thinkers must themselves feel this superiority intensely, but it would be a good thing if their allegiance was less clannish, and, in their external relations, they were less like the herd in thinking these threatened catastrophes as either inevitable or beyond the power of science to prevent. For, indeed, the amount of science required is, in my view, much of the two-plus-two variety. What is more wanted is not a new organization but a Crusade of Scientific Civilizers, a C.S.C. not an S.R.S.

FREDERICK SODDY.

131 Banbury Road,
Oxford.

Complex Formation in Lipoid Films

IT was shown recently[1] that when extremely dilute solutions of certain substances were injected into the substrate under monolayers of various types, the injected substance (for example, cetyl sulphate) penetrated the monolayer (for example, cholesterol), forming a mixed film containing equal numbers of the two molecular species. These experiments were carried out at constant area.

Two experimental methods have now been devised to study area changes in these mixed films formed by the penetrative process under various compressions. In one, a Langmuir trough is employed, the surface tension of the solution behind the barrier being separately determined. In the other, a thin strip of waxed paper attached to the sides of the trough by long vaselined silk threads serves as a barrier. The monolayer under examination is placed in front of the barrier, and behind it a lens and film of a suitable substance serves as a Langmuir piston to compress the monolayer. This piston film, for example, triolein (piston pressure 23 dynes/cm.), must consist of a substance which is not penetrated by the material injected into the substrate.

With a monolayer of cholesterol compressed by a triolein piston, the injection of a dilute solution of digitonin causes an immediate expansion of the monolayer to twice the area, and the previously liquid cholesterol film becomes solid. The triolein is unimpaired and continues to exert a compressive pressure of 23 dynes per cm. If instead of digitonin, cetyl sulphate in suitable concentration be injected and oleic acid is employed as piston (35 dynes/cm.) the area increase is only 50 per cent instead of 100 per cent. Here again, since the molecular areas of cholesterol, digitonin and cetyl sulphate are 40 A.^{2}, 40 A.^{2} and 20 A.^{2} respectively, a complex of 1 : 1 is formed. Replacing oleic acid by the less compressive triolein piston, it is found that on injection of the cetyl sulphate there is an immediate expansion of 50 per cent forming the 1 : 1 complex. This is followed at these lower pressures by a further slow expansion, indicating the formation of a less stable complex of the composition cholesterol, cetyl sulphate (1 : 2). Care has to be taken to avoid leaks, since the detergents in excess remove the liquid paraffins from the threads.

It is of interest to note that a solution of cholesterol in petrol ether spreads rapidly on water and on a solution of cetyl sulphate, but not on digitonin; hence surface peptization is only brought about by the formation of complexes which must be liquid and in order to spread must have stability pressures greater than the equilibrium surface pressure of the underlying solution. With the Langmuir trough it is possible to examine this complex formation over a wider range of areas and pressures. The following general types of complex emerge from this investigation.

(*a*) When both monolayer and penetrating molecules are ring structures, only 1 : 1 complexes are stable.

(*b*) i. When the penetrating molecules are chains penetrating into a monolayer of ring structure, complexes containing one, two, and possibly three chain molecules per molecule in the monolayer have been established.

(*b*) ii. In the inverse system to the above, two chain molecules in a monolayer can interlink with one ring structure molecule from the substrate.

(*b*) iii. Finally, if both monolayer and substrate molecules are linear, two, and possibly as many as three, molecules from the substrate can form from a complex with one in the monolayer, in agreement with a centred hexagonal packing.

(*b*) iv. Van der Waals forces play a large part in the stability of these complexes; thus if dodecyl sulphate instead of cetyl sulphate be used, only very weak 1 : 1 complexes can be established.

We may note that in chain-like molecules insertion of a double bond in the chain may reduce the penetrative power; thus cetyl sulphate penetrates readily a film of the *trans* elaidyl alcohol to form an 'interlocking' solid, 1 : 1 mixed film, but only penetrates with difficulty the *cis* oleyl alcohol, to form a liquid film readily decomposed by pressure. As is to be anticipated, the formation and stability pressures of a series of complexes is dependent not only on the surface pressure, but also on the bulk concentration of the penetrating agent. Again, the formation of complexes is in many cases extremely sensitive to quite minor changes in the *p*H of the underlying solution; thus bilirubin penetrates cholesterol with ease at *p*H 7·2 but has a negligible effect at *p*H 8·2. Biliverdin does not penetrate cholesterol at all. On the other hand, taurocholic acid forms no complexes with bilirubin as measured by these methods.

It is hoped shortly to give an account of the systems investigated, together with the data on the stability of complexes of cholesterol with various substances in respect to their hæmolytic activity and with natural pigments and bile salts as a possible factor in the formation of gall stones.

J. H. SCHULMAN.
E. STENHAGEN.
E. K. RIDEAL.

Laboratory of Colloid Science,
Cambridge.
April 2.

[1] *Proc. Roy. Soc.*, B., **122**, 29 (1937).

Isomeric Forms of Radio Rhodium

WHEN bombarded by neutrons, rhodium gives two radioactive periods, 44 sec. (Rh_1) and 4·2 min. (Rh_2), both being associated with the emission of negative electrons.

Amaldi, Fermi[1], and Segrè[2] have shown that the ratio of the two activities produced in rhodium by *slow* neutrons does not change if the neutrons are filtered with cadmium or rhodium. This indicates that the resonance levels for the capture of slow neutrons which lead to the formation of Rh_1 and Rh_2 have about the same energy and breadth. This supports the hypothesis that the formation of Rh_1 and Rh_2 corresponds with the capture of neutrons in a single level of a definite isotope, that is, that Rh_1 and Rh_2 are two isomeric forms of the same isotope. The experiments of Frisch, von Halban and Koch[3]