Book Reviews

Mathematical Biophysics. Revised edition. N. Rashevsky. Chicago: Univ. Chicago Press, 1948. Pp. 669. $7.50.

The rarity of investigations and books (rarity in English, and indeed, comparative rarity in other languages) devoted to theoretical aspects of biology is one of the primary factors that make this volume a most valuable contribution in its field, as well as one of interest to students and investigators in many other fields of science. As an attempt to formulate a theoretical biology which can accomplish in this field what theoretical physics and chemistry have in theirs, this work is indeed most welcome. Since, however, the mass of available quantitative biological data is so pitifully small, the author and his colleagues have in many cases been compelled to use more or less crude formulations. In spite of that fact, however, they have been able to complete a surprising number of descriptive studies, as well as many estimates of biological quantities.

Since this is a revision of a former edition, a minutely detailed tabulation of the contents is scarcely necessary. The book is divided into four sections: I. Mathematical biophysics of vegetative cells, II. Mathematical biophysics of excitation and conduction in peripheral nerve, III. Mathematical biophysics of the central nervous system, and IV. The organism as a whole and the organic world as a whole. Twenty-nine of the original 30 chapters of the first edition have been retained, and 24 new chapters added, taken primarily from the author's *Advances and Applications of Mathematical Biology* and other publications by his colleagues and associates. It is of interest that (as can be seen from the sections titles) the work concerns itself in large measure with considerations relative to the nervous system, although certain specific cell problems are discussed as well—for example, diffusion, respiration, and growth. The author, in the prefaces and explanatory remarks, has carefully pointed out the more obvious shortcomings of the volume, so that this reviewer feels that it will be of greater value to discuss the work from a more general point of view.

In considering the book, and the "young and new field" it attempts to present, one wonders immediately what they hope to accomplish. The author states that

> . . . it is very important to emphasize that we do not claim to "explain" away all phenomena of life in terms of physics. Whether such a thing is possible or not is for the future to decide. Perhaps biology will eventually have to develop on the basis of some postulates which are not necessarily reducible to present-day physics. This will still not preclude a "mathematical" biology. Inasmuch, however, as biological phenomena are very closely related to physical phenomena, we shall in this book, whenever possible, look for physical interpretations, in line with the desire to unify all natural sciences.

These statements leave one with feelings of dissatisfaction in several directions. A satisfactory mathematical biology, from the point of view of the biologist, would either help to fill the hole created by lack of quantification in this field, or would set itself the task of pointing out paths for the experimentalist to follow in an effort to increase the meager information now available to those who see the importance of being able to analyze biological events in ways similar to those of chemistry and physics. To be sure, to many investigators, and especially to mathematicians, there is great value as well as a certain elegance in the mathematical construction of a given problem. To biologists, however, many of whom are not customarily given to this type of thinking, the power of mathematical analysis lies in its ability to go beyond the experiment and available empirical data, to the formulation of a hypothetical principle, which may or may not then be validated in the laboratory.

It must be remembered, however, that life as a parameter of unknown nature plays a part and is one of the great difficulties in any mathematical treatment of biological problems which attempts to rise above the physical explanation of special detailed phenomena. Living matter is intricate and complex, and an analysis of what in many instances may be oversimplified models thus suffers from severe limitations. This does not mean that the discovery of statistical laws of biological nature and behavior expressible in mathematical terms is impossible, but it is very discouraging to be confronted with the possibility that the great weakness of biological studies over the centuries—namely, their almost purely descriptive nature—will infiltrate the mathematical analyses to the point where mathematics becomes only a technique employed for a new symbolic type of description. It would appear that the important contribution of a "mathematical" biophysics is not to "unify the natural sciences," but first to find or lead to the discovery of purely biological principles, and then to discuss them in a mathematical way in order to elucidate their nature and interpret their consequences. It is not enough to describe specific events, although a certain amount of important information can be, and already has been, gained in this way.

For example, it is of great value, as shown in one of the studies in the present volume, to give us indications as to the order of magnitude of such constants as the permeability of the cell membrane to oxygen, and the diffusion coefficient of oxygen in the protoplasm. It would be remarkably stimulating to the biologist, however, if in addition to such specific problems an attempt were made to consider metabolism as a whole, and to set up general metabolic equations which might be applied to the further analysis of any aspect of the dynamics of the organism.

The section of the book concerned with the nervous system demonstrates, among other things, the need for a further mathematical analysis which would indicate more as to the exact nature of this system, its units, and their role in the general behavior of the living organism. The analysis presented here does, however, point out

where some of the necessary information is lacking, and develops a physicomathematical approach to nervous activity which fits a certain amount of the experimental data and has been extended to include the recent work of McCulloch and Pitts, the implications of which are remarkably intriguing. The method they employ (in terms of Boolian algebra) and certain of Rashevsky's studies appear to go a long way toward providing not only description of neural events in quantitative terms, but also prediction of certain factors. How far these studies will lead toward the formulation of fundamental laws of behavior and activity is still uncertain. The excitation theory, perhaps of necessity, is partially based on certain assumptions which one may or may not accept, and is limited, as the author states, to "a purely phenomenological mathematical descriptive point of view."

