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# Book Reviews

**Uranium and Graphite,** Proceedings of a Symposium held in London, 20–21 March, 1962, No. 27. The Institute of Metals, 17 Belgrave Square, London, S.W.1. England, 99 pp., 1962, 50s.

There is some question concerning the use of the term symposium with respect to this book. In essence it is divided into eight unrelated articles dealing with uranium and five articles pertaining to graphite.

A few general comments can be made. All papers were authored by people from Great Britain so the contents tend to be oriented along specific lines in both research and technology. It is rather surprising that this emphasis extended into the references cited. Conceivably the publication dates served as a limitation, but one would expect to find some of the relevant work from the United States quoted covering the period 1959–1961. Certainly, there were several articles from the United States during this period that are immediately applicable.

The papers tend to be refinements of previous work rather than presentation of new concepts. As such they should appeal more to the experts in the field who are looking for additional data, rather than the person desiring a broad and general acquaintance with one or both of the fields of graphite and uranium. Finally, the quality of the papers is somewhat uneven. There are some excellent articles representing definite advances in the fields of uranium and graphite. Also, there are some papers of a quasi-review nature that make no particular contribution.

The papers dealing with uranium cover grain size and preferred orientation, a study of the beta to alpha phase change, effects of neutron irradiation and thermal cycling on deformation under load, isothermal and thermal cyclic creep of alpha uranium, oxidation in carbon dioxide and carbon monoxide between 200 and 500°C, irradiation growth relationships in mono- and poly-crystalline uranium, electron microscopy studies of irradiation damage, and the swelling in alpha-uranium irradiated to 0.7% burnup.

The graphite papers cover pore properties, control of anisotropy, irradiation-induced dimensional effects, creep under irradiation, and the influence of lattice defects on physical properties.

Those concerned with the deformation of metallic uranium during irradiation will find the elegant extension of Cottrell's original creep theory of some interest. The fuels engineer who requires creep data on uranium should find the parametric plots for isothermal and thermal cycling creep invaluable. These data represent a major share of the available information.

A substantial insight into the mechanisms of dimensional instability and swelling of uranium can be gained from the papers of Buckley, Makin *et al.*, and Bellamy. The work of Bellamy is of major interest in that it defines compositional variables that markedly inhibit the swelling of uranium during irradiation. Since swelling has limited the use of uranium at higher temperatures, the approach suggested by Bellamy may extend the useful range of uranium in temperature and/or burnup.

Two of the papers on graphite deal with manufacturing variables controlling porosity and anistropy and the significance of porosity and anisotropy on the physical properties of graphite. As such they will interest users of nuclear graphites. Williamson's paper relating lattice defects to physical properties does an excellent job of relating such defects as vacancies and dislocations observed by transmission of electron microscopy to the stress/strain behavior in graphite.

One cannot quarrel with the price of this book (50s), but it will probably appeal to a rather limited audience in this country because of its specific nature, and because it is oriented to British reactor technology, like all such books it is partially obsolete by the time it is published, and in the case of the graphite work, the new book "Nuclear Graphite" covers similar ground in greater detail.

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**Reactor Handbook, Vol. III, Part B. Shielding,** 2nd ed. Interscience, New York, 287 pp., 1962, $10.00.

This is the second edition of a handbook first published in unclassified form in 1955; it is natural, therefore, to begin by comparing it with the first edition. Although the page size and the broad outlines of the contents remain unaltered, it may be remarked that the amount of subject material has been increased by nearly fourfold with a corresponding increase in the number of authors from 8 to 18. The description of "second edition, revised and enlarged" is, therefore, modest in the extreme; this is virtually a completely new book.

The volume begins with a short chapter describing the basic problems of shielding. The hazards of reactor radiation are described, radiation dose rates are defined, a brief outline of the necessary steps in shield design is given, and the chapter is closed with a description of some reactors

used for shielding research. This chapter is new, and a welcome addition to the contents of the volume. Because this is a handbook written by specialists, the scientist new to shielding problems will find it an invaluable help to achieve a perspective of the problems which await him.

Next, a chapter on radiation sources in which the yield and radiation spectra of neutrons from fission and ($\gamma$, n) reactions, and gamma radiation from fission, the fission products, (n, $\gamma$) reactions, and many common radioisotopes are described in great detail. Of particular note are graphical presentations of the fission product gamma-ray intensities in which fine scales are provided so that data reading can be accomplished without the all to frequent chore of interpolating on a scale which is neither centimeters nor inches, and a fine tabulation of capture $\gamma$-ray spectra which should save many hours of literature searching.

