraordinarily skilful regarded as miniatures, but as examples of pottery decoration they cannot be compared to the swift, apparently careless, brushwork of the great masters of earlier times. So pronounced was the demand of the period for smooth even finish that such ground colours as *gros-bleu* and *bleu de roi*, where the colour naturally came varied and uneven, were subsequently decorated with small diapers or lines of gold in the form of *œil de perdrix* or *vermicelle*, so as to produce a more regular and even effect. The most elaborate and costly of all the varieties of old Sèvres is what is known as "jewelled Sèvres," which is richly sown with imitation jewels, such as turquoises, pearls and rubies, closely resembling the real stones. These imitation jewels were in every case set in beautifully chased mountings of gold,

and in the museum at Sevres are to be found examples of the punches and other tools used in making these mounts. On account of the enormous expense involved in the production of such costly triumphs of skill, examples of jewelled Sèvres are rare even in the best collections, but the English student is fortunate in the fact that the Wallace collection contains a considerable number of them.



Sèvres Potters' marks, 1753 and 1772.

Many reasons—the prestige attaching to a Royal Manufactory, the knowledge that the porcelain was produced regardless of cost, the mechanical perfection of its colours, gilding and decoration, as well as the fact that the glassy porcelain was abandoned as too costly and risky after about 1780—have all conspired to raise the prices which modern collectors are prepared to pay for fine examples of *vieux Sèvres*. It is doubtful whether even the prices paid for paintings by old masters have advanced so rapidly as those paid for Sèvres porcelain of the best period. In the 'seventies of the 19th century it was deemed worthy of remark that a sum of £10,000 should have been paid at public auction for three old Sèvres vases; thirty years later one such piece would probably fetch the same price. It should be added that the extravagant prices now paid for Sèvres porcelain, which is much more a triumph of technical than of artistic skill, have led to an extensive system of "faking" and even forging specimens which are purchased at high prices by amateurs.

Beautiful as the old Sèvres porcelain was, those who were responsible for its manufacture could not fail to recognize that the porcelain made at Meissen and other German factories was both harder and whiter in substance, more truly resembling the oriental porcelain in every respect. It was also known that these German porcelains were not so difficult, and therefore so costly to manufacture as the French, and all these causes combined to make the directorate of Sèvres unremitting in their efforts to discover in France natural materials analogous to those used by the German and Chinese potters. Père d'Entrecolles, the famous Jesuit missionary, had forwarded to France long before an account of the methods used by the Chinese, as well as samples of the materials they employed; and after many years' research Millot and Macquer discovered the precious materials at St Yrieix near Limoges (see Auscher, *History of French Porcelain*, pp. 77-81). The first experimental pieces of this French porcelain, similar in material to the German and Chinese, appear to have been made about 1769; but it was some years after this before the manufacture of the new product was firmly established, and then to the end of the 18th century more and more of the hard porcelain and less of the glassy porcelain was made at Sèvres. Speaking broadly, we might say that after 1780 comparatively little of the original French porcelain was made in France; and from that time to this practically all French porcelain has been of the same type as the German porcelain, viz. made with china clay and felspathic rock. This technical change in the nature of the materials had a profound influence on the artistic qualities of French porcelain, and the change was doubtless accentuated by the neo-classical rage which followed on the discovery of Herculaneum and Pompeii. The influence of antique vase shapes and of modern renderings of Greek motives in design spread over Europe like a plague, and whether in France, Germany or England the last quarter of the 18th and the first quarter of the 19th century mark a definite period in pottery design and decoration. The introduction of hard-paste porcelain rendered the manufacture of large vases and other pieces possible; and after 1780 we find the manufactory at Sèvres engaged in the production of enormous vases 5 or 6 ft. in height, a manufacture which has been continued there to this day. About the same time, too, we find the first production of large plaques or slabs of porcelain on which copies of well-known pictures were painted in enamel colours. The earliest of these slabs were in soft-paste porcelain, but in this material it was only possible to make them of quite modest dimensions; with the introduction of hard-paste porcelain very large slabs were manufactured, and a series of these are to be seen in the museum at Sèvres.

The most artistic of all the productions of Sèvres are undoubtedly the "biscuit" figures and groups. These were modelled with great skill by many of the best French sculptors of the day, such as Pajou, Pigalle, Clodion, La Rue, Caffieri, Falconet, Boizot, Julien, Le Riche, &c. The best of these Sèvres "biscuits" have a real artistic value which places them in a class quite apart from the German porcelain figures made at Meissen, Frankenthal and Höchst.

Paris.—Although during the reign of Louis XV. many privileges and prerogatives had been given to the Sèvres manufactory, such as the exclusive right to gild or paint in colours on porcelain, the breakdown of the monarchical régime, which was rapidly accelerated after the accession of Louis XVI., led to the establishment in Paris and its environs of a number, of factories for the production of hard-paste porcelains more or less in open rivalry with the royal manufactory of Sèvres. In order that the royal edicts might be more easily evaded, most of these factories were placed under the patronage of one of the French princes of the blood or even of Queen Marie Antoinette. There is little need to dwell on the doings of these Parisian factories, but the productions of the best of them, such as those of Clignancourt (patronized by Monsieur,

the king's eldest brother); Rue Thiroux (patronized by Queen Marie Antoinette); Rue de Bondy (patronized by the duc d'Angoulême), compare not unfavourably with those of Sèvres itself.

It is impossible to do more than mention the other important French factories at Mennecy, Sceaux, Bourg-la-Reine, Strassburg, Niederviller, Marseilles, Limoges and Caen. In the disastrous years of the French revolution (between 1789 and 1800), such of these factories as had survived came to an untimely end, even the royal factory at Sèvres passing through a kind of lingering death between 1792 and 1801, and it was not until Napoleon decided to revive the glories of Sèvres that modern French porcelain really came into being.

Just as the manufacture of German porcelain spread into Holland, Denmark, Sweden, Russia, &c., we find the manufacture of a glassy porcelain analogous to the early French arising in Belgium, Italy, Spain and England. The materials and methods were so like those used in France that it would be ridiculous to claim for them an independent origin, even were we unable to prove by documentary evidence that workmen trained in the French factories had migrated into those countries.

Italy.—In Italy we have the factories at Le Nove near Bassano (1762-1825); Doccia near Florence (founded in 1735 by the marchese Carlo Ginori, and still carried on by the same family); and Capo-di-Monte near Naples (1736-1820); with minor factories like those at Vinovo, Treviso, and the Volpato factory at Rome. The most important of these were the factories at Doccia and Capo-di-Monte. The porcelain made at Doccia was famous for its soft translucent texture, so that it lent itself beautifully to the production of white glazed porcelain figures resembling in quality the white pieces of Fu-kien.

Capo-di-Monte Potters' marks; 1736, 1759, 1780.

The factory at Capo-di-Monte was under the direct patronage of Charles III., king of Naples. The earliest and best of its productions are in pure white, probably made in imitation of Chinese white pieces, though modelled in the form of natural shells supported by corals and seaweed. Figure-modelling was also largely practised, and besides groups of statuettes and figures in conjunction with vases, we have the typical Capo-di-Monte examples in which vases, cups, saucers, plates, &c., are covered with groups of figures modelled in high relief on a minute scale. This trivial style of work is greatly admired because of the minuteness of its execution. At a later period the works was removed to Portici and ultimately to Naples, but after about 1770 the classic style was adopted for the shapes and decorations. The factory came to an end as late as 1820.

