A handbook of chemical manipulation

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Section V. Baths

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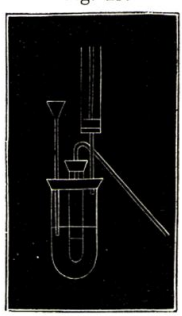
SECTION V.

BATHS.

61. There are numerous instances, in almost every department of chemistry, where it is necessary to apply heat, but in a gradual and gentle manner; in all these cases it is advantageous to be aware of the actual temperature of the exsiccating medium. In fact, by the skilful use of a few very simple instruments, we have it in our power to apply any heat, from that which is scarcely perceptible to the hand, to a bright red. There are many substances which it is necessary to obtain in a dry state, but which are decomposed by the slightest elevation of temperature: instances of this kind will be noticed in the section on Operations preparatory to Weighing. Where the application of a very gentle and uniform heat is necessary, as sometimes happens in certain researches, we use ether or alcohol, or their vapour at the boiling-point, under ordinary pressure, as the medium of communication. Under such circumstances, an apparatus like that in the margin may be used, the shape, size, and arrangement, varying according to the nature of the operation.

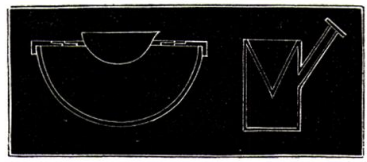
Fig. 49 represents a glass or metal vessel to contain the spirit, provided with a tube-funnel, by which to add more if required. The exit-pipe for the vapour of the spirit leads to a vessel of cold water containing ice, where, being condensed, it returns to the chamber to be cohobated again and again. A small test-tube is represented as converted into a retort, and containing the substances to be distilled. Heat may be applied by means of a lamp.

Fig. 49.



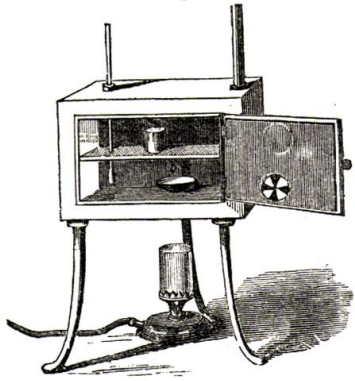
Water-baths are made in several different ways, some of porcelain, others of metal. Fig. 50 is simply a hemispherical cup of porcelain or earthenware, with another

Fig. 50. Fig. 51.



having flanged edges hanging within it. Fig. 51 is a filter-drier, of porcelain, made in one piece; it has an aperture which serves the threefold purpose of a handle, a place to insert the water, and an exit for the steam. Fig. 50 may be made of metal, preferably copper, having a number of concentric rings of different diameters, to adapt it to various-sized dishes. The rings are socketed in the same manner as the furnace-rings represented in section in fig. 2, only, of course, very much thinner. Fig. 52 is a bath, or rather hot-air chamber, of very different construction; it consists of a double box of copper, the water being contained between the two. The latter is inserted through an aperture provided for the purpose. The other hole is intended to enable the operator to keep a thermometer inside the bath, to indicate the temperature. The chimney on the right serves to create a draught. The substances to be dried are placed in capsules, supported on shelves placed within the chamber. By keeping a small piece of tube in the aperture by which the water is introduced, and reaching to the bottom of the double chamber, we may always ascertain the depth of water, by closing it with the finger after it has been plunged in, and then withdrawing it, somewhat in the manner of a wine-taster; the height of the water in the tube of course corresponds to that in the chamber.

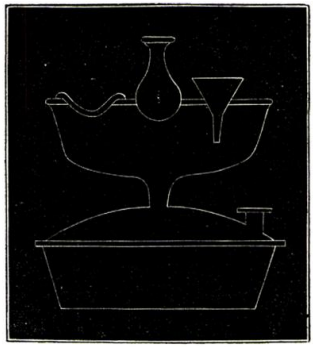
Fig. 52.



All these water-baths may be heated by placing them upon a tripod or retort-stand over a lamp. Those of porcelain require

more care than the others, and are preferably heated on the sand-bath. When it is required to expose substances to a temperature above 212°, but still below a red heat, the bath may be filled with linseed oil, or a solution of the chlorides of calcium or zinc: the retort or flask to be heated, should be immersed in the fluid to about two-thirds its depth. For temperatures above that at which oil or the saline bath alluded to can be conveniently used, fusible metal is sometimes, though rarely, employed; in general, it is much more convenient to employ a hot-air bath, such as will be found in the section on Distillation. Moreover, the heat of the latter can, by management of the fire, be rapidly raised or lowered; but the fusible metal requires a considerable time to fall even a few degrees; and is inconvenient, from the rapidity with which oxide is formed at high temperatures; and if it be attempted to prevent this by a layer of grease, the odour becomes so disgusting when it approaches the decomposing point, that it forms a serious objection to its use. The same inconvenience is found in oil-baths, unless care be taken to prevent the heat rising too high. It is sometimes advisable, where a water-bath is to be raised to 212° rapidly, to have a thin layer of oil upon the water, to retard evaporation; and, of course, the heat rises more rapidly than it would without this precaution. Where a given fixed temperature is required, the heat must be regulated by keeping a thermometer immersed either in the bath, or perhaps preferably in the retort, or other vessel in which the liquid under examination is contained. When it is intended to use steam as the heating agent, the apparatus figured in the margin (fig. 53), contrived by Dr. Ure, may be conveniently employed. Its construction is obvious: the apertures are intended to hold flasks, capsules, or other vessels to be exposed to the heat.

