two volumes, present a good summary of our current knowledge and research on the fission process, as did the symposium. The complexity of the process is indicated by its many specific aspects listed among the session titles. The increasing capacity of experimental techniques to record and correlate various specific events associated with fission is strongly evident in the wealth of new data presented, as well as in the variety of new techniques by which they were obtained. The paucity of adequate theory relative to unexplained data, which has characterized fission research almost from its beginning, is also documented in these volumes.

The fact that theory continues to encompass an adequate description of only a small fraction of the observed facts is not, however, an indication that our knowledge of fission is static. It is, rather, associated with the circumstance that large distortions of a finite liquid drop (let alone a many Fermion system) pose a difficult problem and that many aspects of nuclear fission may be essentially dominated by the details of the distortion process. Sufficient progress has been made, however, to lead W. Swiatecki to propose that "we should. . . settle down to working things out from first principles in a thorough and definitive manner."

Another encouraging item for fission theory evident from the Salzburg proceedings is the continuing evolution of our understanding of the transition states through which the nucleus passes en route to scission into fragments. These are a feature of nuclear fission specifically unrelated (so far as is known at present) to the details of the scission itself. Study of them has therefore enabled certain theoretical predictions to be tested, and some implications of data for the transition states to be drawn, even in the absence of a complete theory of fission. The result has been a growth of the effort aimed at illuminating the transition state spectrum, as well as various proposed expansions of the range of fission effects considered relevant to that spectrum. Moreover, modern nuclear structure physics has come, through the study of the transition states, to enjoy a quantitative relevance to some nuclear fission phenomena.

The proceedings document this process in many detailed reports and reconfirm the reviewer's judgment at the time of the Conference that fission barrier transition states may lead fission physics back towards the mainstream of nuclear structure research by providing data on very deformed nuclei which are available for study through nuclear fission alone. The experimental study of fission is, in fact, moving steadily toward the stage when it will provide for the transition-state spectra data of the kind which served as the basis for the unified model of deformed nuclei. In turn, the resulting spectroscopy of transition-state nuclei might allow more rigorous tests of theories of nuclear structure than stable nuclei can provide. Finally, any success in establishing the relevance of other fission phenomena to these transition states simplifies the puzzle of fitting the so many details of fission together into an adequate liquid-drop or many-body theory.

The proceedings also testify to the technological revolution which has been wrought in the scientific laboratory by recent counter and computer advances. The study of x rays from fission fragments, for example, now allows a unique charge to be assigned to a prompt fragment, while modern data processing equipment permits an ever expanding number of nuclear events to be specifically associated with such a label. Here, too, nuclear fission can make a contribution to nuclear structure physics by providing structure studies of nuclei far off the line of beta stability.

The Salzburg conference made it quite clear that such techniques would soon (and had already!) make available data of such quantity and quality as to insure that theory, even armed with computers, would not soon improve its (relative) comprehension of fission phenomena.

In sessions on fission cross sections, on charge, mass and energy distributions in fission, and on beta, gamma, neutron and light particle radiations, these proceedings provide a current source book which is indispensable to researchers and students who must know what is known about nuclear fission. The format is crisp and legible, and the time lag (one year) a credit to the editorial staff.

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April 29, 1966

About the Reviewer: James J. Griffin was graduated from Villanova College in 1952 and received an MS degree at Princeton in 1954 and a PhD in Physics in 1956. He was a Fulbright Fellow at the Institute of Theoretical Physics in Copenhagen, Denmark, during 1955-56, and a National Science Foundation Fellow at the University of Birmingham, England, during 1959-60. He has recently joined the Physics Department of the University of Maryland.

Genie Atomique — Book IV: Les Propriétés des Materiaux des Reâcteurs Nucleâires (Properties of Nuclear Reactor Materials, Vols. I, II), 2nd Edition. Presses Universitaires de France - E. Crémieu - Alcan, Secretary of Editorial Committee (1956). 1400 pp.

At first glance, this two-volume text on *Properties of Nuclear Reactor Materials* seems to represent a major contribution to the literature on nuclear materials technology. Unfortunately, closer examination does not confirm the initial opinion. About 200 pages of the total represent information gained since 1960. The remaining 1200 pages are relatively unchanged from the previous edition.

Volume I is divided into two sections. The first (A) deals with metallic, ceramic, and semimetallic fuels; the second (B) covers metallic and ceramic cladding and structural materials.

Volume II is divided into four sections: 1) Section C is a general discussion of fuel elements for heterogeneous reactors; 2) Section D covers moderators; 3) Section E presents metallic and ceramic control materials; and 4) Section F covers gaseous and liquid coolants.

Returning more specifically to the sections in each book, Part A covers uranium, plutonium, and thorium metal and alloys, as well as their oxides. It also deals with uranium carbide, uranium nitride, plutonium carbide, and thorium carbide. Specific areas of weakness include the limited coverage of swelling in metallic uranium, the absence of newer data on kinetics of transformation in plutonium, and the virtual absence of information of UO_2 and PuO_2, where major contributions have been made in the past five years. Some of the information on carbides of uranium, plutonium, and thorium, and on UN is satisfactory, though limited in scope.

Section B deals with the properties of aluminum, magnesium, beryllium, zirconium and their alloys, plus the steels; it also includes information on ceramic materials and irradiation effects. The work dealing with metals and irradiation damage is out of date, with most of the information of no more recent origin than the second Geneva

Conferenc If one considers the extensive reactor experience with materials such as the zirconium alloys, and the new inforn ation on irradiation damage, the coverage in this sectio is of limited value. The ceramic data are newer, albe t somewhat superficial.

