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