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Acid Fuchsin for Demonstration of Ingestion in *Paramecium caudatum*.

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The study of ingestion in *Paramecium* is ordinarily accompanied by considerable difficulty due to the fact that there is little difference in color between the animal, the surrounding medium, and the bacteria which serve as food. The following method differentiates these elements by means of contrasting colors.

The dye used in this investigation was acid fuchsin, certification number NR-2, having a dye content of 62%. Solutions were prepared with distilled water so that their described percentages represented the actual dye strength.

Two drops of culture fluid containing large numbers of paramecia were placed on a clean slide, a drop of 1% solution of acid fuchsin added, and a cover glass applied. The fluid formed a thick layer under the cover glass, but the dye solution was unequally distributed. The preparation was allowed to stand undisturbed for one or 2 minutes, then examined under low magnification with reduced light. The paramecia, under these conditions, appeared to be outlined sharply in black. A portion of the fluid was then drawn off by the application of a strip of filter paper, thus reducing the thickness of the film of solution under the cover glass. In this thinner layer paramecia appeared to be colored a pale, luminous green, the color being deeper in those animals which had spent some time in the more deeply colored portions of the preparation before swimming out into the lighter areas. It must be emphasized here that this color phenomenon appears only when the amount of liquid under the cover glass is small; it will not appear if the cover glass "floats high."

If a quiet *Paramecium* is studied under high magnification, the process of ingestion and the formation of food vacuoles may be seen with a diagrammatic clearness. The green animal lies in a red or pink environment. Bacteria, stained pink or red, are swept into the cytopharynx which, due to the color of its fluid contents, appears a delicate pink. The undulating membrane can be clearly seen in action. At the tip of the cytopharynx the forming food vacuole may be observed, its contents in rapid motion due to the continuous entry of additional water and food. The pink vacuole is sharply set

off from the surrounding green protoplasm. Finally the sharp contraction of the protoplasm at the tip of the cytopharynx may be observed, and the course of the newly formed food vacuole, with its pink and red contents, followed in its passage through the cytoplasm.

It should be pointed out that this color phenomenon is in no way due to changes in pH. It is not, therefore, an indicator effect such as was described by Nirenstein,¹ The effect has been demonstrated in several microscopic organisms by the use of acid fuchsin, phenosafranin or erythrosin. It appears to be a physical phenomenon, closely related to the existence of extremely thin films of dye solution. Further study of this effect is under way.

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Polarization Studies in Tissue Models.*

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It is known that the electric resistance of animal tissues, contrary to that of solutions, is not determined by the law of Ohm alone.¹ This has been explained as consequence of polarization caused by semipermeable cell membranes at cell interfaces. The degree of polarization and, therefore, of the permeability can be measured by the capacitance or inductance needed to obtain a sharp minimum on the Wheatstone bridge. As further manifestation of polarization, the resistance of tissues decreases with the increasing frequency of the alternating current. While other authors worked mostly with methods based on the first phenomena, we used the difference in conductivity at high and low frequencies as measure of membrane polarization and permeability. In order to elucidate to some degree the chemical and colloid-chemical conditions underlying the polarization and permeability phenomena, different artificial membranes with various constituents were used.

A Wheatstone bridge was employed. Alternating currents of

¹ Nirenstein, Edmund, *Z. f. wiss. Zool.*, 1925, **125**, 513.

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¹ Gildemeister, M., *Handb. d. norm. und pathol. Physiol.*, 1928, **8**, 657.