tury ago that the essential living parts of the cell preserve their fundamental structure so long as the cell survives. The character which does change readily, either due to chromosomic constitution or to the agency of external factors, is the way the cell synthesizes or accumulates non-living constituents. Under favorable conditions a cell provided with the proper genes actively uses up the heterogeneous materials absorbed from the environment to build up homogeneous materials, which appear under the microscope as "optically empty" cytoplasm, mitochondria and "vacuolar sap." Under unfavorable conditions the homogenizing process is inhibited, resulting in the accumulation of unmetabolized products in the form of amino-acids, glucids or phenolic compounds in solution in the vacuolar sap, or as inclusions such as protids or lipids. In other cases, unused glucids accumulate as starch within the plastids.

Starch storage (which is concomitant with the differentiation of more mitochondria into amyloplasts) is correlated with inhibition of respiratory activity and a retarded rate of growth.

The results of modern cytological studies have shown that a living cell is not necessarily a physiological unit. On the contrary, metabolic processes utilizing the energy afforded by respiration probably take place mainly along the interphase between cytoplasm and vacuolar solution, and each of the "respiratory surfaces" within the cell may be differently affected by external stimuli, thereby producing a definite polarization within the living cell.

The total respiratory activity on an organism is the sum of the respiration on which depends the upkeep of the cell activity—maintenance—and of the respiration which provides energy for the syntheses within the growing cell. The former—the maintenance respiration—may proceed, although the latter—the growth-providing respiration—is inhibited by various agencies.

It is almost axiomatic that one who studies cytology should attempt to preserve the actual cell structure as well as possible. When studying cell morphology one should rely on the results of killing and staining methods only when he can check them through the observation of the living cell.

The killing fluid employed should, therefore, preserve as well as possible all constituents that can be seen in the living cell. It is especially important to preserve as much as possible of the apparent homogeneity of the cytoplasm, the clear-cut appearance of mitochondria and plastids, the outlines of the vacuoles and, above all, the products of cell metabolism. These results can be obtained only when the killing fluid penetrates the living tissues rapidly. Meves' fluid, which is admirable for some purposes, penetrates slowly. Tissues should be kept in Meves' for a week. It stains lipid inclusions dark brown and precipitates phenolic compounds as black bodies in the vacuoles, but may produce artifacts of a deceptive nature.

Nemec's killing fluid penetrates quickly, due to its formaldehyde content, and preserves the morphological integrity of the cell.[1] For the best results it requires a subsequent treatment in 3 per cent. potassium bichromate of at least 8 days to mordant the mitochondria and other constituents. Nemec's fluid precipitates phenolic materials as yellow flocculi, the consistency of which depends somewhat upon the concentration of potassium bichromate employed.

If principles like these were followed, investigators would soon cease to discuss the "good" or "poor" killing obtained through the use of mixtures containing acetic acid or alcohol, since they would realize that such mixtures so wreck the cell structure as to make any inferences drawn from the subsequent staining reactions void of significance.

J. DUFRENOY
H. S. REED

CITRUS EXPERIMENT STATION
RIVERSIDE, CALIF.

ON THE MAPPING OF THE VELOCITY-POTENTIAL AND STREAM FUNCTIONS OF AN IDEAL FLUID

THE methods of Hele Shaw[1] and of Osborne Reynolds[2] in showing the form of the stream-lines about an obstacle are well known. Other methods have been developed by Relf[3] for ideal fluids and by Taylor and Sharman[4] for compressible fluids. Both of the two latter methods require rather elaborate set-ups of a more or less permanent nature, involving considerable apparatus. A modification of these methods, used by the writer in 1932–1933 in connection with some aerodynamic testing, proved quite helpful.

Acting upon the suggestion by Grillet[5] that sheets of conducting paper might be used to plot mathematically orthogonal functions, the writer has obtained satisfactory results, using in place of the usual liquid electrolyte an inexpensive black silhouette paper. The experimental procedure was, of course, identically the same as in the laboratory experiment showing equi-

[1] H. S. Reed and J. Dufrenoy, *Amer. Jour. Bot.* In press.

[1] Trans. Inst. Naval Architects, p. 27, 1898; *Comptes Rendus*, 132: 1306–1312, 1901.

[2] *Phil. Trans. Roy. Soc.*, 1883.

