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Book Reviews

Thermal Neutron Scattering. Edited by P. A. Egelstaff. Academic Press, London and New York (1965). 496 pp. 115 shillings.

Peter Egelstaff has done a good job of editing this collection of ten review papers, and I recommend the book to anyone seriously interested in the field of thermal neutron scattering. The fact that the chapters are really review papers, and *good* review papers, means that the book will not be of great value to the student trying to learn the field, but this is no criticism, merely an observation.

As an example, to understand Chap. 3 ("Crystal Diffraction Techniques") requires some knowledge of, say, Bacon's book on neutron diffraction, but for the person who has such knowledge, this chapter will serve as an excellent source of references, an outline of the methods and their theoretical bases, and an updating of the field.

The authors of the various chapters are among the outstanding names in the field, so it is no surprise that they have maintained a high technical level. Presumably, the excellent choice of topics, leading to a broad coverage of the field, and the consistency among the various chapters, as well as the fine job of cross referencing and indexing, are due to the editor.

As always, faults may be found. The most serious, in my opinion, is a slight unevenness in level, both among the chapters and within a given chapter. Thus, for example, we find Chap. 7 ("Theory of Neutron Scattering by Liquids") by Sjölander is aimed at the theoretician working in this field. One might then reasonably expect that Chap. 2 ("Mechanical and Time of Flight Techniques") by Brugger should be aimed at the experimentalist working with chopper systems. However, the level of Chap. 2 is such that I feel it might be more profitably read by an expert in some other area of thermal neutron scattering who wants to learn something about choppers.

The same dichotomy exists between portions of Chap. 1 ("Introductory Theory") by Lomer and Low in that some parts are very elementary, whereas the overall level is quite high. The elementary parts might better have been omitted in view of the expected proficiency of the reader.

I particularly liked Chap. 7 (previously mentioned) and Chap. 6 ("Magnetic Inelastic Scattering of Neutrons") by Sjölander and by Jacrot and Riste, respectively. In addition, Chap. 3 by Cocking and Webb ("Neutron Sources and Detection") warrants special mention, as does Chap. 9 ("The Theory of Neutron Scattering by Molecules") by Janik and Kowalska. (This chapter, incidentally, appears to be the least well referenced of the collection, and also omits some important work, but makes up for these deficiencies with a very lucid presentation.) Cocking and Webb probably do not devote enough space to discussion of linear accelerators, which have only recently become important as a source for thermal neutron scattering experiments. Also, nowhere in the book was I able to find a good comparison of various systems—choppers, crystal spectrometers, rotating crystals, etc.—which would help someone choose the system most appropriate to the experimental program he wished to carry out.

Neither this, nor any other single book, could presume to cover an entire field. Thus, much important work is not discussed at all, although most of it seems to be referenced. One would like to have read more details about calculations of scattering from organic molecules, more about Nelkin's water calculations, and considerably more about the cross-sections calculations for crystalline materials that have been carried out at General Atomic. But there are limits to how much could be included. (The omission of many of these details is exactly what might be be expected in a review paper—the reader is expected to have the competence to refer to the original papers). I would not let any of these minor complaints dissuade me from owning a copy of the book.

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About the Reviewer: P. F. Zweifel is a professor of Nuclear Engineering at the University of Michigan where he has been a member of the faculty since 1958. During earlier years he held various academic positions at Duke, MIT, and Union College; more recently he was visiting Professor at Wisconsin and at Middle East Technical University, Ankara, Turkey. He was also manager of the theoretical physics group at KAPL, and has been associated with a number of industrial and governmental laboratories as a consultant. Dr. Zweifel received his academic degrees from Carnegie Tech and Duke.

Reactor Technology - Selected Reviews 1965. Edited by Leonard E. Link under auspices of the USAEC. Available as TID-8541 from Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, US Department of Commerce, Springfield, Virginia 22151. 439 pp. $4.50.

This latest in the series of paperback annual reviews of selected topics in reactor technology is, like its predecessors, dated by the year of intended publication, but the material presented has a "closing date" in the Autumn of 1964, according to the preface. While previous numbers have dealt primarily with narrowly defined topics in reactor technology, nearly 60% of the present volume is devoted to subjects of interest to reactor designers, but peripheral to their own field of endeavor. These are articles in "Radioactive Waste Management," by W. G. Better and D. W. Pearce; "Transportation of Radioactive Materials," by L. L. Zahn, C. L. Brown, and J. W. Lang-

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.

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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-