it was pointed out that the properties of the xylenes, like those of the octanes, are entirely in accord with the theory of atomic compressibility.

Ethyl benzene is not very different from *m*-xylene as regards its physical properties, but the correspondence between them, as regards these properties, is not so close as between the individuals of any pair of the three xylenes. This would indeed be expected, because of the difference in structure.

"Total surface energy" is seen to vary very little with changing temperature.

We are glad to acknowledge the assistance of a grant from the Carnegie Institution of Washington.

Summary

This paper recounts experimental work performed in 1910, which has awaited publication until more exact knowledge of the problem of medium-sized capillary tubes had been secured. The method consisted in the measurement of differences of capillary rise in two narrow tubes of different diameters. Now that the means for calculating the correction to the rise in the wider of these tubes is certain, this method becomes a very convenient one for the purpose, possessing many advantages. The tube was standardized by means of pure water. With it the surface tension of water, three isomeric octanes, *o*-, *m*- and *p*-xylene and ethyl benzene were determined, each at three temperatures. Equations are given for the calculation of the surface tension at any intervening temperature. The total surface energies are recorded; they change but slightly with changing temperature. The results are essentially in accord with the theory of atomic compressibility.

CAMBRIDGE 38, MASSACHUSETTS

NOTES

Density and Hydration in Gelatin Sols.—In a recent article, Svedberg and Stein[1] determined "*d*," the change in density when 5 g. of gelatin was suspended in 100 cc. of various solutions. The following quotation gives their method of calculation.

> "The volume of the pycnometer was determined in the usual way. The density difference, *d*, was arrived at quite directly: the difference in weight between the pycnometer plus the gelatin sol and the pycnometer plus the pure solvent was divided by the volume of the pycnometer. A concrete example taken from the results will make the statement clearer. For 5% gelatin solution in *N* hydrochloric acid we find,

$$\begin{array}{lll} N\,\text{HCl solution} & +\ \text{pyc.} & = 50.8212\ \text{g.} \\ N\,\text{HCl} & +\ \text{pyc.} & = \underline{50.4740} \\ \qquad\text{Diff.} & & = 0.3472 \end{array} \qquad \frac{0.3472}{\text{vol. of pyc. } (27.17565)} = d = 0.012776.\text{''}$$

---

[1] Svedberg and Stein, THIS JOURNAL, **45**, 2613 (1923).

The changes in density are ascribed to "the formation of a shell of highly compressed water around the gelatin particle." With strong solutions the change of density was less than with weak solutions. This is ascribed to a contest set up between the gelatin particles and the solute for the possession of the water. Ethyl alcohol, and methyl alcohol gave anomalous results in that "d," the increase in density, increased with increasing concentration of these solutes. "Apparently their presence encourages the hydration of the gelatin."

The conclusions are in error and the form in which the data are arranged is misleading because the method of calculating change in density does not take into account the fact that for each different solution the change in density is calculated from a different basic density. The results are really due solely or almost solely to the fact that a nearly constant volume of gelatin displaces its own volume of solution in the pycnometer. The gelatin is denser than any of the liquids; hence, there is always an increase in gross weight when gelatin is added. That increase in weight is equal to the weight of the gelatin diminished by the weight of the equal volume of solution displaced; the less dense the solution, the greater this difference. Hence, the alcohol solutions show a greater increase in density than the pure water.

If there is no condensed shell of water, the weight of 1 cc. of a gelatin sol can be expressed by the equation

$$\sigma v + \rho(1-v) = D = \rho + d \qquad (1)$$

where σ is the density of gelatin; v, the volume of gelatin in 1 cc. of sol; ρ, the density of the dispersing medium; D, the density of the sol; and d the increase in density as found by Svedberg and Stein.

Using pure water at 37.2°, $d = 0.01443$, $\rho = 0.9933$, $D = 1.00773$; σ and v can be calculated by a series of approximations.

