ART. XXXIV.—*Some practical remarks on the use of Flame Heat in the Chemical Laboratory, especially that from burning gas without the aid of a blast;* by J. LAWRENCE SMITH, Louisville, Ky.

THERE is probably no more important era in the operations of the chemical laboratory than that of the introduction of the lamp as a source of heat for a large number of chemical operations, and that without the aid of a blast. Berzelius was doubtless the first to accomplish much in this direction, which he did by the agency of the lamp that so commonly bears his name, and which, more or less modified, is still in use where the ordinary illuminating gas is not to be had.

Although illuminating gas has been in use for about seventy years, it is only within a comparatively recent date that it has been pressed into service, and used as a heating agent in the laboratory. The reason of this arose from the fact that when burnt in the ordinary manner it deposited soot on the vessels heated by it. This difficulty has been overcome by burning the gas from small orifices made in a tube bent in the form of a circle, the holes being from 1 to 2 centimeters apart, and, sometimes, combining two or more rings in concentric circles. This method, however, has not been generally adopted.

We must date the successful introduction of gas for heating purposes to the use of a mixture of gas and air passed through wire gauze and ignited above the gauze, giving a flame without light and with great heat; the invention of this method is

claimed by several, and doubtless was discovered by different individuals at about the same time, without a previous knowledge of each other's results; this method is still more or less employed for certain purposes.

The next step in this direction, and doubtless the most important up to the present time, is to burn the mixture of gas and air without the agency of wire gauze; it was first made known to the public in the burner commonly called the Bunsen burner, doubtless from its being either invented or brought into extensive practical use by the distinguished chemist of Heidelberg. Its form is too well known to require more than a mere mention here, and it is now made of all sizes from those capable of burning 4 cubic feet of gas and under, to those which can burn 15 or 20 cubic feet from a single burner, or from a combination of several smaller ones. To this burner, some material additions have been made by different individuals. J. J. Griffin, (the chemical instrument dealer in London), was, I believe, the first to introduce the use of the rosette and the register for the supply of air. The most remarkable results accomplished by this method of burning gas and air are those obtained by G. Gore of Birmingham, (all of whose results I have verified), where gold, copper, cast iron, &c., were fused in crucibles without the agency of any artificial blast. Mr. Gore evidently realized fully the true principle of burning this mixture, so as to obtain a maximum effect; the burner, however, with its furnace arrangements, is unavoidably of a form and on a scale limiting its application.

The usual form of the Bunsen burner, with the rosette and register (when required), bids fair to hold its own against any other form for general purposes, and whatever modifications may be made on it should be of such a character as not to entrench on its simplicity. One or two of these modifications are now in daily use in my laboratory, for which there is no claim to any special originality, nor are they intended to supplant the ordinary form.

As simple an instrument as the Bunsen burner appears to be, its principles and effects are well worthy of being carefully studied.

As the gas passes from the small orifices* in the lower part of the burner, and mixes with the air drawn in at the lower opening, and passes out at the open end of the tube, it usually contains not quite enough oxygen for its complete combustion, and requires free access of air to the outer portion of the flame

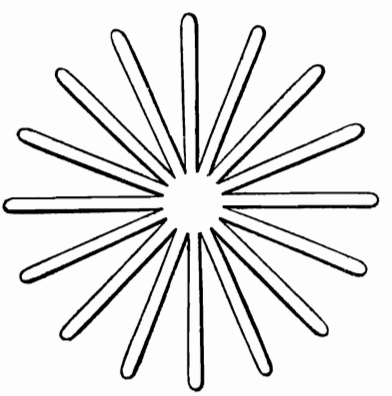
* The outlet for gas may be in the form of crossed slits or two small holes of (1-32 inch diameter each) for the small size burner, the length of tube being about 4 to 4½ inches long; the next larger has four openings (about 1-25 inch diameter each) and the tube about 5 inches long.

to complete the combustion; yet even with this, the flame is hollow in its lower portion, having a cool center, its most intense heat being at about three or four inches above the end of the tube in the smaller Bunsen-burners, and eight or ten inches in the largest size. If a proper access of air is not allowed to the flame, as sometimes happens in some of the furnace connections occasionally used with Bunsen's burner, acetylene is formed from the imperfect combustion, which is recognized by its disagreeable odor, or by collecting some of the gas formed during the combustion; the presence of acetylene may be rendered evident by a small amount of a solution of ammoniacal cuprous chlorid.

The best heating effects of the gas used in the ordinary round Bunsen burner, when employed in the heating of crucibles and other vessels, are not obtained; yet in the great majority of cases the small loss of gas is not worth considering, especially as to obtain better results in most cases, would only complicate this beautifully simple instrument.

To get the best effects of heat, we must imitate the principle applied in the Argand burner, namely to flatten down the exit of the mixed gases. It was by following out this principle that Mr. Gore was enabled to make a burner having a number of radial flat orifices as represented in the figure (1), the air from without having free access to the flame along the entire length of the slit openings, the number of slits used are more numerous than those represented in the figure. With the flame from this burner introduced into a certain form of refractory cylinders, cast iron can be melted in a crucible, without the aid of a blast, as has already been stated; the little chimney to the furnace being two inches in diameter, and four feet long. This burner and its furnace is of but limited application, and the amount of gas consumed considerable.

1.



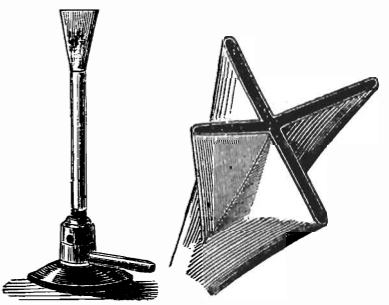
The openings at the exit of Gore's burner.

The principle, however, of the above burner is introduced in constructing a more simple form, and the flattened orifice is now used in the construction of what I conceive to be the best form of furnace for heating glass tubes for organic analyses and other purposes; such furnaces are made by Weisnig of Paris, and Desaga of Heidelberg.

The use of the flattened burner is not fully appreciated; its advantages are, that there is no cold point in the flame, and the burner can be brought much nearer to the object to be heated, within 20 to 25 millimeters for the small sized burners. In this burner as usually made, the opening is too broad, experience having convinced me that a slit 2 millimeters across and about 40 millimeters in length is the most effective one for a small size burner, consuming about 5½ cubic feet per hour; this burner is represented in fig. 1, which can be used with the ordinary tube, by detaching the tube with the flattened orifice.

By taking a burner of this description and putting two pieces on each side of the center, as represented in fig. 2, a very efficient burner is made for heating platinum crucibles in silica fusions, &c., and with such a burner, consuming 5½ to 6 cubic feet of gas per hour, I conduct most effectually all silica fusions in one hour or less, taking care to protect the crucible from the current of the air by a properly constructed short conical chimney, which chimney can be made of soap stone, sheet iron, or any other convenient material.

2. 3.



As was stated in the commencement of this article, it was not intended to describe the more complicated methods of burning gas in furnaces and by means of a blast, but to confine the remarks to the simpler forms in every day use, which can be made to accomplish all the requirements of the usual laboratory operations, and when a higher heat is required, the furnace must be our recourse, whether burning gas, charcoal or coke. The burner represented in figure 2 is the one I now employ in heating the crucible in my method of alkali determination with carbonate of lime and sal ammoniac, which method, with its more recent modifications, will be published in a very short time. The description of it, with all the minute details of manipulation, being ready for the press.