date to 1950, when he joined the staff of Walter Levy Associates. He has also been affiliated, as a consultant or a research associate, with such organizations as Resources for the Future, the Electric Power Research Institute, the Petroleum Industry Research Foundation, and the Gas Requirements Agency at the University of Denver. He is currently a member of the Governor's Energy Task Force of Arizona. His publications include Crude Oil Prices in the Middle East, *contributions to* Middle Eastern Oil and the Western World, *and monographs and articles in professional journals on a wide range of topics in energy economics and energy policy.*

Basic Nuclear Engineering

Author	K. S. Ram
Publisher	John Wiley and Sons, Inc., Halstead Press (1977)
Pages	212
Price	$9.75
Reviewer	Barry D. Ganapol

With the increased reliance on nuclear power in the U.S., it became apparent ~20 yr ago that a sufficiently knowledgeable work force had to be educated to bring the nuclear option to fruition. This challenge was undertaken by the educational community, and many fine texts on reactor physics and engineering were produced. These texts were initially designed to accommodate students of various backgrounds (chemical and mechanical engineering, nuclear physics, etc.), since few nuclear engineering disciplines existed at that time. They emphasized light-water-moderated systems, since these reactors were destined to become the workhorse of the U.S. nuclear power grid. India, recently turning to the nuclear option to meet its energy requirements, finds itself in a position similar to that of the U.S. two decades ago. Like the early U.S. nuclear engineering texts, *Basic Nuclear Engineering* by K. S. Ram is an attempt to provide the required training in nuclear engineering fundamentals to students or practicing engineers with varied backgrounds, emphasizing heavy-water-moderated systems, which initially will be the mainstay of the Indian nuclear energy program.

This text is written in much the same format as the U.S. texts. The initial chapters are concerned with a review of nuclear physics, introducing only the very basics on the assumption of prior knowledge of the subject. The next three chapters deal with neutron physics and diffusion, with application to homogeneous systems. Chapter 7 then applies the fundamental concepts presented in Chaps. 1 through 6 to heterogeneous reactors and completes what the author designates as the first part of the book concerned with basic principles. The second part opens with a chapter on steady-state multigroup diffusion theory methods, followed by two chapters dealing with time-dependent aspects (burnup, control rods, etc.). The final section of the text is concerned with the engineering fundamentals of nuclear power—fuel pin heat transfer, thermal stresses, shielding, and fuel cycle considerations. The text of 212 pages is replete with examples, most of which have to do with the RAPP (Rajastham Atomic Power Plant) heavy water reactor, thus serving to familiarize the reader with D_2O systems, while using the fundamentals just presented. In addition, problems well suited to the beginner are given at the end of each chapter. Appendices containing relevant derivations and explanations not germain to the main thrust of the chapter are included at the end to maintain continuity.

The author has attempted to cover much of the material in Lamarsh's *Nuclear Reactor Theory*, Bonilla's *Nuclear Engineering*, and portions of El-Wakil's *Nuclear Power Engineering* in his short 212-page volume. At best, only the surface of the many subjects covered can be presented, and to provide a clear picture to graduates in nuclear engineering, supplementary material would be necessary. It becomes readily apparent that this book is essentially a glossary of nuclear power terminology and provides very little in the way of stimulation and deep understanding. This is apparently in keeping with the author's intention of training personnel and providing a review of the field for practicing engineers rather than producing researchers of advanced systems.

Since the text is directed toward those unfamiliar with the subject, it is imperative that the presentation be clear and error free. Unfortunately, this is not the case. Some material is presented without explanation, such as question 1-8 in Chap. 1, where the threshold energy is asked for but is nowhere defined, or in Chap. 4, where the idea of energy flux is not introduced and the differential dE seems to appear magically. These are only two examples of many. There are also several examples of misleading statements, such as on p. 61: "It is customary to say that the medium of three diffusion lengths behaves as an infinite medium." What I believe the author wanted to state is that the neutron flux at a position greater than three diffusion lengths from a surface is relatively unaffected by the surfaces. Probably the most annoying aspect of Dr. Ram's new book is the occurrence of many typographical errors and omissions, for which the publisher is as much responsible as the author. These errors include incorrect formulas, such as the second of Eqs. 4.14, which should read

$$\lambda_{tr} = \frac{\lambda}{1 - \bar{\mu}} \left(\text{not } \Sigma_{tr} = \frac{\Sigma_s}{1 - \bar{\xi}} \right) ,$$

missing terms, such as the source strength in Eq. 13.6, and incomplete, duplicated, or missing sentences.

In the final analysis, this text is not of the quality of U.S. texts, but it does orient the reader toward the Indian energy program—a major reason for its existence. It is the hope of this reviewer that, if and when there is a second printing, the author and publisher both take the time to correct the many errors and omissions in this first printing.