Spain.—Charles III. of Naples ascended the throne of Spain in 1759 and took with him to Madrid many of the workmen from the Capo-di-Monte factory, as well as the best moulds and models. He established a new china factory in the gardens of Buen Retiro, a palace outside Madrid. As long as Charles III. lived immense sums were lavished on this factory, and the ware was not allowed to be sold, but was either used for the decoration of the royal palaces or for presentation to other European sovereigns. Enormous vases were made, following the example of Sèvres, and these were often filled with bouquets of flowers modelled in porcelain. The most famous productions of this factory, however, were the plaques and slabs of porcelain used for lining the walls of certain rooms in the royal palaces. Two of these rooms still remain, and are frightful examples of the Spanish *rococo* style. The factory was entirely destroyed in 1812 during the French war, and since that date no porcelain of any importance has been made in Spain.

Buen Retiro Potters' marks.

English Porcelains of the 18th century.—There can be no doubt that whatever experimental work may have been conducted by our early English potters, such as the famous John Dwight of Fulham, nothing like an established manufacture of porcelain existed in this country prior to about 1740-1745. There are records of many tentative experiments before this date, but no real history. Between 1745 and 1755 important porcelain works were established at Chelsea, Bow, Worcester and Derby, and when we examine the productions of these factories it is impossible to avoid the conclusion that the processes had been imported from France. The early English porcelains, like all the French porcelains of that date, were composed of artificial or glassy mixtures.

We may take the early productions of Bow and Chelsea as typical of the earliest English porcelain of which there is any definite record. The material was a mixture of pipe-clay, sand from Alum Bay in the Isle of Wight, and glass, while the glaze was a fusible English flint-glass rich in lead. It is obvious, therefore, that we are dealing with substances very similar to those used in the glassy French porcelain (see above), and such mixtures were very difficult of fabrication, being subject to great loss in the process of firing. In the other European countries the manufacture of porcelain was almost invariably carried on at the expense of some royal or princely patron; in England, however, the manufacture was not subsidized in this way, and it is

probably for this reason that at a very early date we find the English porcelain-makers experimenting with other materials than glass and clay in order to make their processes more certain. In a patent taken out in 1749 by Thomas Frye of the Bow works we find mention of the use of bone-ash—the material that was to make English porcelain a distinct species by itself. From 1750 onwards there can be little doubt that, though a large proportion of glass was still used in the composition of the English porcelains, bone-ash was more and more introduced into the paste in order to obtain a more refractory material; yet it was not until about 1800 that Josiah Spode of Stoke-upon-Trent abandoned entirely the use of glass and composed his porcelain of china clay, bone-ash and felspathic rock for the body, glazing it with a rich lead glaze, and so laid the foundation of distinctively English porcelain. The material has many merits both from the useful and artistic points of view; it is much more easily fabricated than the old glassy porcelains, it endures better for ordinary table use than any other kind of porcelain, and it permits the fullest range of decoration.

Before entering upon a detailed notice of the important English factories of the 18th century, something should be said of the various influences that were at work in determining what the porcelain-maker should do, both in the way of shape and decoration. The eyes of all men were, of course, turned first to the porcelain brought from the far East; and in the early efforts of the English factories, as of those of France and Germany, we notice a predominance of white pieces or of pieces decorated with paintings in under-glaze blue alone, obviously inspired by the current importations from China. Bow and Chelsea produced large quantities of ware of this class, and in the early days of the Worcester factory little else was made there than white, or blue and white pieces closely simulating the Chinese. Another oriental influence was to be found in the Imari patterns of Japan, particularly those in the style of Kakiemon. It has been noted that Meissen, Chantilly and other continental factories had already created a vogue for these reproductions of Japanese decorations, and in our own country Bow, Chelsea and Worcester followed suit. The later Imari patterns, heavily decorated with blue and red and gold for the use of “the foreigner,” furnished another popular style for Worcester and Derby, and the vogue of these English “Japan” patterns, in the last quarter of the 18th century and the first half of the 19th century, was so great that they represent a large proportion of the output of our English porcelain works during that period. The productions of the German and French factories also exerted a profound influence on English potters; so that throughout the 18th century English porcelains largely consisted of imitations of the foreign wares brought into the country by the wealthy.

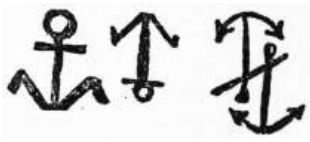
We can only point to one method of porcelain decoration which undoubtedly arose in England. This is the method of transfer-printing, whereby patterns printed on paper from engraved copper plates are transferred to porcelain or pottery and subsequently fired, either under or on the glaze. At the best these printed patterns are in no way superior to the stencilled work of modern oriental porcelain, while, at the worst, European and American printed patterns have been perhaps the most inappropriate decoration ever applied to porcelain in the world. It has been generally urged on behalf of transfer-printing that it enables elaborate effects to be produced at a small cost and so brings decorated pottery within the reach of the humblest. The truer view is, that the simplest brushwork patterns, or even no pattern at all, would be preferable to the tawdry results that the cheapest forms of transfer-printing have rendered possible.

Chelsea.—Between 1750 and 1770 the Chelsea factory was the most important of all the English porcelain works, and fine specimens of this period command high prices in the saleroom to-day. We know little of the origin of this important factory, though it is believed to have been in existence from some time after 1740 to 1784, when it was finally demolished and some of the workmen and part of the plant were removed to the then important works at Derby. The first manager was one Charles Gouyn, who was followed by a Mr Sprimont before 1750. Sprimont retained possession of the works until 1769, and died in 1771. It was during his management, from 1750 to 1770, that the finest and most characteristic pieces of Chelsea porcelain were made.

Although the styles in vogue at Chelsea are extremely varied, little was produced there that was really English in character. The earliest pieces appear to have been either in pure white or in white decorated with paintings in under-glaze blue. The goat-and-bee cream jugs, crawfish salt cellars, the shell and rockwork salt cellars, jugs, sauce boats, small cups and saucers of this type are fairly plentiful. Then came the decorations, mainly in red and gold, of the Kakiemon style, followed by reproductions of the brocade patterns of Imari porcelain. Afterwards we find the appearance of table wares modelled in imitation of leaves, animals, fruits, birds and fishes, apparently adopted from current French and German practice.

In another direction the influence of Meissen was also shown by the production of statuettes (see in Chelsea figure, Plate X.), and of the small modelled trinkets, scent-bottles and toys of which there is such a fine collection in the British Museum. In the latter days of the factory (say

after 1758) we find Chelsea following in the wake of Sèvres in the production of large and elaborate rococo vases, with pierced necks and covers, scroll-work bases and interlacing handles such as are to be seen in the Jones Bequest in the Victoria and Albert Museum. Pieces of this elaborate kind are overlaid with rich grounds of Mazarine blue, turquoise, pea-green, or the famous Chelsea claret-colour, while white panels are reserved framed with gilt scrolls and painted in enamel colours with flowers, birds or figure-subjects in absolute rivalry with the pieces manufactured at Sèvres.



Chelsea Potters' marks.

The Chelsea works appears to have come to an end through the ill-health of Sprimont, and it was sold in 1769-1770 to Duesbury, the proprietor of the Derby works. He carried on the establishment from 1770 to 1784, but in this period a great change is noticeable in the product of the factory. The "rococo" forms and decorations of the true Chelsea porcelain were replaced by works in the neo-classical style already rendered popular by the success of Josiah Wedgwood, and the Derby-Chelsea porcelain is quite a distinct production from the early works of Chelsea. The most distinctive mark of the Chelsea porcelain is an anchor—either embossed in the paste or painted in gold or colour. Often the anchors occur in pairs, and it is frequently associated with other marks such as a dagger or a cross. Some of the Derby-Chelsea pieces are marked with a conjoined D and an anchor.

