evaporation has lowered D, sufficiently more water will run into the bath to take the place of that evaporated. A small stream of water flows constantly out at C and into the sink, but it need be very small indeed.

If the bulb E enters the bath through a place needed for evaporations, a small copper cylinder slightly larger than the opening and having a narrow strip cut out of it for D to move up and down in, may be placed over it as in the cut. Of course, the float may be placed in a side tube soldered to the bath with water-connection to it. If one cannot make it of glass it could easily be constructed of metal by any tinman.

I find also that the same idea works admirably for constant feeding of a small platinum dish in evaporating large quantities of water or other liquids for analysis of residues. In such cases the tube D′ is directly connected with a bottle holding several liters of water in the manner illustrated in the cut at the right. As D′ falls through evaporation of the water in *m*, air enters through L and water drops out at *n* till D′ rises so that *n* is higher than the bottom of L when it stops, and thus the level in *m* is constant. In this case the tube D′ is very small so that the bulb can be very small and still hold it up. In the one I use, the bulb is only 1.5 cm. in diameter and the tube *n* so close to it that it can be used in a crucible. It is very easy to clean the float from the slight residue clinging to it at the end.

I use the same apparatus for washing precipitates with a large amount of water, placing the bulb in the funnel on the surface of the wash-water.

BOWDOIN COLLEGE,
BRUNSWICK, MAINE, NOVEMBER 18, 1893.

A SCALE OF HARDNESS FOR GLASS.[1]

BY W. NIEHLS.

THE term "hardness" as applied to glass, refers to its degree of fusibility in the flame of the blast-lamp. Thus a glass which softens readily in the flame is called a "soft" glass, while one which softens with difficulty is called a "hard" glass. Between the extremes of a very soft and a very hard glass there

[1] Read before the Cincinnati Section, April 16, 1894.

is also quite a series of grades whose differences become very pronounced in actual glass working.

If this difference between two sorts be considerable it is impossible to effect permanent union by fusion between two samples. When the difference is slight, union may be effected between two sorts, but a condition of tension is produced which often causes later, a springing apart at the point of junction, even when not exposed to external strain. Permanent and satisfactory union is accomplished only when the varieties of glass are of the same, or nearly the same, hardness. Practiced glass-blowers make use of this fact in testing the sorts of glass placed at their disposal with reference to their power to unite. Samples of two sorts in the form of small rods are brought together evenly in a small pointed flame, heated therein uniformly, and when soft, fused together by pressure. They are then drawn slowly apart. The softer sample is drawn out more or less easily from the harder, so as to leave a quite pronounced edge when the difference in

Fig. 1.

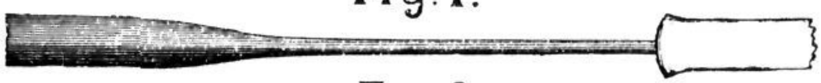

Fig. 2.

Fig. 3.

hardness is considerable (Fig. 1).

When differences are less marked or are even quite slight, the different lengths of the drawn-out ends are quite noticeable and the dividing line between the two sorts is evident to the eye (Fig. 2).

If the two sorts are of the same hardness both ends are drawn out evenly and there is no line of demarcation (Fig. 3).

Hitherto there has been no systematic classification of glass varieties according to hardness for the convenience of commerce, industry, and science. This lack I have supplied by the arrangement—with the co-operation of the German Physikalisch-

Technische Reichsanstalt—of a well-defined scale of hardness for glass, divided into eight degrees. The following are the typical sorts of glass for each degree:

I. The softest glass in commerce, French crystal.

II. Soft Thuringian glass, used for artificial flowers, toys, etc., English crystal.

III. Hard Thuringian glass, as used for thermometers, finer apparatus, etc.

IV. Jena normal thermometer glass (XVI''' of Schott and Co.).

V. French hard crystal used in Paris for normal thermometers (by Tonnelot).

VI. Jena boro-silicate thermometer glass (59''' of Schott and Co.).

VII. Jena thermometer glass free from alkalies (122''' of Schott and Co.). Both VI and VII are used for high temperature thermometers and many other purposes.

VIII. Cavalier's Bohemian crystal glass, used for combustion tubes, etc.

Normal scales of hardness for glass, arranged according to the above scheme, have been prepared and can be secured through dealers in chemical apparatus. They contain on cardboard, illustrative samples of the results of fusing (as described above), each number in the series with the next following number. Compartments also are well stocked with small rods of each degree on the scale—each rod stamped with its number—to be used for testing.

The use of such a scale brings a most desirable element of certainty into the glass trade as well as into the technique of physical and chemical laboratories, and many industrial operations.

[CONTRIBUTIONS FROM THE ANALYTICAL LABORATORIES OF THE SCHOOL OF MINES, COLUMBIA COLLEGE.—NO. 6.]

A METHOD OF DETERMINING THE KOETTSTORFER FIGURE OF DARK-COLORED SUBSTANCES.

BY PARKER C. MCILHINEY, PH.B., A.M.

Received May 5, 1894.

THE Koettstorfer figure of a fat or resin is the number of milligrams of potassium hydroxide required to saponify one gram of the substance. It is determined by adding to a