Book Reviews

Advances in Nuclear Science and Technology, Vol. 6. Ernest J. Henley and Jeffery Lewins, Eds., Academic Press (1972). $14.50.

A series like *Advances in Nuclear Science and Technology* serves as the vehicle for review literature too brief for textbook or monograph form and inappropriate for journals devoted to original contributions. The articles in the earlier volumes, and this one as well, deal mostly with the physics and engineering of nuclear reactors. The range of topics appears to be restricted to a narrower scope than that covered by *Annual Reviews of Nuclear Science*. The series started in 1962, and succeeding volumes appeared approximately every year. Their aim has been to provide readers with authoritatively written reviews of selected topics, a kind of current encyclopedia.

The first of the six articles, "The Core Design of the Reactor for the Nuclear Ship *Otto Hahn*," is by D. Bünemann, M. Kolb, H. Henssen, E. Müller, and W. Rossbach. Operated as an ore carrier, the *Otto Hahn* was launched in 1964, and the reactor on board was made critical in 1968. Its core design characteristics are presented as well as the general outlines of the calculational methods. The zero power experiments are described, and good agreement was obtained between measured and calculated flux distributions. The layout of a proposed second core is discussed; the new core is to have a 50% increase in power density and a sharply increased burnup. (In the first core the burnup was 7300 MWd/MTU; in the second core a burnup of 25 000 MWd/MTU is planned for the 8 outer elements.) The authors conclude that, while the first nuclear demonstration ships *Savannah* and *Otto Hahn* have not been economical, the work done so far indicates that a nuclear ship in the power region between 50 000 and 100 000 shaft horse power can be competitive with conventional ships.

The second article by Stig-Olof Londen of the Helsinki University of Technology is entitled "Stability Analysis of Non-Linear Point Reactor Kinetics." A review of the known results concerning the qualitative behavior of the solutions of the point model equations is presented. Suggestions for further research are offered, among which is a proposal that the particular features of reactor non-linearity be taken more into consideration than has been done up to now. To quote directly: "Results worked out for more general differential or integral equations should not be blindly applied . . . there are far too many papers in reactor dynamics which only try to apply some more general criteria to [the classical point model equations] and which do not take the special features of these equations into account. Usually this approach produces overly restrictive results." Further, the author states " . . . even if the results are too restrictive it should at least be possible to convince oneself of the truth of the stated criteria by working through the proofs. It is a sad fact that this is frequently not the case." An explicit discussion of the author's reservations would have been appropriate here, but unfortunately no specific examples of such papers or proofs are given.

The third article should be of considerable current interest since it deals with "The Quantitative Description of Deformation and Stress in Cylindrical Fast Reactor Fuel Pins." The author, J. R. Matthews of AERE, Harwell, reviews the techniques and assumptions used in computer codes such as CYGRO to simulate fuel element behavior. The specific characteristics of fast reactor fuel elements are briefly outlined, followed by a discussion of the mathematical modeling of various physical problems which have been considered. A tabulation of 20 computer codes is provided with one- or two-sentence descriptions of each, together with references. The author offers general conclusions concerning specific aspects of fast reactor fuel stress calculations such as axial extrusion, fuel cracking, and clad swelling. The importance of experimental data in calculations on porous and vibro-compacted fuels is emphasized. Overall, he feels that there are sufficient mathematical techniques available to calculate fuel behavior under normal conditions.

Next, there follows a chapter by Prof. Donald R. Olander on the "Technical Basis of the Gas Centrifuge." In Europe and Japan interest in the gas centrifuge as an enrichment method is prompted both by the lack of a present commitment to gaseous diffusion technology and the enormous power requirements of the latter. The review refers the reader elsewhere for discussions of economic and engineering aspects of the gas centrifuge method and is concerned only with the analysis of countercurrent gas centrifuge performance. The separative and hydrodynamic aspects of the problem are individually discussed, and the equations, assumptions, and calculational methods of the various workers in this field are succinctly reviewed and compared.

The fifth article is "Heat Transfer in Liquid Metal Cooled Fast Reactors," by Alexander Sesonske of Purdue University. The author is concerned with giving an overall picture of the technical aspects of this important subject without excessive involvement in theoretical details. As such, both the experienced and those new to the field will find it a useful discussion of many of the principal engineering problems of LMFBRs.

The last article is by J. J. Went and W. K. Wiechers of KEMA, The Netherlands; its subject is "The Impact of Fuel Cycle Economics on the Future Development of Nuclear Power." The discussion starts out on a very elementary technical level, describing the basic facts of the fission process and the essentials of breeding and conversion. The authors then turn their attention to the economic analysis of fuel cycles. They developed a calculational model which takes into account initial loading and fissile material inventories, diffusion and fabrication plant capacities, recovery costs, and delay times in the fuel recovery process. Various alternative nuclear programs are considered in the light of assumptions of power demand and reactor characteristics. The sensitivity of the results to these assumptions was also studied. The article is quite interesting as a report of an individual study, but it is regrettable that the authors say very little to compare their work with that of others.