Bow.—The date of the establishment of the factory at Stratford-le-Bow, in what is now the East End of London, is quite uncertain, but in 1744 Edward Heylyn and Thomas Frye, who were connected with this factory, took out a patent for the manufacture of porcelain. The materials mentioned in this patent are not such as would produce porcelain at all, and it appears likely that the specification was made purposely defective. In 1748 a further patent was applied for in which we get the first mention of bone-ash, so that from the technical point of view the wares made at the Bow factory are of the utmost importance as indicating the experimental beginnings of our English porcelain in which bone-ash plays such an important part. In 1750 the works at Bow belonged to Messrs Weatherby & Crowther, and was then known as "New Canton," and as 300 workpeople were employed, the operations must have been conducted on a large scale; but ultimately, from causes that can only be surmised, the partnership was dissolved and the business failed, so that in 1775 the works was bought for a very small sum by the William Duesbury already mentioned, who transferred part of the plant and moulds to his more prosperous works at Derby. It would appear from what we know of the factory and its productions that the business was conducted on simpler lines than at the Chelsea works. We have, for instance, no elaborate vases in imitation of Sèvres, and no important groups of figures which might challenge rivalry with Meissen. We find, as is common with all the early porcelain factories of Europe, first the production of white pieces with modelled reliefs, or of pieces painted with under-glaze blue in imitation of Chinese porcelain. Then followed the well-known "Quail," or "Partridge," and "Wheat-sheaf" patterns in red and green and gold in imitation of the Japanese patterns; and the manufacture of table ware decorated with these simple yet bright and pleasant devices seems to have formed the greater part of the work at the factory. Many figures and statuettes were also produced at Bow, but they are fewer in number and less cleverly made and decorated than the contemporary productions of the Chelsea factory. We may surmise that there was considerable rivalry between these two works situated on the outskirts of the metropolis, for we find the "anchor" mark, which is the best recognized mark of Chelsea porcelain, often occurring on specimens that from internal evidence or from the piece itself we should rather attribute to Bow. The Bow marks are not very certain, but some of the likeliest are here given.

Bow Potters' marks

Worcester.—The third of the early English factories, and ultimately the most important of all, was that founded at Worcester in 1751 by Dr Wall, a man of unusual attainments, and a number of his friends. How Dr Wall came to learn the secret of porcelain making is absolutely unknown, but even assuming that he acquired some information from wandering workmen it is certain that the Worcester porcelain was soon developed on original lines. The nature of the paste and the glaze of the early Worcester productions, as well as the sobriety of their decorations, stamp this factory as the first where Englishmen really developed a native porcelain. Between 1751 and 1770, the first period of Worcester porcelain, the prevalent influence was that of Chinese blue-and-white, and the pieces of that period are rightly esteemed by collectors for their artistic quality. Probably nowhere in Europe, certainly nowhere in England, was oriental blue-and-white more carefully studied, and a collection of this blue-and-white Worcester is most satisfactory from the aesthetic point of view. The productions at this time were tea and coffee services, bowls, dishes, mugs and plates. The cups were usually made without handles in imitation of the oriental practice, but large, two-handled covered cups for

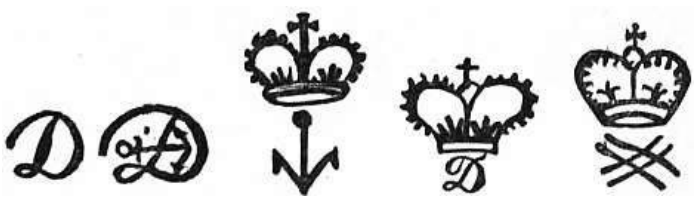
caudle, broth and chocolate were also made during the early period. Many of these larger cups bore an embossed pattern resembling a pine-cone, possibly imitated from a shape produced at St Cloud; while openwork dishes, plates and fruit baskets were also made in imitation of a popular Meissen fashion.

Early Worcester Potters' marks.

The method of decorating porcelain with transfer prints was introduced at Worcester as early as 1756, when Robert Hancock, an engraver, came from York House, Battersea, where the process was first employed for the decoration of the Battersea enamels. The early Worcester prints comprised portraits of celebrities of the time (the Frederick the Great mug), or adaptations of the works of great artists such as Gainsborough and Watteau, or copies of current engravings or sporting prints. The first printing was done in black or purple, and transferred on to the fired glaze, and it was not until about 1770 that the process of printing in blue under the glaze was perfected. It is interesting to note that for many years this process of transfer printing was developed side by side with the older method of porcelain painting, and until the end of the 18th century the processes appear to have been used at Worcester quite independently. The closing of the Chelsea factory in 1770 led to the migration of some of the Chelsea painters to Worcester, and from about that date a considerable amount of Worcester porcelain was decorated on the glaze with enamel colours and gilding after the styles that had been rendered popular at Chelsea and Bow. It is only fair to remark, however, that the Worcester patterns are always distinguished by a certain English character both in the style and the workmanship (see example, Plate X.). The first and most artistic period of Worcester porcelain came to an end before 1783, when, after the death of Dr Wall, the works passed under the control of Thomas Flight and his two sons, who had been jewellers. The Flight influence was soon noticeable from the fact that the new shapes were more and more based on those of Sèvres and Meissen, while the decoration became more mechanical and precise as befitted the work of jewellers rather than potters. King George III. and Queen Charlotte visited the works in 1788 and bestowed upon the firm the privilege of styling themselves "China Manufacturers to Their Majesties," since when the works has always been known as the Worcester Royal Porcelain Works. In 1793 Martin Barr was taken into partnership; the "Flight & Barr" period, so well known to collectors, lasted until 1807.

Another Worcester porcelain works was in existence after 1784, viz. the Chamberlain factory, which was working in rivalry with the original establishment; but its productions are of no particular artistic merit, and in 1840 the two firms became amalgamated, and so gave rise to the present Worcester Royal Porcelain Co. The most noteworthy feature of the productions of both the Worcester works at the end of the 18th century were the "Armorial" services made for various royal and noble families, and those adaptations of Imari patterns known as "Old Japan."

Derby.—Experiments in the manufacture of porcelain appear to have been made at Derby as early as 1750 by a French refugee, Andrew Planché; but the business, which was afterwards to attain such a great development, was only founded in 1756 with William Duesbury as its manager. Duesbury was originally a decorator of china figures in London, and his career proves that he was a man of great industry and energy, for within twenty-five years he not only built up a large business at Derby, but he absorbed the decadent works at Bow and Chelsea, so that in the last quarter of the 18th century Derby was the most important china manufactory in England. As is so often the case, a commercial success like this implied the absence of any distinct artistic impulse. The porcelain produced at Derby is for the most part only an echo of the successes of Meissen, Sèvres, or the earlier English factories. It is only fair to remark that a very deep and rich under-glaze blue was attained at the Derby works, and that this was associated with very mechanical painting of birds and flowers and with gilding of exceptional quality. At this factory, too, the old Japan patterns were imitated with exceptional vigour, until "Crown-Derby Japan" became a standard trade name for this clobbered oriental style.



