Book Reviews

The Rare Earths. Edited by F. H. SPEDDING AND A. H. DAANE. Wiley, New York. 1961. 641 pp. $14.75.

The Rare Earths is a book containing the papers presented at a symposium co-sponsored by the American Society for Metals and the Atomic Energy Commission in November of 1959. F. H. Spedding and A. H. Daane, the organizers of the symposium and the editors of this volume, have on the whole made good choices of the authors of the papers–chapters of the book. The material is presented in an interesting manner, is well written, and appears to be up-to-date. The editors could have reworked the introductions to some chapters to avoid repetition. The book is concerned with the rare earths and the associated elements lanthanum, yttrium, and scandium. It is obvious from reading this book that the so called rare earths can no longer be considered rare and are now readily available in moderate purity in quantity for research and commercial application. This reviewer was surprised to learn that 29,000 lb of yttrium metal was prepared between 1957 and 1959.

The book is broken down into four main sections; (I) Occurrence and Extraction of Rare Earths, (II) Preparation of Rare Earth Metals, (III) Properties of Rare Earth Metals and Alloys, and (IV) Applications of Rare Earth Metals and Compounds. The first section is subdivided into five chapters, the first of which is a very interesting one entitled, "Historical Introduction to the Rare Earths." This is followed by a chapter on the chemistry of the rare earths and three chapters on the separation methods.

The second section covers the preparation of the fluorides and halides of these metals—chapters 6, 7, and the reduction methods—chapters 8, 9, and 10. Since the production methods yield material of commercial purity there is a chapter (11) on purification followed by a chapter (12) on fabrication.

In the first three chapters (13, 14, 15) of the third section the physical properties, the crystallography, and metallography of the rare earths are presented. Chapters (16, 17), entitled "Rare Earth Metal Phase Diagrams" (there are 95 complete phase diagrams, and a resume of information available on the other rare earth phase diagrams) and "Principles of the Alloying Behavior of Rare Earths," are excellent. The section is concluded with the chapter on the mechanical properties of yttrium, scandium, and rare earths.

The final section covers applications to magnesium technology and ferrous and non ferrous alloys, non nuclear uses, and nuclear applications (chapters 19, 20, 21, 22). The concluding chapters present the analytical chemistry and analytical spectroscopy of the rare earths.

A number of books are being published which are collections of papers presented at symposiums. This book differs from most of the ones the reviewer has seen in that there is good continuity from chapter to chapter. This reviewer, who has not worked with rare earths, enjoyed reading this book and can recommend it as an introduction and a source book to the rare earths.

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(About the Reviewer: Dr. David H. Gurinsky is Head of the Metallurgy Division of Brookhaven National Laboratory. After receiving his Ph.D. at New York University in 1942, he joined the University of Chicago Metallurgical Laboratory, and after two years transferred to Los Alamos and then back to the University of Chicago. He has been at Brookhaven since 1947 and is a Fellow of the Society.)

Textbook of Reactor Physics. By J. F. HILL. Allen & Unwin, London, 1961. 228 pp., 76 figures, and 35 tables. 36s ($5.04).

This small book was written by a former principal of the Reactor School at Harwell under the auspices of the United Kingdom Atomic Energy Authority. The philosophy behind the book can, perhaps, be indicated best by quoting from the author's preface.

"A large number of advanced textbooks on reactor physics is available, but there are very few suitable for readers with a limited knowledge of mathematics. Many people now concerned with reactor design work require to understand the elementary principles of reactor physics, and I have therefore tried to explain these principles to the non-specialist, using the minimum of mathematics while retaining as complete an account as possible; this book also aims to serve as an introduction to the subject and as a preparation for further reading for those who are better equipped mathematically."

The book opens with a review of those aspects of atomic and nuclear physics which are pertinent to reactor physics. The review is brief and to the point. There follows an excellent introductory description of the chain reaction and a survey of problems encountered in reactor physics and design.

After discussing the behavior of neutrons in moderating media, the author goes on to the calculation of the reactor parameters, first for homogeneous reactors, then for heterogeneous reactors. He concludes with an account of the effects of fission product buildup, temperature changes, and fuel depletion and with a discussion of reactor kinetics.

In order to give the reader a feeling for the subject, numerous graphs and tables are given. Most of the figures are plots of reactor parameters, fluxes, etc. In the later chapters extensive lists of formulas are given, the derivation and origin of which are, of course, impossible to give in the space allotted. An appendix lists thermal cross sections of the elements.

Throughout the book the author speaks in a direct, informal manner, often using the first person plural. In this way he has been highly successful, the result being a clear and simple presentation of problems and methods of reactor physics. There are no side-tracking excursions into topics of interest only to specialists, and the practical significance of the results from design and operational viewpoints is kept in the fore.

