LETTERS TO THE EDITORS

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An Electron Microscope Study of the Nuclear Membrane

THE giant nuclei of full-grown oocytes of Amphibia offer unique opportunities for anatomical and physiological study, on account of the relative ease with which they may be isolated and handled. The material for the present study was obtained from *Triturus cristatus* and *Xenopus lævis*.

Under a low-power binocular, the nuclei are isolated into distilled water with the aid of needle and forceps. In this medium the nucleus rapidly swells, and meanwhile adhering cytoplasmic materials may be pumped away by means of a pipette. The entire nucleus, freed from cytoplasm, is then transferred to fresh distilled water: a copper specimen grid is now placed in the same container, and the nuclear membrane ruptured and stretched out over the grid by means of a pair of fine-pointed tungsten needles. After the stretched membranes have been pumped free from nuclear sap, they may be dried directly or after prior fixation. For the preservation of fine structure, fixation appears to be necessary.

Grids carrying nuclear membranes were examined in a Siemen's electron microscope operating at 52 kV., the magnification of the photographic negative being 12,000–15,000 diameters. The photographs, three of which accompany the present letter, indicate that the nuclear membrane is a compound structure. One component is a porous sheet, the pores being approximately 300 A. in diameter in hexagonal array, with a repetition distance of about 800 A. It must be borne in mind, however, that the membranes are readily distorted during preparation, the hexagonal arrangements being frequently disturbed. The other component is a membrane with no evident fine structure. This closely over- or underlies the porous membrane; but the relative positions of the two are not yet known. Under certain as yet ill-defined conditions, the porous membrane disintegrates in the process of specimen preparation, leaving the structureless membrane only.

It may be presumed that the structureless component determines the permeability properties of the nuclear membrane. Other investigations have shown that egg albumen cannot penetrate this membrane, and hence even if a porous structure is present it would be beyond the limits of resolution of the existing microscope. The visibly porous membrane, on the other hand, probably acts merely as a mechanical support for the structureless membrane.

This work is being continued, and a detailed account will be published elsewhere.

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X-Ray Diffraction Study of the Structure of Bacterial Flagella

FOLLOWING on the demonstration by Gard[1] of the practicability of obtaining the flagella from bacterial cultures in fair yields and in a highly purified state more detailed chemical and physicochemical investigations are now being undertaken under a scheme supported by the Swedish Natural Science Research Council. Data have already been published by Weibull and Tiselius[2] on the flagellar material prepared by Gard from *Salmonella paratyphi* B., and by Weibull[3] on the flagella of the harmless and easily cultivated *Proteus vulgaris*. The present communication is a preliminary account of an X-ray diffraction study of flagellar material prepared at Uppsala and brought to Leeds.

We have so far examined the flagella of *Proteus vulgaris* and *B. subtilis*. The method of preparation was as already described[3]; here we need only say that the final product from *Proteus*, for example, forms a colourless stable viscous solution with strong flow birefringence. It gives a precipitation reaction with a *Proteus* × 19 *H* rabbit antiserum, has a nitrogen content of 15·7–16·1 per cent, shows only traces of phosphorus and 1 per cent carbohydrate at the most, and contains no tryptophane and no purine or pyrimidine bases: it has the characteristics of a protein but not of a nucleoprotein. When examined in the electron microscope, essentially only one structural element is seen—long flexible threads of the same thickness as the flagella on the bacterium, but shorter, presumably owing to breakage during the purification process.

The flagella are also reversibly precipitable with ammonium sulphate and show electrophoretic mobility; in brief, they behave like long macromolecules and therefore invite X-ray study by just those tech-

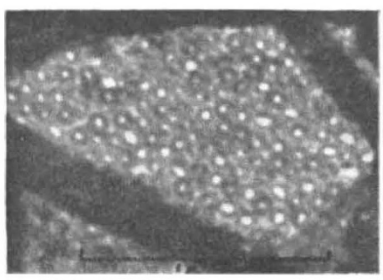

Fig. 1

Fig. 1. *Triturus cristatus*. The porous sheet component of the nuclear membrane after fixation with osmium tetroxide. Magnification 34,000 diameters

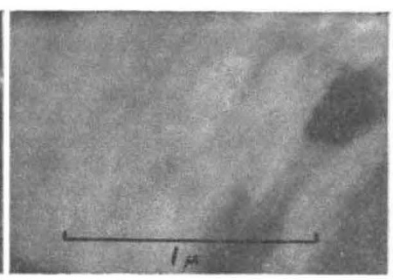

Fig. 2

Fig. 2. *Triturus cristatus*. The structureless sheet component of the nuclear membrane after fixation with osmium tetroxide. Magnification 34,000 diameters

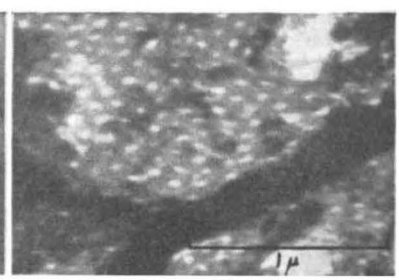

Fig. 3

Fig. 3. *Xenopus lævis*. Portion of nuclear membrane fixed with phosphotungstic acid. Magnification 27,000 diameters