Derby Potters' marks.

Mention has already been made of the "biscuit" porcelain figures made at Derby, which are superior in style to anything else made in-Europe in the 18th century except the "biscuit" porcelains of Sèvres. The Derby "biscuits" of the best type range from 1790 to 1810, and the finest specimens have a "waxy" surface, though there is little or no sheen and every detail

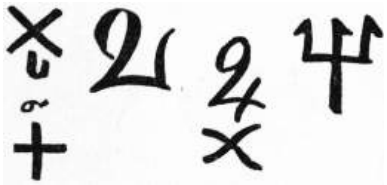
remains as crisp as when the figure left the hand of its maker. The most famous of these figures are the portrait medallions and statuettes of British generals and admirals which were modelled by an artist named Stephan. Spengler, a Swiss, modelled numerous groups adapted from the drawings of Angelica Kaufmann, while a workman named Coffee seems to have modelled only rustic figures and animals.

Plymouth and Bristol.—The porcelain factories at Plymouth and Bristol are mainly noteworthy because they were the only English factories in which a true porcelain strictly analogous to the Chinese was ever manufactured. William Cookworthy, a Quaker druggist of Plymouth, was greatly interested in attempting to discover in Cornwall and Devonshire minerals similar to those which were described in the letters of Père d'Entrecolles as forming the basis of Chinese porcelain. After many years of travel and research he ascertained the nature of the Cornish stone and Cornish clay, and in 1768 he founded a works at Plymouth for the production of a porcelain similar to the Chinese from these native materials. Readers interested in this abortive enterprise, from which such great results were afterwards to come, can only be referred to the general histories of English porcelain, for the factory was removed to Bristol in 1770 and was shortly afterwards transferred to Richard Champion, a Bristol merchant, who had already been dabbling in the fashionable pursuit of porcelain making. Champion's Bristol factory lasted from 1773 to 1781, when the business had to be sold to a number of Staffordshire potters owing to the serious losses it had entailed. The Bristol porcelain, like that of Plymouth, was always a true felspathic porcelain resembling the Chinese, but made from the china clay and china stone of Cornwall. It is, therefore, harder and whiter than the other English porcelains, and its cold, harsh, glittering glaze marks it off at once from the wares of Bow, Chelsea, Worcester or Derby.

The Bristol porcelain resembled that of Meissen quite as much in its style of decoration as in the nature of its materials. One can point to nothing distinctly English about it, and if specimens now command very high prices in the salerooms it is on account of their rarity rather than of any intrinsic quality or beauty that they possess.

Table ware of various kinds formed the greater part of the production of the Bristol works, but a considerable number of figures are known, in many cases obviously copied from those of Meissen, and a few large hexagonal vases similar in style to specimens produced at Chelsea and at Worcester. The most distinctive pieces made at the Bristol factory are certain small plaques or slabs in "biscuit" porcelain, usually bearing in the centre a portrait medallion or armorial bearings surrounded by a wreath of skilfully modelled flowers. Good examples of these choice productions are to be seen in the British Museum.

The Plymouth factory is supposed to have adopted as its general mark the alchemical symbol for tin. This mark was also used to a limited extent at the Bristol factory, though the general Bristol mark was a cross or a copy of the crossed swords of Meissen. The Staffordshire potters who bought the rights of the Bristol porcelain factory from Champion established a works at Shelton, near Stoke-upon-Trent, in Staffordshire, under the name of New Hall Porcelain Co., but they never manufactured anything of artistic account.



Plymouth, Bristol, Champion and Swansea marks.

Minor English Factories.—A number of other porcelain factories were founded in England in the latter half of the 18th century, but none of these produced ware of any particular merit. The porcelain made at Longton Hall by William Littler (1752-1758), always clumsy and ugly in form, is interesting for a splendid blue colour characteristic of the factory. This small venture was ultimately absorbed by William Duesbury.

The colony of potters established in Liverpool also made a certain amount of porcelain, as well as "Delft" and other earthenwares, and the Liverpool Museum contains some good examples of their productions.

A little factory at work at Lowestoft in the last quarter of the 18th century has attracted much more attention than it deserves, because certain writers foolishly attributed to it large quantities of "Armorial" porcelain which had, undoubtedly, been made in China. Recent excavations have established the fact that this factory was only of minor importance, and was mainly occupied in producing cheap wares in rivalry with, and even in imitation of, those of the more important English factories.

Towards the end of the 18th century the manufacture of English porcelain spread into the Staffordshire potteries, and the firms of Spode, Davenport and Minton became the most important English factories of the early 18th century. For notices of the minor English factories of the late 18th century and early 19th century, such as Caughley, Coalport, Swansea and Nantgarw, the student is referred to the special works dealing with the history of English porcelain.

Collections.—The British Museum and the Victoria and Albert Museum contain the best general collections of English porcelain. The museums at Bristol and Liverpool contain examples of the local wares; while the museum at the Worcester Royal Porcelain works has an admirable collection of the wares of that factory. Many noteworthy private collections are in existence, of which we may mention those of Mr Dyson Perrins, Mr Cockshutt and Mr Trapnell.

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(W. B.*)

POTTERY AND PORCELAIN DURING THE 19TH CENTURY

The development of the manufacture of pottery and porcelain in Europe and America throughout the 19th century need not be treated in such detail as the history of its growth up to that period, for modern means of communication and the general diffusion of knowledge have tended to destroy the individual character which was so marked a feature of the pottery of different countries in previous centuries. The 19th century was distinctly the century of machinery, and, for the most part, it witnessed the displacement by mechanical processes of those methods of handicraft which made the older pottery individual and interesting even in its simplest forms. Collectors are prepared to pay very large sums for choice examples of the potter's art of bygone centuries, but it is doubtful if much of the pottery of the 19th century will ever be collected for its intrinsic merits, though it may be preserved as an illustration of the spirit of the age.

In preceding sections of this article the development of the brightly painted tin-enamelled wares and the gaily decorated porcelains of various European countries have been traced down to the end of the 18th century, because that date marks, quite distinctly, the period when the old handicraft of the potter was for various reasons displaced by organized manufacture. The disturbed economic condition of Europe in the last quarter of the 18th century and the Napoleonic Wars of the early 19th century proved disastrous to most of the pottery and porcelain works where artistic wares were made, and the disturbance of traditional methods was completed by the superior mechanical perfection and cheapness of the English earthenware introduced by Wedgwood and his contemporaries. The English pottery was neater, more perfectly finished and more durable than the painted tin-enamelled pottery of the continent. It vied in finish with the expensive continental porcelains, and for nearly half a century it carried all before it, not only in England, but throughout the world. An intelligent observer, M. Faujas de Saint Fond, writing in the beginning of the 19th century, remarks of English pottery that "Its excellent workmanship, its solidity, the advantage which it possesses of sustaining the action of fire, its fine glaze impenetrable to acids, the beauty and convenience of its form, and the cheapness of its price, have given rise to a commerce so active and so universal, that in travelling from Paris to Petersburg, from Amsterdam to the farthest parts of Sweden, and from Dunkirk to the extremity of the south of France one is served at every inn upon English ware. Spain, Portugal and Italy are supplied with it; and vessels are loaded with it for the East Indies, the West Indies, and the continent of America."[36] It was calculated that at this time three-fourths of the pottery manufactured in England was sent abroad. Such a state of things was not likely to continue, and in most of the European countries, after the settlement of 1815, such of the older factories as had survived, or new factories specially created for the purpose, adopted English methods of manufacture. In many cases experienced Staffordshire potters were procured to direct these works, and so far as ordinary domestic pottery was concerned, the first half of the 19th century witnessed the establishment in every country of Europe and in the United States of America of pottery works managed by Englishmen, where earthenwares were made after the English fashion. We shall refer presently to the survival or revival of the older styles of pottery and porcelain, but the English influence was undoubtedly paramount, with one or two notable exceptions, down to 1850, or even later. England itself witnessed a notable development of its pottery manufacture, which became more and more aggregated in that district of North Staffordshire designated emphatically "The Potteries," where, in spite of later developments, from two-thirds to three-quarters of all the pottery and porcelain made in the British Isles is still produced. This concentration of the industry in England has resulted in a race of pottery workers not to be matched elsewhere in the world, and while it was the supply of cheap coal and coarse clay which first gave Staffordshire its pre-eminence, that pre-eminence is now retained as much by the traditional skill of the workmen of the district as by the enterprise of its manufacturers.

