for high school science teachers. It should also be of interest to those in nontechnical work who would like to become acquainted with the nuclear field. It is not recommended as a text for college use.

The last section of the book is devoted to a series of diverse experiments or demonstrations which can be performed with a "minimum of special equipment." Several of the experiments involve the construction or assembly of equipment which can be used as part of other experiments. The outlines of experiments are very concise showing the materials to be gathered, the procedures or methods to follow, and the results or conclusions that should be reached. The experiments range from the response of yeast cells to irradiation (ultraviolet) to the fabrication of fuel elements. The latter experiment obviously requires some special equipment.

The book is well written and serves as an excellent introduction to the field of nuclear science and engineering.

P. F. Pasqua
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Knoxville, Tennessee

(About the Reviewer: P. F. Pasqua is Professor and Department Head in the Nuclear Engineering Department of the University of Tennessee. He has been on the staff of that university for the past nine years. He obtained his Ph.D. at Northwestern University in 1952.)

Rare Earth Alloys, A Critical Review of the Alloy Systems of the Rare Earth, Scandium and Yttrium Metals. By Karl A. Gschneider, Jr. Van Nostrand, Princeton, N. J., 1961. 449 + xiii pp. $12.75.

Scientists whose field includes the rare earth metals should be interested when a man who works at the Los Alamos Scientific Laboratory writes a book on alloys of the lanthanons. When this man has previously worked with Spedding and Daane at the Ames Laboratory and has received the PhD at Iowa State University, the probability is strong that the book will be good and that the author will know whereof he speaks.

Dr. Karl A. Gschneider, Jr. has made a very scholarly effort to collect and to evaluate data critically on the physical metallurgy of alloys containing one or more of the lanthanons, scandium, or yttrium. Data not readily accessible in the United States, particularly information published in some rather obscure Russian journals and books, are included. One hundred phase equilibrium diagrams have been redrawn after being carefully checked against all available sources of information.

The book is well-written. Organized into four sections, its first part deals with the physical properties of the metals themselves. The second section is given over to presentation of the phase equilibrium diagrams, together with an excellent discussion of some applicable portions of the theory of physical metallurgy. A particularly well-written discussion of the Hume-Rothery Rules and the related Darken and Gurry Plots furnishes some meat for the first section of Part II. Darken and Gurry ellipses for eight of the lanthanons are presented in the book. Part III is a carefully and critically evaluated collation of the crystallographic data on the lanthanons, yttrium, and scandium. Part IV, consisting of a list of all references cited in the previous parts of the book, actually forms a bibliography on rare earth alloys with 653 entries.

One of the most useful aspects of this book is the excellent job of indexing. All binary systems are indexed separately, followed by an index to multicomponent systems. A one-page index to structure types is useful, as is the complete author index.

Many people feel that a book reviewer has not done a good job unless he finds something about which to complain. In order not to disappoint these good people, your present reviewer would make a point that Dr. Gschneider, in his urgent efforts to pick the brains of the eminent Russian experts, may have overlooked a few items of good American work. For instance, the work of Robertson and Kato, at the Albany Station of the U. S. Bureau of Mines, was rather inadequately covered. Kato's work on the dysprosium–zirconium system, complemented by that of Ray and Wasielewski at KAPL on additions of dysprosium to Zircaloy-2, was missed. However, in defense of the author, it was impossible to find, even with reasonably diligent searching, any place in the book "Rare Earth Alloys" where Dr. Gschneider laid claim to complete coverage of all the bits of published information in this broad field.

This is a good book. The style of writing is excellent. Dr. Gschneider says briefly and lucidly what he means. The text is easily understood. No efforts at pedantry were found, and most of the book could be read with understanding and profit by even senior undergraduate level college students of metallurgy or physical chemistry. The format for the book is slightly unconventional, but not in any sense offensive. On the contrary, the format serves its purpose quite well, improving the facility with which the book may be used for reference. This reviewer can only join Dr. Gschneider in recommending the book to those physicists, chemists, and metallurgists engaged in research "in the field of metals" as well as solid state physicists, physical chemists, and engineers who have even a passing idea that some alloy containing yttrium, scandium, or one or more of the lanthanon metals might help them to arrive more quickly at some desirable end.

W. Kermit Anderson
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(About the Reviewer: Dr. W. Kermit Anderson is Consultant—Materials Engineering to the staff of the Materials Development Operation at the Knolls Atomic Power Laboratory. Trained in chemical engineering and physical chemistry at the Agricultural and Mechanical College of Texas, he received the first PhD granted by that institution in the physical sciences. His interest in the rare earths was first aroused at Oak Ridge during a search for high efficiency shielding materials while employed by the NEPA project. This interest was maintained during employment at the Argonne National Laboratory and, more recently, at the Knolls Atomic Power Laboratory, where his desire to apply the lanthanons as absorbers for control of reactors has led to several publications in the field.)

Protective Construction in a Nuclear Age. Proceedings of the Second Protective Construction Symposium: The Rand Corporation. J. J. O'Sullivan, editor. Macmillan, New York, 1961. 2 vols., 884 pp. $25.00.