In Volum II, Section C presents a generalized history of fuel eler ents. The imbalance due to lack of coverage since 1960 i apparent, when one sees only 4 pages devoted to ceramic fuels in a 90-page section

Section D discusses various moderators, including graphite, beryllium oxide, hydrides, light and heavy water, and organics. There have been substantial revisions in the parts dealing with beryllium oxide, the hydrides, and light and heavy water. While the graphite coverage is substantial, it predates 1960, and lacks much of the late information on irradiation effects. The beryllium oxide coverage is satisfactory, but is completely lacking in reference citations. In the organics chapter, the pre-1960 coverage is excellent and extensive. One could use it with considerable confidence as a complete coverage prior to 1960, and update from that time.

Section E represents a superficial coverage of metallic and ceramic control materials. There is very little to recommend it.

The final section (F) covers coolants. The chapter covering gaseous coolants is the best in either book in this reviewer's opinion. It presents an excellent, up-to-date, well-balanced picture of gaseous reactor coolants, covering selection and purification, as well as reactions with metallic and ceramic fuels, structural and cladding materials, and moderators. The graphical information is very good. The remainder of the section dealing with water and liquid metal coolants is much less satisfactory. Too much of the information is generalized, and too little presents the current state-of-the-art in water-cooled and liquid-metal-cooled reactors. The index is reasonably satisfactory, though not outstanding.

If one examines the two volumes as an entity, it is apparent that there are rather severe imbalances in the emphasis on the various chapters, and in the coverage relative to its current importance in the reactor field. For example, one might appreciate the excellent coverage in organics, but feel that 100 pages devoted to this topic is hardly justified. The reviewer feels that the editors devoted too little time to establishing the relative importance of the sections and chapters. In fact, the variability from chapter to chapter in referencing, handling of data, and methods of presentation leads one to believe that there was little reviewing or editing.

While many aspects of science do not change markedly over a span of four or five years, this does not apply to so rapidly a changing field as reactor and materials technology. A substantial share of the information presented is technically obsolete, due to changes in material compositions, fabrication processes, newer and better information on properties, and a better understanding of the behavior of materials in reactor environments Some of the information presented is excellent and up to date. Unfortunately, this is not true for the major portion of this book, and it is rather difficult to recommend a two-volume text where nearly 80% of the coverage is of historic rather than current technologic interest.

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June 20, 1966

About the Reviewer: Dr. Bush is presently consultant to the Director of the Pacific Northwest Laboratory of the Battelle Memorial Institute. He has been associated with Hanford operations since 1953, principally with the General Electric Company, where he held supervisory positions in metallurgy and in reactor fuel fabrication, following completion of his academic work at the University of Michigan. Irradiation effects and fabrication processes of nuclear materials are among the reviewer's major interests along with reactor safety and information retrieval processes. Dr. Bush is the author of numerous publications in these fields including the ASM-AEC monograph Radiation Effects in Reactor Structure and Cladding Materials *and chapters in the* Reactor Handbook.

Non-Destructive Testing in Nuclear Technology, Vol. I, II. Proceedings of a Symposium on Non-Destructive Testing in Nuclear Technology held by the IAEA in Bucharest, 17-21 May 1965. Published by the International Atomic Energy Agency, Vienna. Distributed by the National Agency for International Publications, Inc., 317 East 34th Street, New York 16, N. Y. (1965). Vol. I, 392 pp. $8.00. Vol. II, 446 pp. $9.00.

Forty-six technical papers from 15 different countries were presented at this symposium. In excess of 35 different nondestructive techniques for detecting defects in materials or for determining physical or mechanical properties of nuclear materials or components were discussed. Although none of the techniques discussed was entirely new, many unique variations and applications to specific problems were presented.

Ultrasonic, eddy-current, and radiographic methods for measuring wall thickness and for detecting mechanical defects in tubing, used as cladding for fuel elements, were discussed in many of the papers. Slight variations exist between the techniques used in Europe and the United States. For example, many of the European speakers reported the use of two transducers for detecting longitudinal cracks in tubing by an ultrasonic method; generally, only one transducer is used in the USA. Nevertheless, the basic theory of the techniques is the same. Most of the papers described testing for defects that penetrated five to ten percent of the wall thickness, and for wall thickness variations of about plus one percent. The only unusual technique, described by Bonnet and Jansen, involved the radiography of a single wall of a tube by placing rolled film on a high-density mandrel and inserting it into the tube. The complete assembly was then rotated in a lathe under a low-energy collimated x-ray source. This permitted them to obtain a much higher resolution radiograph.

Two papers discussed the ultrasonic inspection of metallic uranium billets and rolled rod for internal defects. In addition, five of the papers presented data obtained from ultrasonic attenuation studies. The attenuation of the ultrasonic beam through a uranium or a uranium-alloy matrix is related to grain size and is used to insure proper heat-treating techniques. Considerable attention was also given to the evaluation of coated fuel particles. Microradiography was discussed in three papers for this application. In this technique, enlarged images are obtained, either by an x-ray projection system or by photographic enlargements of fine-grain x-ray film. In either case, low-energy x-rays were used and enlargements varying from 30 to 100 X were obtained. From these microradiographs several things