Advances in Nuclear Science and Technology, Vol. 4. Edited by P. Greebler and E. J. Henley. Academic Press, New York and London (1968).

The series, *Advances in Nuclear Science and Technology*, appears annually to bring together, in a timely fashion, reviews of significant topics and developments in the nuclear science and technology field. It can thus fulfill an important function in coping with the prolific outpouring of technical books, articles, and papers in this field, and help the reader to remain informed with relatively little effort. To be successful, it is of course, desirable that the selection of topics discussed be indeed timely, and that the review articles presented be authoritative and comprehensive.

The 1968 edition, Vol. 4, meets these requirements admirably. The editors have demonstrated a keen awareness of timely and important developments, and have been able to assemble a very impressive compilation of papers.

Volume 4 contains seven chapters. The first two chapters deal with important reactor concepts, the gas cooled reactor and the sodium cooled fast breeder reactor. Chapters 3 and 4 discuss safety problems in fast reactor technology. The last three chapters deal with more general topics: control theory, perturbation theory, and industrial applications of ionizing radiations, respectively.

The first chapter, "Gas-Cooled Reactor Technology", by H. B. Stewart, C. L. Rickard, and G. B. Melese, presents a useful historical summary of the development of the gas cooled reactor concept and a comprehensive discussion of the problems of using gas as a reactor coolant. The enthusiasm of the authors is quite apparent. At times, the article is perhaps a little too partisan in tone.

The second chapter, "Safety and Economic Characteristics of a 1000-MWe Fast Sodium-Cooled Reactor Design," by K. P. Cohen and G. L. O'Neill, covers the status of technology of large fast reactors as of the mid-sixties. Emphasis is placed on safety criteria and operating limits. The distinction between "credible" and "hypothetical" accidents is delineated. As the title implies, the chapter is primarily a discussion of a specific design, and thus it tends to be somewhat too restrictive in scope.

The third chapter, by R. B. Nicholson and E. A. Fischer, on "The Doppler Effect in Fast Reactors" summarizes the currently available derivations and discussions of the Doppler effect in fast reactors. It is a very careful exposition of this subject, and can serve as an excellent review paper.

R. A. Meyer's and B. Wolfe's article on "Fast Reactor Meltdown Accidents Using Bethe-Tait Analysis" (Chapter 4) is important reading for people working in this field. The energy release from a meltdown accident in a 1000-MWe fast ceramic reactor is discussed. The effects of different parameters and their impact on energy release are described in detail.

The fifth chapter, "Optimum Nuclear Reactor Control Theory," is by J. Lewins and A. L. Babb. The authors state that "This paper reviews the basic theory of Pontryagin's treatment of optimal control in a formalism that should be readily understandable to nuclear engineers, using examples drawn from problems in nuclear control to illustrate the main aspects of the theory." The paper does fulfill this objective. In fact, it may provide the necessary stimulus to search for applications of optimum control theory to more substantial problems in nuclear engineering.

Chapter 6, "Developments in Perturbation Theory," by J. Lewins, reviews recent developments which have increased the scope and importance of perturbation theory in reactor physics. By necessity, the paper is highly mathematical in content, and requires considerable mathematical skills on the part of the reader to appreciate it fully.

The last chapter, "Industrial Applications of Ionizing Radiations," by S. Jefferson, R. Roberts, F. J. Ley, and F. Rogers, is an excellent introductory article to this field. The review of industrial applications is confined to x rays, gamma rays, and high-energy electrons. Three topics are covered: ionizing radiations in the chemical industry, ionizing radiations in the medical product and food industries, and sources of ionizing radiations. In each case, the treatment is quite comprehensive and the presentation is interesting and very clearly written.

In summary, the 1968 Volume 4 of *Advances in Nuclear Science and Technology* is a worthwhile and useful contribution to the technical literature.

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June 10, 1968

About the Reviewer: Peter L. Hofmann is presently Manager of Reactor Physics for the Fast Test Reactor at PNL. Before coming to Hanford in 1961, he held various positions at the Knolls Atomic Power Laboratory in the Submarine Intermediate Reactor Project (SIR) and in the D1G Nuclear Destroyer Project. He received his D. Eng. Sci. in Nuclear Engineering and Science from Rensselaer Polytechnic Institute. His undergraduate work was done at Cooper Union.

Principles of Radiation Protection. Edited by K. Z. Morgan and J. E. Turner. John Wiley and Sons, Inc., New York, N.Y. (1967). 622 pp. $13.95.

This is the first definitive book in the field of health physics this reviewer has seen. Although it is an edited book, the two editors participate directly in the book as writers of certain sections, and it is obvious that the selected contributors are authorities in their individual fields.

