A handbook of chemical manipulation

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London, 1857

Section III. Lamps

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SECTION III.

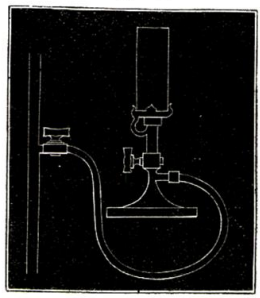
LAMPS.

39. The extreme cleanliness, and great facility with which the heat of lamps can be regulated, render their possession, under one or other of the numerous forms which fancy or necessity has created, quite indispensable to the experimental chemist. It is to be observed that much difficulty is often found by the inexperienced operator in selecting the most really useful form of lamp for general use, and, as is so frequently the case, under very different circumstances, the most simple is likewise the most generally efficacious.

As in all towns of any importance gas is to be had at a moderate cost, it becomes for many reasons by far the best and most economical fuel. In the first place, with moderate care, there is no waste, there is also no spilling of oil, no evaporation of spirit, no trimming of wicks, no tendency to derangement in the mechanism, and therefore no trouble in obtaining precisely the most eligible amount of flame. Gas as a fuel is therefore most strongly recommended for general use instead of either oil or spirit.

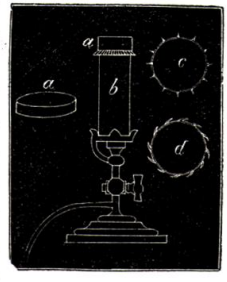
40. Several kinds of gas-lamps are in use in laboratories, and all of them have excellencies in one way or another. The first and most simple is the common Argand burner, a vulcanized india-rubber pipe connecting it with a supply-pipe. The burner is generally supported upon a heavy foot, as in fig. 23. It has two taps, one at the supply-pipe and one at the burner. The effect of the second is to enable us to use the gas at some distance from the supply-pipe, without the necessity of going from the lamp to regulate the flame, an important thing where, from the opacity of the chimney, which must be of copper or brass, it becomes impossible to adjust the flame

Fig. 23.



without being sufficiently close to look down into it. It is also necessary to have a tap at the supply-pipe as well as the burner, in order to facilitate the removal of the latter for the purpose of cleaning, &c. without causing escape of gas. The great command which the operator has over this arrangement makes it the most generally useful of any. From the smallest blue flame to a heat sufficient to raise to dull redness a moderately large platinum crucible may be obtained. The next method, where the gas mixed with air is burnt on the top of wire-gauze, is far less easily regulated, but is, nevertheless, extremely valuable in cases where a powerful temperature is desired, as in the fusions which occur in the analysis of siliceous minerals, the ignition of precipitates, the combustion of the platinum and gold double salts formed by the different bases, with a view of ascertaining their atomic weights; also in the determining the quantities of baryta, lead, and silver in the salts formed by the union of those substances with the organic acids* &c. The simplest way to construct a lamp of this kind, is to take a piece of wire-gauze of moderate fineness and press it over the chimney, *b*, fig. 24, until it is folded down sufficiently, and then to pinch the creases with a pair of pliers until they take the shape seen from the top at *c*: this will have the effect of drawing the gauze tight over the chimney; the points are then to be folded against it as at *d*, and the ring, *a*, is then to be put over the whole to keep it in its place. The gas is turned on for a few seconds before a light is applied, otherwise the mixture is so explosive that the flame passes through the gauze. When alight, and the proportion of air and gas properly regulated, it is observed that a pale blue flame is obtained, showing the absence of solid carbon. Moreover, if we place a basin or other vessel over it, no soot is deposited. In the Argand lamp, where

Fig. 24.

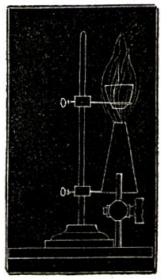


* In these latter experiments, it is better to commence by heating gently over the Argand lamp, fig. 23, until all volatile matters are expelled, and to finish by ignition over the Bunsen's burner, fig. 30.

the combustion is, chemically speaking, less perfect, the flame, if allowed to play on the bottom of a vessel, immediately deposits carbon, causing inconvenience, not only by the soiling of the vessel, but also by preventing the due access of heat.

41. Another, and, in some cases, more convenient method of burning coal-gas with air is represented in fig. 25, where a gas-pipe, fixed to a table, as alluded to in the description of the laboratory (§ 9), is seen to open beneath a funnel-shaped tube; by this means a blue flame of great intensity may be obtained, in which, equally with the last arrangement, all the carbon is oxidized; moreover, the flame is more compact, and, by a little management, may be obtained in a form admirably adapted for the ignition of platinum crucibles, and many other purposes. The neck of a broken glass retort supported by a clip, or even by a wire, answers every purpose. This instrument is, it is believed, the contrivance of Mr. Remington.

Fig. 25.



