BOOK REVIEWS

COMPUTED EMISSION TOMOGRAPHY. P. J. Ell, B. L. Holman, Eds. New York, Oxford University Press, 1983, 546 pp, $75.00

This multiauthored book is designed to serve as a survey and in-depth review of the various technical aspects and clinical applications of positron emission tomography (PET) and single photon emission computerized tomography (SPECT). For the most part it is quite successful and can be used by physicians and scientists for an overview of the topics covered and as a reference.

The PET section begins with a clear and comprehensive description of available instrumentation, technical problems and their solutions, and new developments. This is followed by a detailed review of pharmaceuticals available for positron imaging, along with methods for production and labeling. Chapters on the heart and brain demonstrate applications to various types of pathology while stressing the use of a variety of radiopharmaceuticals in conjunction with appropriate physiological models to obtain metabolic information. Finally, an excellent summary chapter places everything in proper perspective.

In the SPECT section a brief, nontechnical description of instrumentation is supplemented by two very technical chapters dealing with attenuation correction and noise characteristics of rotating camera systems, which are written from a theoretical rather than a practical viewpoint. A more unified approach would have been preferred, for these chapters do not provide the clear and balanced treatment of instrumentation that the corresponding chapter in the PET section provides. Developments in single photon radiopharmaceuticals are nicely covered in three chapters dealing with receptor-specific, antigen-antibody, and metabolic analogue tracers. The chapters on the brain, liver, and heart present results of tomographic imaging with standard radiopharmaceuticals for various types of pathology. Most of the clinical images were obtained with the Cleon (or Union Carbide) multidetector imager, a device no longer available. The editors appear to have a strong bias toward this device (see p. 406) but do not acknowledge the significant problem of nonuniform sampling by the Cleon imager nor the major advantage of enabling one to generate high quality sagittal and coronal images from the rotating camera. The many Cleon images in the book do demonstrate the indicated pathology adequately, but I would not consider them comparable to those currently being obtained with rotating camera systems.

Special mention must be made of three chapters in the SPECT section: One by Lassen describing exciting work on regional cerebral blood flow through tomography with inhaled xenon-133; One providing excellent coverage of the use of radiolabeled amines for brain blood flow; and one describing how tomographic lung imaging can be used to generate true quantitative measures of regional ventilation and perfusion.

In summary, one should not expect this book to serve as an atlas of emission tomographic pathology or as a guide to the use of the rotating camera, but it can be highly recommended to all physicians and scientists desiring a detailed, well-rounded account of the current status and the potential of positron and single photon emission tomography.

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CRC HANDBOOK OF CHEMISTRY AND PHYSICS, 64th EDITION. R. C. West, M. J. Astle, W. H. Beyer, Eds. Boca Raton, Florida, CRC Press, Inc., 1983, 2386 pp

The *Handbook of Chemistry and Physics*, published almost annually since 1922 by the CRC Press, is one of the most informative sources for scientists in the physical sciences, and is of considerable benefit to those in the biological sciences. The Editorial Board and staff of collaborators and contributors are distinguished scientists, all authorities in their particular fields. The usefulness of this handbook is attested to by the fact that many eminent chemists and physicists extend the effort to offer suggestions for continued improvement of each succeeding volume.

As stated by the Editor-in-Chief (RCW), the aim of the text has been to present in a condensed form a large amount of accurate, reliable, and up-to-date information on the fields of chemistry and physics consistent with convenience in form and possibility of wide distribution and utility. An examination of the several tables, such as "Physical Constants and Inorganic Compounds," "Physical Constants of Organic Compounds," and "General Physical Constants" reveals a plethora of comprehensible information in a very condensed format.

As in the past, thorough revisions and additions have been made as the directions of the physical sciences dictate. All of the tables have been revised and several new tables added. For example, the nomenclature of the sugars has been updated and their structures redrawn. The effort required to maintain accuracy is exemplified by the tables enumerating more than 15,000 organic compounds.

This handbook is one of those reference texts essential for every library and laboratory, either clinical or research. As in previous editions, the entire volume is excellently executed.

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THE PHYSICS OF RADIOLOGY. H. E. Johns, J. R. Cunningham. Springfield, Illinois, Charles C Thomas, 1983, 796 pp, $49.50

The Physics of Radiology is considered by many to be the "bible" of radiological physics. This is the fourth edition, the first having been published some 30 yr ago, in 1953. Traditionally, it has been a "therapy-oriented" book, and the newest edition continues that tradition. The emphasis has shifted, however, and this edition contains substantially more material on the physics of radiological imaging (particularly x-ray) than previous ones.

Because this is a standard text, and probably familiar to most readers, I will not embark on a detailed chapter-by-chapter review. Rather, I will itemize some of the changes from the third edition that appear to me to be of greatest interest.

