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I. S. SOKOLNIKOFF

Mathematical biophysics. By Nicolas Rashevsky. Rev. ed. University of Chicago Press, 1948. 23+669 pp. $7.50.

The wide attention and considerable acclaim given to the first publication of Rashevsky's *Mathematical biophysics* in 1938 was due in large part to the rich promise contained in that book. Those mathematicians who loved to see mathematics in the role of fathoming nature's secrets viewed mathematical biophysics as a new area of conquest. Those biologists who were "monists" or "reductionists" at heart hailed it as the much needed link between their own methods and those of mathematical physics.

The revised edition gives ample evidence that the promise is being fulfilled. Almost twice as large as the original publication, the revised edition includes in its pages ten years' progress in mathematical biology.

The progress is largely due to the work of Rashevsky himself and that of his principal collaborators, who are or have been members of the Committee on Mathematical Biology at The University of Chicago. The work covers a wide range of topics, but essentially it can be viewed as pursuing two main directions: (1) The extension of the theory and methodology; (2) The applications of the theory.

With regard to the first direction, an important extension of the previous approach is the approximation method used in computing the forces of metabolic origin acting on a cell of "arbitrary" shape. The method was sketched in the appendix to the first edition and is more fully developed in the new book. The previous line of attack was through the diffusion equation, a partial differential equation which could be solved explicitly only in very special cases involving highly symmetrical boundary conditions. By means of a bold approximation method, Rashevsky was able to reduce the partial differential equations to ordinary ones and to express the forces in terms of parameters amenable to "rough and ready" measurement: the "long" diameter and the "short" diameter of an "oblong" cell.

The inclusion of a kinetic theory of diffusion also appears as a worthwhile extension of the old avenues of attack. One would guess that the "true" picture of the diffusion processes of a metabolizing cell lies somewhere between the two extremes—the hydrodynamic, continuous model and the kinetic, discontinuous one. A two-sided attack on the problem seems the logical way to proceed.

A third, extremely promising, methodological innovation is the introduction of Boolean algebra (or logical calculus, or symbolic logic) methods in the construction of models for neural nets with specified properties. The method was initiated in a paper by McCulloch and Pitts published in The Bulletin of Mathematical Biophysics in 1943. In the hands of Rashevsky and his collaborators, notably Householder and Landahl, the method was greatly extended and enriched. In particular the previous "continuous" theory of neural nets was reinterpreted as a limiting case of the "discontinuous" theory involving a large number of neural elements. One is inclined to regret that a more extended development of the method was not included in the revised edition.

The new applications of mathematical biology form the other direction in the extended work of Rashevsky. It is particularly gratifying to see the inclusion of a considerable amount of experimental data, which were only scantily represented in the first edition. Significantly, the reason for the paucity of experimental evidence in the first edition is that a great deal of it was obtained *since* 1938. It thus forms to some degree a corroboration of the *predictions* of the theory.

In part I, the most interesting data are those dealing with the rates of cell division, exhibiting an interesting relation between the rate of elongation and the rate of constriction, predicted by Rashevsky's theory of cell division based on the approximation method.

The most abundant extensions of applied mathematical biophysics are found in Part III, which deals with the central nervous system, especially in the chapters on discrimination, delayed reflexes, error elimination and learning, and visual perception. These chapters now include an impressive amount of experimental evidence in sufficient agreement with the Rashevsky two-factor theory of nervous excitation to put beyond doubt the usefulness of the theory.

A. RAPOPORT

Equazione differenziali. By Francesco Tricomi. Turin, Einaudi, 1948. 312 pp.

This text contains a somewhat unusual but interesting and well integrated sequence of topics. A Picard type existence theorem is