

much altered by the architects engaged to carry on the work, and in particular by Michel Angelo. Competent judges are strongly of opinion that Bramante's designs, if carried out, would have had a much greater effect than those which were finally adopted.

Bramante had a great influence in Italy. By his careful study of the ancient forms of art he became the real introducer of the so-called classical style. His own genius was bold and inventive, delighting in mass and breadth, but occasionally failing in the perfection of detail.

BRAMANTINO. See SUARDI.

BRAMBĀNAN, a village in Java, notable for extensive and remarkable ruins of Hindu character. The place lies directly south of the great volcanic cone of Mir-Api (8640 feet) in the territory of the sultan of Yugya-karta (written by the Dutch Djokjo-karta), and 10 miles east of the capital, just on the border of the other native state called Surakarta or Solo.

The remains embrace six groups of temples, besides two buildings intended for residence, perhaps monastic. The most remarkable of the former is that called *Chandi Sewu*, or "The Thousand Pagodas." The centre of the group is a large temple of cruciform plan, standing on a terraced basement, and surrounded by four (originally, perhaps, by five) concentric squares, formed by rows of small detached cells or temples, the whole area forming a square of upwards of 500 feet to the side. Statements differ as to the exact number of these cells, but a plan given by Raffles shows 238 as now standing. They are sculptured externally with mythological reliefs, each is crowned with a small *dagoba* of the usual Buddhist pattern (*i.e.*, very like the minor domes over the west portico of St Paul's), and probably all originally contained images of Buddha in the usual cross-legged attitude (of which a few still remain), whilst the central shrine contained, no doubt, a great image or images of Buddha also. Mr Fergusson thinks the group to be Jaina rather than Buddhist; and this a closer examination of the images and their symbols alone can decide. But similar series of shrines, clustered round a central pagoda, are found in Buddhist Pegu. There is a professed restoration of the central temple of Chandi Sewu in Raffles's *History*; but the details of this plate (pl. 40) are not to be relied on.

Another Buddhist edifice, single but more perfect, is known by the name of Chandi Kali Baneng. This also is cruciform; it stands on a boldly moulded basement, and the external decoration exhibits pilasters richly carved in scroll-work, and massive double cornices. Small Buddhas in niches remain, but the great figure which must have occupied the interior has disappeared.

A third group of temples, once, probably, the most important, is known as *Lara Jongran*. These are so ruined that at a short distance they present the aspect of vast and shapeless cairns of stone. One of them contains in three upper cells fine figures of purely Hindu and Brahmanical character. To the north is Durga (here in the character of a strong but beneficent power) slaying the demon Mahishāsura,—precisely the same subject that is to be found in Moor's *Hindu Pantheon*, pl. 35. This is the *Lara* or Virgin, who gives the popular name to the group of temples. To the west is the elephant-headed Ganesha, and to the south a fine Jove-like Siva, bearded and trident-bearing. Offerings are sometimes made to these images by the peasantry, in spite of the universal Mahometan profession.

The name of the place is said by Friedrich to be properly *Paramānan*, and to mean probably "the Place of Teachers." The whole of the temples are alleged, in traditional rhymes, to have been erected between 1266 and 1296 A.D. But the chronology and history of the older

Javanese remains is still very obscure, and probably the date of some of the Brambānan temples must be carried much farther back. The destruction of the last-described group must have been the work of earthquake, and we must suppose the date of the other buildings to be subsequent to the destruction. Some general points worthy of note in regard to these buildings are the following:—

(1.) They are all built of hewn stones without the use of any cement.

(2.) There are distinct traces showing that the exterior and interior of the buildings were once covered with a fine coat of stucco, not excepting the most elaborate sculpture in scroll-work, &c. We know that the sculptured cave-walls of Ellora, the great idols at Bamian, and the Doric order at Selinus were similarly coated; and probably in all these cases the stucco was intended to bear colour or gilding.

(3.) No real arch exists in these buildings. The vaults and doorways are covered by the corbelling, or stepped projection, of the horizontal courses. Mr Crawford makes a contrary statement, but that historian, usually so trustworthy, was certainly mistaken on this point.

(4.) Many of the peculiarities of this architecture, both in general plan and in ornamental details, indicate a close relation to the mediæval styles of Burmah and Cambodia; and points almost necessarily to an original common type in India, a type which as yet we cannot trace satisfactorily. In this lies a problem of interest, which the accumulation of photographs will perhaps allow of being worked out. It is notable, however, that in the Burmese mediæval brick buildings of analogous character the true arch is used profusely.—(*Chiefly from the notes of a visit to Brambānan by the writer.*) (H. Y.)

