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 (γ, n) reactions, and gamma radiation from fission, the fission products, (n, γ) 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 γ-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 γ-ray attenuation have remained virtually unchanged since the first edition. The subsequent chapter on γ-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

1958. The volume was originally published in Russian in 1960.

The book contains papers on a wide range of subjects, including production of thorium, chromium, niobium, zirconium by the iodide process, and the properties of the metals produced; survey discussions of the metallurgy of beryllium and the rare-earth metals; the problems associated with using liquid Li as a reactor coolant; and the distribution of alloy constituents after a number of heat treatments.

The first four chapters describe Russian use of the iodide method for refining Th, Cr, Zr, Hf, and Nb. (Nb metal refined by the iodide process is confusingly called "niobium iodide.") The mechanical properties of the products are compared with the same metals refined by other techniques. Analyses for nonmetallic impurities are not given. Chapter 5 describes in detail an investigation of the Zr–Al–Be phase diagram.

Chapters 6, 14, 15, 16, 17 describe studies on liquid Li technology. These include production and uses of Li (a survey paper), measurements of solubilities of Fe, Cr, Ni, Zr, and U in Li, and studies of interactions between Li and components of steels. These chapters are of considerable interest to U. S. workers in liquid metals technology. The conclusions are similar to those of U. S. writers in this area. Results of the radioactive tracer experiments to determine the role of C, P, S in steels on their behavior in Li are particularly interesting.

Chapters 7–13 describe work on oxidation of Zr and on diffusion and electrodiffusion in Zr-base alloys. The paper on oxidation of Zr alloys offers little that is not familiar to U. S. workers in this field. The diffusion and electrodiffusion studies are particularly interesting because of the extensive use of radioactive tracers and autoradiography. Alloying elements studied include Sn, C, Pb, Ag, and Ni.

Chapters 18–20 describe an internal friction apparatus suitable for measurement up to 1600°C, and the results obtained with it on U and on Zr and Nb and their alloys. Measurements include temperature dependence of the shear and elastic moduli, and their behavior during structural changes.

Chapters 21–25 describe work on the distribution and diffusion of C, S, P, Fe, Ni, Cr in steels using radioactive tracers. The results using radioactive P and S are especially noteworthy.

The final two chapters survey the production and uses of rare earth metals and Be and are principally survey papers. Much discussion is made of the use of Mg alloys with Th and rare earths in the U. S. for jet engines. Russian techniques for melting and casting Be are described.

The title of the book obviously does not indicate its diverse contents. As in any foreign translation the choice of technical words is not always ideal; the meaning, however, is always clear. References are nearly all to Russian work or to the Russian language editions of western writings. Names of Western authors are often distorted upon retranslation and have not been corrected by the editor. A reconversion of references to those familiar to readers of the English edition would have been desirable. The book is not indexed.

This book gives a very interesting description of Russian research in metallurgy. Experimental techniques are often carefully described with clear drawings. Its usefulness as a reference lies principally in the interesting work with autoradiography, which this book shows to have become a powerful metallurgical tool, and in the studies of phase transformations by internal friction measurements.

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(About the Reviewer: Dr. John R. Weeks is currently group leader in corrosion research in the Metallurgy Division at Brookhaven National Laboratory. Since coming to Brookhaven in 1953, he has been engaged in research in liquid metal corrosion and liquid metal fuel constitution, and is currently materials consultant for the high flux beam reactor under construction at Brookhaven. During 1962–3 he served as an adjunct associate professor at the State University of New York at Stony Brook.)

Advances in Computers, Volume 3. FRANZ L. ALT AND MORRIS RUBINOFF, eds. Academic Press, New York, 1962. 361 pp. $12.00.

This book, Volume 3 of *Advances in Computers*, is the latest and best of the three volumes which have been published in this series. It also contains more information of interest to members of the nuclear science and engineering fields than the previous two volumes.

The book consists of six articles:

The Computation of Satellite Orbit Trajectories, by Samuel D. Conte, pp. 2–76.

Multiprogramming, by E. F. Codd, pp. 78–153.

Recent Developments in Nonlinear Programming, by Philip Wolfe, pp. 156–187.

Alternating Direction Implicit Methods, by Garrett Birkhoff, Richard S. Varga, and David Young, pp. 190–273.

Combined Analog-Digital Techniques in Simulation, by Harold K. Skramstad, pp. 275–298.

Information Technology and the Law, by Reed C. Lawlor, pp. 299–346.

The first article dealing with the computation of satellite trajectories is very comprehensive and presents a thorough discussion of various methods of numerically integrating systems of ordinary differential equations. The discussion involves a consideration of the complexity of the integration formulas, their flexibility, their speed, their accuracy including round-off, and the computer storage requirements. The various methods are compared with the above considerations and numerical results are presented. This article should be read by anyone concerned with nuclear space flights or reactor kinetics calculations.

The article dealing with multiprogramming deals with the concurrency of operations within computer systems. While this is of considerable importance in speeding up reactor calculations, it is not of direct interest to members of the nuclear field.

The discussion of nonlinear programming indicates the general methods which are used in attacking systems of nonlinear algebraic equations. Linear and nonlinear programming has found considerable use in solving economic, scheduling, and distribution problems. A theoretical discussion is given of the methods of differential gradient, large-step gradient, simplicial, columnar, and the cutting-plane. References are given to computer routines and the literature.