LETTERS TO THE EDITORS

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Electron Micrographs of Cross-Sections of Protein Monolayers

ELECTRON micrographs of cross-sections of protein monolayers have been obtained in the following way. A monolayer of protein, a commercial sample of egg albumen, was spread at the surface of water contained in a small Langmuir type trough. This layer was then compressed and crumpled by advancing a barrier coated with paraffin wax towards a second retaining barrier. When the two barriers were about a centimetre apart, the crumpled film became visible at the interface and was lifted from the water as a frail thread by means of a wire yoke. Portions of this thread were prepared for cross-sectioning by dehydrating in an alcohol series and embedding in an epoxide resin[1]. It was found advantageous to 'stain' the specimen first by treating it for a short time in a buffered osmium tetroxide solution. The thread, darkened and hardened by this treatment, was easier to handle and to see by eye in the block and also in the electron microscope. Very thin sections were cut from the block at right angles to the length of the thread by the standard procedure for electron microscopy[2] and examined in a Siemens 'Elmiskop I microscope.

The cross-section of the crumpled sheet of protein appeared as a thin, dense, highly convoluted line (Fig. 1). Since the thickness of the best sections (about 200 A.) was still some ten times that of the monolayers (10–20 A.), it was not expected that the films viewed end on would everywhere reveal their true thickness. The thinnest portions observed in osmium-fixed material were in fact about 50 A. thick, and some of these appeared double, suggesting either that the osmium was deposited on each side of the protein film or that more than a simple monolayer was present. Occasionally a contaminating layer was seen adsorbed on one side of the film and pinched-off tubules usually enclosed amorphous material which may have been excess protein.

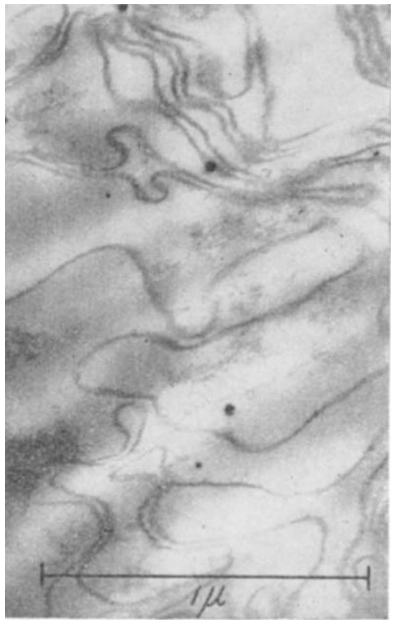

Fig. 1. Electron micrograph of a cross-section of a crumpled monolayer of egg albumen stained with osmium tetroxide

This work is part of an attempt to prepare artificial models of cell membranes. Multiple layers and tanned layers are also being examined. It is remarkable how closely some of the chance structures in these crumpled films resemble sections seen in electron micrographs of such organelles as the mitochondrion and the Golgi complex.

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[1] Glauert, A. M., Rogers, G. E., and Glauert, R. H., *Nature*, **178**, 803 (1956).

[2] See accounts given in Proceedings of the International Conference on Electron Microscopy, London 1954 (1956).

Ion Cyclotron Resonance

A CHARGED particle of mass m and charge e crossing a uniform magnetic field of strength H will describe a circular path with angular frequency $\omega = eH/mc$, independently of the particle's energy (c is the velocity of light). If such a particle is subjected to an alternating electric field, at the cyclotron frequency, perpendicular to the magnetic field, then absorption of energy from the electric field may be expected. A measurement of the frequency at which absorption takes place should therefore enable the mass of the resonating particle to be determined, given e, H and c, while the amount of absorption should provide information on the number of resonating particles present.

This technique has previously been successfully applied at frequencies corresponding to the electron cyclotron resonance, but so far has not been reported at frequencies corresponding to positive-ion cyclotron resonances in an ionized gas or plasma.

Recently, in this Laboratory, an experiment was performed with the object of detecting the cyclotron resonance for the positive ions in a discharge in hydrogen. A discharge was established in a tube containing hydrogen at low pressure, and a radial electric field at a frequency of about 750 kc./sec. was applied to the plasma. The tube was immersed in a longitudinal uniform magnetic field of approximately 500 gauss, superimposed on which was a sinusoidal magnetic field of amplitude of the order of 10 gauss at a frequency of 50 cycles/sec.

The resonance was detected by displaying the rectified signal, obtained from electrodes external to the tube, on a cathode-ray tube which was scanned at a frequency of 50 cycles/sec. On this cathode-ray tube a 'pip' was observed which behaved, with