BRANDE, WILLIAM THOMAS, chemist, was born at London in 1788. After leaving Westminster school he spent some time on the Continent, and acquired a knowledge of French and German. On his return he began the study of medicine, and in 1806 a communication of his to the Royal Society was printed in their *Transactions*. In 1809 he was made a fellow of the Royal Society, and became assistant to Sir Humphrey Davy at the Royal Institution. He succeeded Davy in the chair of chemistry in 1813, and in the same year received the Copley medal of the Royal Society. From 1816 to 1836 he was joint editor with Faraday of the *Quarterly Journal of Science and Art*. In 1825 he was made superintendent of the die department in the Mint, and in 1853 he received the honorary degree of D.C.L. of Oxford. He died on the 11th February 1866. Besides numerous papers, which marked him out as one of the most vigorous and able chemists of the day, Brande was the author of several important works. The *Manual of Chemistry*, 1819, and *Elements of Chemistry*, 1831, were the best works of the time, and soon became popular. He also published a *Dictionary of Materia Medica* in 1839, and a *Dictionary of Science, Literature, and Art* in 1842. The latter is an exceedingly able and valuable work of reference; a new edition of it has recently appeared under the editorship of Mr G. W. Cox, 1875. Brande was the author of the third of the Dissertations (that on the progress of Chemical philosophy) prefixed to the supplement of the fourth edition of the *Encyclopædia Britannica*.

BRANDENBURG, one of the largest provinces of Prussia, and the division from which that powerful monarchy originally sprung. It lies between 51° and 53° 34' N. lat. and 11° 25' and 16° 10' E. long., and is bounded on the N. by Mecklenburg and the province of Pomerania, E. by Posen and Silesia, S. by Silesia and the kingdom and province of Saxony, and W. by Anhalt and the provinces of Saxony and Hanover. It has an area of 15,403 square miles, and is divided into the two governments of Potsdam and Frankfort, the capital, Berlin, forming a separate jurisdiction. The province is a sandy plain interspersed with numerous fertile districts and considerable stretches of woodland. Its barrenness was formerly much exaggerated, and it was popularly described as the sandbox of the Holy

Roman Empire. It is generally well-watered by tributaries of its two principal rivers, the Elbe and the Oder, and is besides remarkable for the number of its lakes, of which no fewer than 600 or 700 great or small are enumerated. The mineral products comprise coal, limestone, gypsum, alum, and potter's earth; barley and rye are the usual cereals; fruits and vegetables are abundant; and considerable quantities of hemp, flax, hops, and tobacco are raised. The breeding of sheep receives great attention, and the province furnishes a greater export of wool than any other in the kingdom. Bees are kept in considerable numbers, especially in the neighbourhood of Sorau. The climate is cold and raw in winter, excessively hot in summer, and there are frequently violent storms of wind. The manufacturing industry of the province is both varied and extensive, but is for the most part concentrated in the principal cities. The most important branches are the spinning and weaving of wool and cotton, the manufacture of paper, and the distillation of brandy. Educational institutions are very numerous, not only in the capital, but throughout the province. There are in all 135 towns in the province, the most important being—

Potsdam, population .....	43,834
Frankfort " .....	43,214
Brandenburg " .....	25,822
Spandau " .....	19,690
Prenzlau " .....	14,442
Luckenwalde " .....	13,539
Ruppin " .....	11,590

In 1871 the population was 2,863,229, of whom 2,720,242 were Protestants, 86,047 Roman Catholics, and 47,484 Jews.

BRANDENBURG, a town of Prussia, capital of the circle of West Havelland, in the government of Potsdam, and province of Brandenburg. It is situated on the River Havel, and on the Magdeburg and Berlin Railway, 37 miles W.S.W. of Berlin. The town is enclosed by walls, and is divided into three parts by the river,—the old town on the right and the new town on the left bank, while on an island between them is the "cathedral town," also called, from its position, "Venice." Many of the houses are built on piles, through which the water of the river flows. The cathedral, an ancient structure of the 14th century, the old church of St Katharine, erected in 1410, and the council-house, deserve notice for their antiquity and as works of art. There are also a castle, a gymnasium, a riding academy, a public library, a theatre, and several hospitals. In the market-place stands a *Rolandssäule*, a colossal figure 18 feet in height, hewn out of a single block of stone; and a little to the N. of the town is the Marienberg, on which the heathen temple of Triglaff and afterwards the church of St Mary's were built. The town has a very considerable trade, with manufactures of woollens, silks, linens, hosiery, and paper, as well as breweries, tanneries, and boat-building. Population in 1871, 25,822.

Brandenburg, originally *Brennabonch*, was founded by some Slavonian tribes, from whom it was captured in 923 by the emperor Henry I., who surrounded it with strong fortifications. A bishopric was founded there in 949, subject to Mayence, and subsequently (968) to Magdeburg; but the heathen Wends succeeded in getting possession of the town, and were only expelled by Albert the Bear in 1161.

