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Fluid crystals and meristematic growth.

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(Introduced by M. T. Burrows).

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In an attack upon certain phases of the problem of meristematic growth, a cytological investigation of the cells of the squash root tip was made. Tissues fixed in fluids which preserve lipoidal structures, such as formalin-bichromate mixture, and osmic acid revealed structures which warrant description.

The growing tips were fixed by two to three weeks impregnation in 2 per cent osmic acid, after the Kopsch-Mann technique. The sections were mounted in balsam unstained. In such preparations there appeared granules of varying sizes but of uniformly high refringency. These granules were practically round, and in ordinary light the centers appear lighter than the periphery. They are present in all parts of the tip. In the growing point they are small and occur from three to six to the cell and are usually clumped in one corner or are arranged along the cell wall. Some cells, however, appear to be devoid of these characteristic granules. In the highly vacuolated cells they are much larger and fewer to the cell than in the tip. In such cases they are almost invariably found to lie at the periphery of the vacuole, close to the cell wall. The object in making these osmic acid preparations was to determine whether any structures are present which might correspond to the Golgi bodies of animal cells. It is not certain whether these granules are actually Golgi bodies. Other granules which are not birefringent are also present and the probability is that they represent different stages in the metabolic activity of

the cell. There is no evidence of a canalicular apparatus such as Bensley[1] found in the cells of the onion root tip.

When these granules were studied with the polarizing microscope they were found to be uniaxial sphaero-crystals. A very good imitation of these crystals may be obtained by making a thin smear of lecithin on a slide and treating the smear with 2 per cent osmic acid for a short time. Upon examination of such a preparation in polarized light, each of the many highly refringent droplets displays a black cross in the center, if the axis of the crystal is parallel to the optical axis of the microscope.

These birefringent droplets belong to the class of substances first termed by Lehmann, fluid crystals. Since then, Friedel[2] has suggested that this state of matter be called the mesomorphic state, being neither fluid nor crystalline, but possessing many of the properties of both states. The birefringent structures found in these cells seem furthermore to be in the state corresponding most closely to the subdivision called by him the nematic state.

The significance of the fact that many cell structures such as lipoidal granules, mitochondria, and perhaps the Golgi bodies are in the mesomorphic state in normal cell function is just beginning to be appreciated by cytologists and cell physiologists. In a valuable review of the subject, Giroud[3] has very recently called attention to the formative and proliferative power of substances in this state, with especial emphasis on mitochondria. In view of the rapid rate of division and growth of the meristematic cells, the suggestion is offered that the fluid crystalline bodies found in these cells may be important factors in this high rate of activity.

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[1] Bensley, R. R., *Trans. Chicago Path. Soc.*, 1910, viii, 78.

[2] Friedel, G., *Annales de Physik*, 1922, xviii, 273.

[3] Giroud, A., *Archiv. d'Anat. Mic.*, 1925, xxi, 145.