CHAMBERS'S
INFORMATION FOR THE PEOPLE.
CONDUCTED BY WILLIAM AND ROBERT CHAMBERS, EDITORS OF "CHAMBERS'S JOURNAL" AND "HISTORICAL NEWSPAPER."
No. 48. PRICE 1½d.

CHEMISTRY APPLIED TO THE ARTS.

THERE is not an art or manufacture in which the principles of chemistry are not in one way or another employed, and practically illustrated. The applications of chemistry in the arts, manufactures, &c. are indeed so numerous, that we can scarcely do more in this paper than give a short account of the most important of them. In order to render our descriptions as intelligible as possible, we shall in the first place present a brief view of a chemical laboratory, with its various apparatus.

THE CHEMIST'S LABORATORY.

A laboratory is a chemist's workshop. It is the place where he performs his experiments, and is of course provided with all the utensils necessary for doing so. The size of an apartment of this kind necessarily varies with the purpose for which it is constructed. If it is attached to a public institution, it should be large; if for private experimentation, in a very moderately sized room the most important processes of chemical manipulation may be easily performed. It should, if possible, be upon the ground floor, and well lighted and ventilated; a skylight throws a very agreeable and convenient illumination over such an apartment. Shelving should run round the walls for the reception of vessels. The chimney should be high enough to admit of a person standing under it, and as broad as possible. Here the general working furnace, as well as others, both portable and fixed, together with an oven and a sand-bath, may be conveniently placed. It should also be provided with a pair of bellows. The other most essential fixtures are a large table in the centre of the room, on which experiments with the lamp may be performed, mixtures made, and so on. A sink having an abundant supply of water is a very important appendage; for water is continually wanted in chemical operations, both in the performance of experiments and in the cleansing of vessels. It should be placed in a corner of the room, to be out of the way. Cupboards, drawers, small portable tables or stands, blocks of wood, and boxes, are also very useful. The other small moveables, or utensils of a laboratory, are hand-mortars, of iron, glass, agate, and Wedgewood's ware, together with their pestles; earthen, stone, metal, and glass vessels of different kinds; funnels, measures, &c. These we shall describe in course. Filters and troughs are very important, and charcoal is an essential article in the replenishing of a laboratory.

BALANCES AND MEASURES.

Correct weighing is indispensable to every chemical experiment, and therefore an exact and very delicate balance is an essential requisite. There should be at least two balances; one for weighing heavy matters, and another for very minute quantities. The last instrument should be sufficiently delicate to weigh from 600 to 1000 grains, and downwards, indicating, distinctly and certainly, differences equal to the 1-50,000th or 1-60,000th part of the weight in the scale. These small weights are sometimes as low as the hundredths of a grain, and are usually made of platina, because air and moisture do not act upon that metal. As it is by carefully weighing substances, both before and after being experimented upon, that the exact constituent parts of bodies are determined, and the most important chemical truths ascertained, the balance and weights should be carefully examined at intervals, and their accuracy ascertained. The methods of determining the specific gravity of bodies by immersion in water, will be found described in our article upon Hydrostatics.

Measures are necessary for ascertaining the bulk of liquids or gases, and two integers are sufficient, the pint and the cubic inch. Measures should be made of glass, and have a graduated scale marked on both sides. They are commonly of a cylindrical shape, like a phial bottle, and possess a small spout at the orifice. The graduations on these instruments are sometimes very minute, and indicate exceedingly small quantities of matter put into them. The measures should be verified by weighing into them successively portions of mercury and water. A cubic inch of the former, at a temperature of 62°, weighs 3425.35 grains, and the same quantity of the latter at the same temperature weighs 252.458 grains. Water answers well enough for estimation down to the cubic inch, but for the tenths and the hundredths of an inch, mercury is both more exact and more expeditious.

FURNACES, LAMPS, AND BLOWPIPES.

Heat is one of the most powerful and extensively useful agents employed by the chemist for ascertaining the properties of bodies, and the methods of its production become of great moment to him. The most simple way of producing heat is by means of a common fire. Furnaces are more scientifically and elaborately constructed than our common fireplaces and stoves, and a more intense heat is accordingly generated by them. The forms of furnaces are almost innumerable, every month or even week giving birth to some new improvement upon them; but one general principle is kept in view in their construction; that is, the production of the greatest amount of heat by means of the smallest expenditure of fuel. Mr Faraday describes a very cheap and useful furnace which he is in the habit of using, made of clay and plumbago, or black lead, mixed. It is simply a vessel shaped like a common flower-pot, and having holes perforated in its sides for the admission of air. As it is liable to crack after being used, it is bound with iron or copper hoops, or wire. A small portable cast-iron grate is made to fit into it, and repose about two-thirds downwards from the top to the bottom. Charcoal, the fuel employed, is placed upon this grate, and there reposes the crucible with the substance to be experimented on. A funnel pipe may be made to fit upon this furnace, by which means the draught, and consequently the heat, is greatly augmented. This is a very simple form of such apparatus, and can be obtained for a mere trifle. Furnaces upon a large scale are constructed in various ways of fire-brick, which resists fusion, at least until the temperature is very high. The main object is to produce an immense amount of heat, and this can be accomplished either by propelling air upon the combustible matter by means of bellows, in which case the furnace is called a *blast-furnace*, or by forming long flues and raising a high chimney, so as to produce a strong draught of air; this is termed a *wind-furnace*. The best construction of furnaces has scarcely been ascertained, certain kinds of them being best adapted for certain purposes. Upon the top of the furnace, and even upon the flues, vessels containing sand, and hence called sand-baths, are placed. In these, bodies can be raised to a high degree of temperature. Charcoal is the substance most commonly used in furnaces. It produces an intense heat without smoke, but very soon consumes. Coke or charred coal produces a strong and lasting heat.

