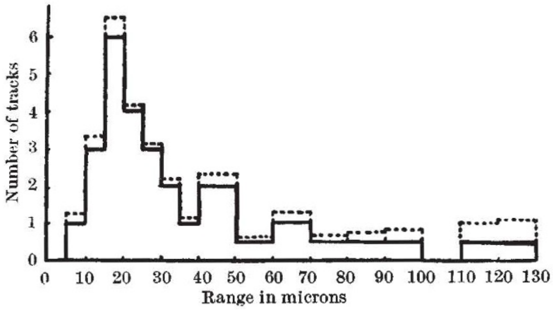

The range distribution of the complete heavily ionized tracks is shown in the accompanying histogram, which has been corrected for loss of tracks due to (*a*) those remaining in the gelatin layers, (*b*) those which pass out of the emulsion. The corrected distribution is shown by the dotted curve.

This work is being continued, and will be reported more fully upon completion.

J. B. HARDING
Imperial College of Science and Technology,
London, S.W.7. Jan. 25.

[1] George, E. P., *Nature*, **162**, 333 (1948).
[2] Thomson, G. P., Bakerian Lecture Roy. Soc., 1948.
[3] Harding, J. B., *Phil. Mag.* (in the press).

Structure of Molecular Films of Stearic Acid on Copper

ELECTRON diffraction patterns obtained during an investigation of the effect of temperature on mono- and multi-molecular layers of stearic acid on copper have produced evidence for the existence of crystallites of a metal soap on the copper surface.

The layers of acid were deposited by the Langmuir–Blodgett method[1] on a metal surface which had been finely polished with rouge on 'Selvyt', degreased electrolytically and rinsed in distilled water. Three or more layers give diffraction patterns at 20° C. consisting of strong grease bands (Fig. 1), corresponding to the different orders of the 2·54 A. alternate carbon-to-carbon spacing in the hydrocarbon chain. On raising the temperature of the metal support, the bands gradually fade. At 80–85° C., while the band pattern is still visible, continuous rings corresponding to spacings of 3·76, 4·17 and 4·38 A. appear (Fig. 2). These rings increase in intensity with temperature, and at approximately 100° C. begin to arc. Further faint rings appear, until, at 115° C., there is a strong cross-grating pattern (Fig. 3). The pattern persists until at a temperature of 127–130° C. it fades suddenly, leaving a diffuse background.

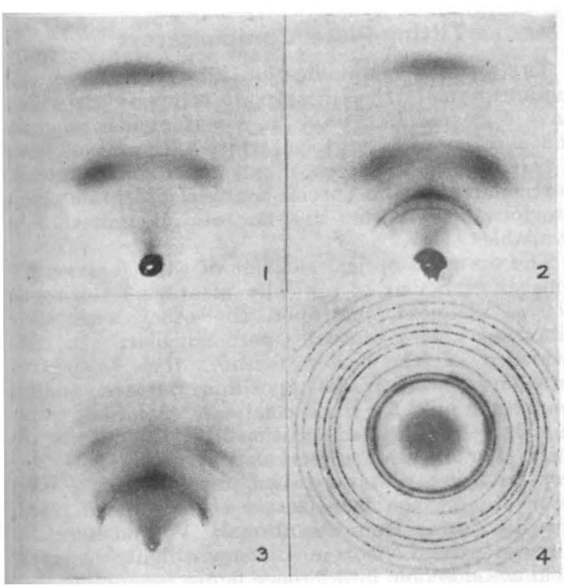

Fig. 1. Reflexion pattern of 7 layers of stearic acid on copper at 20° C.
Fig. 2. Same, after heating to 95° C.
Fig. 3. Same, after heating to 115° C.
Fig. 4. Transmission pattern of copper stearate dissolved from copper surface

The obvious conclusion, that the rings are due to the appearance of copper stearate, was confirmed by comparison of the planar spacings with those obtained from transmission patterns of a copper stearate powder prepared in the laboratory. When a specimen giving the pattern shown in Fig. 3 is boiled for several minutes in pure benzene, the subsequent solution after evaporation on a collodion support gives a strong transmission pattern (Fig. 4). The strongest two rings correspond to spacings of 3·76 and 4·17 A.

From these observations it would appear that at some temperature below 80° C. the stearic acid begins to melt (if one can speak of melting in such layers), reacts with the copper and forms copper stearate. (The bulk melting point of stearic acid is 69° C.; copper stearate softens at approximately 125° C. The effect of the metal surface on the melting point of molecular layers of such compounds is being investigated.) The stearate gradually collects into discrete crystallites, projecting from the metal surface and showing some preferred orientation. The pattern indicates that the crystals are oriented with their (001) plane parallel to the metal surface. At 130° C. the crystals melt.

Further experiments, however, indicate that, if the multi-layers on copper are allowed to age for some days, similar crystallites are obtained at temperatures well below the melting point of stearic acid. Melting of the acid apparently merely accelerates the reaction and subsequent crystallization.

Reaction between molecular layers of polar compounds with the underlying metal or metal oxide surface has been proposed by previous workers[2–4]; but no definite electron diffraction evidence of the existence of the products of such reactions has previously been reported. The conception of the crystallization of multilayers of long-chain compounds is not a new one. Coumoulos and Rideal[5] reported in 1941 that molecular layers of long-chain esters on nitrocellulose supports crystallized on ageing.

Further work on other metals is in progress.

My thanks are due to Dr. A. L. G. Rees for permission to use the electron diffraction camera of the Chemical Physics Section, Division of Industrial Chemistry, and for his constant advice and criticism. The work forms part of the general programme of research of the Tribophysics Division of the Council for Scientific and Industrial Research.

J. A. SPINK
Tribophysics Division,
Council for Scientific and Industrial Research,
University of Melbourne.

[1] Blodgett, K. B., *J. Amer. Chem. Soc.*, **57**, 1007 (1935).
[2] Bowden, F. P., Gregory, J. N., and Tabor, D., *Nature*, **156**, 97 (1945).
[3] Tanaka, K., *Mem. Coll. Sci. Kyoto Imp. Univ.*, A, **22**, 377 (1939).
[4] Brummage, K. G., *Proc. Roy. Soc.*, A, **191**, 243 (1947).
[5] Coumoulos, G. D., and Rideal, E. K., *Proc. Roy. Soc.*, A, **178**, 421 (1941).