Mathematical Biophysics. Physicomathematical Foundations of Biology. By Nicolas Rashevsky. University of Chicago Press, 1938. 18+340 pp.

It is likely that biology will eventually be as full-panoplied with mathematically expressed theory as physics now is. The process is already started, and the history of the older natural sciences like astronomy, physics, and chemistry admits of no doubt as to the final outcome. There is no substitute for mathematics to state in rational shorthand the relations between natural phenomena or generalizations about them. Progress towards a sound and useful mathematical biology will be slower, however, than has been the case with either physics or chemistry. The phenomena are inherently more complex. What happens when pure chemical substances react together can be completely described, and predicted, in terms of the stable constitution of the initial substances plus the environing circumstances within the frame of which the reaction takes place. What living organisms do involves a third and extremely troublesome element. An organism is not a stable thing of fixed and permanent intrinsic constitution, so long as it is alive. On the contrary it is constantly changing internally, and these internal changes play an important part in determining what it will do in a given set of circumstances. Too little is known in detail about the precise pattern of these changes to make it possible now to reduce them to simple and rigorous mathematical expression, save in a comparatively few and relatively simple cases.

So then the approach to the laying of physicomathematical foundations of biology, towards which Rashevsky is pioneering in this book, has to be at present by the postulational route. In essence the procedure is to take some biological phenomenon, such as cell division or the conduction of a nervous impulse, and lay down a set of initial postulates about it, which shall be at once both simple enough to be manageable mathematically and complicated enough hopefully to have at least some relation to biological actuality, and then work out mathematically the logical consequences that will flow from the postulates and their interplay. This is the plan followed in the present book relative to such biological matters as cell morphology, cell division, diffusion of substances in and through cells, and various phenomena involving the nervous system, central and peripheral. It would be too much to expect at this early stage of development of the subject that there should be any coherent or unified "red thread" of important theory running through the book. There is none. Rather Rashevsky's present objective appears to be exploratory—trying out the general postulational technique on a variety of biological problems with the hope of uncovering some promising leads that will repay further and more penetrating treatment.

Somewhat unfortunately the pioneers in this field of endeavor have a hard and discouraging row to hoe. The reaction of the biologists—including both those who are able to understand the mathematical procedures and the much larger number who are not—is apt to be that the initial postulates are always too much simplified to have any *significant* relation to biological reality as they know it (and the mathematicians do not). On the other hand the mathematicians find little nourishment in the comparatively simple and elementary (to them) mathematical procedures employed. In the present book there are few mathematical ideas beyond those comprised in the general frame of theoretical mechanics—statics and dynamics. To be sure a few of the developments and results do suggest purely mathematical problems worth following further from that viewpoint. But in the main the manipulations along well-worn paths of algebra, calculus, and differential equations will not greatly excite competent mathematicians.

But in spite of this more or less inevitable falling between two stools that is the pioneer's sad lot, the endeavor in itself is altogether worthy of encouragement. Mathematical biology will never develop unless somebody starts the process. Fortunately it is now well started with the work of Lotka, Volterra, and Rashevsky, not to mention various lesser but significant and useful workers. Mathematicians should read this book, if for no other reason than to get a first-hand acquaintance with the early steps of the Queen of the Sciences to bring under her dominion another great field of natural knowledge. Biologists should read it for the same reason, and also because a number of the theoretical developments suggest new lines of experimental approach to old and important unsolved problems.

RAYMOND PEARL

The General Field Theory of Schouten and Van Dantzig. By N. G. Shabde. (Lucknow University Studies, no. 10.) 1938. 4+58 pp.

During the 25 years that have elapsed since the appearance of the general relativity theory the subject has attracted the attention of many mathematicians and has been developed in several different directions. The pamphlet under review belongs to the series of rather formal developments which were prompted by the idea, as the author puts it, that "in Riemannian geometry of ordinary general relativity a unification of electromagnetic and gravitational phenomena is impossible"; whether the statement is true or not, this conviction has been the source of a series of brilliant and elegant generalizations connected among others with the names of Weyl, Cartan, Kaluza, Veblen. In particular, Shabde's contribution is more closely related to the work of Schouten and Van Dantzig. It consists of an exposition in somewhat generalized form of projective relativity of Veblen followed by reports on the author's two papers published in periodicals. The pamphlet hardly can be recommended for one who has not already acquired familiarity with the theories presented; for a specialist it may be convenient to have in this form the contents of the author's articles, one of which has appeared in a not easily accessible publication. Misprints are abundant and some may be disturbing for the uninitiated.

G. Y. RAINICH

Topologie der Polyeder und kombinatorische Topologie der Komplexe. By K. Reidemeister. (Mathematik und ihre Anwendungen, vol. 17.) Leipzig, Akademische Verlagsgesellschaft, 1938. 9+196 pp.

This book contains a rigorous and clear treatment of the combinatorial theory of polyhedra. The point of view is strictly combinatorial, there being no attempt to introduce notions involving continuity. A polyhedron is a subset of a linear n-space which is a sum of convex rectilinear pieces, the latter being intersections of a finite number of linear half-spaces and hyperplanes. By definition, two polyhedra are topologically equivalent if they have isomorphic subdivisions. A discussion of the simple transformations of Alexander (cf. Annals of Mathematics, (2), vol. 31 (1930), pp. 292–320) is given as is the theorem of Newman (cf. Proceedings of the Academy of Sciences, Amsterdam, vol. 29 (1926), pp. 611–641) that two polyhedra are equivalent if and only if any of their simplicial subdivisions are related by a sequence of simple transformations. Homology groups are introduced and their invariance under subdivision is proved. There is no discussion of the cohomology groups. The intersection is presented with application to duality on a manifold. The fundamental group is introduced and applied to the theory of covering complexes. The book concludes with an all too brief discussion of the author's own invention: homotopy chains.

The book is well illustrated but contains too few examples. It is clearly intended that the book is to supplement the author's earlier and more elementary book (*Einführung in die kombinatorische Topologie,* Vieweg, Braunschweig, 1932) which does contain many examples and provides the requisite knowledge of group theory. The notation is concise and well organized. This enforces slow reading.

N. E. STEENROD