for courses at the junior-senior undergraduate level or first-year graduate level. It would also serve well as a state-of-the-art reference book for professionals. A background in calculus, differential equations, and basic atomic and nuclear physics is required. Thorough review of the material presented will enhance the reader's ability to use radiation safely, efficiently, and effectively in scientific research or on the job. This text addresses the use of radiation in fields ranging from medical diagnosis and medical therapy to industry and power production.

The first chapter defines the energy ranges of various radiation types, discusses sources of error, and provides a general description of a typical counting system. Chapter 2 provides more detailed information to include basic definitions of probability and statistics, distribution function errors, and error reduction and illustrates how these characteristics of the counting of radioactivity interact to limit minimum detectable activity levels. The third and fourth chapters provide a good review of atomic and nuclear physics. Basic facts, such as the concept of binding energy, radioactive decay laws, mechanisms of energy loss, and radiation interaction with matter, are reviewed in these final two chapters of the introductory material.

The next three chapters 5, 6, and 7 provide the reader with descriptions of different types of radiation detectors and include the desirable and undesirable characteristics of each design. The detection systems discussed range from simple ion chambers to semiconductor detectors and organic and inorganic scintillator systems. The effects of repeated exposure to radiation are also outlined, especially with respect to the damage of semiconductor material. Important considerations of source detector geometry are outlined in the eighth chapter.

Following the introduction and characterization of the detectors, the next six chapters (9 through 14) of the text deal with the electronic components of spectroscopic systems and include methods of analyzing experimental data obtained with these systems. Of special use to researchers are the discussions of differentiating and integrating circuits, pulse shaping, timing, preamplification, amplification, and analog-to-digital conversion. Photon, charged-particle, and neutron spectroscopy systems are discussed briefly. Chapter 11 expands the previous discussion of evaluation of data to include interpolation, smoothing, curve fitting, and folding and unfolding. This material provides a basis for extended discussions of the analysis of gamma and x-ray spectra (Chap. 12), charged-particle spectroscopy (Chap. 13), and neutron detection and spectroscopy (Chap. 14). These presentations outline the basic interactions with matter that allow for spectroscopic analysis of the detected radiation and in addition describe typical systems one might find in an on-the-job or research effort. Chapter 15 discusses techniques of activation analysis to include sample preparation, radiation sources, and subsequent data analysis.

The sixteenth chapter provides the reader with an introduction to the principles of health physics. Exposure limits and dosimetry of external and internal exposures are discussed along with a presentation of basic information on the effects of radiation. This chapter will also serve as a review chapter for professionals whose major background is in a field other than health physics.

The final chapter of this text contains important information about specialized, state-of-the-art detectors and spectrometry systems with emphasis on the use of these systems in various fields. Self-powered detectors, fission track detectors, compensated ion chambers, and position-sensitive detector systems are some of the many systems presented.

This text is appropriate for courses in nuclear and electrical engineering, health physics, and chemistry. It will also serve well as a source/reference book for professionals. The text includes a wealth of graphs and charts that summarize and further illustrate the written material. Photos of the equipment under discussion are included. Numerous sample problems are presented along with several "rules of thumb" that are frequently employed to simplify these calculations and/or design experiments. As with any "first edition" of a text, there are some misprints; for example, on p. 83 when discussing the unit used for measurement of nuclear mass, the text states $\frac{1}{12}$ of the mass of C-13. This error is corrected in the following equation. Fortunately, the number of errors is very limited and most, like the example cited, tend to be obvious.

In summary, this text is appropriate for courses in radiation measurement as presented in nuclear and electrical engineering, physics, and chemistry. It will also serve as a source book of practical know-how for on-the-job training programs and as a reference for practicing professionals.

After receiving his MS in nuclear engineering from the University of Missouri at Columbia in 1970, Gerald Schlapper joined the reactor operations staff of the University of Missouri Research Reactor Facility. During this time he served for five years as a reactor physicist and was responsible for core design and burnup calculations. Dr. Schlapper received his PhD in 1977 and remained on the staff of the Research Reactor Facility until January 1981, when he assumed his current position as a faculty member of the nuclear engineering department at Texas A&M University. During his career he has served as a consultant to various government and private organizations.

