Book Reviews

Mathematics

Lectures on Modern Mathematics. vol. 1. T. L. Saaty, Ed. Wiley, New York, 1963 x + 175 pp. Illus. $5.75.

The preface states that the six expository lectures published in this volume are the first in a series of 18 lectures being given at George Washington University, jointly sponsored by the university and the Office of Naval Research. Two subsequent volumes will contain the remaining lectures. The idea behind the series is to describe a substantial research area of mathematics, broadly and comprehensively, for an audience of mathematicians not specialists in that area.

The first lecture, "A glimpse into Hilbert space" by P. R. Halmos, covers seven topics including commutators, shifts, and Toeplitz operators. Halmos lists ten unsolved (at that time) problems, and it is worthy of note that, as of 2 May 1963, three of the problems had been solved.

In "Some applications of the theory of distributions," Laurent Schwartz summarizes the main elementary results of the theory and then discusses applications to partial differential equations with constant coefficients and to inhomogeneous equations. There is also discussion of division of distributions.

A. S. Householder's "Numerical analysis" gives a comprehensive survey of the problems of that subject, which are classified by the author as "dirty" problems (that is, given a method which would be effective for computing a certain quantity if strict arithmetic operations were possible, how effective is that method when account is taken of the fact that the operations actually available are only pseudoarithmetic?) and "clean" problems (that is, those of constructing and undertaking methods that are at least theoretically effective). An example of a "dirty" problem is error analysis, and of a "clean" problem, matrix inversion and reduction.

The first paragraph of the lecture "Algebraic topology," by Samuel Eilenberg, contains the following sentence: "Progress in algebraic topology is usually not achieved by going forward and applying the already existing tools to new problems, but by constantly going back and forging new more refined tools which are necessary to achieve further results." Eilenberg illustrates his point with the problem of the existence of a continuous tangent vector field on the n-sphere in Euclidean $(n + 1)$-dimensional space. He convincingly shows that "the solution involves everything we know in algebraic topology." [The first result was due to L. E. J. Brouwer (in 1908) and the final solution to Frank Adams (in 1962).] The rest of the lecture deals with applications of algebraic topology to other branches of mathematics.

In his lecture, "Lie algebras," Irving Kaplansky discusses, among other topics, the connections with groups, the classification of simple algebras, and Lie algebras of characteristic p.

The final lecture of this volume is "Representations of finite groups" by Richard Brauer. Brauer begins by reminding his audience that a "tremendous effort has been made by mathematicians for more than a century to clear up the chaos in group theory. Still, we cannot answer some of the simplest questions." Brauer gives that as his reason for being fascinated by the subject, and he communicates something of this feeling to his audience. He makes an exhaustive survey of the theory of representations of finite groups, including no fewer than 40 unsolved problems. There is also a section in which the author's aim is "to demonstrate that characters form a powerful tool for the study of finite groups."

It is difficult to judge the success of the actual lectures by reading the essay. However, since each author is a top-ranking specialist speaking to the nonspecialist, one must accept what each regards as challenging and important, although another specialist in the field might be more critical. In the preface, the editor remarks that the series should be useful and encouraging to the graduate student in mathematics who is embarking on his research career. This may very well be so, but nearly all the lectures are somewhat formidable and one appears quite dull. On the other hand, several are fascinating and challenging. Which is which should be decided by the reader himself.

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Nuclear Engineering

Introductory Nuclear Reactor Theory. Herbert S. Isbin. Reinhold, New York; Chapman and Hall, London, 1963. xvi + 624 pp. Illus. $22.50.

The present stage of development of nuclear engineering makes the writing of a textbook on nuclear reactor theory a difficult task. It is necessary to give the student a physical feel for the behavior of a chain reacting assembly while introducing him to some of the problems and methods of reactor design. As a result of the changing nature of the field, there is considerable disagreement among reactor designers and teachers with respect to the content, emphasis, and desirable level of a textbook on reactor theory. In view of the difficulties, Isbin has made a reasonable, consistent, and useful selection of material for a first-year graduate course. He emphasizes the basic aspects of the theory but also touches on some of the more advanced theoretical treatments. The latter are supplemented by many references to the recent literature. Newer practical developments are covered in examples and in a large number of excellent problems which broaden the treatment beyond what is possible in the classroom.

The author begins with a general introductory chapter on nuclear reactors; this is followed by a brief review of nuclear reactions, and then by chapters on neutron moderation, neutron diffusion, steady-state aspects of nonmultiplying media, the bare, critical, homogeneous reactor, the reactor with a reflector, characteristic dimensions and theory, reactor dynamics, transport theory, a generalized treatment of the

bare, homogeneous reactor, perturbation theory, multigroup methods, homogeneous thermal reactors, heterogeneous thermal reactors, and more advanced problems in reactor dynamics. The choice of topics and their order leave little room for argument.

