tube bearing a rubber tube, and pinch-cock, which is used to control the access of air through a small glass jet attached, thus allowing the solution to run out as required. The pipette is similarly constructed. The rubber tube connection shown in the cut as 5 c.m. long, is in practice as long as the burette, and the cock is thus placed at the hand of the operator as he is seated. In filling the burette, the jet is attached to the tube from the aspirator, the cork above the jet is opened, and a beaker full, or the required amount of solution in a beaker, placed under the stem; the aspirator cock is opened for a sufficient length of time, and the burette thus filled. In a very fine orifice burette, we may use two pinch-cocks, 5 c.m. or so apart, to control the access of air.

XXXII.—New Filtering Apparatus.

By P. Casamajor.

In the year 1875,* I published descriptions of two funnels for filtering under pressure, one of which was to be applied to the method of filtration proposed by Dr. H. Carmichael, and described in the "Select Method of Chemical Analysis," of Mr. William Crooper (p. 429). In this method, the liquid is separated from the precipitate by the agency of a small disk of filtering paper, held against the perforated surface of a vessel, the interior of which communicates with an aspirator. This vessel, having the paper disk held against it, is placed directly in a platinum or porclain dish, in which the precipitate is to be afterwards heated.

Dr. Carmichael made his vessel, communicating with the aspirator, of glass, but his method for making perforations on the flat side of this vessel was, to say the least, so very difficult, that very few chemists had succeeded in applying his method of filtration. The funnel which I used for the purpose, was of glass, the shape being that of a Platner's blow-pipe mouth-piece. The mouth of the funnel was closed by a small disk of filter paper, resting on a perforated platinum plate. This plate was also circular and slightly smaller than the disk of filtering paper. Both the perforated plate and disk of filter paper were held tightly against the funnel by the suction of an aspirator.

In the same paper there is a description of another funnel, to be used with the same filter, but, in using this funnel, whose shape is

* *American Chemist*, 5, 440, and *Chemical News*, 32, 46.

that of a large thistle tube, the perforated platinum plate is placed on the bottom of the funnel, and, over it, the small disk of filter paper, the edges of which slightly overlap those of the perforated plate. The liquid to be filtered is poured in the funnel. With this funnel, any ordinary aspirator may be used, but I have always used, in connection with it, a simple aspirator consisting of a straight vertical tube of small diameter, attached to the bottom of the funnel. I again called attention to this particular form of aspirator in a subsequent paper,* published shortly after, in which are given fuller details as to its use.

The vertical tube acts by the weight of the column of water, which it holds suspended below the liquid. Its use was made possible by the fact that, when there was no more liquid above the moist disk of filter paper, this became impervious to air, and the column of liquid in the vertical tube continued to be held in suspension, but any additional liquid poured in the funnel went through the paper disk without any difficulty.

I pointed out that, instead of using a disk of filter paper, paper pulp or asbestos pulp could be poured into the funnel. The excess of water would run out, and a layer of paper or of asbestos would be left on top of the perforated plate, and around its edges, and form a very efficient filtering medium.

This aspirator, consisting of a vertical tube, was found so simple and convenient, that I tried to apply it to the funnel first described, which is used in Dr. Carmichael's system of filtration, but the experiments were not successful. In funnels of this shape, the perforated plate and disk of filter paper are held on the under side of the funnel by the suction of an aspirator. Whenever the aspirator ceases to act, the platinum plate and sheet of paper drop down.

The difficulty experienced was due to this: that the paper filter cannot be held in position unless there is a volume of liquid in the vertical tube, while, at the same time, the vertical tube cannot be filled unless the paper filter is held tightly against the funnel.

These are the antecedents of the filter and the aspirator which I now propose to describe.

In this new filtering apparatus, the filtering medium is laid on a perforated plate, provided with a tube open at both ends, which is

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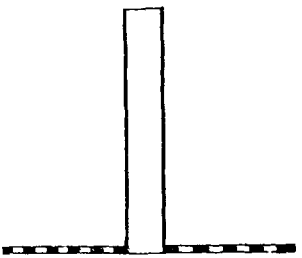
* Funnels with auxiliary vertical tube; see *American Chemist*, **6**, 124, and *Chemical News*, **32**, 184.

firmly attached to the plate, over a hole of the same size as the tube. Figure 1 shows a section of the plate, with the tube attached.

Fig. 1.