BRANDIS, CHRISTIAN AUGUST, a distinguished scholar and historian of Greek philosophy, was born on 13th February 1790 at Hildesheim. His father, a physician of some distinction, held for a time a professorship at the university of Kiel. His education was begun at the gymnasia of Holzminden and Kiel, and in 1806 he entered the university of the latter town. His attention was soon drawn from theology, in the study of which he was then engaged, to philosophy, particularly to Plato. In 1809 he

accepted the post of private tutor in the family of Count Adam Moltke at Nütschau, and there became acquainted with Niebuhr, whose noble character made a deep impression on him. In 1812 he graduated at the university of Copenhagen, and presented as his thesis "Commentationes Eleaticæ," a careful collection of the fragments of Xenophanes, Parmenides, and Melissus. Two years later he attended the university of Göttingen, and in 1815 presented as his inaugural dissertation at Berlin an essay *On the Idea of the History of Philosophy (Von dem Begriff der Geschichte der Philosophie)*. In 1816 he had the offer of an extraordinary professorship at Heidelberg, but preferred to accompany Niebuhr to Italy. Six years were spent in examination of the principal libraries, and Brandis began the labours of Aristotle which were to occupy many years of his life. In 1821 he was made professor of philosophy in the newly founded university of Bonn, and in 1823 appeared in edition of the *Metaphysics* of Aristotle (*Aristotelis e Theophrasti Metaphysica*). To this was added in 1837: second part, *Scholæ Græcæ in Aristotelis Metaphysica*. He became part editor, along with Boeckh and Niebuhr, of the new classical journal *Rheinisches Museum*, and contributed largely to it. His articles on Socrates (1827, 1829) are particularly deserving of notice. In 1835 appeared the first part of his great work, *Handbuch der Geschichte der Griechisch-röm. Phil.*, and in 1836 the *Scholæ in Aristotelem*, forming the 4th volume of the Berlin edition of Aristotle. The following three years were spent in Greece, whither he had gone as instructor to the young king Otho. Some of his experiences in Greece were published in 1843 (*Mittheilungen über Griechenland*). The remainder of his life was devoted to his history of Greek philosophy, the last part of which was published in 1866, little more than a year before his death, which took place on the 24th July 1867.

Brandis's great work, that by which he will be best remembered, appeared at intervals from 1835 to 1866, and altogether fills six volumes. It is characterized generally by great extent of reading, sound judgment, and critical examination of authorities. But it is to some extent defective in speculative insight and in power of exposition. The history for the most part is moulded too rigidly on the work of the author under consideration, and the whole course of exposition follows the order of the author's thought. Thus in many cases it is apt to degenerate into what is little more than a running commentary or summary of the original text. This is particularly noticeable in the portions on Plato and Aristotle. There is no attempt made to bring together information from all quarters and to work the whole into an organic unity. A comparison of the work of Brandis with that of Zeller would bring out the contrast between the two methods. At the same time the *Handbuch* will always retain a high value, even by the side of Zeller's later work, and its best portion, that on Aristotle, is perhaps as complete and accurate an account as can be desired. That Brandis himself felt the defects of his own method of history is shown by the fact that he threw the whole matter of his larger treatise into a smaller and more systematic form, the very title of which, *History of the Developments of Greek Philosophy (Geschichte der Entwicklungen der Griechischen Philosophie*, 2 vols., in three parts, 1862, 1864, 1866), indicates the change made. This smaller work is decidedly one of the best and completest histories of Greek thought in existence.

A sketch of the life of Brandis, with full list of his works, will be found in the notice read by Trendelenburg to the Berlin Academy, 1868 ("Zur Erinnerung an C. A. Brandis," *Abh. der Kön. Akad. d. Wiss.*, 1868, pp. 1-24).

BRANDT, SEBASTIAN, German satirist, was born at Strasburg about 1458. He studied at Basel, took the degree of doctor, and seems to have held a professorship for some time. After his return to Strasburg he was made syndic and then chancellor of the town. He died in 1521. Among his writings are some Latin poems and treatises on law; but the work by which he is best known is the satirical poem *Das Narrenschuff*, published in 1494. The *Ship of Fools*, though without artistic beauty of structure, and though its satire is often coarse, took the popular taste.

It was translated into Latin in 1497 by Locher, and soon appeared in almost every European language. Alexander Barclay's *Ship of Fools* (1509) is a free imitation of the German poem, and an abridged prose translation was published by Watson in 1517.

