An Introduction to the Mathematics of Medicine and Biology. J. G. Defares and I. N. Sneddon. Year Book Medical Publishers, Chicago, Ill., 1960. xii + 663 pp. Illus. $14.

Defares is a physiologist in Leyden where theoretical biology is actively pursued. Sneddon is a well-known Glasgow author of texts on classical mathematical analysis. Their 650-page book gives a polished account of calculus with some 200 pages of applications to physiology. The theory is presented on its own merits, for the most part without apology, and with considerable technical detail and skill. The examples are inclined to be repetitive in principle and are described with less clarity and force than the theory. The printing is excellent.

The book is designed for "the graduate well launched on his chosen career who has ceased to study mathematics many years previously." However, the authors hope "the book will be of use for work in courses on mathematics for biologists." It will compete with a growing number of books for these audiences. There are many indications from influential quarters that the role of mathematics in biological research and teaching is expected to, or "should," expand explosively. At least three conferences on this topic will be held in the United States during this spring and summer. But, curiously enough, the movement seems to come more from the mathematicians than the biologists. Practically no biology department in North America requires any mathematical prerequisites of its graduate students, and it appears that most students don't have much training in mathematics. The physical and social sciences have been much more demanding and articulate in stating their mathematical needs than the biological sciences. Thus, there is no generally agreed upon pattern for books of this kind, and so any opinion on whether such a book attains its aim is likely to depend on the personal experiences and interests of the reader. This, of course, is not to suggest that there should be a fixed mold for books in this or any other area. Furthermore, the range of disciplines encompassed by the biological sciences is so vast and diversified that many types of books are required. Perhaps they will come most naturally, as this one has, by the joint efforts of a biologist working in a specific field of research and a mathematician.

The first two chapters (109 pages), "Algebraic preliminaries" and "Functions of a single variable," review most of the precalculus mathematics covered at school with the exception of algebraic equations. Many examples of the relation of one variable to another are given. Several show how to rescale so that the plot is linear. From my experience, the appreciation of the idea of a function that students gain from this approach is not strong enough to support a discussion of, for example, differential equations. The next three chapters (106 pages), "Limits and derivatives," "The differential calculus," "Integration," cover, without scientific interruption, these topics excellently in the standard way for algebraic and trigonometric functions. Chapter 6 (46 pages) introduces the logarithm as an integral and the exponential as its inverse and gives a number of applications. One interesting example here, entitled "Optimal dosage of drugs," may serve to illustrate my feeling that the treatment of examples is too formal and verbose. The object is to study the build-up of the concentration of a drug in the body, on continued periodic administration, to a maximum level—or that was the object in the original paper abstracted. Here it is also to show students *how* to formulate and solve such a problem. The natural order would seem to be: a rough, intuitive, smooth graph; a saw-tooth graph showing intuitively the effect of elimination of the drug between administrations; a schematic flow diagram labeled with rates of administration and elimination; and then the mathematical formulation, the steady state solution, and then the build-up solution. Instead the differential equation for elimination is given immediately, and three pages of analysis precede the graph. The summing up is diffuse so that in the end very little pedagogic good comes from an excellent example. Chapter 7 (94 pages), "Techniques of integration," begins with 80 well-written pages of technique including a mathematical account of normal, gamma, and beta density functions and a short section on Laplace transforms. The last 20 pages are examples that use only the logarithms and exponentials of the previous chapter. Chapter 8 (73 pages), "Functions of more than one variable," covers briefly partial differentiation, line integrals, a summary of thermodynamic relations, maxima and minima, and double integrals. The only application bearing on the theory concerns the propagation of errors. The book deliberately does not discuss errors statistically so it is inevitable that this classical topic has an air of finality that it does not deserve. Chapter 9 "Differential equations" (81 pages) surveys methods of solving ordinary and partial differential equations while, in chapter 10 (112 pages), "Further applications to medicine and biology," some of these methods are applied to a variety of interesting and instructive problems. Partial differential equations occurring in neurophysiology are not discussed. An appendix describes linear equations and determinants.

The book provides a rapid and reliable introduction to calculus with all the useful results and methods well listed, and with the solution of many differential equations occurring in physiology. Problems (with solutions) are provided.

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Prediction and Optimal Decision. Philosophical issues of a science of values. C. West Churchman. Prentice-Hall, Englewood Cliffs, N.J., 1961. xv + 394 pp. $9.

