Book Reviews

Principles of Isotope Geology. By Gunter Faure. John Wiley and Sons, Inc., New York (1977). 423 pp + appendixes and indexes. $19.95.

In the opinion of this reviewer, this is a very thorough, authoritative, up-to-date, and well-presented treatment of the subject of isotope geology. Its 21 chapters consist of 5 introductory chapters (on radioactive decay and mass spectrometry), 11 chapters on the principal methods of geological age dating (Rb/Sr, K/Ar, U/Pb, Th/Pb, Re/Os, Lu/Hf, and K/Ca methods and their various modifications), and 5 chapters on light-element dating methods (hydrogen, carbon, oxygen, and sulfur). The book also includes two appendixes and author and subject indexes. Each chapter is well supplied with literature references, ranging from 7 to 107 references per chapter, with a mean of 49 references per chapter. The text portions of the chapters range from 6 to 31 pages per chapter, with a mean of 16 pages of text per chapter. From the standpoint of its use as a textbook, it should be noted that all but two of the chapters have a number of problems at the end—ranging from 3 to 14 problems per chapter, with a mean of 6 problems per chapter.

In general, each chapter is replete with explanation, derivations, equations, tables, and graphs. Of particular interest to chemists and archeologists, the chapter on ^{14}C age dating is well done and up to date, and the chapters on the fission-track method of dating and those devoted to isotopic fractionation in nature are of particular interest. As with most first printings of first editions, the book contains a modest number of errors, mostly typographical. (These have been called to the attention of the author and hopefully will be corrected in later printings.) It should be emphasized, however, that these minor errors do not significantly detract from the usefulness and value of this excellent book.

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About the Reviewer: Vincent Guinn, with experience in radioactive matters spanning nearly three decades, again reviews for us, this time Professor Faure's writing on isotope geology. Professor Guinn is at the Irvine Campus of the University of California. His current academic responsibilities were preceded by industrial-laboratory experiences at Shell Development and General Atomic. Professor Guinn's graduate training was at Harvard.

Nuclear Power Reactor Safety. By E. E. Lewis. John Wiley and Sons, Inc., New York (1977). 630 pp. $32.00.

In the Preface, the author of the book states "It is difficult to recommend a reference to which a student, faculty member, or practicing engineer can turn for a unified overview of reactor safety. The objective of this text is to fill this void by providing a coherent treatment of the primary facets of reactor safety within a single volume of reasonable length. . . . Because the study of reactor safety must necessarily cut across many scientific and engineering disciplines, it is impossible to cover any one aspect of the subject with the depth available in more specialized publications. Thus, instead of emphasizing computational refinements, I have attempted to utilize the simplest mathematical models that will provide a quantitative understanding of the more important phenomena: Neutronics is treated with one-group diffusion theory, heat transfer by lumped parameter models, and so on. Where these models are inadequate, emphasis is placed on the graphical presentation of results obtained from more sophisticated analysis or from experimental data."

In effect, the author has recognized in his Preface the very great difficulty in writing a textbook about so broad a subject as power reactor safety. Were it easy, the two thick volumes on *The Technology of Nuclear Reactor Safety* by Thompson and Beckerley would have been followed by several textbooks by now.

To this reviewer, the question of whether the author has met his objective will, in large part, depend on the degree of sophistication sought by the reader and user of the book. For the faculty member new to reactor safety who seeks a readable, introductory text, the book may be quite suitable. The book is clearly written and includes background material and a skillful discussion of physical concepts and phenomena important to most of the safety topics treated. The book should be quite readable for most MS candidates in nuclear engineering.

For the faculty member or student seeking an intermediate or more advanced level of treatment of reactor safety, however, the book will not be adequate. And it generally does not provide enough tools to facilitate the step into a more advanced treatment.

The chapter headings are as follows: Chap. 1, Nuclear Power Reactor Characteristics; Chap. 2, Safety Assessment; Chap. 3, Reactor Kinetics; Chap. 4, Reactivity Feedback Effects; Chap. 5, Reactivity-Induced Accidents; Chap. 6, Fuel Element Behavior; Chap. 7, Coolant Transients; Chap. 8, Loss-of-Coolent Accidents; Chap. 9, Accident Containment; and Chap. 10, Releases of Radioactive Materials.

Clearly, a broad spectrum of safety-related topics is included, especially in view of the coverage of light water reactors (LWRs), high-temperature gas-cooled reactors (HTGRs), liquid-metal fast breeder reactors (LMFBRs), and gas-cooled fast reactors (GCFRs). Quite naturally, the depth of treatment varies. For some topics, basic analytical methods are presented, while for others, only qualitative discussion is given.

Chapter 2, Safety Assessment, provides a useful introduction into the probabilistic nature of reactor safety and a brief introduction to the basic mathematical formulation of reliability analysis.

