Book Reviews

Nuclear Radiation Physics, Fourth Edition. By Ralph E. Lapp and Howard L. Andrews. Prentice-Hall. (1972). 447 pp. $13.95.

Since the first edition in 1948, *Nuclear Radiation Physics* by Lapp and Andrews, has played an important role in the training of physicists and especially health physicists. This new edition represents a growth of ideas and presentation. The order of presentation has been changed so that the book begins with a discussion of ionization and ionization chambers. Gas filled pulse counters are presented with a discussion of counting statistics, resolving time, and counting schedules. This introduction of measuring devices at the beginning of the course, gives the student an appreciation and understanding of how information concerning radioactivity is obtained. It is especially advantageous when the course is associated with a laboratory.

Classical mechanics, relativity, and quantum theory are presented factually rather than from the viewpoint of derivation customarily employed in physics courses. This type of development of ideas is characteristic throughout the book. It would be pedologically impossible to cover the scope of material included in this book from the viewpoint of careful derivation of theoretical ideas. The presentations are, however, lucid and clear cut and give the reader an appreciation of the physical ideas involved. It is somewhat doubtful that the Schrodinger equation has much meaning for the student when presented this way. The Bohr atom is presented in sufficient detail so that it should be understood by the reader. The discussion of the structure of the atomic nucleus is descriptive. Many have a preference for an historical approach in teaching modern physics. Lapp and Andrews have done very differently. X rays and the discovery of naturally occurring radioactivity are dealt with after the discussion of the structure of the atomic nucleus!

Chapter 8, which has the heading Ionizing Radiation, starts with Roentgen's discovery of x rays followed by Becquerel's discovery of radioactivity. Then alpha, beta, and positron emission, electron capture, and internal conversion are presented. This chapter is followed by natural radioactivity with the usual presentation of the uranium, thorium, actium, and neptunium series. In Chaps. 10 and 11 alpha particle emission is studied in more detail followed by beta-ray emission, Fermi's theory of beta-ray decay, parity conservation, and the binding energy parabolas. Photon absorption and scattering including pair production are discussed and the relative importance of photo-electric, Compton scattering, and pair production are well presented.

The discussion of exposure and absorbed dose and the problems inherent in ion chamber measurements of the roentgen and the rad are a most welcome addition so frequently missing from more customary texts. The chapter on absorption of charged particles has been extended to include tissue dose.

Nuclear reactions and the concept of the compound nucleus are followed by a chapter on charged particle accelerators. The discussion of neutron physics includes a section on fluence-dose calculation and the definition of kerma.

The book ends with a presentation of fission reactors and the hopes for a controlled fusion source of energy and, lastly, a very brief presentation of cosmic and terrestial radiation and transuranium elements.

The book contains more material than can be presented in a semester course; however, it is so arranged that appropriate topics can be selected by the instructor without undue complications. Problems are included at the end of each chapter.

This reviewer is anticipating with pleasure using the book as a text in a course in modern physics designed primarily for those interested in health physics and radiological science.

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About the Reviewer:

We again welcome Newton Underwood to these columns where his reviews of books treating health physics have appeared before. His tenure in the Physics Department of Vanderbilt bracketed very significant contributions to the gaseous diffusion process for the separation of the uranium isotopes. With dual interest in physics and biology, Dr. Underwood is presently professor of both physics and of public health at the University of North Carolina.

Education and Research in the Nuclear Fuel Cycle. By David M. Elliot and Lynn E. Weaver, (Eds.). University of Oklahoma Press, Norman, Oklahoma. (1972). +334 pp.

The 18 contributions to this volume provide a reasonably good summary of the status of nuclear fuel design, development, and manufacture, and of the related ex-reactor fuel cycle, as of mid-1970. There are significant gaps, however, particularly in the areas of environmental considerations, waste transportation and management, and nuclear safety. The contributions consist of papers presented at a symposium of the same title held at the University of Oklahoma in October, 1970. They do not appear to have been significantly edited or updated.