Fig. 53.

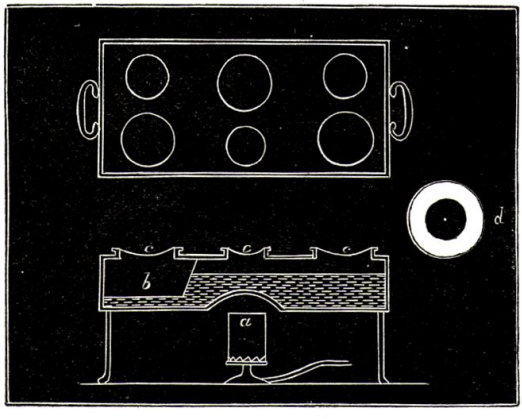


It will be seen that, from the steam-chamber being placed above the boiler, the condensed water is raised over and over again.

Fig. 54.

A water- or steam-bath may at any time be constructed in the laboratory, by placing one capsule over another, the lower one being partly filled with water, fig. 54. Fig. 55 represents a very convenient water-bath for many purposes. It consists of a rectangular tin-plate or copper box, somewhat hollowed up in the spot where the lamp *a* is stationed. It is provided with six apertures, which may be covered,

Fig. 55.



if necessary, by pieces of metal plate, or watch-glasses; or evaporating basins may be placed over them. These apertures are represented in the section at *c c c*; metal plates, *d*, provided with apertures of different sizes, may be used to contract the holes if required. One of the openings communicates with the box, *b*, intended to contain preparations for desiccation. The apparatus is neat, but less convenient for laboratory use than the square chamber-bath, fig. 52. In all these arrangements, of course care must be taken that the bath does not boil dry.

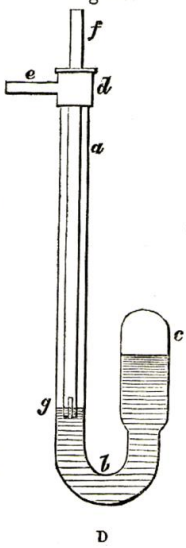
In using baths for various operations, it is often advantageous to be enabled to employ a fluid of known boiling-point, and, for this purpose, the following Table will be found useful:—

TABLE OF BOILING-POINTS OF SATURATED SOLUTIONS OF VARIOUS SALTS.

	Boiling-point.
Chloride of calcium	355° Fahr.
Acetate of soda	256 „
Nitrate of soda	246 „
Sal-ammoniac	236 „
Common salt	224 „
Cream of tartar	214 „

62. It will be seen that, in the above Table, solutions have been selected which, with the exception of the first, give boiling-points, as nearly as could be obtained, 10° above each other; and, as a certain amount of heat is always lost before it reaches the contents of the vessel immersed in the bath, it is an advantage to select fluids, the boiling-points of which increase in a ratio a little more than the 10°, as more than the difference will be lost from the reason stated. The above solutions have been chosen, because, in fractionating volatile substances, it is usual to separate the products by differences of temperature equal to 10° Fahr.

Fig. 56.



D

It will be proper in this place to describe the ingenious device of Mr. Kemp for enabling the flame of a gas-burner to be so regulated as to allow of a constant temperature being maintained for any length of time. A glass tube, *a b c*, fig. 56, formed into a reservoir at *c*, is partly filled with mercury, the rest being occupied by air. A brass piece, *d e f*, is cemented at the top. This latter consists of a stuffing-box, *d*, through which the tube, *f*, descends, and is capable of motion up and down. The gas enters by *e*, and to reach the burner has to

pass down the glass tube, up the brass pipe, and out of the flexible pipe which connects the apparatus with the gas-lamp. The bulb, *c*, is to be immersed in the fluid of the bath to be heated, and the tube, *f*, is to be so adjusted in the mercury, that a slit which is made in it at *g* just allows sufficient gas to pass to keep the bath at the required temperature. If now the gas should, from the other lights in its vicinity being extinguished, or other causes, flow faster than before, and cause a larger flame, the air in the reservoir, *c*, expands, and elevating the mercury in the tube, decreases the aperture by which the gas reaches the burner. The instrument is therefore on the principle of the air-thermometer. To allow of complete contact between the end, *g*, and the mercury, the brass at the extremity is platinized.

This apparatus has been used for some time in the laboratory of the University of Glasgow, in various researches, particularly in investigating the action of nitric acid on narcotine*, and it has been found to answer perfectly.

* Transactions of the Royal Society of Edinburgh, vol. xx. part 3. p. 359.