

## Book Reviews

**Nuclear Propulsion for Merchant Ships.** By A. W. KRAMER. Division of Technical Information, U. S. Atomic Energy Commission, Washington 25, D. C. 600 pp. \$2.25.

This book is an extremely comprehensive review of the background as well as the past and present developments regarding the application of nuclear power for the propulsion of merchant vessels. The stated purpose of the book "is to set forth in one volume and in as simple language as possible the essence of the information [on the nuclear ship program in the United States] contained in . . . many highly technical publications." Inasmuch as the book was written for "anyone interested in the subject" it was not possible to go into much depth in any area. The book does, however, cover with considerable clarity not only the stated subject but also many of the peripheral areas associated with the nuclear ship program in the United States, including the legislative history of the program, status of nuclear liability and indemnity, actions by international bodies, negotiations with foreign governments, programs of other countries etc.

As is not unexpected, approximately half of the book is devoted to the N.S. Savannah. Included are chapters as follows: Chapter 4, The N.S. Savannah (design and description); Chapter 5, Hazards Analysis; Chapter 6, Operating and Environmental Characteristics; Chapter 7, Servicing Nuclear Ships; Chapter 8, Training of the N.S. Savannah Crew; and five appendices consisting of 40 pages of additional design details. The author did not intend (nor in the pages allocated was it possible) to go into any great detail on any one feature or consideration, but the review presented is a good qualitative review of the subject. However, the book is not without some omissions. Nowhere is it made clear that the "containment" provided with the power plant depends upon the vented reactor compartment as well as the pressure containment vessel. Furthermore, while the subject of environmental exposures is discussed, no concentration or exposure data are presented—possibly in deference to public reaction. It is also unfortunate (though hardly the fault of the author) that the book does not contain information on port criteria and harbor evaluation, but it would appear that this information was not fully developed until after the book was completed.

Several chapters of the book are related to comparative design and cost studies of various reactor and ship types. There have been so many such studies both here and abroad that it is indeed difficult in any such compilation to interpret or even to fully comprehend all the conflicting data. This portion of the book is thus somewhat confusing, although there seems to be general agreement that the nuclear ship propulsion will be more economical than conventional ships—someday.

With so much material to cover one cannot help but question the need for 60 pages on the basic principles of nuclear

reactors (Chapter 3). It would, of course, have been quite appropriate to have given greater emphasis to the U.S. Naval Program and the USSR Lenin, although one may presume that this information is harder to come by. Actually, the book is a must for anyone associated with the nuclear ship business as the author has well effected his stated objectives.

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*(About the Reviewer: Mr. Cottrell is currently Supervisor of the Nuclear Safety Section of the Reactor Division of the Oak Ridge National Laboratory. He is responsible for the safety analysis of a number of reactors with which the Laboratory is concerned. In this capacity he not only participated in the N.S. Savannah safety review undertaken at ORNL but was co-author of the original harbor safety analyses report. Mr. Cottrell has also been editor of Nuclear Safety since its creation in 1959.)*

**Space Research II: Proceedings of the Second International Space Science Symposium, Florence, April 10-14, 1961.** Edited by H. C. VAN DE HULST, C. DE JAGER, AND A. F. MOORE. Interscience, Division Wiley, New York, 1961. 1241 pp. \$29.50.

When conferences-by-invitation-only first mushroomed in the postwar years the proceedings, if any, were usually crude mimeographed reports privately distributed to chosen recipients who guarded them more zealously than classified documents. There were, however, a few voices raised protesting against such an irresponsible, almost immoral, procedure which closed off the majority of the scientific community from the benefits the conferences were supposed to bring. In time these protests began to have some effect, and the justice of their point of view is now almost universally subscribed to. But some of the original protesters must begin to have regrets over the Pandora box they helped open, for our library shelves sag under the accumulated weight of conference and symposium literature.

The volume under review shares most of the shortcomings of the species. It is bulky (1241 pages), prohibitively priced for the private pocket (\$29.50), and only became available a considerable time after the conference involved (eleven months in this case). Its contents are made up of a large number of highly specialized research papers (105, count 'em) aimed by and large at the workers in the immediate field. The articles are of widely varying significance and quality (one of the papers emanates from the private observatory of an apparently highly affluent amateur astronomer). The symposium reported here differs from most of its neighbors in that many of the topics discussed

occasion newspaper headlines and carry important overtones of international politics.