As is common in edited books, there are differences in style and skill of presentation in the various chapters. The reviewer has used this book as a text in a Health Physics course this Spring Semester. It will require a year to cover the material presented in the book. It is most excellent as a reference book in a course or courses, but, as a textbook, it has some deficiencies. For example, some of the problems at the end of each chapter require mastery of material presented much later in the book. Its usefulness as a text would be improved if it contained more illustrative problems worked out in detail with particular emphasis on the careful handling of units. The definitions are given accurately, but frequently from a mathematical rather than a physical background which makes it difficult for a student to appreciate them.

The organization of the book is excellent. It starts with a history of harm done in the early days of man's experiences with ionizing radiation and a discussion of natural background radiation. Next, the physical details of the interaction of ionizing radiation with matter are discussed. There follow the official quantities and units and a careful presentation of the physical basis of radiation dosimetry. Methods of measurement are presented first and then there is a study of special methods in dosimetry. A clear distinction is made between external and internal hazards. The basis for determining maximum permissible concentrations is given. There follow several chapters emphasizing various phases of radiation biology. Appropriately, the book ends with a careful discussion of nuclear criticality accidents.

As with all new books, it is plagued with typographical errors and blunders, but to a less-than-usual extent. For example, on page 82, equation (2-19) is upside down. These are very minor things and do not detract from the overall usefulness of the book. It is hoped they will be corrected in the second edition.

This reviewer has taught Health Physics for the past eighteen years and is most happy to have at long last an excellent and authoritative book for his students to use in his courses and to keep for their further use in future years.

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May 26, 1968

About the Reviewer: Dr. Underwood is not a newcomer to these pages, having reviewed a health physics book for us in October 1967. That his interests are broad is attested by his position as Professor of both Physics and Radiological Science at Chapel Hill. He completed his graduate work at Brown and has been a member of the faculty at Vanderbilt and North Carolina State.

Nuclear Reactor Materials. By Charles O. Smith. Addison-Wesley Publishing Company, Reading, Mass. (1967). 262 pp. $13.50.

The author is Professor and Chairman of the Department of Mechanical Engineering at the University of Detroit. A former Oak Ridge National Laboratory staff member, he taught the Reactor Materials course in the Oak Ridge School of Reactor Technology for nine years. This book, an adaptation of the notes used by the author in the course, should, in his opinion, be useful to people engaged in the areas of education, operation, design, and development as they pertain to nuclear reactors. The publisher states that the book is an in-depth survey of the subject, one which "surveys the spectrum of materials usage." In addition, the publisher feels that the logical development of the role of materials in reactors is an important feature of the book, intended to serve beginners in the reactor field.

The 262-page book consists of four general or introductory chapters plus chapters on Radiation Effects (30 p.), Uranium (21 p.), Plutonium (10 p.), Thorium (8 p.)., Structural Metals (26 p.), Ceramics and Cermets (14 p.), Graphite (8 p.), Fuel Elements (16 p.), Liquid Fuels (27 p.), Materials Development (9 p.), and Some Specific Applications (20 p.).

The physical quality of the book is good. It contains a generous supply of pictures, drawings, and tables. In a few cases, however, over-reduction of figures led to illegibility. Few proofreading errors were found. The bibliography has 55 entries (average publication date—1959), including 8 handbooks and 9 ORNL series documents. An Appendix contains 12 tables of material property values. The index consists of about 3.2 pages.

The book is about reactor materials. To a greater degree than in most books of this type, materials applications are discussed with relation to specific reactors. While this may be a useful pedagogic approach, the reader's perspective may become distorted if the group of reactors used in this way is not carefully selected. Professor Smith's choice of examples will not reveal to the student that a strong, substantial light-water-moderated reactor industry exists and that several billion dollars worth of such reactors either are operating or are in various stages of design or construction. Nor will the reader become aware that the fast breeder reactor is the focus for the major materials development efforts in government- and industry-sponsored programs today. Fast reactors receive only passing mention in the text and no mention in the index.

The book will not be easy reading for beginners. Terms are frequently introduced without definition and the scanty index is of limited assistance. Acronyms are freely used and, although they are defined once, their appearance later in the book strains the memory unduly. The figures are frequently poorly explained in the text, and, in many, extraneous unexplained details are given. The sentence structure and grammar are unusual and the clarity is reduced by the rambling generalities often encountered. It is difficult to determine what degree of accomplishment is presumed for the reader. In a chapter containing a rather detailed description of the crystallography of deformation of zirconium, for instance, the review questions start off with "Why is aluminum a commercial structural metal?"

Because of its historical interest, the book is recommended to those libraries which desire to maintain a state of completeness in their collections.

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May 14, 1968

About the Reviewer: T. W. Evans is a member of the materials development staff of the Pacific Northwest Laboratory. He has been at Hanford since 1952, first with General Electric and for the past year with Battelle Memorial Institute, with interests in various problems in metallurgy and ceramics. In particular, he was involved in the design and development of fuel elements for the Plutonium Recycle Test Reactor and the N *power-production reactor. His current interests are ceramic reactor fuel and fast-reactor control materials. Dr. Evans completed his graduate studies in physical chemistry at Wisconsin following undergraduate work at North Dakota State University.*