

ART. XXV.—*Apparatus for Rapid Filtration*; by E. W. MORLEY.

I HAVE had in constant use for some months an apparatus that lessens considerably the time which it is necessary for the analyst to devote to a quantitative filtration. The device has become so indispensable to me, and has been so favorably received by other chemists, that an account of it may be of some value to those who employ Bunsen's method of filtration.

After fitting the platinum cone and filter in the funnel (*a*), a second funnel (*b*) of the same diameter, with a rather wide neck, is inverted over the first. A strip of thin vulcanized rubber (*c*), two or three centimeters wide, is stretched around the rims of the two funnels, so as to make a nearly air-tight joint. An elastic band (*d*) secures this strip. A syphon (*e*), inserted in the neck of the upper funnel, is made to reach below the rim of the filter, and the joint at the neck of the upper funnel is made tight by a piece of rubber tube (*f*). The outer arm of this syphon should be a few centimeters longer than the inner. The beaker (*g*) containing the liquid to be filtered is placed upon a support whose height admits of easy adjustment, so that the syphon reaches nearly down to the precipitate. A vacuum being now produced in the flask, the liquid in the beaker is drawn over into the filter, and keeps it filled to a level which depends on the amount of air entering between the rims of the funnels. If the liquid rises above this level, more liquid and less air pass the filter, the degree of exhaustion in the funnel is lessened, and the flow through the syphon is retarded. If the liquid falls below this level, the degree of exhaustion in the funnel is increased, and the influx of liquid by the syphon quickened. The oscillation of level while a clear or nearly clear liquid is passing from the beaker is only one or two millimeters. If the rubber surrounding the rims of the funnels is about twice as thick as the paper on which this page is printed, and is stretched one third or one half its length in applying it, and if the ends of the strip are pressed tightly by the elastic band, no further adjustment is needed than is made in putting the apparatus together as rapidly as is possible. In sixty seconds after moistening the filter, one may have completed the arrangement of the apparatus, and have left it to itself, to require no more attention till all the liquid above the precipitate shall have passed over.

If the precipitate is to be washed by decantation, the liquid from which the precipitate has settled is removed in the same way. When the precipitate is ready to be transferred to the filter, the beaker is raised so that the syphon reaches to the bottom of the precipitate. The precipitate then passes over, and may be completely removed from the beaker by the use of the rubber and wash-bottle, drawing the wash-water through the syphon. During this process, the action of the syphon may be hastened by closing the air passage (at *h*) by pressure, and may well be suspended at times by loosening the joint (*f*) at the neck of the upper funnel, so as to prevent particles of liquid holding precipitate in suspension from being thrown upon the sides of the funnel. If the bulk of the transferred precipitate is not too large, its washing may now be completed

by adding to the beaker a sufficient quantity of water. No further attention is required till the operation is completed by removing the upper funnel and washing its inner surface, together with the outer surface of the short arm of the syphon ; on which some drops of liquid are often thrown by the bursting of air bubbles, when the level of the liquid in the beaker sinks below the end of the syphon.

The advantages of this method of filtration are—that any amount of liquid can be passed through a small filter without attention ; that liquid and precipitate can be transferred with less liability to loss than by the usual methods ; that the apparatus can be adjusted for use in less than a minute ; and that it is composed of parts which may be said to involve no additional expense ; also, that if the precipitate is not too bulky, its whole washing may be effected without attention during the passage of the wash-water.

In an experiment which was a fair sample of the use of the apparatus, the moistening of the filter and adjustment of syphon took $1\frac{3}{4}$ minutes ; the passage of 380 c.c. liquid, $11\frac{1}{4}$ minutes ; the transferring of the precipitate (hydrate of aluminum), using 70 c.c. water, $8\frac{1}{2}$ minutes ; the passage of 85 c.c. wash-water, $10\frac{1}{4}$ minutes. Attention was given during $10\frac{1}{4}$ minutes, while the filtration lasted $31\frac{3}{4}$ minutes. In a second experiment, on the same precipitate, the apparatus was adjusted in $2\frac{1}{2}$ minutes ; 500 c.c. liquid passed through in $16\frac{1}{2}$ minutes ; the precipitate, with 25 c.c. of water, was transferred in $11\frac{1}{2}$ minutes, of which $6\frac{1}{2}$ minutes needed no attention ; and 105 c.c. wash-water passed through in $18\frac{1}{2}$ minutes. Attention was given during $7\frac{1}{2}$ minutes, while the filtration lasted 49 minutes.

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