Space permits but a cursory summary of this book, which is of great importance to practitioners of science. Important it is, for it deals directly with science's ubiquitous question: how can we work toward a science whose recommendations are consistent with social morality? The need for an empirical science of ethical decisions is urgent, but urgency must give way before the recognition that we have little available information about the decision processes science as an institution now employs. In short, a science of science must precede a science of ethical judgments.

Examination of what scientists do shows that value decisions permeate the selection, organization, and analysis of knowledge, yet the way in which these judgments affect their resultant recommendations for action is far from clear. Should the scientist's recommendations be expressed in simple hedonistic terms? In terms of a Kantian calculation of pain-pleasure units? In terms of such more recent concepts as "utility" or maximization of gain? None of these standards for decision fulfills all the requirements of a

"scientific" standard, and none will, seemingly, unless it is a standard rooted in an empirical analysis of actual human behavior.

The preferential choices of humans behaving under conditions of uncertainty can, if other standards of adequate measurement are met, be taken as statements of value. While this is not the only value standard which might be employed, the defensibility of the concept is substantial. Certainly, the careful scrutiny Churchman devotes to this central idea is well worth the significant fraction of the book it occupies.

Equally intricately worked out are the concluding sections of the book, in which Churchman applies the same rigorous empiricism to the value standards of groups and in which he applies value theory to industrial accounting practices and to science itself.

Churchman is explicit: the book is programmatic. This is all to the good, for we may yet hear more of certain subjects (such as his "psychologistics") which seem tantalizing. It is good, too, in that by holding open the theory of science and its values, we may also hear from the theoreticians of differing views who can give this book the serious consideration it deserves.

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Das Leben des Szelider Sees. Limnologische Studien an Einem Natriumkarbonat-Chloridhaltigen See des Ungarischen Alfold. Ernö Donászy. Akademiai Kiadó, Budapest, Hungary, 1959. 425 pp. Illus. Plates + soil map (in color).

This book is a well-organized and well-documented inventory of the limnological characteristics of a shallow Hungarian lake whose waters contain unusually large quantities of sodium carbonate and sodium chloride. Incorporated are contributions by a number of collaborators working in various Hungarian laboratories. The chemical constituents of the lake are recorded in detailed figures and tables. In addition, there are drawings of diatoms and algae and quantitative data on phytoplankton, large aquatic plants, entomostraca, and rotifers.

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New Books

Mathematics, Physical Sciences, and Engineering

Advances in Chemical Physics. vol. 3. I. Prigogine, Ed. Interscience, New York, 1961. 381 pp. Illus. $11.50.

Advances in Electronics and Electron Physics. vol. 13. L. Marton, Ed. Academic Press, New York, 1961. 464 pp. Illus. $13.50.

Algebra. An elementary text-book for the higher classes of secondary schools and for colleges. pts. 1 and 2. G. Chrystal. 595 pp; 640 pp. Chelsea, New York, ed. 6, 1959. Illus. $2.95 each.

Aristotle's Physics. Newly translated. Richard Hope. Univ. of Nebraska Press, Lincoln, 1961. 254 pp. $6.

Atomic Physics Today. Otto R. Frisch. Basic Books, New York, 1961. 562 pp. Illus. $4.50. A volume in the Science and Discovery Series, intended for high school students and general readers.

The Behavior of Plasticizers. Ibert Mellan. Pergamon, New York, 1961. 273 pp. Illus. $8.

Calculus and Analytic Geometry. Robert C. Fisher and Allen D. Ziebur. Prentice-Hall, Englewood Cliffs, N.J., 1961. 781 pp. Illus. Trade, $12.65; text, $9.50.

A Collection of Tables and Nomograms for the Processing of Observations Made on Artificial Earth Satellites. I. D. Zhongolovich and V. M. Amelin. Translated from the Russian by Prasenjit Basu. Pergamon, New York, 1961. 200 pp. $15.

College Chemistry. A systematic approach. Harry H. Sisler, Calvin A. Vander Werf, and Arthur W. Davidson. Macmillan, New York, ed. 2, 1961. 719 pp. Illus. $7.50.

Directory of Industrial Research Laboratories in New York State. New York State Department of Commerce, Albany, 1960. 302 pp. Lists 1008 laboratories, including 628 which accept work from outside organizations and 31 in educational institutions and four other agencies.