Collected in these two volumes are 45 papers presented at the Second Rand Corporation Protective Construction

Symposium, held in March 1959. These proceedings, originally circulated to the Symposium attendees in loose-leaf notebook form, remain almost unchanged in the hard-cover version. The papers are grouped into the following sections:

General Problems
Problems of the Underground Area
Site Selection for Deep Underground Installations
Design of Exposed Items
Utilities for Deep Underground Installations
New Construction Methods and Equipment
Underground Construction Experience
Nuclear Burst-Underground Phenomena

Most attendees were connected in some way with the military, and the emphasis is heavily placed on underground construction for military offsensive forces, with only a few papers contributing to the problems of nonmilitary protective construction. Even the military problem is somewhat unevenly handled. For example, in the section on General Problems, Herman Kahn discusses the philosophy of thermonuclear war and the need for protected offensive forces without so much as mentioning the relative merits of hardened versus mobile forces.

Where uncertainties are as great as in the construction of hardened military installations, the avoidance of problems is often a sign of prudence not cowardice. One such case occurs in a discussion on the vulnerability of communications. Proposed solutions include duplicate facilities, hardened facilities, routing of communications around target areas, and diversification; the latter two are chosen, apparently only because of the higher costs and many uncertainties of the former. Occasionally, the existence of problems is overlooked. Two papers concerned with communication systems consider only mechanical effects (blast), avoiding completely the possibility of electromagnetic effects on hardwire systems or the nuclear blackout of radio communications.

Another point concerns an inherent weakness in a collection of this kind, namely, that the reports are separate and are not integrated to focus directly on the pertinent problems. For example, there are two excellent papers in the section on Problems of the Underground Area, one on the dynamics and mechanics of spalling by John S. Rinehart and another concerned primarily with static stresses around openings in rock by Wilbur I. Duvall. Had these papers been prepared together, spalling around openings in rock could have been considered and a much more significant contribution made to the design of shock-resistant tunnels.

Sherwood B. Smith ably summarizes the damage produced on tunnels in tuff by deep underground nuclear bursts of relatively small yield. While such bursts cannot be compared directly with the large-yield surface bursts to be expected in a nuclear attack on hardened bases, this is still probably the most useful information now available for the design of underground facilities.

Edward Cohen suggests a number of clever arrangements for blast-resistant openings, including several that are fail safe, and H. L. Brode proposes novel means for reducing air blast in tunnels. Typical of the lack of integration is the fact that while Brode deals with a surface burst of several megatons—a logical choice against the hardened targets being considered—the authors of a following paper on antenna hardening inconsistently deal with air bursts of a few tens of kilotons.

In the section devoted to the design of utilities for underground facilities, major emphasis is placed on the provision of heat sinks for the period during which access to the outside is denied. (Here another inconsistency is noted when one compares the long periods of "button-up" considered with the use of fast-acting blast valves mentioned earlier.) While conventional engineering procedures are used to determine the heat-sink requirement, no attention is paid to the vulnerability of the utilities, except that isolation from exterior blast is presumed.

Some of the papers are tutorial; instances are "Adaptation of Oil Well Drilling Techniques" by Gene Graham and "Recent Developments for Drilling Large Diameter Hlles" by John C. Haspert and Jack McKinney. They described methods in current use, but the relation of these techniques to the problems of protective construction is left for the reader. Furthermore, the articles on tunneling and mining techniques seem far more pertinent to protective construction problems than those on vertical drilling techniques. Especially noteworthy is the article on high-speed, low-cost excavation methods by J. J. Walsh and Robert Budd, whose contribution stems not so much from improvements in technology as from a careful re-evaluation of the mining operation.

In the section on Underground Construction Experience are several excellent descriptions of the design and construction of underground power stations, again without specific relation to military problems. The best is a description of the Australian Snowy Mountain Hydroelectric Authority program written by Thomas A. Lang; of special interest are the applications of small-scale laboratory models to the investigation of critical stress problems in rock.

The last section, Nuclear Burst-Underground Phenomena, consists of the reports of three working groups which met separately but as a part of the Symposium. These groups considered both present knowledge of basic phenomena and ways in which understanding could be improved in the areas of cratering, wave propagation, and underground structures. Since the recommendations of these committees are of great interest to research workers in these and related fields, it seems that a more extensive treatment than that given was warranted.

Briefly, these volumes constitute a state-of-the-art presentation, as of March 1959, to the extent permitted by classification. In reading the proceedings, one is conscious throughout that the new ideas and concepts presented are based almost entirely upon intuition, conventional techniques, and practical experience; extrapolation of theoretical consideration or engineering principles into areas of uncertainty is notably lacking. Only in the last section is the needed bid for a better understanding of basic phenomena made.

Illustrations at the end of each paper rather than inserted in the text are always an irritant.

The major accomplishments of the Symposium were to bring related (although sometimes only remotely related) experience and techniques to bear on military problems and to introduce new faces into an already somewhat inbred discipline. However, an omnibus of this kind can be expected to receive little attention from those not concerned with problems directly related to hardened underground facilities for the military.