BRANDY, a spirituous liquor obtained by the distillation of wine, the aroma of which is due to ether and other volatile products. It may be distilled from any wine, but red wines yield a less pure and less aromatic spirit than light coloured varieties. In the departments of Charente and Charente Inférieure a variety of grape is cultivated exclusively for the production of brandy, the yield of which constitutes the cognac of commerce. In portions of the departments of the Landes, Gers, and Lot et Garonne, the preparation of brandy is also an important industry, and the produce is commercially known as armagnac, from the name of the district. The cognac district which produces the most rich and delicate spirit distilled is separated into distinct zones of production, according to the quality of the spirit each yields. In the centre of the district on the left bank of the Charente is the *Grande Champagne*, and radiating beyond it are the *Petite Champagne*, the *Premiers Bois*, and the *Seconds Bois* successively. The *Grande Champagne* is the source of the finest brandy anywhere produced; and as the area of cultivation recedes from that centre, the quality of the spirit proportionately lessens. The quantity of brandy exported in 1868 from Tonny Charente was 9,187,416 gallons, valued at £1,887,678, the greater part of which was consigned to British ports; but the exports fluctuate greatly according to the character of the years. Thus in 1872 the total imports to Great Britain were only 3,505,295 gallons, while in 1873 the quantity was 6,483,486 gallons, of which 6,378,398 gallons came from France. By storage in oak casks the spirit takes up a portion of tannin, which gives it a delicate golden hue, but the deeper colour of brown brandy is communicated by caramel. Cognac is kept in carefully ventilated stores for two years, during which time it decreases in bulk and strength by evaporation, but mellows and develops aroma which continues to increase the longer it is kept. Brandy is very popular as a medicinal stimulant, and for use in cases of sickness, diarrhoea, and spasms. It is very often adulterated, and a vast amount of spirit which passes under the name is really either beetroot spirit or grain whisky coloured and aromatized with the cognac-flavoured ceanothic ether or Hungarian oil. See DISTILLATION.

BRANTFORD, a town of the Dominion of Canada, in the province of Ontario, capital of the county of Brant, is situated on the Grand River, about 24 miles south-west of Hamilton. It is an important station on the Goderich and Buffalo line, with extensive engine-works and foundries. Brass, iron, and tin wares, agricultural implements, window blinds, and pottery are its principal manufactures. It is lighted with gas, and has a good supply of water. As the river is not navigable as far as the town, a canal has been constructed which gives communication with Lake Erie. There are fine county buildings, ten churches, an orphanage, banks, and newspaper offices. Population in 1871, 8107.

BRANTÔME, PIERRE DE BOURDEILLES, SEIGNEUR DE, French historian and biographer, was born about 1540. He was the third son of the Viscount de Bourdeilles, and at an early age entered the profession of arms. He approved himself a brave soldier, and was brought into contact with most of the great leaders who were seeking fame or fortune in the wars that then distracted the Continent. Soon after the death of Charles IX. he retired from active life, and spent his last years in writing his *Memoirs* of the illustrious men and women whom he had known. He died on the 15th July 1614. He left distinct orders that his manuscript works should be printed, and a first edition ap-

peared in 1665-6, not very complete. Of the later editions, the most valuable are—one in 15 volumes, 1740; another in 8 vols., 1787; one in 2 vols., 1842, by Buchon; that of the *Bibliothèque Elzévirienne* in 3 vols., 1858-9; and Lalanne's edition for the Société de l'Histoire de France, 6 vols., 1865, seq. Brantôme can hardly be regarded as a historian proper, and his *Memoirs* cannot be accepted as a very trustworthy source of information. But he writes in a quaint conversational way, pouring forth his thoughts, observations, or facts without order or system, and with the greatest frankness and naïveté. His works certainly gave an admirable picture of the general court-life of the time, with its unblushing and undisguised profligacy. There is not an *homme illustre* or a *dame galante* in all his gallery of portraits who is not stained with vice; and yet the whole is narrated with the most complete unconsciousness that there is anything objectionable in their conduct. There does not appear to be any English translation of Brantôme.

BRASIDAS, one of the most famous of the Spartan leaders in the early part of the Peloponnesian War, first distinguished himself by the relief of Methone, which was besieged by the Athenians (431 B.C.) For this service he was publicly commended at Sparta. In 429 he was sent to assist Cnemus, and appears to have taken part in the unsuccessful attack on the Piræus. Two years later he accompanied the admiral Alcidas to Corcyra, but did not succeed in inducing his superior to make an attack on the city. He was severely wounded in the assault on Pylos (425), and lost his shield, which was picked up and carried in their triumph by the Athenians. When it was resolved by Sparta to carry the war into Thrace, Brasidas was selected as leader. He relieved Megara in 424, and in the same year succeeded in passing through Thessaly and in effecting a junction with Perdicas of Macedon. He assisted Perdicas to put down a revolted vassal, Arrhibæus, and then, in an extremely short time, partly by his skilful policy, partly by the rapidity and boldness of his movements, succeeded in gaining possession of Acanthus, Stagira, Amphipolis, and Torone. In the spring of 423 a truce was agreed upon; but Brasidas insisted upon retaining Scione, which had capitulated a day or two after the truce began; this was denied, however, by the Spartan general. The revolt of Mende gave him another opportunity, and he seized that town. Later in the same year he again accompanied Perdicas against Arrhibæus, and made a most skilful retreat. He received no reinforcements from Sparta, where the leaders seemed jealous of his success, his conciliatory manners, and his dexterous policy. The Athenians, on the other hand, sent out a new armament, retook Mende, and repelled an assault on Potidæa. In 422 Cleon with the fresh Athenian troops besieged Amphipolis. A swift sally, directed by the skilful generalship of the Spartan leader, was crowned with success. The Athenians were routed, and Cleon slain, but Brasidas himself was mortally wounded. He was interred at Amphipolis, the inhabitants making him the founder of their city, and instituting yearly sacrifices and games to his memory. *Brasidaia* were also celebrated to his honour in his native city, none but pure Spartans being allowed to join in the games. Brasidas is the only Spartan general whose character displays nobility or grandeur. He had to some extent thrown off the mental stiffness produced by the rigid oligarchical institutions of his native city. He could make himself popular with the allies, and the charm of his personal character secured for Lacedæmon many a city which would not otherwise have joined the league. Thucydides gives him great praise, describes him as being eloquent for a Spartan, and mentions his reputation for justice, liberality, and wisdom. Brasidas was indeed the

saviour of Sparta in the early period of the war, and had he lived the contest might have come more quickly to an end.