Discourses on Bodies in Water. Galileo Galilei. Translated by Thomas Salusbury. Introduction and notes by Stillman Drake. Univ. of Illinois Press, Urbana, 1960. 115 pp. Illus. $5. A facsimile, except for page numbering, of Salusbury's original translation, printed in London by William Leybourn (1663).

Elements of Nuclear Engineering. Glenn Murphy. Wiley, New York, 1961. 226 pp. Illus. $7.50.

The Fermi Surface. W. A. Harrison and M. B. Webb, Eds. Wiley, New York, 1960. 371 pp. Illus. $10. Proceedings of the international conference held at Cooperstown, N.Y., in August 1960, and attended by 90 scientists from seven countries.

Fracture Systems and Tectonic Elements of the Colorado Plateau. Publ. in Geology, No. 6. Vincent C. Kelley and N. James Clinton. Univ. of New Mexico Press, Albuquerque, 1960. 104 pp. + 3 maps. $2.75.

Gas Chromatography, 1960. R. P. W. Scott, Ed. Butterworths, Washington, D.C., 1960. 483 pp. Illus. $17.50. Proceedings of the third symposium organized by the Society of Analytical Chemistry and the Institute of Petroleum, Edinburgh, June 1960.

The International Dictionary of Physics and Electronics. Walter C. Michels, Editor-in-Chief. Van Nostrand, New York, ed. 2, 1961. 1355 pp. Illus. $27.85.

An Introduction to the Theory of Vibrating Systems. W. G. Bickley and A. Talbot. Oxford Univ. Press, New York, 1961. 252 pp. Illus. $4.80.

Magneto-Fluid Dynamics. Publ. 829. F. N. Frenkiel and W. R. Sears, Eds. Natl. Acad. of Sciences–Natl. Research Council, Washington, D.C., 1961 (reprinted from *Reviews of Modern Physics* **32**, No. 4, pp. 693–1032). $4.

Mineral Metabolism. An advanced treatise. vol. 1, pt. B, *Principles, Processes, and Systems.* C. L. Comar and Felix Bronner, Eds. Academic Press, New York, 1961. 552 pp. $14.50.

Modern Aspects of the Vitreous State. J. D. Mackenzie, Ed. Butterworths, Washington, D.C., 1960. 234 pp. Illus. $9.50.

Modern Factor Analysis. Harry H. Harman. Univ. of Chicago Press, Chicago, Ill., 1961. 485 pp. Illus. $10.

Name Index of Organic Reactions. J. E. Gowan and T. S. Wheeler. Interscience, New York, ed. 2, 1960. 301 pp. $8.50. A compilation of 739 reactions referred to by the name of chemists in the current literature and textbooks; original edition was published by the Society of Chemical Industry (1950).

Nuclear Proplusion. M. W. Thring, Ed. Butterworths, Washington, D.C., 1960. 300 pp. Illus. $9.50.

Organo-Metallic Compounds. G. E. Coates. Methuen, London; Wiley, New York, ed. 2, 1960. 379 pp. Illus. $7.50.

Planets, Stars, and Galaxies. An introduction to astronomy. Stuart J. Inglis. Wiley, New York, 1961. 484 pp. Illus. $6.75.

Power Reactor Technology. James K. Pickard *et al.*, Eds. Van Nostrand, Princeton, N.J., 1961. 426 pp. Illus. $11.25.

The Precambrian Geology and Geochronology of Minnesota. Bulletin 41. Samuel S. Goldich, Alfred O. Nier, Halfdan Baadsgaard, John H. Hoffman, and Harold W. Kruegar. Univ. of Minnesota Press, Minneapolis, 1961. 214 pp. + maps. Illus. $4.

Specifications and Criteria for Biochemical Compounds. Publ. 719. Division of Chemistry and Chemical Technology. Natl. Acad. of Sciences–Natl. Research Council, Washington, D.C., 1960. $1 (loose leaf). This publication, covering 113 biochemicals, resulted from a 5-year study of ways to improve the quality of chemicals available for biochemical research by establishing criteria, standards, or specifications which can be used for describing such chemicals, particularly with regard to purity. Supplements will be issued, probably annually.

Theories of Engineering Experimentation. Hilbert Schenck, Jr. McGraw-Hill, New York, 1961. 249 pp. Illus. $7.

Theory of Formal Systems. Raymond M. Smullyan. Princeton Univ. Press, Princeton, N.J., 1961. 154 pp. Paper, $3.

Unified Calculus and Analytic Geometry. Earl D. Rainville. Macmillan, New York, 1961. 742 pp. Illus. $8.50.