Sèvres. Pâte-tendre, c. 1757, painted by Falot and Morin

Meissen. May-flower vase mounted in ormolu. Pâte-dure

Meissen. Crinoline figure (Kandler), Pâte-dure

Sèvres. Pâte-tendre, c. 1756

While we must admire, from the economic point of view, the methods of manufacture which have placed England in the first rank as a pottery-producing country, inasmuch as they have brought within the reach of the humblest domestic utensils of high finish and great durability, it is impossible to say much for the taste or art associated with them. Neatness, serviceableness and durability, English domestic wares undoubtedly possess in a degree unknown to any earlier type of pottery, but the general use of transfer-printing as the principal method of decoration, and the absence of any distinctive style of ornament, must cause them to take a low rank in comparison with the wares of past centuries, when mechanical perfection was impossible and rich colour and truly decorative painting were the chief distinctions of the pottery of every country. The London International Exhibition of 1851 is generally supposed to indicate the low-

water mark of art as applied to industry; it should rather be regarded as marking the period when many of the old handicrafts had been extinguished by the use of mechanical appliances and the growth of the factory system, and when the delight of men in these current developments was so great that they were regarded as triumphs in themselves, when they were only “means to an end.”

Since that period the development of pottery and porcelain has followed two main directions: (1) an attempt on the part of manufacturers to produce the most artistic results possible with modern processes and methods, and (2) the interesting and valuable efforts of those individual potters in every country with whom art was the first consideration and commercial production was disregarded.

Though the English pottery factories were of such paramount importance in the first half of the 19th century, it must be remembered that some of the oldest factories in Europe were still alive and active. The royal factories in Sèvres, Meissen, Berlin, Vienna, St Petersburg and elsewhere, surviving the wreck of the Napoleonic Wars, continued at the expense of their respective states, to produce porcelains which were the legitimate development of their work during the 18th century.

Meissen and Berlin.—At Meissen, efforts were made to improve the technical process in use, but, unfortunately, the old Meissen wares had already become valuable, and they were reproduced, marks included, until all initiative was destroyed, and the factory continued to live, mainly, on its old reputation.

At Berlin, the financial troubles of the Prussian monarchy throughout the early years of the 19th century were severely felt, so that a cheaper class of porcelain was manufactured. The only innovations that can be ascribed to the factory during this period, though highly esteemed at the time, form striking examples of the artistic decadence of the period. Such was the lace-work decoration made by dipping lace in porcelain slip so that on firing the thread burned away, leaving a porcelain facsimile; another was the production of slabs of porcelain modelled in such a way that on viewing the piece by transmitted light it appeared like a picture painted *en grisaille*.

From the artistic point of view there is little to be said for the majority of productions of the Berlin factory, but nowhere in the world has greater attention been paid to the technical and scientific problems of porcelain manufacture, and this establishment has rendered the greatest service in the development of the important chemical and electrical industries of Germany by the splendid appliances it has invented for scientific use.

Since 1870 the works, removed to Charlottenburg, have been conducted with very great enterprise. It was here that Seger perfected his soft porcelain based on the glazes and bodies of the best Japanese porcelains, and here also he developed the manufacture of copper-red glazes in imitation of the old *sang-de-boeuf* and *flambé*, glazes of the Chinese, at the same time establishing some of the scientific principles underlying their production. At Berlin, too, all the modern methods of decoration, whether in coloured glazes, raised enamels, *pâte sur pâte*, the elaborate paintings of flowers, birds or figures, or the use of crystalline glazes, have been followed with great success; but the factory has never yet given any special impetus or new direction to the decorative side of porcelain.

Vienna.—Few European factories were so little affected by the general trend of affairs as the royal factory at Vienna. We have already referred to the elaborate paintings and rich gilding which became the distinguishing feature of its wares towards the end of the 18th century, and this style, once perfected, seems to have been continued with little change. It has been stated by a renowned German authority, that the Viennese porcelain was at its best between 1785 and 1815. During this period the plan of painting copies of pictures on porcelain was developed to its utmost, and this, in combination with the richest gilding, marks the apotheosis of Viennese porcelain. The factory came to an end in 1864, but collectors should be warned that a flood of cheap porcelains, decorated in modern Viennese workshops, and therefore styled “Viennese porcelain,” has during the last twenty years overwhelmed the English and American markets.

Sèvres.—The important part played by the Royal French manufactory at Sèvres has already been sketched. During the troublous years of the French Revolution the works practically came to a standstill, and under the Directory it was a question whether this manufactory, along with certain other state establishments in France, should be closed. Napoleon, however, decided that for the glory of France and as a means of encouraging its porcelain industry, seriously threatened by the English potters, the establishment at Sèvres should be conducted as a national factory. By a splendid coincidence Alexander Brongniart, a man of great natural ability, and a noted scientist, was appointed director, and retained that post under the successive governments of France until his death in 1847. In the hands of Brongniart the establishment at Sèvres became at once a school of research and a centre of practical accomplishment—the influence of which was felt throughout Europe. Its products were obviously inspired by the

demands of successive French monarchs and their courts. It ministered to the grandiose ideas of Napoleon, who demanded pieces that were to speak of his victories, and after every campaign a fresh table service or new suite of vases was produced to commemorate the emperor's successes. The most striking piece of this kind was the vase made to commemorate the marriage of Napoleon and Marie Louise in 1810. It was designed by Isabey and was modelled with figures in bas-relief. The principal group contains not less than 115 such figures, while the subsidiary group, representing the acclaiming populace, contains between 2000 and 3000 figures. This vase was three years in making, and is said to have cost something like £1250. Unfortunately this was not a solitary example of the productions of Sèvres, for under every successive government of the 19th century the factory has been called to produce enormous vases which are to be found in the rooms or corridors of every palace and museum in France, and while these pieces represent wonderful technical skill, both in their manufacture and the decorations with which they are covered, very few of them possess either spontaneity or charm. They are correct, frigid, cold, and compare most unfavourably from the artistic point of view with the masterpieces of oriental pottery.

Everything was carried out on the grand scale, and once again the influence of Sèvres became paramount in Europe, and its styles of painting and decoration were eagerly followed from 1830 to 1870 by all those European potters who were attempting to make anything beyond useful domestic wares. As an instance of its aims in the period between 1830 and 1850, large sums were spent in the production of great slabs of porcelain many feet in area; on which were painted copies of some of the famous portraits and other pictorial masterpieces in the galleries of the Louvre. A number of these are preserved in the museum at Sèvres, and must always excite admiration and even wonder at their technical accomplishment.