BRASS, an alloy of copper and zinc, the composition of which will be discussed under the heading COPPER. In this place we have to do simply with its history, and the various applications of the alloy in the arts. Although the term brass frequently occurs in Scripture from the era of Job downwards, there is no indication that brass, as known in modern times, was in use previous to the period of the Roman empire. By the Romans a compound was used under the name *oricalchum* or *auricalchum*, which appears to have possessed the composition and properties of brass. With their conquests they carried a knowledge of the arts they cultivated into the countries they subdued, and from these the art of preparing the alloy extended with civilization throughout Europe. The earliest traces of brass in Great Britain are found in the mediæval monumental "brasses," found commonly over the tombs of civil and ecclesiastical dignitaries (see BRASSES). That the alloy was manufactured in England during the reign of Henry VIII., however, is indicated from the passing of an Act of Parliament prohibiting, under severe penalties, the export of brass, a prohibition which was not withdrawn till so recent a date as 1799. During the reign of Queen Elizabeth the manufacture was systematically developed and extended, and a patent for working calamine stone (the principal ore of zinc) and making brass was granted by the queen to William Humfrey and Christopher Schutz, securing to them the exclusive right of manufacturing brass. The patent rights granted to these persons were gradually extended and merged into a company under the name of the "Governors, Assistants, and Societies of the City of London of and for the Mineral and Battery Works," which continued to exercise its functions down to the year 1710. In the year 1721 it was estimated that about 30,000 persons found employment in the brass industries. From a very early date brassfounding was prosecuted in Birmingham, and by degrees it there assumed more important proportions till it has become the most distinguishing industrial feature of the town. The late Mr W. Aitken, in his valuable report on brass and brass manufactures, to which source of practical information we have to express our obligation, says:—"What Manchester is in cotton, Bradford in wool, and Sheffield in steel, Birmingham is in brass; its articles of cabinet and general brassfoundry are to be found in every part of the world; its gas-fittings in every city and town into which gas has been introduced from Indus to the poles."—(*Birmingham and the Midland Hardware Districts*, London, 1865.)

The brass trade of the present day is, according to Mr Aitken, conducted under nine different heads:—(1), brass-casting; (2), cabinet, bell, and general brassfoundry; (3), cock-making and plumbers' brassfoundry; (4), stamped brassfoundry; (5), rolled brass, wire, and sheathing; (6), tube-making; (7), lamp-making; (8), gas-fittings; and (9), naval brassfoundry. It frequently happens that several of these departments are carried on in the same establishment; but numerous as are these divisions, they by no means exhaust the industries in which brass plays a principal part. Thus the pin manufacture, button-making, and the gilt jewellery trade, are eminently characteristic of Birmingham, and in these brass is the principal metallic substance employed. According to the different forms under which brass is to be employed it is fashioned by the various processes of—1st, casting; 2d, rolling and drawing; 3d, stamping; and 4th, tube-drawing and casing; and to these, with 5th, brass-finishing, we shall briefly allude.

*Casting*.—The first operation necessary in connection with casting is the preparation of patterns of the object to

be cast. Castings, of course, vary in all degrees in intricacy and elaboration of details, and the getting up of the more ornamental patterns necessitates the employment of persons of artistic ability to prepare the design, and superior artisans to finish the pattern blocks. Three classes of castings are recognized in the trade—1st, common castings, made from any plain pattern, an impression of which can be formed and the pattern taken out without breaking the mould; 2d, cored castings, such as plumbers' cocks and other tubular work, where the metal must be poured round a central core; and 3d, false-cored castings, where the pattern is so undercut that the mould must be built up of such a number of separable sections as the intricacies of the pattern may require. When the mould is formed each of these sections is lifted off, the pattern is taken out, and they are then built together in their original position. This description of moulding requires much skill and dexterity. Moulds are made in sand of a free, fine-grained, and uniform character; and moulding-boxes of wood or cast-iron which fit together in two or more parts, with moulding-boards of wood and clamps to hold the parts together, are employed in casting. In the forming of common castings, the lower division of the moulding-box is packed with sand, and the pattern, if deep, is driven half its depth into it, parting sand is dusted over the surface, and the upper part of the box is fitted on and similarly packed with sand. When the box is filled, a moulding-board, forming a top or bottom to it, is laid on, the two halves of the box are separated, the pattern withdrawn, and "gates" or channels formed between the mould and the aperture by which the metal is poured in. The surfaces are then dusted over with flour or powdered charcoal, and the mould placed in an oven to dry. On their withdrawal from the oven the two parts of the moulding-box are clamped together, the molten metal is poured in, and a perfect copy of the pattern produced. In making common castings as many patterns as the superficial area of the moulding-box will accommodate are cast at once, "gates" leading to the entire series; and for many plumbers' castings, &c., a series of half patterns, with moulded gates, are fixed on two sides of a plate by which the whole may be moulded and finished at one operation. The cores for tubular work are separately made, and are supported on bearings in the mould. When the casting is cold the hardened core is picked out, and the article is then ready for finishing. Fine ornamental castings which contain minute details are moulded with special care in very fine sand, faced with charcoal powder, which faithfully reproduces the most delicate lines. The metal is poured direct from the crucible in which it is prepared, by the aid of strong tongs, and all spilt metal is carefully swept up, cleaned, and remelted.