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laboratories in Switzerland (Swiss Institute for Reactor Research) and France (Center for Nuclear Studies at Saclay), where his interests were in biomedical research and reactor theory. He has a lovely wife and plays a mean guitar.

Tumour Localization with Radioactive Agents
(Proceedings, Advisory Group Meeting, Vienna, December 9-13, 1974)

Publisher	International Atomic Energy Agency (Distributed by Unipub., Inc.) (1975)
Pages	142
Price	$10.00
Reviewer	James M. Woolfenden, MD

This volume, the Proceedings of an International Atomic Energy Agency Advisory Group Meeting held in Vienna in 1974, is composed of 11 contributed papers and group discussions. The purpose of the meeting was to summarize results obtained to date using radioactive tumor-localizing agents and to delineate some possible trends in further development. Characteristics of an ideal radiopharmaceutical for tumor localization are noted in the Foreword:

> The present agents for detecting tumors by scintigraphic techniques are not as good as they should be. The ideal agent should be highly specific for cancer with an avid uptake in the tumor, and a fraction which is not taken up by the tumor should be rapidly excreted from the body. The compound should be inexpensive, simple to prepare, heat-stable, easily sterilized, have low chemical toxicity, be reliable and only cause a low radiation exposure. These criteria may never be met at the same time in any one radiopharmaceutical.

The present era of tumor localization with radiopharmaceuticals and external imaging devices was foreshadowed, as one of the contributors notes, as early as 1930 by Herbert Kahn, who discovered that radioactive bismuth could accumulate in tumors. Kahn observed that if adequate equipment were available, the agent could be used for "photographic" diagnosis of a primary tumor and its metastatic lesions. Although no chapter of the book is devoted expressly to the history of tumor-seeking agents, historical citations such as this one help to place the current search for better tumor-seeking radiopharmaceuticals in perspective.

The overall quality of the contributed papers is excellent, and several are outstanding. McCready and Trott of the Royal Marsden Hospital provide a detailed survey of the physical and biological factors affecting tumor imaging. In a complementary paper, Hayes of Oak Ridge Associated Universities presents a lucid discussion of factors affecting tumor uptake of radioactive agents.

The stimulating discussions that follow each paper provide useful perspective on the papers and also contribute additional theoretical and practical information on tumor imaging. The "Summary of General Discussion," presented as the final chapter, provides concise guidelines and recommendations for developing new tumor-seeking radiopharmaceuticals. This summary should be required reading for anyone interested in tumor localization using radionuclides.

Most of the material presented remains timely, although the meeting was held in 1974. Gallium-67 citrate, which at present is probably the most widely used agent for soft tissue tumor imaging, is considered in some detail. Cobalt-57 bleomycin, which at present is a promising investigational new drug for tumor localization, is briefly discussed, along with other radiolabeled antibiotics that show selective uptake in tumors. Preliminary data are presented that suggest some of the radiolanthanides may have useful tumor-seeking properties; the lanthanides have not yet been fully evaluated in this regard. The chapters on radiomercurials and ^{75}Se labeled compounds are now mainly of historical interest.

The final contributed paper by Comar from Orsay, France, presents the potential for tumor localization using compounds labeled with accelerator-produced short-lived radionuclides, such as ^{11}C, ^{13}N, ^{15}O, and ^{18}F. Development of such compounds poses a number of challenges, particularly in the area of ultra-rapid radiochemistry; as Comar observes, the 2-min half-life of ^{15}O prevents its use in synthesis of complex molecules or investigation of slow phenomena. Utilization of such compounds also requires proximity to a particle accelerator; Comar anticipates that compact medical cyclotrons, installed in or near hospitals, will become more widely available.

This book is well produced, with a clear typeface and a minimum number of typographical errors. Graphs and line drawings are clear, but the few radiographic and scintigraphic images are poorly reproduced.

Tumour Localization with Radioactive Agents is highly recommended to anyone interested in medical applications of radionuclides. At $10.00, the book is an exceptional bargain.

James M. Woolfenden is assistant professor of radiology in the Division of Nuclear Medicine at the University of Arizona Health Sciences Center, Tucson. He received his undergraduate degree from Stanford University and his MD from the University of Washington. His current research is directed at developing both improved tumor-seeking radiopharmaceuticals and miniature radiation detectors for in vivo *localization of the radiopharmaceuticals. He has been actively involved in clinical studies of radiolabeled bleomycin for tumor localization.*

Exploration for Uranium Ore Deposits
(Proceedings of a Symposium, Vienna, March 24 to April 2, 1976)

Publisher	International Atomic Energy Agency (Distributed by Unipub, Inc.) (1976)
Pages	807
Price	$49.00
Reviewer	Donald E. Livingston

This volume, costing $49.00 for 807 pages, more than 6¢ per page, is hardly the kind of tome a person would buy just to find out the contents. Certainly students and