the suggestion made by Jones and Veazey, that the increase in viscosity which results when associated liquids which diminish each other's association are mixed, is due to the *larger number* of *smaller parts* that are present.

These results are also in perfect accord with their suggestion as to the cause of the diminution in the viscosity of water, produced by salts whose cations have very large ionic volumes, such as salts of potassium, rubidium and caesium.

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NOTES.

Some New Forms of Apparatus: I. A Substitute for the Twin-bulb Trap in Toluene-Mercury Thermoregulators.—Toluene, on account of its high coefficient of expansion, is to be preferred to all other liquids for use in thermoregulators. Since, however, it is practically a nonconductor and quite volatile, it is ordinarily used with mercury for the contact in all electrically operated thermostats.

In order to use these two liquids together, the common form of apparatus hitherto employed has been the twin-bulb device, which, however, has the following disadvantages:

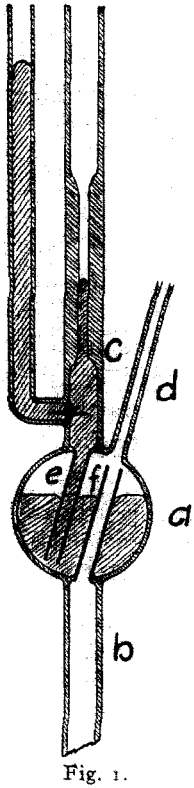

Fig. 1.

1. It is very fragile and can only be made by an expert glass-blower.

2. When the mercury level in the capillary has been once adjusted for any given temperature and the toluene reservoir sealed, the regulator is practically useless for any higher temperatures without opening the reservoir and removing the excess of toluene in order to preserve the equilibrium in the two bulbs.

3. It is difficult to prevent the toluene from finally creeping around between the mercury and the glass walls into the capillary and fouling the contact surface of the mercury, since the same continuous tube contains both the toluene and mercury.

To overcome these difficulties as far as possible the apparatus illustrated in Fig. 1 has been devised. This consists of a bulb (*a*) attached at the bottom by the tube (*b*) to the toluene reservoir which may be of any desired form. Exactly opposite to (*b*) is a corresponding tube (*c*), which carries the capillary and sealed-in platinum contact.

The interior construction of (*a*) is as shown in the figure. The small tubes (*e*) and (*f*) are prolongations of (*c*) and (*b*), respectively, having a length nearly equal to

the diameter of the bulb. These tubes are inclined at an angle of about 30° from the perpendicular. The short side tube (*d*) is used in filling the regulator and is in exact alignment with (*f*).

To prepare the regulator for use, mercury is poured in through the capillary until the bulb (*a*) is from one-half to three-fourths filled. A tube drawn out to a small diameter is then inserted through (*d*) and (*f*) into (*b*), and toluene allowed to run in until the reservoir is filled and also the space in (*a*) above the mercury. The tube (*d*) is then sealed, and by adding or withdrawing mercury from the capillary the contact level may be adjusted for any desired temperature.

By this method a toluene-mercury regulator is constructed with a range of 50° or more, all adjustments being made through the capillary which should be of from 1.5 to 2 mm. bore, according to the capacity of the toluene reservoir.

All danger of the toluene creeping into the capillary is removed since the tubes (*e*) and (*f*) terminate in the same liquid which is contained in them.

This trap is compact, not easily broken and is comparatively simple to construct. In addition to this it lies within the plane of the reservoir and contact tubes.

P. B. DAVIS.

II. A New Form of Pycnometer for Liquids.—The authors have recently had occasion to carry out a large number of density determinations with various liquids. For this purpose a modified form of the Sprengel pycnometer, as described by Jones and Bingham[1] and Jones and Veazey,[2] was first adopted, but was found to have the following disadvantages:

1. In instruments of large capacity (10 to 20 cc.) the long capillary side-arm adds greatly to the weight and hence impairs the accuracy of the pycnometer.

2. The fragility of the older form makes rapid handling practically impossible.

3. The instrument is difficult to dry and polish before weighing.

To remove these defects the form shown in Fig. 2 was devised, and has been found to be more convenient and accurate than the old form.

In the figure the symbols have the following significance:

(*a*) A reservoir of thin-walled glass tubing which may be of any desired capacity; those in use in this laboratory holding, respectively, about 6, 10 and 20 cc.

(*b*) Tapering tube of thin glass reaching almost to the bottom of (*a*), and having a bore at the open end equal to or slightly greater than that of

[1] *Amer. Chem. J.*, **34**, 48 (1905).
[2] *Z. phys. Chem.*, **61**, 641 (1908).

the capillary (0.5–0.75 mm.). This tube is of use in drying and filling the instrument.

(*c*) Outlet tube sealed on to the end of (*b*). This is drawn out slightly at the end and is bent at an angle of 60° close to the reservoir.