*Sheet Rolling and Wire Drawing*.—The raw material of a large proportion of the brass trade consists of sheet-brass, as from it stamped work of all kinds is prepared, and jointed tubing and sheathing are made; and, generally, the processes of rolling must be adopted when sheets of large dimensions or of great thinness are required. For the purpose of rolling the metal is melted and cast in broad flat moulds of cast-iron; and in cases where a large quantity is dealt with, the moulds are hewn out in granite. These moulds are rubbed with oil and powdered with charcoal before being used. The ingots for rolling, termed "strips," are in the cold state passed successively between rolls (pairs of chilled-iron cylinders) of large size which squeeze them out and extend them lengthwise. As often as necessary in the process the sheet is annealed in a muffle or reverberatory furnace, being allowed to cool down after each annealing. The sheet is finished, after "pickling" in acid, by passing it through a pair of highly polished rolls. Muntz's sheathing metal is a form of brass containing a large proportion of

zinc, and as this alloy can be rolled out hot it is much more cheaply and expeditiously prepared than ordinary sheet brass.

**Wire Drawing.**—Brass wire is consumed in enormous quantities, first and chiefly for pin-making, next for shoe-rivets, then for brush-making, for paper-makers' wire web, and many other purposes. The metal for wire drawing is rolled into long strips of a suitable thickness and cut into "strands" by means of slitting rolls. The strands, which are square in section, are drawn through a succession of circular holes in a steel draw-plate, till the desired degree of fineness is reached, and are wound upon a rotating drum or block. The wire has to be repeatedly annealed as it passes through the plates of ever-diminishing gauge.

**Stamping.**—A large number of useful articles, as well as many ornamental details, which were formerly produced by the process of casting, are now cheaply and expeditiously made by stamping out of sheets of rolled brass. In this way the ornamentation applied to the cheaper kinds of gasaliers, balance-weights, chain-links, &c., are formed, and cornice-pole ornaments and curtain-rings made; and the process is also applied to the making of door and shutter knobs, finger plates, and lamp-burners, and to the striking up of many useful articles, such as basins and other vessels. In the process of stamping, a die, in which the pattern to be formed is sunk, is prepared by the ordinary process of die sinking, and securely fixed to a heavy iron block sunk into the ground. From each side of this block rise two cast-iron guide pillars, which act as guides to the heavy hammer or ram arranged to slide up and down between them. Into this hammer a "force," or exact counterpart of the sunk die, is fitted, so that on the fall of the hammer the force exactly fits into the die. The work of the stamper in raising his hammer is much lightened by passing the lifting belt over a pulley attached to a shaft moved by steam-power. By this arrangement the workman has only to hold his cord sufficiently tight to create the friction between the belt and pulley necessary to raise the weight, and by letting go his hold, the stamp is allowed to fall with its full momentum against the die. In a compound of such hardness and brittleness as brass it is necessary to raise any pattern by repeated strokes, annealing the metal between each separate blow. The number of blows necessary to bring up any pattern depends on the depth and convexity of the die. The "forces," or counterparts of the die, are made of lead, tin, or other soft metal, while for finishing the stamping when the die contains fine details a "force" made of brass is employed. A modification of the steam-hammer has been adapted for use in the process of stamping. Stamped work as compared with castings is deficient in depth and richness, as it is not practicable to attain any great boldness and sharpness of outline, and the "force" having to fit into every portion of the die, no undercutting is possible. Globular articles, such as balance weights, are stamped in two (or if necessary more) parts and the pieces joined by soldering. Mr James Atkins of Birmingham has patented an ingenious method of filling stamped shells, such as balance-weights, with molten iron by simply keeping the shell in water while it is being filled.