The most noticeable invention of Sèvres in the middle part of the 19th century was the *pâte sur pâte* decoration in which porcelain clays of various colours are used as the artist's medium. The idea appears to have been adopted from an old Chinese vase by Robert, the chief painter, and at the London International Exhibition of 1862 some small cups decorated in this method, by Gely, were first shown. The most successful work in this style was, however, that produced by M. Solon, who worked at Sèvres until 1870. In that year he came to England and was employed at Minton's, where for about thirty-five years he continued this method of work, one of the few artistic and beautiful styles of pottery decoration of the 19th century. As practised by M. Solon the *pâte sur pâte* decoration took the form of paintings of figure subjects or dainty ornamental designs in white slip on a coloured porcelain ground of green, blue, dark-grey or black. On such grounds a thin wash of the slip gives a translucent film, so that by washing on or building up successive layers of slip, sharpening the drawing with modelling tools, or softening or rounding the figure with a wet brush, the most delicate gradations of tint can be obtained, from the brilliant white of the slip to the full depth of the ground. This method was rapidly adopted by all the principal European factories, though nowhere was it carried to such perfection as at Sèvres and at Minton's. M. Taxile Doat has executed many extraordinary pieces in this style of decoration at Sèvres, and in the British Museum there is a large vase of his, presented by the French government at the beginning of the present century. One great feature of French porcelain manufacture during the 19th century was the development of the industry at Limoges and the neighbouring district of central France. Limoges was a small centre of porcelain production in the period between 1780 and 1850, but after the latter date it rapidly developed into a pottery centre second only in importance to that of the Potteries district in England. We can do no more than mention this fact, because, for the most part, the activities of Limoges have been devoted to the production of pottery commercially, rather than pottery as an art.

The Franco-German War proved a disaster for Sèvres, and all work came to a standstill for a time. The existing manufactory, which was almost completed before the outbreak of the war, was opened by Marshal MacMahon in 1876, but for many years the work was continued under great discouragement. Between 1879 and 1889 attention was paid to the study and imitation of old Chinese methods, and this resulted in the reproduction of many of those Chinese glazes which had hitherto been the despair of European potters.

At the Paris Exhibition of 1900 the display made by Sèvres was perhaps the most notable feature of the magnificent collection of ceramics gathered there. The collection included many varieties of porcelain, both hard and soft paste, decorated in all the current styles of the period; under-glaze painting, on-glaze painting, flambé glazes and crystalline glazes, but most beautiful of all were the magnificent groups of "biscuit" figures designed as table garnitures by some of the best French sculptors of the time.

English Progress.—The demand for elaborate specimens of painted porcelain was at its height throughout Europe between 1851 and 1880, and this demand was undoubtedly fostered by the series of international exhibitions held during that period, when every European pottery works of note produced large and costly specimens of porcelain or earthenware, smothered with

painting and gilding. Every famous manufactory produced something beyond the ordinary, but undoubtedly the first of European factories during this period was that of Messrs Minton at Stoke-upon-Trent. M. Leon Arnoux, a descendant of the Arnoux's of Apt, an old family of French potters, was at this time the technical and artistic director of Messrs Minton's works, and he was the only pottery director during the 19th century who could in any sense be compared with M. Brongniart of Sèvres. M. Arnoux combined in a remarkable degree artistic with technical skill, and under his management the works of Messrs Minton became the greatest centre of ceramic art in Europe. Skilful modellers, like Jeannest, Carriere-Belleuse, and Protat, and pottery painters such as A. Boullemier, Moussill, E. Lessore and L. Solon were engaged at this factory and produced many of the most characteristic European decorations of the middle of the 19th century.

To this period, too, we must refer another English invention, that of a special porcelain known as "Parian." This in its finest expression was a "biscuit" porcelain used for the production of statuettes and groups rivalling the finest 18th century "biscuit" figures of Sèvres and Derby. It seems probable that this Parian was first made at the works of Copeland and Garratt, at Stoke-upon-Trent; but it was immediately adopted at Minton's, Wedgwood's, and at Worcester; and each of these firms used it in a distinctive way. Glazed Parian was also manufactured at the Belleek Porcelain Works in Ireland (the only Irish porcelain works of any note), and later its manufacture was developed by the Worcester Royal Porcelain Company, Moore Brothers of Longton, and other English manufacturers until it became an important branch of the English porcelain made in the period under review.

Japanese Influence.—At the Paris Exhibition of 1867 the great collection of the applied arts of Japan took Europe by storm, and there was an immediate outbreak of adaptations of Japanese art in Europe once more; not as in the 18th century, when the old Japanese patterns were copied or frankly imitated, but a European-Japanese style arose, based on the methods and ideas of the great Japanese painters and draughtsmen, the workers in metal, in iron, in lacquer and in silk. In England the Worcester Royal Porcelain Company produced a series of elaborate and skilful pieces inspired from this source, which for perfect and minute execution must be ranked before all other European works of their kind.

The most admirable result of this revived interest in Japanese art was, however, developed at the Royal Copenhagen works, the productions of which are not only famous all over the world, but have set a new style in porcelain decoration which is being followed at most of the continental factories. By the use of the pure Swedish felspar and quartz and the finest china clays from Germany or Cornwall a material of excellent quality is prepared, and on this naturalistic paintings of birds, fishes, animals and water or northern landscapes and figure subjects are painted in delicate under-glaze blues, greys and greens. The Royal Copenhagen works has also produced a profusion of skilfully modelled animals, birds and fishes, either in pure white, or delicately tinted after nature, with the same under-glaze colours.

Not only have Berlin, Sèvres and other European factories adopted the modern Copenhagen style of decoration, but the Japanese are now imitating these skilful productions which were originally inspired by their own early work.

Stonewares.—Mention must be made of the revival of the manufacture of artistic stonewares by Doultons of Lambeth, and Villeroy and Boch, the great German potters. Doultons, besides reviving the older forms of English stoneware, made some entirely new departures, and their pieces with designs etched in the clay are admirable examples of the right use of a refractory material. Villeroy and Boch reproduced the old Rhenish stonewares, and many interesting new departures in addition, but mostly in German forms that have not commended the wares to other nations.

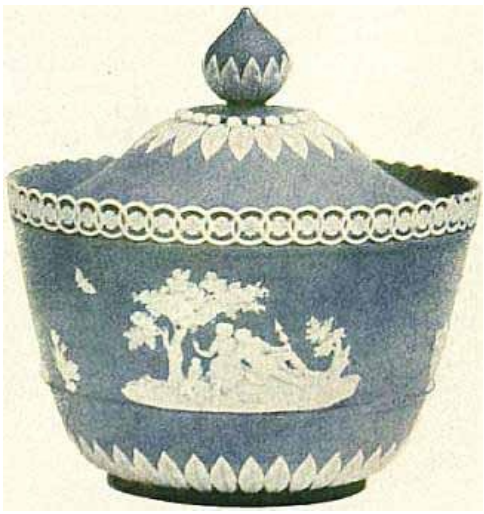
PLATE X.

Chelsea porcelain; 1745-1770 Figure after Watteau.

