haar; and "Remote Fabrication of Reactor Fuels," by A. B. Shuck, A. L. Lotts, and Kirk Drumheller. The volume is rounded out by two selections from reactor technology proper: "Physics of Heavy-Water Lattices," by H. C. Honeck and J. L. Crandall; and "Sodium Technology," by Kurt Goldman and Bertram Minushkin.

Engineers and scientists working in the reactor field, but not specialists in the subject matter of a particular article, will find the technical level of the writing about right. There are abundant lists of references for those who might want more information. The material is generally quite readable and could well provide a good starting point for students and others wanting to improve their grasp of any one of the subjects covered. Each provides a comprehensive summary of its field.

The encyclopedic article on "Waste Management" will probably be of most general interest. It begins with estimates of the quantities of waste that will be generated by a growing nuclear power industry, and proceeds through descriptions of waste treatment processes, methods of final waste storage, and monitoring of the environment in the vicinity of storage and disposal operations. Environmental studies in Canada, England, and France are discussed as well as those at various sites in the US.

The paper on "Transportation of Radioactive Materials" also covers the subject broadly, ranging from governmental regulations to clear photographs of a variety of shipping containers.

The authors of "Physics of Heavy Water Lattices" are to be commended for the technical quality maintained in this concise and readable summary of both the experimental and theoretical sides of the subject.

The problems and processes in the "Remote Fabrication of Reactor Fuels" are well covered in the article by that title. More information on equipment and especially clearer drawings and photographs would have contributed interest, in this reviewer's opinion.

Materials compatibility and methods for monitoring and maintaining sodium purity are the principal subjects in "Sodium Technology." To the extent that this reviewer was able to judge, treatment of these items was comprehensive. The authors apparently regarded the design of mechanisms for operation in a sodium-dominated environment as lying outside the area defined by the title.

All libraries connected in any way with nuclear engineering will want to have copies of this publication as will many individuals. The review of "Radioactive Waste Management" alone is worth the rather modest price.

Paul F. Gast

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May 20, 1966

About the Reviewer: Paul F. Gast is a member of the Reactor Physics Division of Argonne National Laboratory. Before joining ANL in 1964, he had been associated in various capacities with Hanford since Manhattan Project days. While at Hanford, he served as Chief Supervisor of Reactor Physics in the plant technical organization, and, more recently, as manager of Physics and Instrument Research and Development. His PhD degree (physics) was won from the University of Washington, Seattle, in 1941. He is a Fellow of the American Physical Society and of the ANS, a member of the Editorial Advisory Committee of Nuclear Science and Engineering, *and a member of the ANS Board of Directors.*

Radiation Effects in Graphite. By J. H. W. Simmons. Pergamon Press, Oxford (1965). 242 pp. $15.00.

This is the first book devoted entirely to the subject of radiation effects in graphite. It follows several other books on graphite that have been published within the past few years: *Les Carbones* (1965), a comprehensive (2 vols., 1624 pp) coverage of carbons and graphites in French; *Nuclear Graphite* (1962), encompassing the nuclear uses of graphite; *Graphite and Its Crystal Compounds* (1960), covering the crystallographic and physical properties of graphite and its compounds. *Radiation Effects in Graphite* is a well-written book by one of the world's authorities on the subject. The title accurately describes the subject matter. Although the main theme is radiation effects, the introductory chapter contains a brief survey of the structure, properties, and manufacture of graphite that is necessary for understanding radiation effects discussed in subsequent chapters.

The second chapter outlines the theory of atomic displacements in carbon, ending with a discussion of the practical problems of defining a useful dosimetry scale. This latter problem, which is the basis for converting neutron exposure measured in one reactor to exposures in another, continues to be a very difficult one and has not been completely laid to rest in this chapter. For example, there appear to be some inconsistencies in the dose conversion factors. It would be useful to know which physical properties were used to correlate dose scales, as well as which of the several MWd/Ate dose units is used in later chapters.

The method discussed at the end of Chap. 2 for extrapolating high-temperature irradiation data to high doses, based on data at lower temperatures, is not satisfactory (at least in the reviewer's experience). The author might wish to modify this section in the light of recent data.

The discussion of defect structures in irradiated graphite in Chap. 3 is one of the outstanding parts of the book. The theory of defect structures and experimental observations in the electron microscope, with which the author and his colleagues at Harwell have been particularly proficient, have been clearly related.

Dimensional stability of graphite continues to be one of the most serious problems in the use of graphite and also one of the most intriguing and elusive scientific aspects of radiation damage. The subject is covered very well in Chap. 6 to the time of writing. As is always true in such an active field, a great deal of additional data has been published since the book was written. One of the unexpected new features is that graphite contraction is now known to saturate and then expand rapidly at very high doses.