**Tube-making.**—Brass tubes are of three principal kinds:—1st, ordinary soldered; 2d, cased; and 3d, solid tubing. Plain soldered tubes are made from sheet-brass by cutting off, with circular shears, strips of the breadth necessary for the gauge of the tube to be made. These strips are passed through "cupping-rolls," by which they are partially bent round. The end of the strip is then formed into a tang, caught and drawn through a tool called a conductor, which folds over the strip into a circular form, bringing the two edges into close contact. The tube so formed is tightly

tied up with wire at short intervals to keep the edges together in the process of soldering; a mixture of granulated brass and borax is filled into the seam, and the tube is passed slowly through a strong heat in the soldering stove, which melts the granulated brass and so unites the edges. The wires are then cut away, and the superfluous solder filed off, the tube is pickled in sulphuric acid, and again passed through the steel conductor. In the case of tubes which require great accuracy of internal gauge, a mandril or solid cylinder of steel is placed inside the tube before it is finally passed through the tool. The external pressure causes the tube to fit closely to its internal support, and while the outside takes the outline of the steel conductor, the inside is made true to the shape of the mandril. Tubes of any given section are thus formed by the use of mandrils having the outline required. Ornamental patterns are impressed on plain tubes by fitting them on mandrils and passing them through a tool, which consists of a strong iron frame carrying three or more rollers so mounted that the open space between their external edges has the sectional form of the tube to be ornamented. On the external face of these rollers is sunk the design which is to be impressed on the tube, and as it is drawn through them the powerful squeeze they give is sufficient to impress ornaments of considerable depth and boldness. Cased-tubes or rods, that is, tubes or rods of iron cased in brass, were invented in 1803 by Sir Edward Thomason, who thus described his invention:—"In watching the operation of drawing brass and copper tubes upon the mandril, I found it required as much power to slide off the hollow tube from the mandril as was required to draw it on. Reasoning from the adhesion of the brass tube to the steel mandril, I found by experiment that the union of copper and iron or brass and iron could be firmly attached by pressure, and conceived that such an application would be useful for making copper bolts for shipping, solid brass rods for stair carpets, solid brass to go round the top of a room to suspend pictures, as curtain rods for drawing-rooms, and as balustrades for staircases." Wood is cased in brass by a similar process, and used for such purposes as brass cornice-poles. Solid or seamless brass tubes, which are in very extensive demand for locomotive and other steam boilers, are made by drawing down short thick cast cylinders of brass till they reach the desired gauge and thinness. The instrument in which this drawing is accomplished is similar to the apparatus for impressing ornamental patterns on plain brass tubes. Four steel rollers are mounted in a strong frame, the sectional outline of the outer surfaces of which have the size and form to which the tube is to be drawn, and through a series of such tools the cast cylinders are passed, after annealing at each operation. Mr G. E. Muntz in 1852, patented a method of drawing tubes cast in an oval form, in the heated state.

**Brass Finishing.**—The operations in brass finishing comprise "dipping," "burnishing," and "lacquering," and in some cases brass-work is finished by "bronzing." After the article to be finished has been cleaned by pickling in acid, it is passed for dipping into an earthenware jar containing a solution of aquafortis (nitric acid). For bright dipping the acid is used strong, and the brass is immediately withdrawn from the bath, but for "dead" dipping, *i.e.*, for producing a bitten, frosted appearance, the bath is made weaker and the metal left in it till a creamy appearance is seen on the surface. Burnishing is accomplished by rubbing with polished steel tools, called burnishers, the parts of dead dipped work which are to be brightened. The work is then passed through water soured with acid, rinsed, and dried in boxwood sawdust. For lacquering, the work is heated over stoves, and while it is hot, a coating of varnish, made of seed-lac dissolved in spirit, is carefully

and uniformly spread over the surface. Bronzing consists in applying to the surface of the metal an opaque pigment, which alters its colour. Ordinary brassfounders' bronze consists of a solution of hydrochloric acid and ammoniac, or of the same acid, arsenic, and smithy scales. It is chiefly to cabinet brassfoundry and stamped work that such finishing processes are applied.

Vessels of brass for cooking and other domestic purposes are very extensively employed in the East Indies, and the alloy is there also a favourite material for the bangles and other personal ornaments of the lower orders. A large trade is carried on in brass wire, for ornamental purposes, between Birmingham and various African stations; a species of currency called Guinea rods, made from thick brass wire, is made and exported to the Guinea coast; and a kind of cast-brass coin, called a manilla, current in the equatorial regions of Old Calabar, is frequently supplied by Birmingham manufacturers. (J. P.A.)