L. J. VORTMAN
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(About the Reviewer. L. J. Vortman has been associated with the Nuclear Burst Physics Department at Sandia Corporation, Albuquerque, New Mexico, since 1949. There, he has accumulated experience in weapon effects with emphasis on air blast loading and underground phenomena, especially explosive cratering. Since 1955, he has directed Program 34 of the AEC's Civil Effects Test Group at the Nevada Test Site. He is currently a member of the Subcommittee on Protective Structures of the National Academy of Sciences.)

Treatment and Disposal of Radioactive Wastes. By C. B. AMPHLETT. Pergamon Press, New York, 1961. 289 + viii pp. $12.00.

As the preface of this book points out, the field of radioactive waste treatment has recently been undergoing considerable development. In the early stages of nuclear energy, the emphasis was entirely on rapid production and the waste which could not be dispersed to the environment was simply stored; concentration by evaporation was almost the only treatment used.

Recently many new processes have been investigated, most in the laboratory but some on a field scale. Dr. Amphlett, of the Chemistry Division at Harwell, has written this book with the intention of describing these developments, from both the fundamental and applied viewpoints. He has succeeded admirably and his book will be of great importance, not only to those directly concerned with treating radioactive wastes, but also to a great many in the nuclear industry and in fields connected with public health.

The book begins with a discussion of the origin and nature of radioactive wastes, considering quantities, radiochemical properties, behavior in the environment, legal and economic factors, and the relative hazards of various types. This is followed by three chapters on the treatment of high level wastes, including chemical separation, evaporation, and fixation as a solid. In each of these chapters the approach is to describe first the theoretical basis, then the existing practice, and finally new methods which are still experimental. There follows a chapter on disposal of solid wastes including incineration and burial or storage.

A long chapter on the chemical and biological treatment of wastes containing low and medium activity levels follows. The treatment here is historical and very complete, possibly too complete. Some of the early work in this field might well have been passed over.

The next chapter covers disposal to the environment, including discharge into the ground, into rivers, and into the sea. Here again for each of these methods of discharge, the author has considered the principles involved, and then the actual operating procedures. Both American and British practices are given, the differences in attitude often being very interesting. Treatment and disposal of gaseous wastes, both particulate and vapor, is next presented, followed by chapters on minor waste problems such as isotope users, and on the future in waste treatment and disposal.

Dr. Amphlett has done a remarkable job of covering the many diverse aspects of radioactive wastes. He appears equally conversant with all these aspects, and his coverage is both thorough and clear. Bibliographies at the end of each chapter are extensive, covering the literature generally into 1959 and including the large volume of information presented at the Second Geneva Conference on the Peaceful Uses of Atomic Energy in 1958.

Taken all in all, this book is a must for anybody seriously interested in the problems associated with radioactive wastes. The only serious fault I can find with it is that the price of $12.00 will make it inaccessible to many individuals who will unfortunately have to rely on library copies.

ABRAHAM S. GOLDIN
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(About the Reviewer: Abraham S. Goldin has specialized in environmental radionuclide analysis, radioactive pollution, and radioactive wastes. He received his Ph.D. degree from the University of Tennessee. From 1943 to 1950 he worked for the Manhattan District, first at Columbia University and later at the Gaseous Diffusion Plant at Oak Ridge. Following this he spent nine years at the U. S. Public Health Service in Cincinnati as Chief Radiochemist. After serving for a time as Chemical Director of the Atomic Energy Commission's Winchester Laboratory and as an Associate Professor of Industrial Medicine at New York University he has just become Deputy Officer-in-Charge of the Northeastern Radiological Health Laboratory, U. S. Public Health Service.)

Criticality Control in Chemical and Metallurgical Plant. (Proceedings of the Karlsruhe Symposium, 1961, sponsored by the Organization for Economic Co-Operation and Development of the European Nuclear Energy Agency.) (About 90% of the book is in English, and the remainder in French.) 1961. 622 pp. $10.00.

This compilation of the papers and discussions given by many of the leaders in the field of criticality control (nuclear safety), succeeds very well in covering the entire subject from its theoretical and experimental aspects to its practical applications and even some administrative methods currently in use. The summarized discussions following the various papers are of particular note, and rather complete bibliographies are given for each subject. The printing and binding are excellent.

For obvious reasons, the book does not have the continuity and conciseness of a single-author document, and there is some repetitiveness and apparent minor contradictions in the different sections. Indications of personal preference of the various authors are usually handled with restraint, although there are some instances in which what is identified as an over-all summary or review of a given subject is treated somewhat as would be a research-type paper given at a professional meeting to present an apparently recently developed theory or interpretation.

The book does not have a preface indicating clearly its purpose, nor a simple summary of the basic principles upon which practical criticality is based, but these factors are covered by indirection in the various sections as well as in the bibliographical references and discussions.

The excellent and up-to-date summaries given of experimental data now available from various laboratories are especially noteworthy, and these sections provide what are probably the most valuable single contribution of the volume.

The presentations of theoretical methods are individually well handled and summarized. However, correlations between theory and experiment and their application to practical problems are not as well treated as might be desirable. Thus, the theoretical methods are presented in some