Book Review

An Introduction to Nuclear Physics, with Applications in Medicine and Biology. By N. A. Dyson. Ellis Horwood Limited, Publishers, Chichester, England (1981). Distributed in the United States by Halstead Press, a division of John Wiley & Sons, New York. 241 pp. $54.95.

The author, a member of the Department of Physics at the University of Birmingham (England), states that his purpose is to bring to students a concise account of the basics of nuclear physics and radiation physics and their bearing on applications to the biomedical sciences. At first one is inclined to compare the book to the old Lapp and Andrews' *Nuclear Radiation Physics*, Prentice-Hall, New York (1950) that long ago introduced many of us to nucleonics, but this book is more abbreviated and the writer assumes that the students, or any readers for that matter, are already well grounded in physics and mathematics. The first half of the book is concerned with nuclear physics and has discussions of interactions between radiation and matter, energy losses by particles, electron beams, scattering, nuclear reactions, and the production of radioisotopes. The use and preparation of target materials are discussed with regard to practical attention to quantity, sample dimensions, and temperature, as well as specific activity and purity in view of biological or medical applications. Production of short-half-life isotopes from generator materials is considered, an example being the recovery of ^{132}I from parent ^{132}Te, and recovery of ^{99m}Tc from ^{99}Mo by the (n,γ) reaction or by reactor irradiation, yielding isotopes useful in diagnostic work and in scanning.

In instrumentation for radiation detection, an account is given of Geiger and proportional counters, scintillation counters, and solid-state detectors of selected types with consideration of advantages and disadvantages. The section on instrumentation concludes with a discussion of ionization dosimetry, film use, thermoluminescence, and chemical dosimetry.

A discussion of nuclear reactions that produce radiations precedes a section on specific activity of radioactive sources and the methods of measurement of activity. In this connection the author points out that the curie is now being overridden by use of the term "the Becquerel"; the latter being a handier unit defined as 1 dis/s of the particular radionuclide.

Applications of radioisotopes in biology and medicine are discussed quite thoroughly in terms of topics that the student should know about, i.e., isotope dilution in relation to body compartments and body water; role and amounts and behavior of elements such as sodium, strontium, calcium, and iron in the body; scanning techniques; and therapeutic applications. Also in this connection there is a review of the important problems of internal dosimetry as these relate to the organs or to the body as a whole in radiotherapy and in assessment of radiation hazard and in health physics applications.

In the section on neutron interactions, the author provides in a few pages not only a review of radiative capture and other phenomena associated with neutron exposure but also a rather concentrated introduction to the basic aspects of radiation biology. Target theory and the concepts of linear energy transfer (LET) and relative biological effectiveness (RBE) are introduced and the role of oxygen enhancement in therapy is explained. There is an associated section on neutron dosimetry. It is indicated that neutron activation analysis can be used in detection of some biologically important elements in the human body after brief fast neutron irradiation and use of a sensitive whole-body counter; also detection of "prompt-gamma" radiation can provide measurement for a few of these elements. In the final part of the book, the accelerator-produced radiations are considered, notably the proton-induced x-ray spectra for elemental analysis in water or in biological materials, and photon-activation analysis to avoid a preponderance of ^{24}Na activity. Reference is also made to therapy in depth using negative pions, which can deposit their energies locally at a high LET in a tumor, and with high RBE. The possibilities of detection of muonic and pionic x-ray spectra as indicators of the presence of some chemical elements are also explored. The book can certainly be recommended as an overview of the aspects of nuclear physics that can have direct biomedical applications and as a review volume. Each chapter ends with a listing of cited references from the book and journal literature and these are recommended by the author with expectation that the reader will turn to them for expansion on each subject. This is a useful book, but unhappily its quality has not been equaled by the publisher's bookbinder, for the boards are covered by rather unsubstantial paper instead of the cloth or buckram one might expect for the price.

C. S. Shoup

80 Outer Drive
Oak Ridge, Tennessee 37830

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About the Reviewer: Sam Shoup was retired some years ago from the U.S. Atomic Energy Commission, Oak Ridge, Tennessee, where he served sequentially as chief of the Biology Branch and of the Research Contracts Branch. Previously he was at Vanderbilt University as a professor of biology. Dr. Shoup's graduate training was at Princeton University.