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Existence of Micellae in Aqueous Solutions of Saponin.

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It is well known that if certain surface active substances are adsorbed into a surface to form a monolayer, there are certain critical concentrations in which the static surface tension is at a minimum, these corresponding to the concentrations in which the molecules at the surface form regular patterns. Granted certain assumptions, it is possible to determine from the values for these critical concentrations the dimensions of the molecule of the surface active substance, and in this way du Nouy[1] has determined the mean length, breadth, and thickness of such molecules as that of sodium oleate and serum albumin.

This note concerns the result obtained when similar experiments are carried out with saponin in aqueous solution. The technique of du Nouy was followed in detail, dynamic and static surface tension measurements being made on solutions of quillia saponin contained in Petrie dishes with a surface area of 63.6 cm.^{2} Each dynamic surface tension measurement is the average of 15 separate determinations, and each static measurement the average of 10 determinations made after the solution has remained undisturbed for 2 hours. In the calculation, the density of saponin was taken as unity.

The graph shows that well marked minima occur in the static tension at concentrations of 1 in 12,500, 1 in 24,500, and 1 in 37,500, and the question arises as to what the appearance of these minima means. If we suppose that they are the result of an orderly arrangement of molecules in a monolayer, we get for the dimensions of the saponin molecule 6.3×10^{-6}, 3.2×10^{-6}, and 2.1×10^{-6} cm., which, considering the molecular weight of saponin (in the neighborhood of 1000) are absurdly large. The presence of the minima is nevertheless unmistakable, (the minima being just as definite as those obtained by du Nouy for sodium oleate) and if the method is to be trusted at all, the dimensions which are calculated from the values for the critical concentrations must therefore represent the dimensions of orderly arranged agglomerates: not molecules, but micellae together, perhaps, with imbibed water, which are capable

[1] P. Lecomte du Nouy, A. C. S. Monograph Series No. 27, 1921.

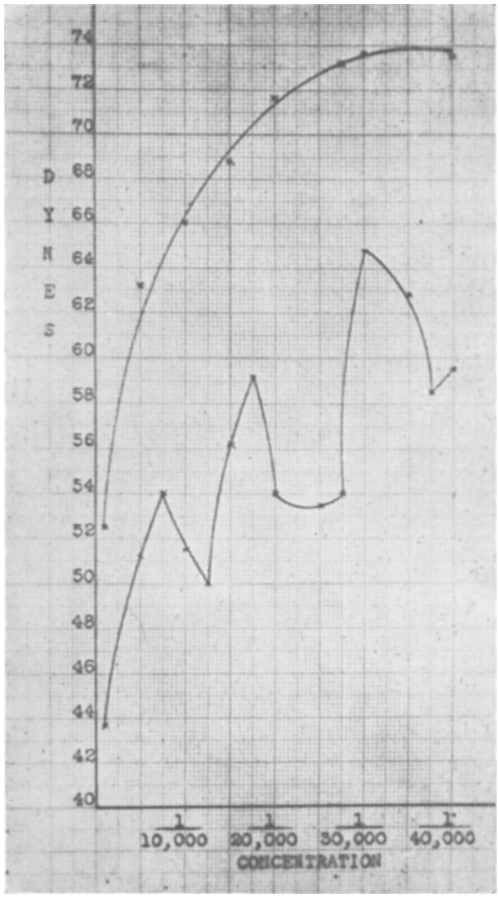

FIG. 1.

of orienting themselves in 3 different ways corresponding to their mean length, breadth, and thickness. The sharpness of the minima, moreover, suggests that the scatter about these mean values is not very great. As the dimensions of these micellae are about 10 times what one would expect for the saponin molecule itself, each agglomerate must contain about 10 molecules.

The concept of regular micellae, though seemingly novel, is in reality that of a liquid crystal formation.