Nuclear Fission Reactors

Author	G. Kessler
Publisher	Springer Verlag, Vienna, New York (1983)
Pages	257
Price	$36.80
Reviewer	Karl Wirtz

This book gives an excellent description of the physics and technology of nuclear fission reactor types with their complete fuel cycles as well as their environmental impacts and risks. The structure of the book can best be seen from the different chapters: 1. "Introduction," 2. "Some Basic Physics of Converter and Breeder Reactors," 3. "Nuclear Fuel Supply," 4. "Converter Reactors with a Thermal Neutron Spectrum," 5. "Breeder Reactors with a Fast Neutron Spectrum," 6. "Nuclear Fuel Cycle Options," 7. "Technical Aspects of Nuclear Fuel Cycles," and 8. "Environmental Impacts and Risks of Nuclear Fission Energy."

The book does not contain an in-depth treatment of the basic physics as one might expect. It rather gives a complete presentation of the many different and complicated results that have been achieved by the cooperation of physics, material sciences, and technological development in the past 20 years. Many tables and pictures are provided. For the first time, the production of nuclear energy by fission is described in its entirety in a reliable and understandable way. No evaluations, at least no direct ones, are tried. For instance, one does not find judgments about the values of the pool or loop type of sodium breeders, but there are reliable presentations of their technical designs.

The important role of the nuclear fuel cycle is discussed as are its principal options, the technical aspects of reprocessing, the conditioning of waste and its final disposal in repositories, as well as radioactive releases during normal operation and possible accidents. The final chapter deals with the risk of nuclear proliferation and related safeguards. In all cases the book gives a clear picture of the problems and refers the reader to the original literature.

The book is certainly not written for laymen, but addresses itself to all the many people with a technical background who want to be informed. The whole field of nuclear energy in all its complexities but with its logical structure is clearly and simply presented. It is the first comprehensive presentation of nuclear energy and its problems known to the reviewer who has read it with much pleasure and gain and can recommend it to the entire nuclear community.

Karl Wirtz (PhD, University of Breslau, 1934) has been a professor of reactor engineering at the University of Karlsruhe since 1957. At the same time he was head of the Institute for Neutron Physics and Reactor Engineering at the Nuclear Research Center, Karlsruhe. During World War II he participated in the early nuclear energy research in Germany under Professor Heisenberg. He is now an emeritus but still active as the European associate editor for Nuclear Technology.

The Synthesis of Carbon-11, Fluorine-18, and Nitrogen-13 Labeled Radiotracers for Biomedical Applications

Authors	Joanna S. Fowler and Alfred P. Wolf
Publisher	Technical Information Center/ U.S. Department of Energy (Sep. 1982)
Pages	124
Price	$11.25
Reviewer	James M. Woolfenden

The field of nuclear medicine uses radiotracers for functional imaging studies of the human body. Radionuclides with suitable emission characteristics are linked to compounds that follow physiological pathways to the organ being evaluated. The past decade has seen the development of new radiotracers for the brain, heart, liver and biliary system, and certain types of cancer, to name only a few. An exciting development has been the ability to image and measure regional metabolic activity in the brain and heart using positron-emitting radiotracers. The synthesis of such positron-emitting tracers poses numerous challenges to the synthetic radiochemist, toward whom this volume is directed.

The book is a monograph on the synthetic organic chemistry of radiotracers labeled with C-11, F-18, and N-13. After a general eight-page introduction to radiotracer design and synthesis, the authors provide an extensive list of compounds and precursors labeled with these radionuclides, along with 300 references. The authors next present a section on synthetic strategy and tactics, which contains many practical points that have been distilled from the authors' wealth of experience in rapid radiochemical synthesis. Specific synthetic methods are presented for C-11 (10 pages), F-18 (14 pages), and N-13 (3 pages). The final section on experimental design includes useful suggestions on topics such as well counter calibration, as well as specific detailed examples of radiochemical syntheses using C-11 and F-18.

The bibliography is a major part of the book. It covers 35 pages and includes 496 entries. Most of the references are for the past ten years; the most recent publication date is 1981.

The prose of the book is serviceable if undistinguished. The text would have benefited from editing to remove grammatical errors, such as a frequent disagreement in number between subject and verb. The line drawings that accompany the text are of generally good quality, but the few black-and-white photographs are poorly reproduced.

Since access to C-11 and N-13 requires an accelerator close at hand, and since there are few accelerator facilities for medical radionuclide production, this book is likely to have limited appeal. However, for those involved in rapid radiochemical synthesis using C-11, F-18, and N-13, the book presents many practical ideas and suggestions for further work. The extensive bibliography alone is worth the bargain price of this book.

James M. Woolfenden is professor of radiology in the Division of Nuclear Medicine, University of Arizona College of Medicine, Tucson, where he has served on the faculty since 1974. He received his undergraduate degree from Stanford University and his MD from the University of Washington. He is a fellow of the American College of Nuclear Physicians. His primary research work is in the field of tumor-seeking radiotracers.