Assume that $\rho = 1.4$. Then 5 g. of gelatin occupies $5 \div 1.4 = 3.571$ cc., and 100 cc. of solution + 5 g. of gelatin become 103.571 cc. Each cubic centimeter contains $5 \div 103.571 = 0.04827$ g. of gelatin. This displaces $0.04827 - 0.01443 = 0.03384$ g. of water. 0.03384 g. of water occupies $0.03384 + 0.9933 = 0.03407$ cc. Then $\sigma = 0.04827 \div 0.03407 = 1.417$.

If a second calculation is made beginning with $\sigma = 1.417$, the correct value is found to be 1.417.

Equation 1 may be put in the form, $d = v(\sigma - \rho)$, and d calculated on the assumption that no condensed shell of water forms; ρ is taken from the published tables of densities by interpolation. For 2 N H_2SO_4, $\rho = 1.0636$. Then $d = (1.417 - 1.0636)\ 0.03407 = 0.01203$; Svedberg and Stein's value is 0.01145. For 2 N ethyl alcohol, $\rho = 0.9874$; $d = (1.417 - 0.9874)\ 0.03407 = 0.01464$; Svedberg and Stein's value is 0.01514. The concentrations of the solutions they used were only approximate and a variation 0.001 in the interpolated densities of the solutions would give calculated values almost identical with the observed values.[2,3]

Contribution from the Chemistry Department
Iowa State College
Ames, Iowa
F. E. Brown

Received November 16, 1923

A Receiving Apparatus for Practical Distillation at Low Pressures.—Anyone who may have had to carry out a fractional distillation at low pressures knows the difficulties encountered in overcoming leaks in the various forms of vacuum distillation receivers. To avoid all leaks and yet be able to perform a continuous fractional distillation, the apparatus as shown in the diagram was constructed and found to work satisfactorily.[1]

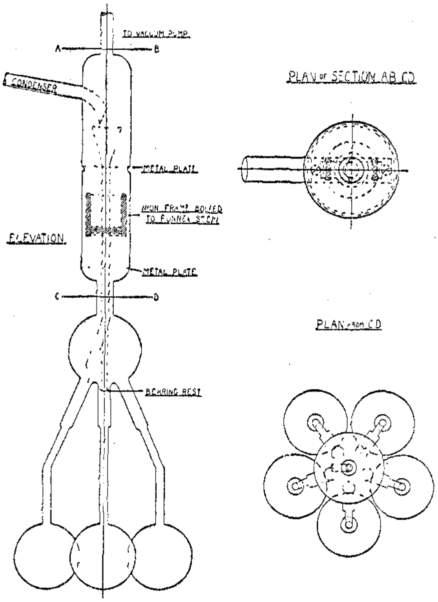

Fig. 1.

The whole apparatus was made of Pyrex glass. This allowed it to be heated whenever there was a possibility of fractions solidifying and blocking the funnel. The details of construction are shown in the figure and are as follows: two metal plates serve to hold the funnel in position and they are in turn supported by constrictions in the large tube; clamped to the funnel are two small pieces of iron rod held together at the ends by brass strips; the funnel with the fixtures turns on a glass bearing which rests in a small indentation. Pivoted in this manner, the funnel and connections swing about easily when a magnet is brought near to either one of the iron pieces.

---

[2] *Editor's Note.* Dr. Svedberg in a private communication to the Editor states that, in view of Mr. Brown's suggestions, he is now determining by means of a dilatometric method the corrections required to ascertain the actual volume changes. He has already found that there is a contraction attending the solution of gelatin in pure water, of about 50 cubic millimeters per 100 cc. This contraction becomes steadily less with increasing concentration of hydrochloric acid.

[3] The author has already commenced a determination of the partial molal volumes of gelatin and of water in various proportions by the methods described on pp. 33–41 of "Thermodynamics" by Lewis and Randall.

[1] A receiver similar to this has been described in the *Chem.-Ztg.*, **1902**, 337, and in Catalog No. 60 of the Kny-Scheerer Company.