It follows, therefore, that *these measurements are not sufficiently accurate to test thoroughly the relation between the color and dissociation.*

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The Confirmatory Test for Aluminum.—As a result of experiments carried out in this Laboratory last year, we were about to publish an account of a modified test for aluminum when a published account of practically the same test appeared.[1] Our procedure for carrying out the test was as follows. Pure asbestos fiber, one-half the size of a pea, was looped in a platinum wire, dipped into a solution of 0.05 N cobalt nitrate, ignited, then dipped into the solution of the aluminum hydroxide precipitate (dissolved in the least amount of nitric acid) and ignited.[2] We found that the test was easily sensitive to 0.2 mg. of aluminum, that the sodium salts did not interfere and that there was no danger of losing the test as with the fragile filter paper ash. This modified procedure is now being used successfully in our classes. Furthermore, we found that this procedure could be used for zinc, 0.5 mg. of the metal being detected with ease.

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A Method for Determining Vapor Densities at Room Temperatures.—A summary of various methods for determining vapor densities is given by Biltz,[1] Windisch[2] and Arndt.[3] A method differing somewhat from any of these was developed and tried out to some extent. It can be carried out at room temperature and the apparatus can easily be built from parts found in any chemical laboratory.

Two two-liter round-bottomed flasks are connected by an oil manometer made of glass tubing of 5-mm. inside diameter. Means for evacuating the flasks simultaneously is provided by two stopcocks joined by a

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[1] Pañganiban and Soliven, THIS JOURNAL, 50, 2427 (1928).

[2] A. A. Noyes, "Qualitative Chemical Analysis," p. 190.

[1] Biltz, "Practical Methods for Determining Molecular Weights," The Chemical Publishing Company, 1899.

[2] Windisch, "Bestimmung des Molekulargewichts," Julius Springer, Berlin, 1899.

[3] Kurt Arndt, "Handbuch der physikalisch-chemischen Technik," Ferdinandt Enke, Stuttgart, 1923.

glass tee and connected through a mercury manometer to a vacuum pump, which may be an ordinary aspirator. The liquid whose vapor density or molecular weight is to be determined is sealed up in an ordinary Victor Meyer vapor density bulb and hung in a loop formed by one end of a stiff copper wire coil wrapped around the sealed end of the oil manometer, projecting four inches into the flask. A small hole is blown in the manometer tubing just below the rubber stopper. The flasks are now evacuated to about one centimeter of mercury pressure and the stopcocks closed. The bulb containing the liquid is crushed against the manometer tubing by an angle bent at the end of the stem of the stopcock, which can be turned from outside. In a few minutes, when the liquid has evaporated and equilibrium conditions have been reached, the increase in pressure indicated by the manometer is observed. This amounts to about 29 centimeters of oil when 0.1 g. of ethyl alcohol is used.

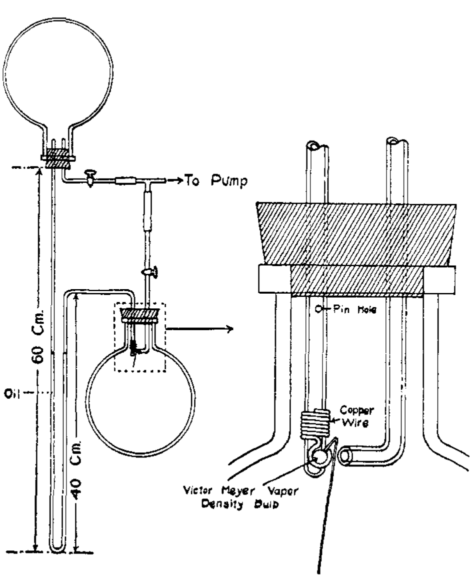

Fig. 1.

The temperature can be determined by a thermometer hung inside or near the flask. The volume of the flask, which must be determined, is made more uniform for different determinations by grinding a shoulder on a rubber stopper that is much too large at first. All the quantities in the familiar gas equation, $PV = WRT/M$, are known except M, which can be calculated.

The error in the pressure reading due to the decrease in volume in the upper flask and increase in the lower flask totals on the average 0.2 mm. of oil and may be neglected. The main precaution to be observed is not to warm the flask with the hands.

The approximate minimum vapor pressure which the substance exerts at room temperature should be 4 cm. of mercury or more. For substances of lower vapor pressure or small molecular weight, a small sample, a larger flask or higher temperatures would be required.

Of the data thus far obtained may be mentioned those taken by Trepp[4] for benzene, 79.7, 79.38, 81.0, 79.13, 79.64, 80.19, 79.42 and 80.23 and for ethyl alcohol 45.34, 44.30, 45.86, 45.99, 45.53, 45.48, 45.29 and 45.34.

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These determinations were made at 23–26°. The benzene was of high purity. The average value obtained for the sample of alcohol corresponded closely to that obtained for it by the Victor Meyer method.

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DOUBLE SALTS OF ANILINE HYDROHALIDES WITH METAL HALIDES

BY GORDON D. BYRKIT AND WILLIAM M. DEHN

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Aniline reacts in a great variety of ways with metallic salts to form molecular compounds, to yield oxidized and halogenated derivatives and to substitute amino or nuclear hydrogen by metal or metal–halide groups.[1] The object of this study is to review and extend the knowledge of molecular compounds of the types $n\text{An}\cdot n\text{HX}\cdot \text{MX}_n$, wherein An is aniline, X is halogen and M is metal. These and their hydrated forms are assembled in the following table. The asterisk indicates new compounds herewith contributed. The symbol of the metal is followed by its valence only where it is other than of the "ic" salt. The types of salts are arranged in the order of increasing complexity with respect to aniline hydrohalide. It will be noted that anhydrous salts are only numbered, while hydrated salts are lettered and correspondingly numbered. There are nine degrees of complexity of anhydrous salts and eight of hydrated salts, making seventeen types of complexity with respect to both aniline hydrohalide and water. In the absence of molecular weight determinations, the simplest formulas are used in the table. There is no evidence that these salts are not polymerized. For example, $\text{AnHCl}\cdot\text{HgCl}_2$ may be $(\text{AnHCl}\cdot\text{HgCl}_2)_8$.

Many of the compounds indicated by the blanks of the table were sought but could not be prepared. The known compounds, therefore, because they are most easily formed, roughly represent comparative capacities of the different metals to unite with aniline hydrohalide, their limits of capacity to enter into such union and the relative affinities of the three halogens.

As is shown in its greater number of types and its ability to form the *octo-aniline* compound, it is concluded that mercury has the greatest

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[1] See especially Whitmore's "Organic Compounds of Mercury," Chemical Catalog Company, New York, **1921**, p. 205.