The choice of subject matter and the arrangement of the material, along with the author's keen physical insight, make for a book which will leave the reader with a limited, but well-balanced, over-all view of the field of reactor physics. The reviewer recommends this book to those who desire a survey of the field, especially those who plan to continue study in this field.

JAMES H. MARABLE
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(About the Reviewer: Our reviewer, James Marable, has been on the staff of the Oak Ridge National Laboratory for the past 10 years. After several years experience with critical assemblies, he engaged in reactor physics research and then transferred to the Reactor School of the Oak Ridge National Laboratory where he has been a lecturer in reactor analysis for the past 5 years.)

Your Future in Nuclear Energy Fields. By WILLIAM E. THOMPSON, JR. Popular Library Guidance Books, Popular Library, New York, 1962. 159 pp., $.50.

A good sign that the nuclear field has reached some maturity is the appearance of this paper bound book on careers. The author, in a simple, brief, interestingly-written volume, has provided much useful factual information about atomic energy and its opportunities, especially for high school and beginning college students.

After a short history of the Manhattan Project, the subject of radiation is emphasized. Descriptions of industrial activities and research and teaching careers follow. Daily activities of a reactor engineer, a development engineer, a research scientist and a professor in a university are nicely portrayed by example individuals. Advice given on preparing for a career is thoughtful, sensible, and realistic. Key ideas are self-evaluation, the exploitation of one's interests and talents, and the importance of satisfaction in chosen work. The sound advice is given that it is never too late to change careers. An evaluation of job openings as they depend on formal training is made. The section on seeking employment is aimed at college students. This is somewhat inappropriate in view of the widespread interviewing practice for graduating seniors with nuclear training. The suggestions are useful however for students with low grade averages who must advance their credentials in order to obtain employment.

The author emphasizes properly in following chapters that education must continue throughout life, and that progress depends on performance, not degrees. Mr. Thompson is to be commended on his style and choice of material. Never pompous, but quietly philosophical, he has provided what should be a useful service to our young people.

RAYMOND L. MURRAY
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(About the Reviewer: Our reviewer, Dr. Raymond L. Murray, Burlington Professor and Head of the Physics Dept. of North Carolina State College, is a consultant and researcher in reactor theory. He is the author of "Introduction to Nuclear Engineering," 2nd ed. (1961), *and* "Nuclear Reactor Physics" (1957). *He is currently Chairman of the Education Committee of ANS.)*

Mathematical Handbook for Scientists and Engineers. By G. A. KORN AND THERESA M. KORN. McGraw-Hill, New York, 1961. 960 pp., $20.00.

This handbook is an almost encyclopedic completion of results and theorems in an extremely broad area of mathematics which the authors feel are likely to be of interest to practicing engineers and scientists, as distinguished from professional mathematicians. In keeping with its character as a handbook proofs are not given, but an important feature of each chapter is a list of references to books where more extended discussions can be found. This handbook will probably be more useful to the engineer who is already aware of a mathematical principle or method he wishes to apply but who has forgotten the details than to the engineer who wishes to apply, or to discover what is available for application in, a completely new field. The latter should be very careful to check the validity of any specific equation he uses for there are several minor errors (equations 1.4-4 and 1.4-5 are typical) which would be readily detected by an engineer with some degree of familiarity with the material but which might cause trouble to the novice. To be sure some errors, even though disturbing to the pure mathematician, will cause no difficulties to the engineer, e.g., the assertion (p. 107) that "The surface area of a curved surface . . . is the limit of the area of an inscribed polybedral surface as the maximum distance between adjacent vertices decreases," for the engineer is quite unlikely to use this prescription to calculate a surface area. On the other hand, the incomplete statement of Cardan's solution of the cubic equation (p. 23) may well be troublesome to the hasty engineer. (The reviewer has himself stumbled in the past over this point.)

The handbook begins with three chapters on elementary algebra and plane and solid analytic geometry, which include material which would be covered in college level courses in these subjects as well as material on polynomial equations and systems of linear equations generally treated in courses in the theory of equations. These are followed by a chapter on the calculus, with material generally taken from courses in elementary and advanced calculus (e.g., Fourier series, Taylor series), and a short but pithy chapter on vector analysis which serves as a prerequisite to a chapter on curvilinear coordinate systems and a later chapter on tensor analysis.

A chapter on functions of a complex variable contains the expected results. The significant sections for the applications are probably those on contour integration and conformal mapping. The Laplace transform is defined and the basic facts about it are given. A short table of transforms appears in the appendix. The chapter on ordinary differential equations is excellent. The engineer will appreciate the discussion of nonlinear second order equations and in particular the treatment of the Kryloff–Bogoliubov method. The chapter on partial differential equations contains primarily definitions and statements of general properties of