The list of authors is impressive and most have done well at what they appear to have set out to do; however, the preface is sketchy and the organization somewhat

haphazard, so that the overall plan is not obvious. For this reason, the discussion will be in a logical, rather than a consecutive, order. Prof. Mason of Massachusetts Institute of Technology opens the discussion with an overall view of the fuel cycle, in which fuel reprocessing technology and economics are emphasized. The initial steps are covered by the customary reviews of uranium reserves, methods for their discovery, and their mining, milling, and refining by E. A. Youngberg, AEC assistant manager at Grand Junction, Colorado, while conversion and enrichment are described by R. W. Levin of the Paducah gaseous diffusion plant. General characteristics and performance of BWR and PWR UO_2 fuels are discussed by R. B. Richards of General Electric; Paul Shewmon of Argonne National Laboratory comments on performance limits of nuclear fuels of clad pin or pellet form in a general way; Ivor Thomas, formerly of Kerr-McGee reviews the then-existing fuel fabrication industry and forecasts needs; while J. Haley of Westinghouse considers the problems involved in utilizing plutonium in thermal reactors and describes his organization's involvement in fabrication and irradiation work to this end. This discussion of the water reactor fuel cycle is concluded by C. W. Smith of General Electric, who describes the design and licensing problems associated with irradiated fuel shipment along with the fuel reprocessing operations to be carried out at the new GE facility at Morris, Illinois, and by Al Veras of Commonwealth Edison who discusses the organization and methods used by his company, as an example of a multi-reactor utility, to plan and manage the purchase and use of fuel material, fabricated fuels, and reprocessing services. The expected fuel needs of the FFTF are indicated by C. E. Weber of AEC-RDT, while E. A. Evans and W. F. Sheely of WADCO describe the design problems and developmental fabrication facilities for this fuel at Hanford. The research status of metallic fast reactor fuels is covered by J. F. Schumar of Argonne and the advantages of utilizing plutonium in fast reactors are presented by Simcha Golan of Atomics International. P. R. Kasten of Oak Ridge National Laboratory compares fuel cycles using thorium with those for uranium for a variety of reactor types. There are three general papers relating to the fuel cycle, one by Dan Hang of the University of Illinois on economics, one by Delmar Crowson, formerly of the AEC, on nuclear material safeguards, and one by Roy Post and Don White of the University of Arizona on radioisotopic, and nonradioactive isotopic, by-products of the fuel cycle. One paper titled "Approaches to Reactor Safety," by Hofmann, et al. of Hanford Engineering and Development Laboratory, seems to be out of place in this symposium. It discusses reactor licensing requirements and compares the accident prevention and consequence limiting features of various reactor designs.

From the standpoint of today, it is felt that the omission of a discussion of the environmental concerns of the fuel cycle and, in particular, of the long-term management of fission product wastes, are serious defects of this volume. This should have been apparent two years ago as it is a subject important to educators. The educational preparation for proper consideration of these matters for the fuel cycle, as well as for those of reactors, may be quite inadequate in current nuclear engineering curricula, as the broad interdisciplinary perspectives needed have not, up to this time, been given much consideration.

The title of the book, "Education and Research . . . ," is quite misleading. There is very little concerning education in its contents, except for a paragraph tucked in at the beginning or end of a few of the papers to the effect that obviously an expanding industry will need a lot of people from a variety of disciplines. It's not that obvious that the probable supply of trained personnel from presently established curricula and institutions will not be fully adequate. A proper analysis of this situation is needed, and apparently has not been made. Research needs are also given a once-over-lightly treatment, and in no case have they been discussed in any depth. Generally, only near future plans and programs have been presented.

This volume illustrates another problem quite often observed in collections of symposium papers. The illustrations used for the preparation of slides for presentation have apparently been incorporated basically without change. Since several were apparently colored slides which have been reproduced in black and white, the reproductions are interpreted only with great difficulty. Other illustrations are inappropriate with regard to the information they convey relative to the space they consume.

The utility of the volume as an information source is markedly reduced by the authors' variations in providing references. Of the 18 papers, no references are provided for nine of them, and less than half of the balance appear to have a reference list which is even superficially adequate for the subject matter.

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About the Reviewer:

Charles Stevenson is a member of the senior staff of the Chemical Engineering Division of the Argonne National Laboratory and, in addition, he is active in the development of American National Standards as the Chairman of an ANSI Standards Committee. His wide experience in reprocessing nuclear fuel includes, as well, a period as technical director of the Idaho Chemical Processing Plant when it was operated by the Phillips Petroleum Company and as supervisor of the EBR II fuel facilities for Argonne. Dr. Stevenson received his academic training at Penn State.