The main fault I have found with Isbin's treatment is in what I consider an insufficient treatment of the basic physical ideas. But I must admit that a treatment that would satisfy me could be included in a book or course of reasonable length only at the expense of some of the more practical and engineering aspects which Isbin has treated very well. The choice is, in any case, a matter of personal taste. There is little on fast reactors but I have not yet found a satisfactory way of treating them in an introductory course either. The book is beautifully set up and printed, but its price will probably make me use it as a reference rather than as a text.

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Metallurgy

Rare Metal Extraction by Chemical Engineering Techniques. W. D. Jamrack. Pergamon, London; Macmillan, New York, 1963. xii + 360 pp. Illus. $10.

Extractive metallurgy has been treated in a number of books in which each metal is discussed in a separate chapter. Such an arrangement makes it difficult to correlate principles, features, and types of equipment that may be common to the processing of many metals; such books therefore tend to be long on description and short on theory.

In an attempt to avoid some of the difficulties inherent in such an arrangement, the author of this book has adopted a so-called "chemical engineering" approach in which "rare metal extraction and purification is divided into a number of 'unit processes,' each of which is discussed in a separate chapter." About half of each chapter is devoted to the particular unit process (ore breakdown, ion exchange, solvent extraction, dryway processes, high temperature reduction, electrolysis, and iodide processes) and half to the applications of that process to nine rare metals (uranium, thorium, zirconium, hafnium, titanium, niobium, tantalum, beryllium, and vanadium).

Nevertheless, the book still is long on description and short on theory. The following passage is typical: "In the open reactor technique, 7 kg. of the double fluoride [of potassium and niobium] is packed into a 3 ft. deep by 6 in. diameter reactor, in layers about 2 in. deep, which alternate with similar packed layers of sodium. The sodium is in the form of cubes about ½ in. in size. . . ." Physical-chemical or chemical-engineering principles are rarely considered. Although some free energy-temperature curves are presented, for example, they are hardly discussed and are not used. Except for a discussion of equilibrium diagrams for solvent extraction, there is little in the book that can be really classed as chemical engineering.

Despite its lack of theory, this book contains many helpful ideas that will be useful to anyone interested in any aspect of the extraction of rare metals. The descriptions of procedures and applications are clear and straightforward, they are well illustrated by excellent line drawings, and they reflect the author's broad experience. Although material on each metal is scattered among the various chapters, it can be followed rather readily with the aid of a series of "from ore to metal" flowsheets in the last chapter and a very good index.

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Panorama of Science

The Century of Science. Watson Davis. Duell, Sloan, and Pearce, New York, 1963. vi + 313 pp. Illus. $5.95.

Watson Davis has set himself a tremendously difficult task. In *The Century of Science* he attempts to tell the story of the scientific and technological advances of the past 60 years in a brief 200 pages. The book contains just over 300 pages, but a third of them are filled with pictures or diagrams. Although the 200 illustrations add to the book, they also reduce the space available for the fast moving and crowded story of scientific progress. The jacket lists 30 fields of science and engineering that are covered in the book, fields ranging from astronomy and agriculture through television and telemetry.

Watson Davis, director of Science Service and a distinguished science writer and educator, is as well fitted as anybody to tackle this almost impossible task. He personally covered many of the stories he retells in *The Century of Science*. Indeed, he took some of the most interesting photographs in the book. He has a wonderful picture of Robert H. Goddard in his laboratory and another of the launching tower at Roswell, N.M., both taken in 1936.

Because he has had a ringside seat at many of the developments and because he writes terse, concise prose, Watson Davis comes close to accomplishing the impossible. Unfortunately, compressing so much into such limited space sometimes makes for staccato, almost telegraphic reporting. For example, three short paragraphs are devoted to the cyclotron:

> One of the great inventions in the acceleration of atomic particles was Dr. E. O. Lawrence's cyclotron, now a widely utilized device for atomic research with several hundreds of them in operation.
>
> Cyclotrons under Lawrence's direction at the University of California in Berkeley, did much of the pioneer creation of new elements beyond No. 92 in the atomic table, uranium.
>
> Plutonium was created in a cyclotron. Plutonium achieved unusual importance because of the fact that it was fissionable and hence capable of being used in atomic bombs.

But Watson Davis is not content with merely telling his hurried, almost breathless story; he devotes a chapter to research as the great invention, emphasizing the 20th Century development of the great research laboratories supported by industry and government. He dips into the future and catalogs some of the scientific problems which are begging for solution. Along the way he passes judgments on such things as the greatest menace of the future (the rivalry between Russia and the United States), the virtue of Interlingua as an international language, and the pomposity of the word serendipity.

Watson Davis has always had a special interest in teen-age scientists. The book probably will be read most avidly by boys and girls whose imagination has been set on fire by the brave new methods of teaching science and who want to know what has happened in science during the past 60 years. *The Century of Science* will give them a vivid panorama.

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