This perforated plate is laid on the bottom of a dish or crucible made of platinum, porcelain, or any other suitable material. The upper portion of the tube is connected with an aspirator, and there must be a small space left between the under surface of the plate and the bottom of the vessel, to allow the filtered liquid to pass through the filtering medium. The liquid which passes into the space under the plate, is removed through the tube by the action of the aspirator.

Fig. 2.

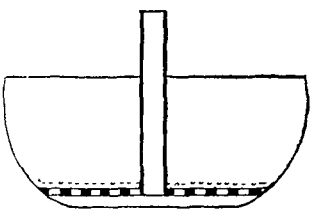


Figure 2 shows the perforated plate in position at the bottom of a platinum or porcelain dish. The filtering medium rests on top of the perforated plate, and is indicated by a fine dotted line. If the bottom of the vessel should be perfectly flat, it would be necessary to make the perforated plate slightly curved, with the concavity turned downward, to allow a space between the plate and the bottom of the vessel.

The filtering medium may be a piece of filter paper, or it may be deposited in the form of paper pulp or asbestos pulp, as already mentioned. If a paper filter is used, there should be a hole in it, to let the tube go through. The perforations in the plate should begin at a certain distance from the tube, so that every portion of the perforated surface may be covered with paper.

It is a very simple matter to make this perforated plate with its tube. Any jeweler can make a tube from platinum foil, and solder the joint with coin gold, which is sufficiently infusible for most purposes, and the tube can be soldered to the plate with the same material. This is the readiest way, and it is next to impossible in this country to have work of this kind done entirely of platinum.

We may also form this piece of apparatus in two portions. Any metal-spinner can turn, on a platinum plate, a tube 5 or 6 millimeters long, and, over this short tube, a platinum tube about 3 centimeters long, can be firmly placed. It is very important that the long plati-

num tube should come down as low as possible over the shorter tube, so that the pulp of paper or asbestos, may be deposited over the joint.

It is almost useless to mention that the weight of the perforated plate should be taken as part of the tare, with the weight of the platinum vessel, and of the asbestos, when a pulp of this material is used. The perforated plate remains in the crucible or dish, while the precipitate is heated, and it is afterward placed on the balance along with the precipitate. When asbestos is used, the requisite quantity should be placed in the vessel in which the precipitate is to be heated, the perforated plate should be added, and the whole sufficiently heated. The vessel and all the contents should then be placed on the balance, so as to obtain the total tare. If the platinum tube is not soldered to the perforated plate, it may with great convenience be left out of the count, as it may be easily removed by holding down the perforated plate with a spatula, and pulling off the tubes after the filtration is over. The quantity of asbestos required is very slight. Dry asbestos, weighing 1 decigram, if sufficiently fine, can easily cover a perforated plate with a surface of 6 square centimeters (about 1 square inch).

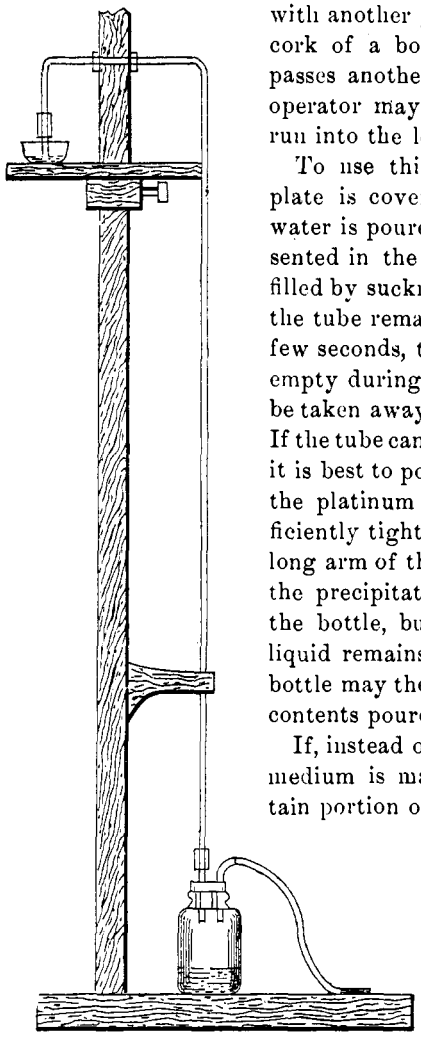
Very full details relating to asbestos filters may be found in an interesting paper of Mr. F. A. Gooch, read before the American Academy of Science, Feb. 13th, 1878, and published in the *Chemical News*, 37, 181. The author does not seem to be aware that I had proposed the use of asbestos pulp, in 1875, as mentioned above, by pouring the pulp over a perforated plate.