There are a few statements at the end of Chap. 6 that are incorrect or controversial. The statement that extruded graphites normally expand in all directions is not true for some nuclear graphites (for example, see Fig. 65). Also, it is stated that the behavior of a new type of graphite can be predicted provided some knowledge can be obtained of the structural parameters $A_{\perp}$ and $A_{\parallel}$. In the reviewer's opinion this has not yet been demonstrated.

Chapter 8 on stored energy is another outstanding part of the book. The problems of accurately measuring the release of stored energy, analysis of the data, and application to the design and operation of graphite reactors are ones in which the author of the book has been closely allied. Following the Windscale accident in 1957, these problems were intensively studied by the Harwell graphite group. Through significant contributions from their ef-

forts, stored energy buildup and release are now well enough understood that stored energy is not considered a problem in modern high-temperature graphite reactors.

The book is almost free of typographical errors, is sturdily and attractively bound, and contains many figures and references to supplement the text. Although the book naturally emphasizes the interests and work in England, the subject coverage is truly worldwide. It will be a very useful book for all engineers and scientists concerned with radiation effects in graphite.

R. E. Nightingale

Battelle Northwest
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May 18, 1966

About the Reviewer: R. E. Nightingale is manager of the Ceramics and Graphite Research Section at the Pacific Northwest Laboratory (formerly Hanford Laboratories) now operated by Battelle Memorial Institute. For the past 12 years, he has been interested in nuclear materials. Most of his research has been on graphite, and he has published extensively in this field. Editor of a recent book, Nuclear Graphite, *(Academic Press, 1962), he was a delegate to the 1958 and 1964 Geneva Conferences and has served as an advisor to the AEC on graphite problems on a number of occasions. Prior to his present position, he was a research associate at the University of Minnesota. He received a PhD degree (physical chemistry) from Washington State University in 1953 and a BA from Whitman College in 1949.*

Strength and Structures of Engineering Materials. By N. H. Polakowski and E. J. Ripling. Prentice Hall, Inc., New York (1966). 535 pages. $17.35.

This book is a long needed and valuable link in technical literature connecting the disciplines of strength of materials and structure of materials. Written in easily understandable language, it is an introduction to the mechanics of deformation and fracture of solids through presentation of the atomic model and interatomic forces, while exposing materials to exterior forces. It has many figures and photographs, and there are problems at the end of each chapter.

The reader who expects to find detailed information on calculational methods quickly realizes that the authors did not intend to improve his calculational skill, but rather intended to help him understand the basic phenomena. Therefore, the book does not give enough information regarding derived equations, beam deflection formulas, or Tables for properties of materials which are available to the structural engineer from standard sources. For the practical engineer, the references at the end of each chapter could have covered a more extensive list of related textbooks in some areas.

The authors use the latest available research results to describe dislocations, elastic and plastic deformation, and static and dynamic effects in metals and nonmetals. The book consists of four main parts: Part I is a short introduction describing deformation and rupture; Part II contains basic definitions related to stress and strain; Parts III and IV comprise the real body of the book.

Part III is a rheology which classifies and describes the structure of materials and contains a well-condensed description of elasticity and plasticity, time-independent and time-dependent deformation and fracturing.

Part IV describes mechanical behavior and properties of materials under tensile and compressive loads, bending, torsion, and shear. It contains a short chapter on hardness and on properties that measure fracture resistance, and chapters on creep and stress rupture, fatigue, and residual stresses.

For teachers and students who intend to achieve depth in knowledge of engineering materials, this book fills the gap between highly specialized aspects of stress analysis and properties of materials. It is a good introduction for the engineering student to the mechanism and calculational models which describe deformation, including the mathematical formulation of time dependency of deformation.

Judging its usefulness for practical engineers, this is a valuable book for those who are not recent graduates and who have not had a chance to update themselves on the new developments of research in the fields of behavior of materials relating to their atomic structures, and who want to understand how different kinds of materials behave under stress and strain.

George G. Biro

Gibbs & Hill, Inc.
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May 31, 1966

About the Reviewer: George G. Biro is on the staff of Gibbs & Hill, Inc., Consulting Engineers, New York City. He is the author of Modern Methods in Stress Analysis of Continuous Structures *(1949) and, at present is in charge of shielding on nuclear power plants. He obtained an MS in Civil Engineering in Brunn, Czechoslovakia, and an MS in Nuclear Engineering at Columbia University, where he is presently a doctoral researcher.*