undergoes no greater change of color than would be expected from the hydrocarbon that enters the two upper layers R_2. Without the A the color returns to that of the unskeletonized film.

Several observations on the rate of removal of stearic acid by benzene have given indications that an A film is somewhat more impermeable than a B film.

Effect of Surface Pressure on the Thickness of Protein Films

The area covered by a film of egg albumin on water decreases to one half when the surface pressure is raised from 15 to 30 dynes/cm. The thickness observed with $PR_{41}B_5$ applied under 15 dynes pressure agrees well with the color of $PR_{41}B_4$ applied under 30 dynes/cm pressure. Thus the thickness of the two kinds of films transferred to the solid differs in the ratio 1.0 to 1.25, while on the water surface the ratio is 1 to 2.

This difference suggests that strong forces of adhesion act upon the protein film on the solid to hold it flat so that the spacing is determined by the C-C and C-N linkages. On the other hand, the presence of the many hydrophilic groups in the protein molecules enables the lower surface of the protein monofilm on water to become wavy and so get into better contact with water. This waviness would account for the marked compressibility on water and the relatively smaller compressibility when forced to lie flat on a solid surface.

We have made some preliminary experiments to devise methods for studying protein films at the interface between water and hydrocarbon. A piece of egg albumin attached to a platinum wire was brought into contact with the interface between a lens of petrolatum and the underlying water. The lens was rapidly deformed in shape and in places made so thin that interference colors were obtained. The duplex films[2,4] thus produced are remarkably stable, as there is no tendency for the petrolatum to peel back, leaving a monolayer of protein on the water. The method just described is apparently not suitable for the formation of a uniform duplex film. A substance such as egg albumin, however, can be introduced as a water solution under the petrolatum. As the spherical molecules come into contact with the film, they appear to unfold into monolayers at the interface. Duplex films produced in this or other ways should afford a useful way of studying interfacial protein films. The preliminary observations show that such films are elastic solids of high compressibility, very much like protein films on water. With stearic acid, films at a water-air and an oil-water interface are very different, usually being condensed in the first case and gaseous in the second.

[4] I. Langmuir, *Jour. Chem. Phys.*, 1: 756, 1933.

Most of the experiments described in this paper have been carried out with egg-albumin on distilled water brought to about pH 7 by the addition of a trace of ammonia. In some cases we have changed the pH to 3 and to 10 but have not observed any marked differences in behavior. A few experiments with pepsin and insulin have shown similar behavior. Undoubtedly by the application of these methods, quantitative differences will be found between the proteins which form monolayers on water.

The addition of formaldehyde to the water under a protein film has been found to decrease greatly the compressibility of these films, presumably by forming new cross-linkages which prevent the waviness of the lower surface or hold the waves more nearly rigid.

The properties of proteins shown by our experiments seem to be in accord with the view that the protein monolayer is a two-dimensional network held together by strong elastic springs and are not in accord with a structure consisting of polypeptide chains.

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