than trying to review the experimental information in the field (already well done by Billington and Crawford[1], which, however, needs updating), he has tried to present the ideas behind present-day research in radiation damage, and to expose some of the controversies and weak points in the theory. Quite a bit of experimental information is included to emphasize or illustrate various points. The initial impression of the book is that a really large number of areas of research are discussed with quite a few references, that considerable care has been taken to give credit to the original investigations in each case, and that a respectable percentage of the physical concepts are given precise formulation, following the treatment of the original papers.

However, in the opinion of the reviewer, the book, upon closer inspection, does not live up to this promise. It is not clear for what audience the presentation is designed. It is far too detailed to serve as an introduction to the field for a general reader (as, for example, the recent book by Chadderton[2]), yet far too incomplete to serve as a reference book for workers in the field. If regarded as a possible textbook, it would have to be for students at the advanced undergraduate or graduate level because of the nature of the theoretical material included. However, it is as regarded from the pedagogical viewpoint that the book shows its greatest failings. The author approaches each topic through a few general statements and immediately launches into an outline of a detailed theory, following some original article. The treatment is such that in most cases there is not enough explanatory material nor enough precise definitions to permit a student to master the subject. This is in contrast to the recent (1965) monograph by G. Leibfried[3] (consistently misspelled in this book as Liebfried) which is clearly and well designed for graduate students.

To this the reviewer must add another and perhaps more severe criticism. It does not seem that the author has sufficiently digested the material (admittedly a vast amount) which he has tried to cover. In many important instances the basic concepts are presented in a way which is misleading or even incorrect. As an example, in discussing dimensional changes in crystals brought about by introduction of point defects (p. 153), the author states that the simultaneous creation of a vacant lattice site and an interstitial atom in the crystal, to a first approximation, increases the volume of the solid by one atomic volume; the creation of an interstitial atom alone, to first order, does not produce any volume increase; the creation of a single vacant lattice site, to first order, increases the volume of the solid by one atomic volume. By "first order" in this case the author makes clear that he means "neglecting lattice relaxation." These mistakes occur so often that the text cannot be regarded as reliable.

In spite of this shortcoming, the book could serve a useful purpose, because of the references accompanying each topic, which would permit the reader to fill in the gaps and correct the errors. However, the author has slanted his references toward the early publications in each area, so that the book cannot serve as a guide to current research. For example, neither of the recent books by Leibfried[3] and Chadderton[2] is referenced. As another example, the brief discussion of conductivity and color centers in ionic crystals has only five references. Four of these are to research papers dated 1953, 1950, 1955, 1957; one reference is to a review article which appeared in 1952.

All in all, the reviewer must conclude that this book provides neither a good review nor a good textbook, both of which are needed (in English!) at the present time in the field of radiation damage.

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About the Reviewer: D. K. Holmes is a theoretical physicist in the Solid State Division of the Oak Ridge National Laboratory. At Oak Ridge since 1949, he has been active in reactor projects and nuclear physics as well as his specialty, which is radiation damage in solids. He is a coauthor with R. V. Meghreblian of the text Reactor Analysis *(McGraw-Hill, 1960).*

[1]D. S. BILLINGTON and J. H. CRAWFORD, Jr., *Radiation Damage in Solids*, Princeton University Press (1961).

[2]LEWIS T. CHADDERTON, *Radiation Damage in Crystals*, Methuen and Co. Ltd., London (1965).

[3]G. LEIBFRIED, *Bestrahlungseffekte in Festkörpern*, B. G. TEUBNER Verlagsgesellschaft (1965).

Introduction to Nuclear Physics. By Harald Enge. Addison-Wesley Publishing Company, Inc., Reading, Mass. (1966). 582 pp. $12.75.

In this age of proliferating textbooks and publishers of textbooks it is a real pleasure to read an outstanding new book. It is probable that Professor Enge's *Introduction to Nuclear Physics* will become a new standard.

This book is intended for the advanced undergraduate or beginning graduate student of nuclear engineering or physics. It will also occupy an important position as a general reference, and is well organized for both purposes.

The plan used in most of the chapters is the description of recent examples of important experiments, followed by theoretical discussion. This is a good choice, partly because it is no longer feasible to write a nuclear physics text from an historical viewpoint. At the same time, the nature (or, if you prefer, the temporary lack of theoretical unity) of nuclear physics precludes the use of a purely deductive approach in an introductory book. Ample references permit both the antiquarian and the deductive theorist to pursue his hobby.