The difficult problem of neutron attenuation forms the subject of the next chapter, and the very considerable volume of data and available techniques bear witness to the amount of work that has been done in this field during the last decade. A welcome addition to this chapter is a discussion of neutron detection techniques, of particular importance in a topic in which the dose rates are number flux dependent. However, the over-all treatment is aimed at the specialist in the field, and the newcomer will find this chapter hard going. In particular, the discussions of the removal cross section method does not draw sufficient attention to the underlying principles, nor give any examples of the criteria to be evaluated for its application. From an English standpoint, too, it is unfortunate that the closing date for references does not allow a more detailed discussion of the "multigroup removal source" method which has been applied so successfully by the Harwell group to concrete and multilayered iron–water shields. These are, however, only minor omissions in an otherwise detailed and authoritative treatment of a difficult topic.

In contrast, the calculation techniques for $\gamma$-ray attenuation have remained virtually unchanged since the first edition. The subsequent chapter on $\gamma$-ray attenuation, then, bears an air of confidence which makes for easy reading, and leads the reader gently from the simple concept of attenuation in a narrow beam to the rather sophisticated treatment necessary at deep penetration.

A very full discussion of the geometrical transformations and analytic techniques so necessary in shield design follows; a new feature here which the reviewer found particularly interesting is the semianalytic approach to spherical shields due to Ascoli and hitherto unpublished. Formulae are tabulated for all the usual geometrical models used in shield design, and here too, the presentation of data in graphical form is beautifully done.

The next chapter deals with the topic of radiation streaming in ducts and voids in shields, and gives an adequate presentation of the semiempirical approach to the problems of straight, cranked, and offset ducts in homogeneous materials. The closing date for references has unfortunately limited the treatment which could be given to this subject also; the interest in gas-cooled reactors in the U.K. has recently produced a great volume of experimental data which could be profitably incorporated in the next edition of this volume.

The treatment of bulk shields is then concluded by a discussion of the problems of heat generation in shields; the general principles are discussed in some detail and illustrated by special reference to the important case of concrete shields. Although the treatment given is adequate to give the nonspecialist a good start, it does not discuss the design criteria for thermal shields, which are often a very expensive item on the shielding account. The raison d'être of shield heating criteria could also have been examined in more detail; for example, since a concrete shield has often only to bear its own weight, the production of reasonably crooked cracks cannot affect the integrity of the shield. Thus, it may be argued that the prime objective of heating calculations is not necessarily the determination of thermal stresses, but, more importantly, the dehydration effects and consequent deterioration of the neutron characteristics which accompany high temperatures. Here is a rich field for the concrete engineer and physicist which, to the reviewers knowledge, lies relatively unexplored.

A tantalizingly few pages on the principles of shield optimization then leads to the final chapter on air, ground, and structure scattering of radiation. This is new to the handbook, and stems from the recent declassification of a large volume of work on this subject in the aircraft propulsion program. Most of the work is presented as basic experimental data with, perhaps understandably, little correlation. Much remains to be done here, although the presentation will allow many hitherto intractable problems to be solved. The reviewer was enraged by the profusion of units in this chapter, however; after the pleasure of reading a book in which all the units have been very carefully arranged to be consistent, to be confronted with a graph of dose rate in r/hr as a function of source-detector separation distance in feet for an air density given in gm.cm$^{-3}$, for example, was a traumatic experience.

It is, of course, a reviewer's task to criticize, and it should be recognized that the criticisms made of this volume are mainly those of omission. Indeed, it is difficult to find anything else to criticize; many of the authors have made important and original contributions to the subject, and their labors have produced a volume which should form an essential part of any shielding reference library. It is attractively bound and beautifully printed, and the reviewer could only find one trivial error in the whole book.

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**Metallurgy and Metallography of Pure Metals.** Edited by V. S. Yemel'yanov and A. I. Yevstyukhin. English edition edited by B. Chalmers. Gordon and Breach, New York, London, 1962. 340 pp.

This very interesting book is an English translation of a series of lectures presented in scientific conferences at The Moscow Institute of Engineering Physics during 1957 and