

absolute temperature; μ is here defined as the total electric moment between the plates of a large parallel plate condenser filled with solvent containing a single solute molecule with its polar axis normal to the plates. In the special case that the solute and solvent molecules occupy equal volumes, there is a simple relation between the value μ_g of μ computed by (1) and the value μ_D given by the usual Debye formula. The ratio μ_g/μ_D is in this case equal to $(\epsilon_0 + 2)/3\sqrt{\epsilon_0}$. This is unity when $\epsilon_0 = 1$ (gaseous state) and when $\epsilon_0 = 4$; it has a minimum value of 0.943 when $\epsilon_0 = 2$.

I have applied formula (1) to Hampson's data for the two monochloronaphthalenes and ten dichloronaphthalenes in benzene and to Jenkins's data for nitrobenzene in the six non-polar solvents benzene, carbon tetrachloride, cyclohexane, carbon disulphide, hexane, decahydronaphthalene. In all cases the values obtained for μ are between 3 and 7 per cent lower than those obtained by the usual formula of Debye. The former values are therefore neither more nor less reasonable than the latter. I do, however, find that as the concentration varies there is no trace of any trend in the value of the left side of (1), whereas the analogous quantity $3\sigma P_2$ in Debye's treatment in many cases has a considerable trend even at the highest dilutions. I suggest that this trend is not due to mutual interaction of the solute molecules, as usually suggested, but is due to the inaccuracy of the Clausius-Mosotti formula.

According to the model used by me, μ should vary from one solvent to another according to the relation

$$\mu (\epsilon_0 + \frac{1}{2}\epsilon_i) = \text{constant} \quad . \quad . \quad (2)$$

where $(\epsilon_i - 1)/4\pi$ is the polarisability (per unit volume) of the solute sphere. This formula does not agree with the experimental dependence of μ on the solvent, nor should we expect agreement, because this effect will certainly depend specifically on how the dipole is situated in the solute molecule, as has been explained semi-quantitatively by Frank².

I hope shortly to publish a detailed derivation of formulæ (1) and (2).

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¹ C. G. Darwin, *Proc. Roy. Soc., A*, **146**, 17 (1934).
² F. C. Frank, *Proc. Roy. Soc., A*, **152**, 171 (1935).

Photo-electric Activity of Iron and its Oxides

THE following results, obtained from a photo-electric examination of the oxidised surfaces of metallic iron, render previous results¹ for other metals more complete.

The surface of Fe_2O_3 was found to be almost photo-electrically insensitive, and no spectral distribution curve could be obtained. The photo-electric currents produced from an iron oxide (FeO) surface were so small that a determination of the photo-electric threshold from the spectral distribution curve could not be made with any accuracy. It did appear, however, that the curve possessed a maximum at 2190 Å., and that the photo-electric threshold was at a wavelength less than 2500 Å. Hughes and Dubridge² give a value of 2620 Å. for the photo-electric threshold of outgassed metallic iron, and I³ have found the threshold of a turned metallic iron surface to be at 2980 Å.; this latter surface has been shown to give results similar to a partially outgassed metallic surface.

These results, therefore, bring iron into line with the other metals previously examined. They support a theory of gas adsorption rather than instantaneous oxidation as the initial change undergone by a clean metal surface on exposure to the air.

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¹ J. S. Hunter, *Phil. Mag.*, **vii**, **19**, 958 (1935).
² Hughes and Dubridge, "Photoelectric Phenomena", p. 75.
³ J. S. Hunter, *Proc. Roy. Soc. Edin.*, **54**, 102 (1934).

Photo-Activation of the Carbonyl Group in Prototropic Reactions

ACCORDING to the theory of the mechanism of the catalysed bromination of ketones advanced by me¹, presented in outline by Nathan Watson and Laurie², and more recently extended by Watson Evans and Morgan³, the function of the catalytic molecule is the introduction of the translational energy of collision specifically into the carbonyl bond through the formation of transient addition complexes, which leave the bond in an electronically activated condition: "the rupture of one link of the double bond, in chemical changes such as the formation of addition compounds, is an asymmetrical process, which can be formulated as depending on the transient formation of a semi-polar double bond in an activated phase of the molecule"⁴.

In confirmation of the foregoing theory, preliminary experiments have shown that it is possible to produce such activation by means of ultra-violet light⁵, and in this way to catalyse bromination. A study of the photocatalysis of such prototropic reactions is now proceeding.

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¹ Thesis, University of London (1933).
² *J. Chem. Phys.*, **3**, 170 (1935).
³ *J. Chem. Soc.*, **167**, 1167, 1173 (1935).
⁴ Cf. Lowry, *Chem. and Ind.*, 456 (1925).
⁵ Cf. Lowry, *J. Chem. Soc.*, 620 (1926).

Alfred Hayes

THE recent death of Alfred Hayes will recall to the minds of many one who was for successive generations associated with the intellectual and social life of Birmingham, not only as Principal and later Secretary of the Midland Institute, but also by reason of his literary activities in various directions. He was recognised as the poet, who held on manfully in surroundings more or less indifferent and even antagonistic to such an immaterial outlook on life. To me his death brought back a particularly striking sonnet, "Pasteur's Grave", which was written in the following circumstances.

At the opening of the session of the Mason College, now the University of Birmingham, in 1895, my husband was asked to give the inaugural address. Pasteur's death had just occurred and Prof. Frankland chose as his subject "Pasteur—his Life and Work". A few days later he received a warm and appreciative letter from Mr. Hayes thanking him for his lecture and enclosing a copy of the afore-mentioned sonnet, which appeared in one of the London evening