Encyclopedic introductory material has been kept to a minimum. The reader is soon at work on important problems (e.g., deuteron structure and partial wave scattering). The treatment of the shell model is good, and this reviewer was transported to his first American Physical Society meeting in January 1950, where Maria Mayer, cigarette holder in hand, lectured on the strong spin-orbit coupling.

The treatment of the collective model is too brief. However, it is followed by thorough and well-written treatments of the classical topics of stopping power, detection, radioactivity, gamma transitions, internal conversion, alpha and beta decay, accelerators, and particle sources. The next chapter, "Nuclear Reactions," is particularly good, containing treatments of charged-particle-reaction spectroscopy, neutron spectroscopy, compound-nucleus theory, resonance reactions, the optical model, stripping reactions, Coulomb excitation, and photonuclear disintegrations.

The short chapter on nuclear energy is a marvel of economy. A little more detail might have prevented confusion about the role of delayed neutrons. One is left with an estimate of exponential period for a thermal reactor that is computed without delayed neutrons, closing with the vague observation that: "When k is made so small that the buildup of neutron density depends on the delayed neutrons, the time constant for the buildup rate will, of course, be strongly influenced by the half-life of the delayed neutrons." When it is noted that the only fast reactor mentioned is a bomb, an unsophisticated reader might be left with some doubts about controllability and safety. Also, the passing reference to breeder reactors leaves the impression that breeding and conversion are the same thing.

The final chapter is a neat summary of "elementary" particles, closing with the Oriental mysteries of SU(3) and the eight-fold way. Appendixes include thumbnail sketches from quantum theory together with a table of nuclides. A useful set of problems has been appended to each chapter.

Regarding the book as a whole, there is very little to complain about. The "Name Index" omits Feynman, Wigner, and Oppenheimer. Max Born is cited only once; the Born approximation might have had more than this one passing reference. Neutron resonances and the Doppler effect are too lightly treated. The "Subject Index" has no "barn," although the unit is employed several places. One other personal parochialism might be expressed: Much space is devoted to operating details of nuclear machines other than reactors (e.g., Appendix 2, "Ion-Beam Focusing and Dispersion, etc."). A reactor man might justifiably demand equal time or at least a few details about experimental facilities of research reactors.

The style of the book is good. Nuclear physics "shop talk" is at a minimum, and where used, it is used gracefully. The neologistic infinitive "to momentum-analyze" (p. 5) is regrettable, but the author commendably refrains from using "to least-squares-fit." (Nuclear physics is fortunate in not having people who try "to bang-bang-control.")

Professor Enge has written a fine, well-balanced introduction to low-energy nuclear physics, and it is to be highly recommended for use in formal courses and individual study.

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About the reviewer: Dr. Hetrick is Professor of Nuclear Engineering at the University of Arizona. His current interests in graduate teaching and research are nuclear reactor dynamics and safety. He was a reactor physicist at Atomics International for nine years, and has taught physics at Rensselaer Polytechnic Institute and San Fernando Valley State College. He received his PhD in theoretical physics at UCLA in 1954.

Beryllium, Its Metallurgy and Properties. Edited by Henry H. Hausner. University of California Press, Berkeley and Los Angeles, California (1965). 322 pages. $9.00.

In recent years the prima donna of metals, beryllium, has largely forsaken the nuclear field for a rendezvous with space. The brittleness problem continues and partial compromise is effected at high cost. The latter is aggravated by the fabricator's inclination to charge what the traffic will bear.

The highlights of current technology are covered in this book based on the lecture notes of some eighteen specialists. The result is an easily readable volume which provides a fairly good overview of the field except for undue emphasis on reactor applications. With this background the reader of technical training, preferably in metallurgy, should qualify as an "instant" beryllium expert.

Characteristic of current low publication standards, the editing leaves much to be desired. Numerous corrections cover the gamut ranging from careless typographical errors to questionable or outright incorrect information. The haste in preparation is perhaps most evident in the figures. Cross referencing between chapters is essentially nonexistent. Duplication is especially conspicuous in the chapters on ductility and future research. A glossary would have been useful, particularly to the reader of limited metallurgical background. Finally, the omission of an index is quite inexcusable.

Accordingly, for treatment in depth the reader will have to resort to the older monographs by White and Burke and by Darwin and Buddery, plus several symposia. Of the latter the most recent is the two-volume AIME symposium, *Beryllium Technology* edited by L. M. Schetky and H. A. Johnson.

Detailed comments have been sent to Dr. Hausner, of powder metallurgy renown, who now largely divides his time between teaching and consultation on materials development.

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