

sponding to a close-packed monomolecular surface layer. In the very few cases<sup>1</sup> where exceptions have been found to this rule, the adsorbates have been soaps or similar hydrolysable molecules, and inter-attraction between the long-chain molecules and their products by hydrolysis has been given as explanation of the sharp breaks which occur in the interfacial tension-adsorbate concentration curves.

In order to test this, a study has been made of much simpler systems where no secondary reaction is possible. The accompanying graph represents the change in interfacial tension between water and benzene as molecules of benzyl alcohol accumulate at the interface, and was obtained by measuring<sup>2</sup> the tension between a water phase saturated with benzyl alcohol, and a benzene phase containing varying amounts of the alcohol. The curve shows two very well-defined breaks, indicating that such breaks must be due to a much simpler cause than has hitherto been believed; it is suggested that they occur whenever an amphipathic adsorbate is soluble in both phases, and that the *two* breaks which normally occur represent the beginning and the end of interpenetration of two identical adsorbed films. It is significant that no break is obtained in the curve for benzyl chloride, which is soluble only in the benzene phase.

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<sup>1</sup> Powney and Addison, *Trans. Faraday Soc.*, **34**, 628 (1938).

<sup>2</sup> Powney and Addison, *Trans. Faraday Soc.*, **33**, 1243 (1937).

#### On the Theory of Dielectric Polarization in Liquids

ONSAGER<sup>1</sup> has developed a theory of the dielectric polarization in liquids, in many respects different from the current theory of Lorentz-Debye. We propose to show that the method of calculating the dipole energy, used by Onsager in his theory, does not correspond exactly to the assumptions of this theory. Onsager calculates the momentum of forces rotating the molecule in such a manner as if the rotation of the resulting moment (being the vectorial sum of both the permanent and induced moment) were decisive for the rotation of the molecule. In fact, however, only the axis of the permanent moment, and not that of the induced moment is rigidly bound to the isotropic molecule. This fact causes the real expression for the energy of the molecule to differ from the formula presented by Onsager. We obtain therefore instead of Onsager's formula:

$$\frac{4\pi N\mu^2}{9kT} = \frac{(\epsilon - n^2)(2\epsilon + n^2)}{\epsilon(n^2 + 2)^2} = \rho(\epsilon, n), \dots (1)$$

the following expression:

$$\frac{4\pi N\mu^2}{9kT} = \rho(\epsilon, n) \cdot \frac{2\epsilon + n^2}{2\epsilon + 1} \cdot \frac{3}{n^2 + 2}, \dots (2)$$

where  $\mu$  denotes the permanent moment of an isolated molecule (that is, measured in the vapour state),  $\epsilon$  is the dielectric constant of the liquid,  $n$  is its refractive index (for  $\lambda = \infty$ ) and  $N$  is the number of molecules per ccm.

Böttcher<sup>2</sup> has proved on ample experimental data that formula (1), when applied to numerous liquids, gives for  $\mu$  values in excellent agreement with those determined from measurements of the dielectric constant of vapours. If we apply, on the other hand, to the same liquids the corrected formula (2), we

obtain lower values, generally by about 15 per cent. The deviations therefore between Onsager's theory and experiment become rather considerable. For example, for nitrobenzene, in which  $\mu = 4.2$  (determined in the vapour), formula (1) gives  $\mu = 4.2$ , while formula (2) gives  $\mu = 3.6$ .

Onsager deduces also an expression for the ratio  $\mu_{app}/\mu$ , where  $\mu_{app}$  denotes the dipole moment determined by Debye's method applied to solutions in non-polar solvents. We have shown that the value of this last expression turns out to be greater than 1 for such solutions as nitrobenzene-hexane, nitrobenzene-benzene and others. It is, however, generally known that numerous experiments yield  $\mu_{app}/\mu < 1$ .

The question will be discussed more fully in a paper to be published shortly in *Bull. Ac. Pol.*

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<sup>1</sup> Onsager, L., *J. Amer. Chem. Soc.*, **58**, 1486 (1936). See also Falkenhagen, H., *Phys. Z.*, **39**, 806 (1938).

<sup>2</sup> Böttcher, C. J. F., *Physica*, **6**, 59 (1939).

#### Avoidance of Crystal Formation during Embedding of Plant Material in Paraffin Wax

THE formation of wax crystals in paraffin blocks containing material for microtoming is a common source of annoyance. As a result of various trials, I have found that the following simple method eliminates the trouble, at least in so far as the various types of wax used in this department are concerned.

Float 'boat' containing melted wax and material suitably spaced in a 500 c.c. beaker containing water the temperature of which is within a few degrees of zero and in which ice is floating. As soon as possible submerge block and remove it from 'boat'. Keep block submerged until hard, and repeat process until all material has been embedded. Then transfer the beaker containing the paraffin blocks to a refrigerator at a temperature about 5° or 6° C. and leave there for one or two days. Then remove beaker from refrigerator, and allow the water and wax therein gradually to assume the temperature of the atmosphere. The paraffin block is now ready for immediate or future use.

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#### Insects in Aircraft

DR. WHITFIELD's recent communication on this problem<sup>1</sup> rightly emphasizes its importance. But it might be gathered from his letter that it is a new problem—one which has hitherto received little attention or one for which no adequate preventive measures have been devised.

Such assumptions would be wrong. The problem has exercised the minds of tropical sanitarians at least since the time of Manson, and the danger is one which has been reiterated on many occasions by the Ross Institute and other authorities. Active measures have been taken and are being taken by aircraft companies and by the sanitary authorities