In the arrangement introduced by Mr. Gooch, the filtered liquid is forced through asbestos, lying on the perforated bottom of a crucible, by the action of an aspirator. There is a tight joint formed around the crucible, by forcing it into a large rubber tube, which also fits tightly on the top of a glass funnel, in the manner proposed for porous earthenware cones by Prof. Munroe. There is no doubt that a very good aspirator, for this filtering apparatus, would be a straight glass tube having a small diameter, connected by a rubber tube with the stem of the glass funnel.

With the new form of filtering apparatus, having a perforated platinum plate, with tube attached, any form of aspirator may be used, and there is no difficulty in using a vertical tube having a small diameter, like those already mentioned, in which the suction is caused by the weight of a column of the filtered liquid held in suspension. This aspirator with filter, shown in section, is represented in Figure 3. The aspirator tube is bent twice at its upper end, and there

terminates in a short vertical tube about 3 centimeters long, connected with the platinum tube, attached to the perforated plate, by a rubber tube. The long vertical portion of this tube is connected, at its lower end, by a short rubber tube, with another glass tube passing through the cork of a bottle. Through the same cork passes another tube, by means of which the operator may start the liquid, and make it run into the long vertical tube.

Fig. 3.



To use this apparatus, if the perforated plate is covered with filter paper, distilled water is poured in the platinum dish, represented in the figure, and the vertical tube is filled by sucking air from the bottle. When the tube remains filled with liquid, for even a few seconds, there is no fear of its becoming empty during the filtration. The bottle may be taken away and a beaker glass substituted. If the tube cannot be made to retain the liquid, it is best to pour some of the precipitate in the platinum dish, and this will make a sufficiently tight joint to keep the liquid in the long arm of the tube. By doing this, some of the precipitate may at first be carried into the bottle, but very soon nothing, but clear liquid remains in the glass tube. The glass bottle may then be taken away, and its liquid contents poured back into the platinum dish.

If, instead of a sheet of paper, the filtering medium is made from asbestos pulp, a certain portion of the pulp will inevitably pass through the glass tube at first. This will have to be poured back into the platinum dish, even if no portion of precipitate has gone through. If paper pulp is used, and only a small portion passes through, without any of the precipitate, there is no necessity of pouring it back.

After the tube has once remained permanently filled with the filtered liquid, no further difficulty will be experienced. The rest of

the liquid to be filtered may be gradually poured in the platinum dish, and subsequently hot water is added to wash the precipitate.

After the operation is completed, if the platinum tube is slipped from the rubber tube which connects it with the aspirator, the water held in the platinum tube will fall back in the crucible. This is easily got rid of by subsequent evaporation, but this quantity of water, and that which remains below the platinum plate, may be mostly carried off through the aspirator by carefully removing the precipitate from a point on the edge of the paper disk, and lifting this up with the point of a needle just sufficiently to let air go in, to clear the aspirator tube from liquid.

XXXIII.—A Method for the Analysis of Mustard.

By Albert R. Leeds and Edgar Everhart.

During the past summer a large number of analyses of various articles of food and drink was made by the authors, on behalf of the State of New Jersey. Among the articles analyzed were thirty different kinds of mustards, as sold in shops. The method of analysis followed was that given in all text-books on the subject, and especially recommended by Blythe and Hassall. The process consists, as is well known, in estimating the moisture by drying at 100–110°; in determining the ash for the detection of mineral adulteration, and weighing the oil. The other adulterations are determined only qualitatively.

In this method reliance is placed principally on the estimation of the oil, and from this is calculated the amount of mustard supposed to be present in the mixture. Blythe gives the following formulæ for calculating the amount of mustard in a mixture of flour and mustard: x = amount of mustard and y amount of oil found,

$$\frac{33.9x}{100} + \frac{1.2\,(100 - x)}{100} = y \text{ and } \frac{36.7x}{100} + \frac{2\,(100 - x)}{100} = y.$$

This method of analysis and calculation might do very well if no foreign fat were added, or if none of the original mustard oil were extracted. In fact, however, flour baked in oil or fat is frequently added to a mustard from which a portion of the original oil has been extracted, and furthermore, mustard, before being put on the market, is subjected to hydraulic pressure and loses from 12 to 20 per cent. of its oil. From this method of analysis, it is evident that satisfactory or reliable results cannot be obtained.