Worcester Porcelain; c. 1760-1770

Whieldon and Wedgwood,
cauliflower ware; c. 1750-1760

Wedgwood’s jasper; c. 1780



Turner’s jasper; c. 1780

Artistic Results.—While the great potteries of Europe have been employed in improving their methods of manufacture and in consolidating their knowledge on the technical and scientific side, so that they are able to produce pottery more perfect in shape, with a higher degree of

finish and greater certainty of result than was ever known before, it cannot be said that the artistic results have been commensurate with the labour expended. Fortunately, however, the success of these important industrial concerns in stereotyping modern production has incited a considerable number of clever men, either potters or artists, to become artist-potters and producers of individual wares, often recalling the works of the great schools of bygone centuries. This movement, which to-day has its exponents in every European country as well as in the United States of America, originated in France between 1840 and 1850, when the formation of the earliest ceramic museums and the new-born interest in the old French faience led to various attempts at pottery-making by the old methods of handwork and rule of thumb. Avisseau of Tours (1845), Pull of Paris (1855), and Barbizet (1859) began to make pieces in the style of Palissy, and Ulysse of Blois (1863) revived painted faience in imitation of that of Nevers. Slowly a demand for painted pottery was created among collectors and amateurs, and in France and other countries artists began to dabble in the painting of pottery. In some cases the artist retained his freedom, painting pieces obtained from some pottery manufacturer, which he sold on his own account after they had been decorated and fired; or he became attached to a particular factory and his productions were sold by the potter; or the artist became an amateur potter, and either worked alone or encouraged other artists to co-operate with him.

It is impossible to do more than mention a few of the prominent men in each class, whose works were not only esteemed in their own day, but are also likely to be regarded always as among the distinguished productions of the 19th century. Emile Lessore and Chapelet were both painters who were attracted by the technique of the potter. For some time they bought specimens of pottery from a small manufacturer named Laurin at Bourg-la-Reine, and after a time they definitely forsook pictorial art for that of the potter. Lessore painted in underglaze colours in a delicate sketchy style figure-subjects, mostly adapted from old engravings. He worked for a short time at Sèvres, and then, like so many other French pottery artists of this period, he came to Minton’s in England, and finally entered into an engagement with the old firm of Josiah Wedgwood & Sons which continued almost to his death (1860-1876). On their fine cream-coloured earthenware he sketched many thousands of fanciful designs which had a great vogue in the ’seventies and ’eighties of the last century. Chapelet pursued a very different course. His first innovation was a method known as “Barbotine” or slip-painting, in which coloured clays were used “impasto,” often in considerable thickness, so that after the work had been fired and glazed it bore some resemblance to an oil painting. For a few years this style of decoration became the rage all over Europe, but it fell into contempt almost as rapidly as it had found favour, and is now only used for the decoration of common wares. Ultimately, Chapelet gave up painting and applied himself to the discovery of technical novelties. He was apparently the first European potter to produce flambé glazes after the manner of the Chinese, and a fine collection of these productions of his is preserved in the museum at Sèvres.

The greatest of all the French innovators was, however, Théodore Deck, who had been trained as a working potter and was led to forsake the management of an ordinary tile and pottery business in Paris to experiment on his own account. He started a little workshop in the Boulevard Montparnasse in Paris and rapidly gathered round him a number of young painters all eager to experiment in the magnificent colours which Deck with his passionate love of Persian and other oriental pottery could place at their disposal. Within a few years this venture was so successful that Deck was known all over the civilized world as a great potter, and his original creations, painted by men like Ranvier, Collin, Ehrmann, Anker and other artists, were readily purchased by the lovers of ceramic art in every country. The crown of his career came in 1887, when he was appointed director of the National Manufactory at Sèvres, for he was the only practical potter who had ever occupied that position; but he died in 1890 before he had been able to impress his personality on the work of Sèvres.

The same movement that was active in France found its exponents in other countries as well. In Italy and the south of France the last quarter of the 19th century witnessed a revival of Italian majolica and of lustre decoration. Prominent in this direction were the productions of Cantegalli of Florence and of the Massiers of Golfe-Juan near Cannes; while in England William de Morgan created an artistic sensation by his tiles and vases decorated with lustres, or with painted colours recalling those of the Persian and Syrian potters of the middle ages. This departure in England was, however, followed up by many manufacturers who were keenly alive to the possibilities of pottery colour, and Mr Bernard Moore, of Longton, Maw & Company of Jackfield, and Minton’s of Stoke-upon-Trent, produced much excellent work, in tiles and vases inspired from the same oriental sources.

Meantime, in America there had been growing up a manufacture of pottery after the approved methods, in Trenton, New Jersey; East Liverpool, Zanesville and Cincinnati (Ohio). To all these centres English workmen had been attracted, and earthenware after the current English styles was manufactured; but, as was the case in Europe, individual efforts were made to produce artistic pottery. The first and best known of these artistic departures was that of the Rookwood Pottery at Cincinnati, and again it was an amateur, Mrs Bellamy Storer, who founded an

enterprise which has since produced some very original work. From 1880 to 1889 the work was mainly carried on at the expense of this lady, but since that date the enterprise has been self-supporting, and the Rookwood pottery has become known throughout the world.

The latter half of the 19th century also witnessed the development of new branches of pottery manufacture for sanitary purposes—and it is not too much to say that much of the improved sanitation of modern dwellings and towns has been rendered possible by the special appliances invented by potters for these purposes. In this direction the English potters undoubtedly led the way, and not only have their methods been imitated abroad, but English manufacturers have also established large works in Germany, France and the United States of America. Varieties, too, of hard-fired pottery, comprising earthenwares, stonewares and porcelains, have been invented for use in the chemical and electrical industries. But these belong to the great modern branch of pottery manufacture, not to pottery art. In the same way, the revived attention paid to the various forms of pottery for the interior and exterior of buildings belongs rather to the question of mural decoration than of pottery.

At the beginning of the 20th century we find England and Germany the leading pottery manufacturing countries; Germany excelling in the amount of its output, and England in the fineness and finish of its productions. France, in addition to the National Manufactory at Sèvres, as much as ever divorced from commerce, has its porcelain industry at Limoges and large manufactories of tiles and earthenware in many departments; while there are also a number of artist potters like Lachenal, Dalpayrat, Delaherche and Taxile Doat who make purely artistic pottery in hard-fired stonewares (*grès*) and porcelain, while the production of decorative stonewares for building purposes has been developed by such firms as Bigot, Boulanger and E. Müller. A great development has also taken place in the production of decorative pottery and tiles in Holland. The famous Delft works, besides producing quantities of painted blue and white earthenware (made in the English and not in the old Dutch fashion), has been experimenting largely in the development of crystalline and opalescent glazes and in lustres, while the Rozenburg factory at the Hague and a factory at Puramerende, near Amsterdam, have made some distinctive but rather bizarre painted pottery and porcelain. The success of the Royal Copenhagen factory has already been mentioned, and this success led to the foundation of Bing & Gröndhal of Copenhagen, who largely follow the styles of decoration initiated at the Royal works. In Sweden there are two important factories at Rörstrand and Gustafsberg. Under the accomplished director of the Rörstrand factory, Mr Robert Almström, a great variety of products have been successfully manufactured, including hard-paste porcelain, English bone china, earthenware, majolica and stoves. Italy, Spain and Belgium have also important modern pottery works. 760

In the United States of America there are large establishments for the manufacture of earthenware, bone china and tiles, all after the English fashion, while in addition there are a number of experimental kilns at work producing artistic pottery. The Rookwood factory has already been mentioned, but the wares produced at the Grueby factory and by Mrs Robineau and T. Brouwer are also worthy of note. (See “Report on American Art Pottery,” pp. 922-935 of *Special Reports of the U.S. Census Office, Manufactures*, pt. iii., 1905.)