Confronted with a collection of this nature, the reviewer has much the same task as if he were asked to give critical comment on a bound volume of, say, *Nuclear Science and Engineering*. With such a many-body problem the approach must of necessity be statistical. About 20% of the pages are concerned with the problems of optical and radio tracking of satellites, the determination of orbits from such tracking data, and information on the shape of the earth's gravitational field that can be deduced from the orbits. Reading this portion one is made keenly aware of the Rip-van-Winkle awakening of classical mechanics as an active research subject after its almost century-long slumber. Another 20% of the pages deal with the hardware involved in telemetry and data transmission in general from satellites and rockets. The last third of the book is devoted to the density variation of the atmosphere and what can be deduced about the atmosphere from the "poor-man's space effort"—sounding rockets. In the remaining portion of the volume the papers are devoted to the scientific information gathered by satellites and deep-space probes, ranging from micrometeorites through cloud pictures to cosmic electromagnetic radiation from the ultraviolet to radiowaves. Of particular interest to the reader of this journal is the coherent set of papers dealing with solar flares and associated perturbations in magnetic fields and cosmic radiation. Here a deviation from the statistical treatment is in order to note especially four specific papers. K. E. McCracken from MIT and T. Gold from Cornell have written separate papers on the solar interplanetary magnetic fields that develop during solar flares. Both papers lead to roughly the same picture and both are distinguished by taking pains to be understood by the nonspecialist. R. G. Athay gives an astronomer's view of solar flares and underlines the great difficulties (at least as of April 1961) in the way of predicting the appearance of such flares in advance. Finally, H. Yagoda and collaborators give some details of the vastly increased flux of energetic heavy particles observed in emulsion blocks flown on a satellite during the strong flare of November 12, 1960. Shielding against such storms clearly presents formidable problems.

There is obviously some convenience in having in one location a collection of papers that summarize in effect the current status of a given field. But it is highly questionable whether this convenience outweighs the wide availability and shorter time lag that could come from publication in standard scientific periodicals. The scientific journals should not yet be dismissed as a means of communicating active research work. Is it hopeless to ask conference organizers to take note?

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(About the Reviewer: Professor Herbert Goldstein of Columbia University spent the war years in radar research at MIT, following which he wrote his well-known *Classical Mechanics*. He joined Nuclear Development Associates in 1960 and was active there in reactor shielding and nuclear cross section calculations. His second book, on shielding, is well known. He was a recipient of an Ernest O. Lawrence Award this year and is a Fellow of ANS.)

### **Tritium in the Physical and Biological Sciences.**

Proceedings published by the International Atomic Energy Agency, Vienna, 1962. Vol. 1, 369 pp. \$7.00. Vol. 2, 438 pp. \$8.00.

Tritium, the ubiquitous radioisotope of hydrogen, is found in natural water, in meteorites, in interplanetary plasma, and in a host of compounds listed for sale by isotope supply firms. It is at once one of the rarest isotopes in nature and one of the cheapest to produce artificially. Having the softest beta ray, it is also one of the most difficult to detect or measure.

These circumstances help explain the exceptional interest in a single nuclide which brought some 290 scientists from 27 countries to Vienna last year for a symposium on the detection and use of tritium in the physical and biological sciences. The proceedings of the conference have now been published in two paper-backed volumes, containing 67 papers. Four are in French, two in Russian, and 61 in English, but abstracts of each are supplied in English, French, Russian, and Spanish.

Over half of the first volume is devoted to techniques for concentrating and measuring tritium. A most profitable feature of the conference was the commingling of proponents of the various techniques and the opportunity to compare the merits of each in open forum. Five papers described Geiger counter techniques, with which natural tritium was first detected. But the more convenient liquid scintillation method, the subject of eight papers, now surpasses the historic method in sensitivity. Two laboratories reported measuring tritium in water below 1 picocurie/milliliter. Further gains are promised through reducing the background of thermal electrons in photomultiplier tubes, and the phosphorescence of tubes and counting cells. Two papers offer contrasting techniques for counting tritium in biological materials: in one, the tissue is dissolved bodily in an organic base and mixed with the scintillator; in the other, the eluate from a chromatographic column is mixed with scintillator and flows through the cell.

But most natural samples of tritium are too dilute to be counted directly on even the most sensitive counter. Its concentration is commonly enhanced by electrolysis by factors up to 1000. Distillation, gas chromatography, and thermal diffusion have also been successfully employed.

Three papers deal with the utilization of tritium from thermonuclear weapon tests as a global tracer; its distribution in the air, ocean, lakes, rivers, and underground is reported. On a smaller scale, it has been used as a tracer to study seepage from irrigation canals and movement through underground reservoirs. A satellite briefly in orbit collected a surprising quantity of tritium, apparently from a solar flare. Six papers describe studies of isotope effects, the mechanism of reactions, and a microanalysis for amino acids with tritium as a tracer.

The second volume contains two sections on preparing labeled compounds, but is otherwise a comprehensive review of recent biological applications, mostly of interest to physiological chemists.

Ten papers deal with preparative methods including radiation labeling, catalytic exchange, recoil labeling, chemical synthesis as well as biosynthesis. The difficulties of radiochemical purification, especially with radiation labeling, were touched on by the authors but were more adequately brought out in the discussions. This example illustratly the