ART. XXII.—*On a Constant Aspirator and Blower*; by
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VARIOUS modes of producing a blast of air by means of the flow of water have been proposed for laboratory use. A somewhat complicated system involving the use of two fluids, mercury and water, was published in the *Philosophical Magazine* some years ago, and more recently an application by Dr. Sprengel of the well-known principle of the Catalonian blast furnace was described in this Journal.

It occurred to me that this principle might be made use of for aspirating, as well as for driving, a current of air, and experiment fully confirmed the idea. I have also modified the shape of the arrangement for catching the air described by Dr. Sprengel, introducing the current of water horizontally instead of vertically. I shall first describe the instrument intended for aspirating, and next the complete apparatus for all purposes.

The aspirator is extremely simple. It is nothing more than a tin tube represented by fig. 1, about two feet long, and four-tenths of an inch internal diameter, with a branch three-tenths of an inch in diameter and 4 inches long, inserted horizontally at a distance of four inches from the upper end.

For use, the tube is supported vertically in any convenient manner over a sink. An india-rubber tube communicating with a water-faucet is passed over the end of the smaller horizontal tube A. Another india-rubber tube connects the opening B with the apparatus through which air is to be drawn. As soon as the current of water is established, the air is aspirated. In the figure subjoined, the air enters at D after being aspirated through the Wolfe's bottle, or other apparatus through which it is desired to pass a current of air, enters the tin tube at B, and is drawn through with the water supplied by the pipe A and, escaping at C. The power of this instrument is such that with

one no larger than here described, a column of water of fifteen inches was easily displaced. The end C may be inserted into the funnel of a Liebig's condenser, and the water employed for cooling may be made at the same time to keep the aspirator in action.*

The aspirating tube (which may also at need replace the blowing tube subsequently to be described) may be easily made by the manipulator himself. A stout cork is bored parallel to its axis and to one side of the centre (not in the middle as in the figure,) and then a smaller hole is made at right angles to the first, communicating with it but not passing further. Three pieces of tube are then fitted into the cork, not allowing either to extend as far in as the junction. The cork is then brushed over with sealing wax dissolved in alcohol.

It is, however, a more convenient plan to construct an apparatus capable of combining both the functions of blowing and aspirating. Such an arrangement is exceedingly useful, and can be made with very little trouble. For this purpose, a tin pipe, A B, about three feet in length and half an inch internal diameter, has two smaller pipes 4 to 6 inches long soldered into it. These are three-tenths of an inch in internal diameter. One, C D, is inserted at right angles, about four inches from the end; the other is inserted about an inch lower, and makes an angle of about 45° . The lower end of the tube passes through the cork of a tolerably wide-mouthed gallon bottle extending rather more than half way down. The tubes may be made of smaller calibre and shorter, even 18 inches answers very well, but the sizes given are those which I have found to afford the best results. The tin pipes can be made by any tinsmith in a few minutes.

Two glass tubes also pass through the cork† of the bottle, a short small tube, G, over the outer end of which an india-rubber tube is passed, and a large tube, H, about half an inch in bore, extending to the bottom of the bottle. Its outer end bends over and is connected by six inches of india-

* This form of aspirator (the tube of glass) has been in use for some time at Sheffield Laboratory in New Haven.—Eps.

† The tube G should extend 6 or 8 inches above the cork, and should not pass below it as represented in the figure.

rubber tube with a straight tube of equal diameter. This last arrangement forms the siphon.

When the apparatus is to drive a blast, an india-rubber tube is connected with a hydrant and attached to the open end of the short horizontal branch of the tin tube. When the water is turned on, the india-rubber tube, G I, is closed for a moment with the finger and thumb. This starts the water through the siphon, and then a continuous and powerful blast of air is driven through the tube, G I, which may be attached to a blow-pipe, a Herapath burner, or be used in any way desired. The main point is this, that the siphon must be capable of carrying off a larger stream of water than that which is allowed to enter: in this way there is never more than an inch or two of water in the bottle, and some air escapes through the siphon, but without stopping its play. Otherwise the bottle may fill up and water be driven through G I. The proper balancing is easily attained and then the apparatus may be put in motion or stopped in a moment, and when in motion goes on indefinitely.

