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Book Reviews

Nuclear Structure Study with Neutrons. Edited by M. Nève de Mévergnies, P. Van Assche and J. Vervier. North Holland Publishing Company (1966). 596 pp. $17.00.

This book embodies the Proceedings of the International Conference on the Study of Nuclear Structure with Neutrons held at Antwerp in July 1965. It is divided into seven sections covering the topics: I—Introduction (the basic neutron-nucleus interaction and nuclear models); II—Nuclear Spectroscopy; III—Neutron Resonances and Strength Functions; IV—Intermediate Structure and Statistical Model; V—Neutron Capture Mechanisms and Photoneutron Reactions; VI—Optical Model; VII—Special Topics (experiments with underground nuclear explosions, neutron reactions in stars, and intense neutron sources from accelerators), and ends with abstracts of the 179 papers submitted to the Conference. Few of these papers were presented orally; most were summarized by eleven speakers whose reports comprise about half the book. The other half is taken up by the contributions of nine invited speakers. To retain the "flavor" of the conference, the discussions after each paper are reproduced verbatim.

This book provides a detailed up-to-date account of the welter of results from neutron experiments of significance in the elucidation of nuclear structure. It also contains lucid descriptions of the current theories of nuclear structure that are capable of being advanced by results from neutron experiments. The best rapporteurs have been able to weld a description of recent advances in experimental and theoretical techniques and a summary of the contributed papers into an elegant whole.

It would be impossible here to comment on all the advances in technique and improved data given in the book, but some outstanding contributions must be mentioned. Vervier describes as a major breakthrough in γ-ray spectroscopy the superior resolution of lithium-drifted germanium detectors for γ-ray energies above 1 MeV and the consequences of this high resolution are well illustrated. Shapiro has produced for the first time a useful beam of polarized neutrons in the energy range below 100 keV and describes their exemplary use to determine the spins of neutron resonances in ^{165}Ho. Diven shows how the technique of using an underground nuclear explosion as a neutron source leads to the possibility of measurements with highly active samples because the intensity of the source neutrons can render the activity insignificant. Rosen describes an attempt to extract one set of optical model parameters to fit the polarization produced by elastic scattering of 14.5-MeV unpolarized protons from 50 nuclides. Variations from these parameters, required to describe results for individual nuclei, should give some information about the details on nuclear structure. Neutron reactions, (n, charged particles), (n,n'), (n,γ), and (γ,n) are all ably summarized and the continued usefulness of the statistical model is clearly explained. Malyshev gives a brief but interesting account of neutron experiments at three laboratories in the USSR. In the section on Intermediate Structure in Nuclear Cross Sections, Feshbach gives a masterly description of doorway states and indicates how their parameters may be found. By his discovery and investigation of quasi-resonances in neutron-induced fission cross sections, Lynn shows inter alia how the estimates of the number of fission channels from Bohr and Wheeler's expression and from the distribution of fission widths, which differ by a factor of about 10, can be brought into agreement. Mang's survey of nuclear models is clear and concise.

Amidst a high standard of presentation, it is a pity that the editors did not tidy up the English in one or two of the papers. What is one to make, for instance, of the sentence on page 177—"It is hard to doubt about the inadequacy of the theoretical assumptions in comparison with present experimental data"?

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About the Reviewer: Dorien James studied at Manchester University and received his PhD for research on the associated production of elementary particles by cosmic rays. He joined the Atomic Energy Research Establishment, Harwell, in 1955 and worked first on the design and assembly of the neutron booster target of the electron linear accelerator and later on the measurement of fission cross sections.

Nuclear Applications of Nonfissionable Ceramics, Proceedings of Meeting, Washington, D. C., May 9-11, 1966, American Nuclear Society, Hinsdale, Ill., 487 pp. $12.50.

The publication of these Proceedings in time to have books available at the Conference represents a great deal of effort on the part of the editors and the session chairmen and they are certainly to be congratulated. Since the papers were by invitation only, the editors utilized the opportunity to set up a well-balanced program. Subjects covered were mechanical properties, physical properties, chemical properties, fabrication processes, and applications for nonfissionable ceramics. The session on applications was quite limited in scope and one might readily conclude that there are few requirements for nonfissionable ceramics in the nuclear industry. Also it appears that the book title is not appropriate for the material covered. The only applications discussed in any detail were insulators for thermionic convertors, nuclear poisons and control materials, and shielding materials. All of these subjects are adequately covered, but the most useful information for direct application by designers or engineers is contained in the paper by Grossman and Kaznoff on thermionic insulators.

Most of the papers in other sessions covered information of general interest to ceramists, e. g., the paper by Blocher and Bowers on nonconventional ceramic-forming methods or the papers by R. J. Stokes or Parikh on mechanical properties. However, there are several papers of direct interest for engineers concerned with the application of ceramic materials in any radiation field. These include a paper by Clarke and Wilks of the UKAEA on the effects of irradiation on mechanical properties. In this paper, particular emphasis is placed on the nature of defects produced by irradiation and their effect on mechanical properties. For those persons not familiar with radiation damage to ceramics, this paper can provide basic background information.

All of the papers in the section on physical properties include information on the effects of irradiation. The paper by Keilholtz et al. is particularly interesting since the authors have irradiated BeO, MgO, and Al_2O_3 to quite high burnup. Although specimens were irradiated in a thermal flux, an attempt has been made to relate property changes to total fast-neutron exposure. Volume increases and fracturing of specimens were the major changes reported and it is suggested that while damage to BeO is a function of fast-neutron dose, damage to MgO and Al_2O_3 is not a function of fast-neutron dosage. Beryllia is one of the ceramic materials most often considered for use in reactors and as such has been studied in considerable detail. The most comprehensive review in this book is the paper by Simnad, Meyer, and Zumwalt on BeO. There is perhaps a tendency to emphasize BeO for use in fuel components but extensive data are presented for BeO.

As a whole, the book provides a well-balanced discussion of problems relating to the use of nonfissionable ceramics. The authors could have perhaps improved the text by controlling the number of review papers, e. g., having one paper that would serve as a comprehensive and detailed review of each subject for discussion. Also, as might be expected in a book prepared in such a short period, there are some typographical errors. However, the timely preparation of the text more than compensates for these factors.

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September 1, 1966

About the Reviewer: Dr. Cunningham is now in the Fuels and Materials Branch of the Division of Reactor Development and Technology, USAEC Headquarters, following a number of years in metallurgy at Battelle Memorial Institute and the Oak Ridge National Laboratory. His major work over these years has been in materials and material systems for nuclear reactors, particularly in dispersion materials as fuels. Also of interest have been basic studies in high-ceramic-content cermets including UO_2 *in continuous matrices of metals and the dispersion of uranium-bearing compounds in Zircaloy, niobium, stainless steel, aluminum, beryllium, and chromium matrices.*

Dr. Cunningham received his academic training at the University of Tennessee and the Ohio State University.