42. A neat gas-burner, on the same principle, is shown in fig. 26; the description of the first renders a second unnecessary. Dr. Lionel Beale has described a gas-furnace (fig. 27) for heating common earthen crucibles: he states that it is capable of raising 10 or 12 ounces of oxide of copper to redness, and of fusing silicates with carbonate of soda. He also states that the tube in which the coal-gas mixes with the air should not be less than 9 inches in height and 3 in diameter. The gas comes from a small tube in the lower part, and burns with the air on the surface of wire-gauze. Just above the gauze there are several small holes. The crucible is supported by pieces of iron, projecting from a wide iron ring made to fit the furnace, and which can be replaced by others adapted to crucibles of various sizes. The upper part of the body of this furnace can be removed when required, and there is a small door in it to enable the operator to watch the process going on within. The next method of applying gas to chemical operations which claims our attention, is the gas-

furnace represented below. It is made of sheet iron, and has two rows of holes, about $\frac{1}{2}$ an inch in diameter, pierced in it, one at

Fig. 26.

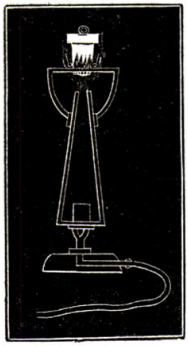


Fig. 28.

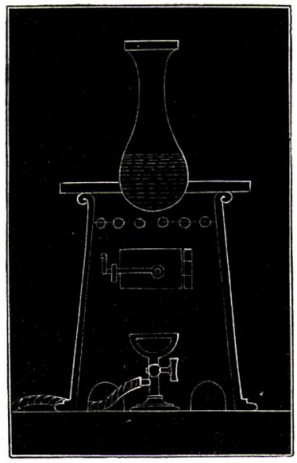
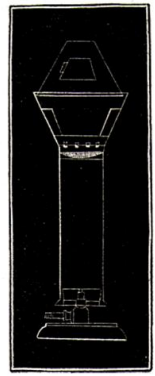


Fig. 27.

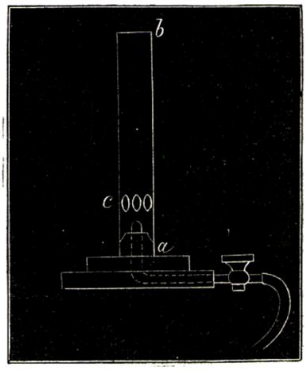


the top and the other at the bottom; the former is necessary to allow the exit of the heated air, in case the whole of the superior aperture becomes closed by a retort or basin, &c. It is advisable sometimes to have a plate of talc adapted to the door, in order to facilitate the regulation of the flame by enabling the operator to see it without opening the apparatus. The burner consists of a large ring pierced with holes, and may be made either to rest on three projecting slips of iron, or on a foot, in the manner shown in fig. 28. The top is adapted to a series of sheet-iron rings of various sizes, which serve to support the vessels over the flame. This instrument is of great use in the laboratory of research, from the ease with which varieties of temperature can be obtained, and still more especially from the fact that a uniform heat may be maintained for any length of time with very little superintendence. A furnace for heating a small sand-bath is shown in fig. 29. It is particularly adapted to analytical operations, from the ease with which the heat is capable of being regulated.

A burner of a very convenient kind for mixed gas and air* has lately been introduced; it consists (fig. 30) of a brass tube, *a b*, of

Fig. 29.

Fig. 30.



about $\frac{5}{8}$ths of an inch in diameter, sliding at *a* on a fish-tail burner; the air enters by holes at *c*, the amount being regulated by means of a small slide, which closes them wholly or partially as may be required. The nature of the aperture by which the gas enters is well adapted for causing it to mix with the air, notwithstanding the small size of the tube *a b*.

43. The admirable contrivance of Dr. Hofmann for obviating the necessity for the use of charcoal in organic analysis, an instrument which must greatly influence the progress of organic chemistry, from the rapidity with which it enables us to make extremely accurate analyses, will be described in the section on Manipulation in Organic Analysis.

44. Chemists who have the misfortune to be unable to procure gas for the laboratory will necessarily be obliged to use oil or spirit, and, where economy of fuel is of secondary importance, methods may be adopted which will prevent the operator from feeling any great inconvenience from the substitution; nevertheless, so considerable are the advantages of gas over any other

* Said to be invented by Bunsen.

source of heat on the small scale, that an effort should be made to procure it.