The book is relatively self-contained with regard to one-group reactor theory, kinetics, and lumped parameter heat transfer. The one-group treatment of reactivity coefficients is clearly handled. However, the absence of a multigroup perturbation theory treatment of the sodium void coefficient represents an example of where this reviewer would have preferred a more advanced theoretical explanation. The Doppler effect is also discussed on a very elementary basis, as are moderator temperature (and void) coefficients of reactivity.

Super prompt critical transients and the Bethe-Tait disassembly model for fast reactors are treated in reasonable depth, as are the singly and doubly lumped parameter models of transient heat transfer. On the other hand, fuel element behavior and failure modes during accidents are discussed qualitatively and in an incomplete fashion.

Beyond the Bethe-Tait model, the rather considerable discussion of fast reactor safety tends to be qualitative except for simple models of the work available from expansion of the fuel vapor or sodium following disassembly.

Chapter 7, Coolant Transients, presents the basic aspects of hydraulic modeling, including natural convection. It also provides an introductory analysis of accidents involving a loss of heat sink.

The chapter on loss-of-coolant accidents (LOCAs), Chap. 8, emphasizes basic concepts and the theoretical formulation of fluid behavior during blowdown, then goes on to discuss the remainder of the LOCAs in an LWR qualitatively. The solution of the traditional depressurization accident for the HTGR is also developed.

Chapter 10, on containment, provides an analysis of a dry pressurized water reactor containment neglecting heat transfer and then correcting for it crudely; pressure suppression is discussed only briefly. The chapter includes a considerable qualitative discussion of many of the phenomena important to various aspects of containment behavior, including failure due to core melt.

The book contains 630 pages including tables and index. There are some problems at the end of each chapter. For a book covering such a wide range of phenomena and topics, the reviewer noted rather few misstatements or statements that have become dated.

In view of the absence of textbooks on reactor safety, the author is to be congratulated for completing a difficult task. Each potential user will have to judge for himself concerning its suitability.

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About the Reviewer: David Okrent has been a protagonist of nuclear reactor safety from its beginnings and has served as a member of the Advisory Committee on Reactor Safeguards since 1963. Following graduate studies at Harvard, Dr. Okrent was associated with the Argonne National Laboratory for about two decades before becoming professor of engineering and applied science at the University of California at Los Angeles. He was Isaac Taylor Visiting Professor of Nuclear Engineering at The Technion (the Israel Institute of Technology) during 1977-1978.

Heat Transfer and Turbulent Buoyant Convection: Studies and Applications for Natural Environment, Buildings, Engineering Systems. Edited by D. Brian Spalding and N. Afgan. Hemisphere Publishing Corporation, Washington, in association with McGraw-Hill International Book Company (1977). 850 pp. $75.00 (two volumes).

In recent years, the subject of turbulent free convection has continued to draw the attention of many researchers throughout the world because of its theoretical and practical importance associated with the studies of jets, plumes, building fires, nuclear reactor safety, combustion phenomena, etc. Owing to the strenuous and unremitting efforts of these researchers, our scientific knowledge of this complicated subject has shown substantial advances, some of which were reported and discussed at the August 1976 seminar of the International Centre of Heat and Mass Transfer held at Dubrovnik, Yugoslavia. This two-volume book is comprised of the more than 60 papers presented at the seminar. The papers are arranged under nine categories following the titles of the sessions in which they were presented. These are: "Interactions of Turbulence and Buoyancy," "One-Dimensional Mixing in Turbulent Stratified Fluids," "Mechanics and Heat Transfer of Layers," "Buoyant Plumes," "Buoyant Flow in Ducts," "Air and Smoke Movements in Buildings," "Free Convection in Engineering Equipment," "Free Convection Phenomena in Gas-Liquid Mixtures," and "Free Convection with Heat Addition and Combustion Phenomena." Papers belonging to the first five categories are contained in Vol. I, with the remainder in Vol. II. These classifications, however, should not be taken too rigidly, because it appears that not all papers fit perfectly into the category in which they are placed.

Because of the wide variety of topics covered and the differences in the method of approach, degree of accomplishment, and level of sophistication, it is difficult to give a brief summary of the technical contents of the papers on an overall basis. It is apparent, however, that significant achievements have been made in some areas with regard to obtaining experimental data that hitherto have been relatively scarce, developing useful correlations thereof, or seeking mathematical solutions to complicated problems, the theoretical modelings of which are made by utilizing the traditional concepts or approaches. It is also noteworthy that the relative importance of experimental study as compared to pure theoretical analysis has not been underrated; indeed, a large number of papers deal with both. The remarkable progress in recent computer technology, coupled with the ability of the researchers to postulate a turbulence model suitable for accounting for the buoyancy effect and to make use of the relevant existing or newly generated data on turbulent flow, appear to form the basis for the recent advancement in the theoretical treatment of turbulent free convection phenomena. Results of theoretical or experimental studies are reported on a variety of subjects ranging from the