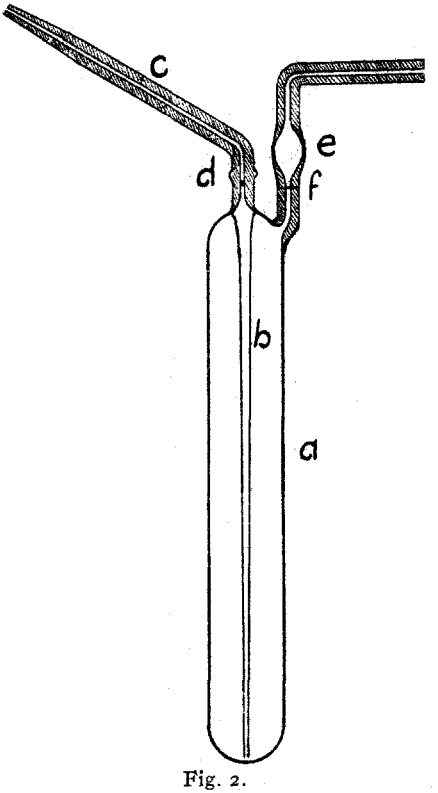

Fig. 2.

(*d*) Slight enlargment in (*c*) which holds in position the wire used to suspend the pycnometer on the balance.

(*e*) Expansion bulb of sufficient size to accomodate the increased volume of any liquid when warmed 10°. If the instruments are used only at 25° this bulb need be only very small.

(*f*) Fine line etched around the capillary at the lower limit of the taper in the bulb (*e*).

In adjusting the instrument when filled, a rubber tube is attached to the horizontal capillary above (*e*), and the liquid blown out gently until the level in (*e*) just reaches the mark (*f*). The excess of liquid is then removed from the end of (*c*) with filter paper. On removing the pressure, the level of the liquid in (*c*) falls until it comes to rest near the bend in the capillary, thereby lessening the danger from evaporation or accidental spilling after adjustment.

The advantages of this form of pycnometer can readily be seen, *e. g.*, the projecting arms are both short and hence not easily broken. Also the net weight has been materially lessened, since the amount of necessary capillary has been reduced to a minimum. The instrument is also much easier to clean and dry before weighing than the older form.

This pycnometer may be provided with ground-on caps when used with alcohol or other volatile liquids, to prevent possible evaporation.

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CORRECTIONS.

Professor James M. Bell has kindly called my attention to an article by Bell and Taber,[1] which was overlooked by me in my article on the

[1] *J. Phys. Chem.*, **12**, 171 (1908).

determination of hydrates.[1] In this work, the authors determined, as we did, the solubility of copper sulfate in sulfuric acid solutions at 25° and Professor Bell has now recalculated the solubility results to a common basis and finds our results confirm his earlier ones. The composition of the hydrates in equilibrium with the solutions was determined by Bell and Taber by the method of residues and graphical extrapolation. We obtained the residues free from mother liquor by treatment with alcohol, depending on the composition of the solutions in a series of determinations for information as to whether the residues thus obtained were pure hydrates or mixtures of two. Both investigations show the presence of the same hydrates. Bell and Taber also calculated the approximate vapor pressures of the hydrates from the vapor pressures of the solutions, a point which we briefly considered without knowing of their work.

H. W. FOOTE.

The Stannic-Stannous Potential.—Mr. H. W. Richter, at present collaborating with one of us, has kindly called our attention to an error in our paper entitled "The Measurement of Oxidation Potentials at Mercury Electrodes. I. The Stannic-Stannous Potential," THIS JOURNAL, **36**, 2035 (1914). Owing to neglect of the temperature coefficient of the normal calomel electrode, its electromotive force at 25° was assumed as 0.560 instead of 0.564 volt. Therefore, 0.004 volt must be added to each of the single potentials recorded, and the value of the stannic-stannous potential at 25° becomes

$$\pi = 0.430 + 0.030 \log \frac{Sn^{IV}}{Sn^{II}} - 0.011 \times \text{conc. HCl.}$$

GEORGE SHANNON FORBES AND EDWARD PAYSON BARTLETT.

[CONTRIBUTIONS FROM THE CHEMICAL LABORATORY OF CORNELL UNIVERSITY.]

THE ORCINOLPHTHALEINS, THE ORCINOLTETRACHLOROPHTHALEINS, AND SOME OF THEIR DERIVATIVES.

BY W. R. ORNDORFF AND E. R. ALLEN.

Received March 9, 1915.

Historical.

Orcinolphthalein was first made and studied by Emil Fischer,[2] working under the direction of A. von Baeyer at Strassburg, and the results published as his inaugural dissertation in 1874. He obtained small amounts of this phthalein by heating orcinol and phthalic anhydride to 210–220°. Much better results were obtained by heating freshly fused anhydride, distilled orcinol and concentrated sulfuric acid for two hours to 135°.

[1] THIS JOURNAL, **37**, 288 (1915).

[2] *Ann.* (Liebig), **183**, 63 (1876).