The author has also included sections on learning, abstraction, logical thinking, visual perception and esthetics, and other mental phenomena. Any effort to clarify these complex and vague states and functions is to be applauded, and it is undeniably stimulating to see an attempt to put them into mathematical terms. One of the great values of this book is the kind of thinking it represents, and this makes it, despite all the shortcomings and limitations of its subject, a treatise of importance to both the mathematician and the experimental biologist.

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Human Helminthology: A Manual for Physicians, Sanitarians, and Medical Zoologists. Third edition. Ernest Carroll Faust. Philadelphia: Lea and Febiger, 1949. Pp. 744. Illustrated. $10.00.

The third edition of Dr. Faust's popular *Human Helminthology* includes much of the new information in parasitology accumulated during the war. This is reflected particularly in those sections dealing with Bancroft's filariasis and schistosomiasis japonica, two of the helminthic diseases which become important military health problems in the Pacific campaigns.

The basic pattern of presentation follows that used in the earlier editions. Following the first section, which deals with general aspects and modern-day concepts of helminthic infections, each important species is considered in detail as to taxonomy, historical background, geographical distribution, structure, life cycle, epidemiology, pathogenesis, symptomatology, diagnosis, treatment, prognosis, and control. A glossary of over 200 medical and zoological terms has been added. Two new sections deal with the pathogenesis and clinical aspects and with the control of helminthic infections. A chapter on leeches has been incorporated. Supplementary and detailed material has been printed in smaller type, making this edition more adaptable as a classroom text. This, combined with the use of a larger printed page size, has made it possible to include additional material without increasing the thickness of the book.

One of the most useful features of the book from the standpoint of the medical zoologist is the chapter on scientific nomenclature which includes the International Code of Zoological Nomenclature. Additional explanation of the code has been incorporated in this edition, along with opinions rendered by the International Commission on Zoological Nomenclature and the Committee on Terminology of the American Society of Parasitologists.

The section dealing with anthelmintics has been completely revised and brought up to date. New illustrations have been added and certain older ones improved. Some of the newer, more effective technical procedures have been included in the revised large section on diagnostic methods. The extensive classified bibliography affords an excellent source of references on all of the various aspects of medical helminthology.

Revised editions of accepted and well-known textbooks should offer more than a mere rearrangement or rewording of the subject matter. Dr. Faust has accomplished this to the extent of preparing an edition which will be useful to workers in the field who already own copies of the earlier editions.

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Scientific Book Register

This Is Race: An Anthology Selected from the International Literature on the Races of Man. Earl W. Count, Ed. New York 21: Henry Schuman, 1950. 747 pp. $7.50.

The Alkaloids: Chemistry and Physiology, Vol. 1. R. H. F. Manske and H. L. Holmes, Eds. New York: Academic Press, 1950. 525 pp.; illustrated. $10.00.

L'Organisation des Os. Pierre Lacroix. Paris VIe: Masson et Cie, 1949. 230 pp.; illustrated. 900 fr.

Brazilian Culture: An Introduction to the Study of Culture in Brazil. Fernando de Azevedo. Trans. by William Rex Crawford. New York: Macmillan, 1950. 562 pp.; illustrated. $12.50.

Thermodynamics: Principles and Applications to Engineering. Ernst Schmidt. Trans. from 3rd German ed. by J. Kestin. New York 11: Oxford Univ. Press, 1949. 532 pp.; illustrated. $7.00.

Metals Reference Book. Colin J. Smithells, Ed. London: Butterworths Scientific Publs.; New York: Interscience, 1949. 735 pp.; illustrated. $13.50.

Selenium: Its Geological Occurrence and Its Biological Effects in Relation to Botany, Chemistry, Agriculture, Nutrition, and Medicine. Sam F. Trelease and Orville A. Beath. New York: The authors, 1949. 292 pp., illustrated. Order from S. F. Trelease, Box 42, Schermerhorn Hall, Columbia University, New York 27, N. Y. $5.50.

Design This Day: The Technique of Order in the Machine Age. Rev. ed. Walter Dorwin Teague. New York: Harcourt, Brace, 1949. 285 pp.; illustrated. $6.00.

Archeology of the Florida Gulf Coast. Gordon R. Willey. Washington, D. C.: Smithsonian Institution, 1949. 599 pp., 60 plates; illustrated. $4.00.