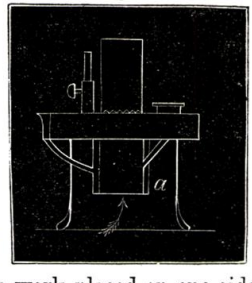
45. The number of lamps which have been invented at different times is almost as great as that of furnaces; it would, therefore, be hopeless to attempt describing them all, and, in fact, very few are really serviceable in practice. Oil-lamps are now but little in request, the heat they give being less powerful, and the combustion, unless great care is used, less perfect than with alcohol or wood-spirit. We are therefore obliged frequently to trim the wicks and clean the instruments, if we would avoid the annoyance of having vessels exposed to the flame blackened by smoke. Sometimes, however, there are occasions when (gas being absent) they are necessary; but this only happens when an extremely gentle heat is required for a considerable time, as, for instance, in the solution of refractory substances, distillation of volatile liquids, drying precipitates, &c. In all these instances the most simple form of lamp is quite sufficient, and it is doubtful if anything would answer the purpose better than that kept for use with the blowpipe. It is quite unnecessary to describe the oil Argand lamp, its construction being so nearly similar to that of the spirit-lamp with circular wick (fig. 31); of course the water-chamber may be omitted; in every other respect the same model may be taken. A few cotton threads gathered together at the lips of a small evaporating basin filled with olive oil may often be used, and, under some circumstances, is an extremely useful substitute for a proper lamp. The operator will find no difficulty in forming an impromptu oil-lamp, if required, from the various pieces of metal, &c. which are generally at hand in all laboratories. When required for giving light to the apartment, the construction so much used now, called the Moderateur, will be found economical and convenient. Colza, or refined rape oil, is the best fuel for it.

46. *Spirit-Lamps.* The ordinary glass spirit-lamp is so common that a description of it is unnecessary; it may be mentioned, however, that, as ordinarily sold, they almost invariably have the cap made too short, so that when placed on the lamp the wick is

compressed. This ought to be provided against by selecting one with a cover sufficiently high. The use of brass wick-holders is liable to many objections. In the first place, they become greatly heated and endanger the splitting of the glass. But the chief objection is the corrosive action which the fuel generally used as a substitute for spirits of wine in this country, exerts on the alloy of which the wick-holder is made; we frequently therefore find a cupreous deposit on platinum vessels when exposed for any length of time to the flame, a circumstance of great importance in many cases, and one which ought to be carefully guarded against. The stoneware wick-holders to be procured at the chemical instrument makers, and first introduced, it is believed, by Mr. J. J. Griffin, are admirable substitutes for the ordinary metal ones; in default of this, a piece of glass tube may be advantageously used. An effective spirit-lamp may at any time be constructed out of a vial having a tube passing through the cork, a cover being formed from a test-tube inverted over the wick, and fitting with moderate tightness on the superior extremity of the cork.

47. The spirit-lamp with the circular wick figured in section in the margin (fig. 31), is a necessary piece of apparatus in all laboratories where gas is not to be obtained. The construction is obvious; it has, however, a peculiarity which deserves attention, namely, the water-chamber *a*, which is seen to surround the wick-holder, thereby preventing the spirit from becoming heated during long operations. It is, however, recommended to have the wick elevated by a circular screw, as in the ordinary Argand table-lamps, instead of the rack-work placed on one side (fig. 31), a mode of elevating and depressing the wick which has many disadvantages. The lamp invented by Berzelius (fig. 32) is much used, and has the spirit-chamber placed at some distance from the wick-holder, by which means the heating of the spirit is prevented; but, from occupying so much space, this arrangement

Fig. 31.



is perhaps scarcely so convenient as the water-chamber. A circular spirit-lamp, to be generally useful, ought to be able to heat a platinum crucible of one ounce capacity and contents to full redness, so as to enable the operator to fuse the more easily decomposable silicates with carbonate of soda or the other fluxes recommended in works on the analysis of minerals; these operations may, however, be performed with a charcoal furnace similar to fig. 19. The modes of rendering even the more refractory minerals soluble have been so far improved by J. Lawrence Smith*

Fig. 32.

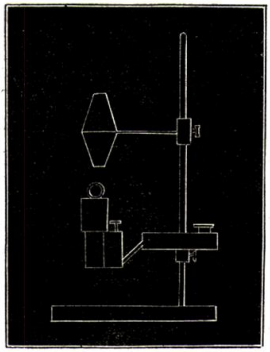
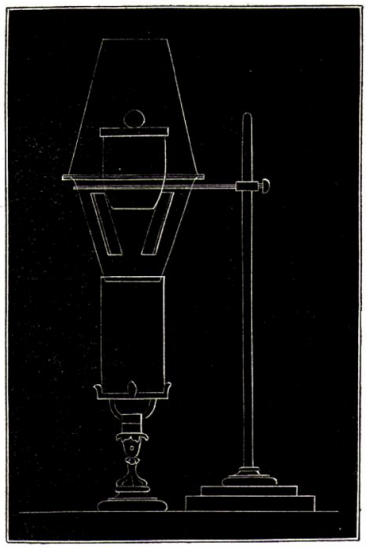


Fig. 33.



and others, that it is seldom necessary to use Sefström's blast-furnace. Where the full powers of a lamp are required to be exerted, the crucible jacket, fig. 33, is necessary; it will be seen that the crucible is supported on three knife-edges; the arrangement is such that the flame is made to act on the crucible in a manner well adapted to economize the heat and avoid loss by radiation.

* Chemical Gazette, vol. xi. p. 252.