When the apparatus is to be used as an aspirator, the tube I is closed by inserting a glass rod, or passing over it a Mohr's stop-cock. B is closed by a cork and E is connected with the apparatus through which the current of air is to be drawn, or E may be closed and the connection made with B.

The arrangement here described for introducing the air and the water at the upper part of the tube was ascertained, after a number of experiments, to be that which was most effective. When the water is thrown horizontally into the vertical tube, it appears to carry with it a larger volume of air than when introduced perpendicularly or in an inclined position. Although the force of the current of air may be regulated to a considerable extent by diminishing or increasing the stream of water, yet it is to be observed that there must be a certain proportion between the stream of water and the size of the tube; a large tube ceases almost abruptly to produce any air-current when the stream of water is reduced below a certain point, and a small tube will not give an air-current of more than a certain force, no matter how great the stream of water. If it is desired that a single apparatus shall produce all degrees of action, a tin tube, like that before described but a little larger in all its parts, may be provided, with a cork fitting its upper extremity. Through a hole in this cork passes a thick glass rod, or tube sealed at one end, of the same length as the tin tube. The introduction of this cork and rod diminishes the effective calibre of the tube, and enables it to blow or aspirate a gentle current of air with a stream of water which would otherwise have failed to set the apparatus in motion; at the same time it can easily be removed when a powerful air-current is desired. The air in this case is derived wholly from the small inclined tube.

I have found this instrument to be of the greatest utility and convenience; so much so that I have two of them permanently fitted up in my laboratory. One valuable application is for getting rid of poisonous vapors. In any distillation, for example, the recipient or Wolf's bottle may be made to communicate with the open air or with a chimney, a cork with a tube may be inserted into the retort, or an extra tube through the cork of the flask in which the distillation is performed, and the flexible tube, G I, passed over it and a current of air be driven through during the whole operation. Or, if the products of distillation are valuable, the tube may be closed at I by one of Mohr's stop-cocks during the distillation, and at the end a current of air may be passed through the apparatus, sweeping it perfectly clean. In this way I have been able to dissolve oxyd of iridium containing osmic acid, in aqua regia, and drive off the osmic acid without suffering any inconvenience from the latter. The chemist who has once used this arrangement will find it so simple and efficacious that he will be led to employ it when manipulating with substances much less deleterious than osmic acid. It is very convenient in operations where chlorine is to be passed over or through substances, especially where the operation requires to be occasionally interrupted to examine the result.

For driving a blow-pipe, an apparatus of this sort, put together with a bottle and a few pieces of tube, is infinitely more convenient than the most expensive and cumbrous table blow-pipe, fed by a double bellows, especially when it is desired to ignite at high temperatures and for a length of time, the automatic nature of the instrument removing the necessity for working the bellows. A considerable degree of heat is easily obtained. A silver piece was laid on a fragment of brick and the flame of a Herapath burner, fed with a stream of air by this instrument, was turned down upon it: the coin withered up immediately. A similar coin was easily fused to a bright button in a porcelain crucible heated from below. Thick brass wire was melted off in drops, etc.

It is not necessary that the instrument should adjoin the blow-pipe or apparatus for which the air current is wanted. In one of mine, the current produced by the tube A B, two feet long, is carried through tubes about sixteen feet, and might easily be carried further without important loss of power.

The quantity of water required for keeping the apparatus in action depends of course upon the force of the current of air desired, but is never large. In an experimental trial it was found that with a consumption of water of 80 litres per hour, a stream of air amounting to 400 cubic centimetres per minute could be maintained, or in other words, a cubic metre (about a ton) of water would suffice to keep the apparatus in motion for twelve hours. This instrument may be appropriately called an *Eolus*.

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