**BRASSES, MONUMENTAL,** a species of engraved sepulchral memorials which in the early part of the 13th century began to take the place of the tombs and effigies carved in stone, which formed such conspicuous features in most of the great churches. Made of hard *latten* or sheet brass, let into the pavement, and thus forming no obstruction in the space required for the services of the church, they speedily came into general use, and continued to be a favourite style of sepulchral memorial for three centuries. Besides their great value as historical monuments, they are specially interesting as authentic contemporary evidence of the varieties of armour and costume, or the peculiarities of palæography and heraldic designs, and they are often the only authoritative records of the intricate details of family history. Although the intrinsic value of the metal has unfortunately contributed to the wholesale spoliation of these interesting monuments, they are still found in remarkable profusion in England, and they were at one time equally common in France, Germany, and the Low Countries. In France, however, those that survived the troubles of the 16th century were totally swept away during the reign of terror, and almost the only evidence of their existence is now supplied by the collection of drawings bequeathed by Gough to the Bodleian Library. The fine memorials of the royal house of Saxony in the cathedrals of Weissen and Freiberg are the most artistic and striking brasses in Germany. Among the 13th century examples existing in German churches the full length memorials of Yso Von Welpe, bishop of Verden (1231), and of Bernard, bishop of Paderborn (1340), may be mentioned. Many fine Flemish specimens exist in Belgium, especially at Bruges. Only two or three examples, and these of late date, are known in Scotland, among which are the memorials of Alexander Cockburn (1564) at Ormiston; of the Regent Murray (1569) in the collegiate church of St Giles, Edinburgh; and of the Minto family (1605) in the south aisle of the nave of Glasgow Cathedral. England is the only country which now possesses an extensive series of these interesting memorials, of which it is calculated that there may be about 4000 still remaining in the various churches. They are most abundant in the eastern counties, and this fact has been frequently adduced in support of the opinion that they were of Flemish manufacture. But in the days when sepulchral-brasses were most in fashion the eastern counties of England were full of commercial activity and wealth, and nowhere do the engraved memorials of civilians and prosperous merchants more abound than in the churches of Ipswich, Norwich, Lynn, and Lincoln. Flemish brasses do occur in England, but they were never numerous, and they are readily distinguished from those of native workmanship. The Flemish

examples have the figures engraved in the centre of a large plate, the background filled in with diapered or scroll-work, and the inscription placed round the edge of the plate. The English examples have the figures cut out to the outline and inserted in corresponding cavities in the slab, the darker colour of the stone serving as a background. This is not an invariable distinction, however, as "figure-brasses" of Flemish origin are found both at Bruges and in England. But the character of the engraving is constant, the Flemish work being more florid in design, the lines shallower, and the broad lines cut with a chisel-pointed tool instead of the lozenge-shaped burin. It is interesting to find that the brass of Robert Hallum, bishop of Salisbury, the envoy of Henry V. to the Council of Constance, who died and was interred there in 1416, precisely resembles the brasses of England in the peculiarities which distinguish them from Continental specimens. Scarcely any of the brasses which now exist in England can be confidently referred to the first half of the 13th century, though several undoubted examples of this period are on record. The best known of the 13th century examples is that of Sir Roger de Trumpington (*circa* 1290), who accompanied Prince Edward in his expedition to Palestine, and is represented cross-legged. About half a dozen instances of this peculiarity are known. The 14th century brasses are much more numerous, and present a remarkable variety in their details. The finest specimen is that of Nicholas Lord Burnell (1315) in the church of Acton Burnell, Shropshire. The full-sized brass of Sir John d'Abernon at Stoke d'Abernon in Surrey (*circa* 1327) has the decorations of the shield filled in with a species of enamel. Other examples of this occur, and the probability is, that, in most cases, the lines of the engraving were filled with colouring-matter, though brass would scarcely bear the heat requisite to fuse the ordinary enamels. In the 15th century the design and execution of monumental brasses had attained their highest excellence. One of the best examples of plate armour is that of Sir Robert Stantoun (1458) in Castle Donnington church, Leicestershire, and one of the finest existing brasses of ecclesiastics is that of Abbot de la Mare of St Albans. It is only in the 16th century that the engraved representations become portraits. Previous to that period the features were invariably represented conventionally, though sometimes personal peculiarities were given. A large number of brasses in England are *palimpsests*, the back of an ancient brass having been engraved for the more recent memorial. Thus a brass commemorative of Margaret Bulstrode (1540) at Hedgerley, on being removed from its position, was discovered to have been previously the memorial of Thomas Totyngton, abbot of St Edmunds, Bury (1312). The abbey was only surrendered to Henry VIII. in 1539, so that before the year was out the work of spoliation had begun, and the abbot's brass had been removed and re-engraved to Margaret Bulstrode. In explanation of the frequency with which ancient brasses have thus been stolen and re-erected after being engraved on the reverse, it may be remarked that all the sheet brass used in England previous to the establishment of a manufactory at Esher by a German in 1649, had to be imported from the Continent.

See Cotman's *Engravings of the most remarkable of the Sepulchral Brasses of Norfolk, &c.* London, 1813-16; and second edition, with additional plates and notes by Meyrick, Albert Way, and Sir Harris Nicolas, 2 vols. folio, London, 1839; *Manual for the Study of Monumental Brasses*, Oxford, 1848; *Boutell's Monumental Brasses of England*, engravings on wood, folio, London, 1849; *Waller's Series of Monumental Brasses in England*, London and Oxford, Parkers, 1863.

**BRASSEY, THOMAS**, an eminent English railway contractor, a man remarkable for his character and abilities as well as for the vast extent and singular success of his