Melvin Tobias

Oak Ridge National Laboratory
Oak Ridge, Tennessee 37830

October 18, 1972

About the Reviewer: Melvin Tobias is a member of the staff of the Reactor Division of the Oak Ridge National Laboratory with broad interests in nuclear reactors, especially the neutronics of fusion reactors. Dr. Tobias did his undergraduate work at the College of the City of New York and completed his graduate studies in chemical engineering at Minnesota.

Neutron Activation Analysis. By D. De Soete, R. Gijbels, and J. Hoste. Vol. 34, Chemical Analysis Series, Wiley Interscience (1972). 836 pp. $36.00.

Professor Hoste and his associates have assembled something far more comprehensive than just another book on activation analysis; this volume might more properly be called "Reference Book for Applied Nuclear Techniques." Treating in considerable detail such diverse but nevertheless important subjects as nuclear models, neutron spectra in reactors, radioactive growth and decay laws in many successive decays and branchings, and absolute counting and coincidence measurements, the authors have combined clarity of presentation with a profusion of references, figures, and tables. Lest the reader think that *Neutron Activation Analysis* is concerned solely with nuclear physics and theory, let me assure him that chemical science is well represented. For example, sections on concentration and separation prior to activation, dry ashing and wet combustion, and methods for interlaboratory comparison are followed by almost 80 pages that treat the general subject of activation analysis with postirradiation radiochemical separations.

Much practical information concerning standards and their preparation, containers and canning material, and selection of facilities and equipment complements the chemical and physical sections. The chapter on systematic errors is unusually detailed and informative; a section on dead-time corrections discusses this most important and often overlooked aspect of counting. Seven appendixes provide fintertip reference to such useful data as cross sections, gamma-ray energies, and attenuation coefficients. Two features of this book satisfy particular prejudices of mine: a complete list of symbols used is given at the beginning and a comprehensive index follows at the end. Thus the book begins and ends well and provides much useful information—symbols defined and well-indexed—in between.

A sin of omission and one of commission strike my eye. The former is the scarcity of information relating to Ge(Li) spectroscopy; while Ge(Li) detectors are discussed in several places, much of the spectrometry section is built around NaI. The sin of commission, I believe, was in including almost 180 pages of a bibliographic survey of neutron activation analysis, most of which is available, and much more up to date than the apparent 1968 cutoff date here, in the NBS bibliographical publications. I can understand the desire to include such documented examples of applied activation analysis, but to consume over 21% of the book for this purpose seems a bit excessive. However, the material is there and perhaps it will be more widely seen than if left to languish in government reports and obscure publications.

Neutron Activation Analysis fills an important need: the need for a comprehensive reference covering the physics, chemistry, and technology of applied nuclear analysis. It appears to be the definitive work that activation analysts have awaited.

W. S. Lyon

Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee 37830

November 19, 1972

About the Reviewer: W. S. Lyon, head of the Nuclear Radiochemical Group of the Analytical Chemistry Division, Oak Ridge National Laboratory, is editor of one of the early books on activation analysis (1964). For ten years he has coauthored the bienniel review Nucleonics *for* Analytical Chemistry. *Recently his interests have included environmental matters and he has coauthored reports on mercury and trace elements from coal-fired steam plants, and the use of nuclear techniques in solving pollution problems. He is on the board of two international journals, active in the American Society for Testing Materials, and a member of a special subcommittee on the National Committee on Radiation Protection and Measurement concerned with neutron generator safety.*

Shock Waves in Collisionless Plasmas. By Derek A. Tidman and Nicholas A. Krall. Wiley Interscience (1971). 175 p. $10.50.

Shock Waves in Collisionless Plasmas, a research monograph, is the residue from a series of lectures given at the University of Maryland in 1968. The authors, well known and respected members of the plasma physics community, recognized that there was a large and reasonably coherent body of knowledge on collision-free shocks but it was scattered among various journals of plasma physics, fluid dynamics, and space physics. They have gathered together that information and assembled it into as reasonable an order as can be expected for a complex subject that is still not well understood. The subject of collisionless shocks is important because the phenomenon occurs in space and because shocks are used to heat plasma to thermonuclear fusion temperature. In this text a collisionless shock is defined as any transition layer which propagates through a plasma in which the classical collision times are long compared to other times of interest, and which causes a change of state. The text is about the theoretical interpretation of such shock waves, and the authors employ the Vlasov-Maxwell system of equations or fluid descriptions derived from them. Classification and analysis of shock jump conditions and shock structures constitute the majority of the text. Because of magnetic fields and the multiple mechanisms by which a shock can change the state of a plasma, the array of explanations of shock structure is