A lamp may be considered a species of small furnace, and is a cheap and convenient source of heat. Spirit-lamps, which are trimmed with cotton-wick in the ordinary way, and fed with alcohol, or spirit of wine, are the most useful. The flame of alcohol, which is pale, produces no smoke or fuliginous matter, and the heat which it generates is very intense. Common oil-lamps, and also gaslight, are used, but the heat of such apparatus is not so great. By means of a very simple instrument, the blowpipe, all the effects of the most violent heat of furnaces can be produced. A common blowpipe is merely a glass pipe, about one-eighth of an inch in diameter at one end. The hole gradually lessens until it terminates at the opposite extremity in a very small orifice. Two or three inches of the narrow end are bent nearly at right angles to the longer part of the tube. By placing the thick end of the instrument in the mouth, and urging a stream of air upon the flame of a lamp or candle, an intense degree of heat is produced, which may be brought to bear upon any substance placed in a small spoon of pure gold or platina. If the body to be fused be not of such a nature as to sink into the pores of charcoal, that substance is commonly used. A great many important and beautiful experiments may be performed by this cheap and convenient instrument, but the proper way of blowing it requires practice. If the two gases, oxygen and hydrogen, be mixed together in the proportions which form water, and compressed to the amount of many atmospheres in a metallic box provided with a small tube, what is called an oxy-hydrogen blowpipe is formed. By this apparatus an almost incredible degree of heat can be produced, but accidents often occur in using it.

TRITURATION, FUSION, SOLUTION, DISTILLATION, &c.

As a general principle, having, however, certain limitations, it may be stated, that the more minutely matter is divided, the more rapid will be the chemical action exerted between the particles. This division of matter is effected in various ways. First, by trituration, or the reduction of substances to a state of powder, which is a mechanical action not affecting the physical state of the body, and only relating to solids. In accomplishing this, the pestle and mortar are generally used. Externally, mortars are usually shaped like a flower-pot, the inside, at the bottom, being curved like the thick end of an egg. They are made of various materials, such as metal, porphyry, agate, and so on, according to the purposes to which they are applied. The pestle is generally of the same material as the mortar, and is a solid rod having a rounded bulb at one end for pulverising the substance in the mortar. Trituration answers very well the purpose of promoting chemical action in a number of experiments, but by fusion and solution it is rendered more complete.

Bodies are said to be in a state of fusion, when, heat being applied to them, they assume the liquid form, a state in which all the particles of a substance move easily amongst themselves. When a solid body, such as a piece of sugar, is put into water, it is gradually dissolved; and when the lump of saccharine matter has disappeared, and become mixed with the water, and remain so, it is said to be held in solution by it. Heat greatly promotes the rapidity of solution; and glass vessels having a rounded bottom, such as a Florence flask, and placed upon a spirit-lamp, are very commonly employed. In processes connected with the subdivision of matter, those in which hot water is merely poured upon the substance, the process is called *infusion*; when heat is applied for some time, it is called *decoction*; and when it consists of pouring hot or cold water on the substance, and allowing it to stand for some time, it is termed *maceration*. There is a process of solution called *fixivation*, which consists in the separation of a soluble body from an insoluble one by means of washing.

Distillation and sublimation mean nearly the same thing; both consist in the conversion of a body into vapour, its transference in that state and consequent separation from other substances, and its ultimate condensation. The difference generally consists in the state assumed by the vapours when condensed; if the product be solid, the process is called sublimation; if liquid, distillation. The substance is raised to such a temperature as causes it to assume the gaseous state, in which state it is conducted into a vessel containing water of a low temperature, where it is condensed into a fluid or solid state. A common still consists of a metal boiler for containing the substance to be distilled; a head terminating in a peak is adapted to it; the latter is made to fit into the commencement of a spiral tube, called a worm, fixed in a tub; the whole of this part of the apparatus being called the refrigerator. The substance is raised into vapour in the still, and being condensed in the worm, runs out at its lower extremity. Distillations are usually effected in the laboratory by means of glass retorts and flasks; for substances, however, which require a greater degree of temperature to effect their distillation, metallic retorts are employed. Bodies which are very volatile