This has scarcely any bearing, however, on the puzzling experimental disagreement between Gaydon and Wolfhard on one hand, and Linnett and Wheatley, Badin et al.[5], Ubbelohde[7], etc., on the other. It is clear that the burner diameter is a factor which must be taken into consideration. However, using a burner of too small diameter at low pressures would be expected to withdraw atoms and free radicals from the flame and therefore decrease the burning velocity. It is hard to see how failure to increase the burner diameter can account for a false *increase* in burning velocity. On the contrary, it would seem more probable that failure to increase the burner diameter sufficiently is responsible for the *decreasing* burning velocities which Ubbelohde[7] and Badin et al.[5] observed below 300 mm., pressure, subsequent to an increase in going from higher pressures to 300 mm. Had larger burner ports been used, a continued increase might have been observed.

It would appear to be desirable, therefore, to go further into the causes underlying the differences in the experimental burning velocity – pressure relations before either one of them is used to draw theoretical conclusions. The forthcoming experiments of Linnett and Wheatley should be of much interest in this connexion.

<div align="right">CHARLES TANFORD</div>

Department of Chemistry and
  Chemical Engineering,
State University of Iowa,
  Iowa City, Iowa.
  Sept. 26.

[1] Linnett and Wheatley, *Nature*, **164**, 403 (1949).
[2] Gaydon and Wolfhard, *Nature*, **164**, 404 (1949).
[3] Tanford and Pease, *J. Chem. Phys.*, **15**, 861 (1947).
[4] Tanford *J. Chem. Phys.*, **15**, 433 (1947).
[5] Badin, Stuart and Pease, *J. Chem. Phys.*, **17**, 314 (1949).
[6] Gaydon and Wolfhard, *Proc. Roy. Soc.*, A, **196**, 105 (1949).
[7] Ubbelohde and Anwandter, *J. Gasbel.*, **60**, 225 (1917).

Expansion of the Lamellar Crystal Lattice of 'Aerosol OT' upon the Addition of Water

IT is a well-known fact that some lamellar crystals, such as montmorillonite, graphite and hæmoglobin[1], swell reversibly upon the addition of water, the latter entering in small defined layers between the crystal planes. It is the purpose of this note to direct attention to some remarkable examples of such behaviour on a much more striking scale. These occur in liquid crystalline solutions of some detergents (anisotropic aqueous phases). In these, all the added water appears to enter the expanded lamellar lattice.

If the swelling occurs in *only* one direction and the amount is determined *solely* by the volume increase due to the added water, the increase of the Bragg 'long spacing', d, determined by X-rays would be

$$\Delta d = d_0 \cdot \rho_s / \rho_w \text{ (gm. water/gm. solid),}$$

where d_0 is the spacing of the anhydrous crystal, ρ_s is the density of the solid and ρ_0 is the density of water.

Many solutions of detergents, soaps and other colloidal electrolytes are well known which yield anisotropic phases over a range of their aqueous systems. These are characterized by double refraction, high anomalous viscosity, and sharp X-ray patterns, and their phase behaviour obeys the phase rule[2]. The X-ray behaviour of these systems falls into two definite groups[3,4]. One of these is given here a definite interpretation.

In the system 'Aerosol OT' (sodium salt of di-octyl sulpho succinic acid)—water, the liquid crystalline phase at 25° C. extends from near the pure solid crystal (100 per cent) down to about 16·5 per cent 'Aerosol OT'. The long X-ray spacing is very sharp and is found to vary exactly in accord with the equation given. A value of 1·1 is assumed for the density of 'Aerosol OT'.

The same quantitative expansion is seen to have occurred in the previously investigated liquid crystalline systems of aqueous glyceryl monolaurate and diglycol laurate measured by Marsden[5] and also in the liquid crystalline phase of aqueous hexanolamine oleate studied by Ross[6]. In these cases, however, the value of d_0 is a few per cent less than that of the solid.

Such linear expansion of a lamellar lattice, with all the added water going into well-defined equally spaced layers in the crystal lattice, can proceed to a limit given by the range of surface forces that cause the lamellar structure to hold together. The mechanism is presumably by relayed dipole orientation through successive molecular layers until the order is broken up by thermal vibration. A review of the evidence for the effective depth of the surface zone of liquids is given by Henniker[7].

The greatest depth of the water layers observed in these three systems is for 'Aerosol OT', 110 A. thick ; for glyceryl monolaurate, 120 A. ; for diglycol monolaurate, 155 A., and for hexanolamine, 45 A. On further addition of water the systems become heterogeneous, separating into two liquid phases.

The relation given in the equation above does not apply to other isotropic aqueous systems of colloidal electrolytes which are either isotropic or where independent Hess micelles or rod-shaped micelles are present[8].

These experiments give positive proof of the existence of a deep surface zone in water of the order of 100 A., and offer a new experimental method for its investigation.

<div align="right">W. PHILIPPOFF
JAMES W. McBAIN</div>

Department of Chemistry,
  Stanford University,
  California, U.S.A.
  May 19.

[1] Boyes-Watson, J., Davidson, E., and Perutz, M. F., *Proc. Roy. Soc.*, A, **191**, 83 (1947).
[2] McBain, J. W., Vold, R. D., and Vold, M. J., *J. Amer. Chem. Soc.*, **60**, 1886 (1938).
[3] McBain, J. W., and Marsden, S. S., *Acta Crystall.*, **1**, 270 (1948).
[4] Marsden, S. S., and McBain, J. W., *J. Amer. Chem. Soc.*, **70**, 1973 (1948).
[5] McBain, J. W., and Marsden, S. S., *J. Chem. Phys.*, **15**, 211 (1947).
[6] Ross, S., and McBain, J. W., *J. Amer. Chem. Soc.*, **68**, 296 (1946).
[7] Henniker, J. C., *Rev. Mod. Phys.* (in the press).
[8] Marsden, S. S., and McBain, J. W., *J. Chem. Phys.*, **16**, 633 (1948).

Crystal Structure of the Hydrate Form of Racemic Acid

As was shown by Pasteur, racemic acid is composed of the two stereoisomers of tartaric acid. Although the chemical properties of racemic and tartaric acids are the same, the existence of a small heat of formation of racemic acid from d-tartaric acid, and differences in the physical properties of the two acids both in crystal form and in concentrated solution, suggest the formation of a definite compound. In early X-ray work on the crystallography of the anhydrous form of racemic acid, Astbury[1] concluded