[3] *Phil. Mag.*, 48: 535, 1924.

[4] *Proc. Roy. Soc.*, London, A 121: 194–217, 1928.

[5] *Comptes Rendus*, 194: 1464–1465, 1932.

potential lines and lines of flow of current; the earphones and the alternating electric current being, however, replaced by a galvanometer and by direct electric current.

The velocity-potential lines about the aerodynamic form were obtained by cutting out from the center of the conducting sheet the exact shape of the form the flow around which was to be studied and then mapping the electric equi-potential lines; the latter corresponding to the velocity-potential lines of a perfect fluid. Lines drawn perpendicularly to these velocity-potential lines gave the stream-line flow about the obstacle. Hence, a complete stream-line pattern about an obstacle was obtained without even making a model of the obstacle.

In mapping the stream-line flow about a form directly, an accurate model of the obstacle, cut from a sheet of highly conducting material, was placed at the center of the conducting paper. To insure that this model of the obstacle made good contact with the paper, small holes were drilled in the model whereby it was tacked to the table top.

Quantitative results were obtained from the patterns by securing an equal drop in electric potential between all lines; this corresponding to an equal drop in the value of the velocity-potential function or in the value of the stream function from line to line. By means of the well-known properties of these functions, the velocity at any point in the vicinity of the obstacle can be obtained in terms of the velocity at some point far removed from the obstacle. This equal drop in the value of the functions between the lines was secured by keeping the fixed electrode in its original position on the first line and displacing the exploring electrode any arbitrary distance toward the obstacle, noting the galvanometer deflection. The fixed electrode was then placed at the new position and the second line was plotted; the location of the fixed electrode for the plotting of the third line being obtained in the same manner as the corresponding point for the second line. The potential difference between the terminals was kept constant, so that the deflection of the galvanometer had the same significance throughout the entire mapping operation.

This method has the advantage that the pattern is obtained directly on the paper which serves as a record of the experiment. This is made possible by using as electrodes two lead pencils, sharpened at both ends, one end being inserted into a short glass tube, and sealed therein with Kotinsky cement. Mercury is poured into this glass tube and a wire is inserted from the top of the tube which is closed with a cork stopper, thus keeping the mercury from spilling and at the same time securely holding the wire in the mercury.

The writer has made numerous patterns on paper about various forms. Those forms for which the flow patterns are furnished by hydrodynamic theory yielded results in satisfactory agreement with the theoretical patterns and irregular forms yielded results which indicated the type of flow patterns which were later obtained in actual wind-tunnel experiments. The ground effect[6] has been obtained both by the reflection method and by the wind-tunnel method of securing the effect by the introduction of a flat plate of large extent beneath the airfoil section, the flat plate being in this case simply one of the straight copper terminals. Circulation effects can be obtained, as in Relf's method, by the application of an electric potential to the model of the obstacle.

Although the paper gives sufficiently accurate results for laboratory instruction purposes, its irregularity reduces the accuracy of any quantitative determinations quite considerably. If, instead of the paper, some thin, very homogeneous substance, such as stainless steel, is used, greater accuracy is possible.

The writer has used a 1/32 inch thick sheet of stainless steel and has secured very accurate results. With thinner sheets and a very sensitive galvanometer, exceedingly accurate mapping is possible.

ALBERT C. ERICKSON

CLARK UNIVERSITY

[6] E. P. Warner, "Aerodynamics," McGraw-Hill, 1927.

SPECIAL ARTICLES

DOES DILUTE HEAVY WATER INFLUENCE BIOLOGICAL PROCESSES?

IN view of the appearance of a number of articles which describe stimulating action of dilute "heavy" water on biological processes, we think that some results which we have obtained in this field may be of interest. A summary of the published work has been presented by Barnes and Jahn.[1]

The "heavy" water used in our experiments was obtained from the Ohio Chemical Company. The original water was slightly cloudy, but was clear after an ordinary filtration. The water was then distilled through two Pyrex glass systems fitted with efficient spray traps. In each distillation the middle three fifths of the distillate was collected. The second distillate, which was used for the experiments, was analyzed by means of an interferometer and was found to contain 0.46 per cent. D_2O. For the controls

[1] T. C. Barnes and T. L. Jahn, *Quart. Rev. Biol.*, 9: 292–341, 1934.