Technical Pottery Works.—It is only possible to give a selection of the best of the modern standard works dealing with the technical side of pottery production. Brongniart, *Traité des arts céramiques* (3rd ed., Paris, 1877), with notes and additions by Salvétat; E. Bourry, *Traité des industries céramiques* (Paris, 1897); Théodore Deck, *La Faïence* (Paris, 1887); A. Granger, *La Céramique industrielle* (Paris, 1905); E.S. Auscher, *La Céramique cuisant à haute température* (Paris, 1899); *Technologie de la Céramique* (Paris, 1901); *Les Industries céramiques* (Paris, 1901); Seger, *Gesammelte Schriften* (Berlin, 1896; Eng. trans., Eastern, Pa., U.S.A., 1902); Langenbeck, *The Chemistry of Pottery* (Easton, Pa., U.S.A., 1895); William Burton, *Porcelain* (London, 1906).

(W. B.*)

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1 The archaeologist is frequently puzzled as to the place of origin of some example of ancient pottery —was it made in the district where it was found, or had it been imported from some other centre? When we possess a sufficient body of analytical data obtained by the use of one general chemical method, an analysis of a fragment will frequently enable such a question to be answered, where now all is doubt and speculation. But the analytical results published hitherto are often not worth the paper they are printed on for such a purpose, the older methods of silicate analysis being only approximate.

2 It must always be borne in mind that, side by side with the production of artistic wares in all countries, the traditional craft of the village pot-maker continued, and has probably been less interfered with than is generally imagined, except in the British Isles. Any country market-place in Spain, Italy, Greece, France, Germany, or Holland is provided to-day with a simple peasant pottery little removed in its forms, its decorations, or its technical skill from the country work of the middle ages. In England the cheapness of machine-made pottery has largely destroyed such village industries.

3 *I tre libri dell' Arte del Vasajo*, by Cipriano Piccolpasso of Castel Durante, A.D. 1548.

4 The earliest glazed objects found in Egyptian tombs (once dignified by the name of Egyptian porcelain) are hardly to be called pottery at all, though we have no other name for them. The material is largely sand held together by a little clay and glass.

5 Foreign pottery had been imported into Egypt at least as early as the XIIth Dynasty, *e.g.* the Cretan polychrome ware of the Middle Minoan period (Kamares style) found at Medinet Ghuraib ("Kahun") and the Cypriote (?) "punctuated" black ware from the same site, and from Khata'anah (17). The date between the XIIth and XIIIth Dynasties is certain (14), but the Middle Kingdom Egyptians do not seem to have imitated these earlier foreign forms. British Museum, No. 17,046, is, however, probably an instance of an Egyptian idea imitated by the foreign potter (17).

6 Some of these figures appear to have been made with a mixture of sand, clay and coloured glass which produced a real glassy porcelain—the earliest porcelain of which we have any record.

7 On this subject see in particular Mazard, *De la connaissance par les anciens des glaçures plombifères*, a scientific and valuable monograph (1879); also Rayet and Collignon, *Hist. de la céramique grecque*, p. 365 (or *B.M. Cat. of Roman Pottery*, Introduction).

8 For a full description and lists of such kilns see Walters, *Ancient Pottery*, ii. 443-454.

9 See examples in colour on Plate V.

10 A peculiarity of the Persian and allied blue glazes, of many shades, is that they appear to have been produced not by dissolving the colouring matter in the glaze, but by coating the white ground of the ware with a thin wash of some cobaltiferous substance—probably an earth containing varying proportions of cobalt, manganese and iron—and then melting a thick alkaline glaze over it.

11 See Drury Fortnum, *Archaeologia*, vol. xlii.

12 Specimens of Turkish and other Eastern wares exist with elaborate English silver mounts of the time of Elizabeth, and these were doubtless included under the name of "Damas Wares."

13 See Riaño, *Spanish Arts*, Victoria and Albert Museum Handbook, pp. 149-151; and *Sobre la manera de fabricar la antigua loza dorado de Manises* (1878).

14 See examples in colour, Plate VI.

15 There is ample documentary evidence to prove how largely the lustred pottery of Spain was imported into Italy from the 12th century onwards; and it is important to note in this connexion that almost all the fine examples of Hispano-Moresque in our modern collections have been obtained from the palaces of ancient Italian families.

16 Piccolpasso, *I tre libri dell' arte del Vasajo*, dated 1548. It has been several times translated both into modern Italian and French. The English reader will find an excellent abstract of this interesting MS. in the volumes on *Majolica* by Drury E. Fortnum.

17 For a full account of the lustre process see Franchet, *Comptes rendus* for December 1905, and W. Burton, *Society of Arts Journal*, 2846, vol. lv., 1907.

18 See Magne, *Le Palais de Justice de Poitiers* (Paris, 1904); also Solon in *Burlington Magazine* (November 1907).

19 See B. Fillon, *Les Faiences d'Oiron* (1862).

20 See E. Bonaffe, *Les Faiences de Saint-Porchaire* (1898).

21 See examples in colour, Plate X.

22 An excellent summary of the remains of English medieval pottery will be found in Hobson's "Medieval Pottery found in England," *Archaeological Journal*, vol. lix.

23 Böttger at Meissen made a similar ware as his prelude to the discovery of white porcelain, but this was after Dwight's death.

24 For a discussion of the stages through which this was achieved the reader is referred to special works, such as Prof. A.H. Church's *English Earthenware*, and W. Burton's *English Earthenware and Stoneware*.

25 It is amusing or annoying to find in European museums the wares of Wedgwood, Turner, Adams and one of the Leeds potteries, all lumped together as "Wedgwood," and yet one can hardly wonder at it, remembering how much has been written of Wedgwood and how little of the other English potters of the 18th century.

26 See examples in colour, Plates VII. and VIII.

27 S.W. Bushell, *Chinese Art* (Victoria and Albert Museum Handbooks, ii. 5-6).

28 *Yao* is the Chinese term equivalent of the English "pottery" or "ware."

29 See Brinkley, *Japan and China*, ix. 353-365.

30 Solon, *The Noble Buccaros* (Stoke-upon-Trent, 1896).

31 M. Reinand, *Relation des voyages faits par les Arabes et les Persans dans l'Inde el à la Chine dans le IX^e siècle* (Paris, 1845).

32 The suggestion has been made that the *céladon* wares found in Western countries were made by Moslem potters and not by the Chinese, but this theory is not generally accepted. On this point consult Karabacek, "Zur muslimischen Keramik" in *Österreichische Monatsschrift für den Orient*, vol. x., 1884; A.B. Meyer, "Über die Herkunft gewisser Seladon-Porzellane" under "Über die Marta banis," ibid. vol. xi., 1885; Hirth, *Ancient Porcelain* (1888), and Bushell, *Oriental Ceramic Art* (1899).

33 It is of interest to note that the "Delft" of Holland, also a product of the 17th and early 18th centuries, makes the nearest approach in quality to the blue and white porcelain of the Chinese.

34 See Drake, Sir W., *Venetian Ceramics*; and Davillier, Baron Ch., *Les Origines de la porcelaine en Europe*.

35 A perfect *tour de force* in this inartistic style of work, preserved in the Dresden Museum and formerly attributed to Meissen, has been shown to be the work of Vincennes. See *Gaz. des beaux-arts*, September 1904.

36 *Travels in England and Scotland* (Eng. trans.), vol. i. p. 97.

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