1. The discussion of radiation therapy machines has been updated to place greater emphasis on linear accelerators, with correspondingly less emphasis on Co-60 units.

2. There is improved and greater coverage of the principles of electron interactions and electron-beam dosimetry.

3. Chapters on photon-beam dosimetry have been improved, with greater coverage of megavoltage beams, the use of transmission computerized tomography (TCT) for treatment planning, and current methods for heterogeneity correction.

4. There is substantially greater coverage of diagnostic x-ray imaging. Materials have been added on TCT scanning, xerography, ionography, and "optimization" of imaging systems (e.g., by beam spectrum modifications). The materials on MTF have been completely reorganized and improved.

5. Low-level radiation is discussed in terms of risk-benefit ratios and relative risks, e.g., the risks of leukemia, thyroid cancer, and breast cancer for diagnostic x-ray examinations are presented, as are comparative occupational risk factors for radiation and nonradiation industries.

6. Sections have been added on quality assurance techniques and equipment selection for diagnostic radiology.

7. Presentations on radiobiology have been refocussed to place greater emphasis on concepts relevant to radiation therapy, e.g., the oxygen effect and patient survival curves.

8. The materials on shielding calculations have been revised to reflect the authors' recommendation that, for planning purposes, radiation levels in shielded areas should be decreased by a factor of ten from previously recommended levels (from 5000 mrem/yr to 500 mrem/yr for radiation workers, and from 500 mrem/yr to 50 mrem/yr for nonradiation workers). The authors base their recommendation regarding radiation workers on the ALARA principle, noting that in shielding design, reduction by a factor of ten "... usually can be achieved without too much difficulty." They also note elsewhere that the health risks to a radiation worker receiving an annual dose of 500 mrem would be comparable to those of other "safe industries," e.g., trade and manufacturing. Regarding nonradiation workers, the authors argue that a limit of 50 mrem/yr would be comparable to differences in background radiation levels in different parts of North America, which are not considered to be an unacceptable hazard by the general public.

9. S.I. units (Grays, Sieverts, Bequerels) are used throughout, with only occasional reference to traditional units (rad, rem, Curie). An exception is the continued use of the roentgen as the unit of exposure, which the authors feel has not been satisfactorily dealt with by international standard-setting bodies.

10. Traditional methods for internal radiation dosimetry calculations have been replaced by the MIRD method, including some useful examples of the inadequacies of "first approximation" dosimetry calculations (e.g., ignoring the effects of scatter) in comparison to MIRD methods.

11. In addition to the changes in content, there also have been organizational changes. For example, theoretical concepts relating to radiation exposure and radiation dosimetry, formerly covered in separate chapters, have been consolidated into a single chapter, while discussions relating to instruments for measuring these quantities are treated in a separate chapter.

12. Vacuum tubes have been replaced by modern components in descriptions of electronic devices.

There also have been noteworthy cosmetic changes. The type is slightly larger (which will be appreciated by those old enough to have been trained on the earlier editions), the halftone photographs are clearer, and the paper seems to have less glare.

Of the changes noted, the recommendation for a factor of ten decrease in radiation levels in planning radiation shielding will surely generate the most discussion. The authors' argument that this is justified on the basis of the ALARA principle is not supported by quantitative example. For a busy diagnostic x-ray facility, this recommendation will add approximately 1 mm of lead or 6 cm of concrete to the shielding requirements. For lightly used facilities, it may require that specific shielding materials be added (e.g., lead-lined walls) where ordinary construction materials would be adequate under current recommendations. In some cases, it may require the use of leaded glass in place of plate glass for viewing windows. While costs will vary widely, some of these additions may be quite expensive if it proves necessary to add concrete or lead to ceilings and floors. Physicists frequently "overdesign" diagnostic x-ray shielding to begin with by generously overestimating workloads (particularly in view of the trend toward more sensitive image recording systems), by using minimum rather than average source-to-barrier distances, and by ignoring shielding provided by components of the x-ray table, cassette holders, and the patient himself. In my experience, no individual working in a shielded area in an x-ray facility (e.g., a control booth), ever comes close to the currently recommended radiation limits, probably due to these "overdesign" factors.

It should be noted that the recommendations given in this book regarding shielding design are not the current standards for the U.S. This may change in the future, however, particularly when recommendations have come from such an authoritative source. Physicists who choose to follow the recommended lower radiation limits should examine their assumptions regarding workload, source-to-barrier distances, etc., carefully and realistically, to avoid unnecessary and wasteful recommendations in their shielding plans.

The reader will note that, except for the introduction of MIRD concepts, my list of "interesting changes" does not contain much material of relevance to nuclear medicine. This does not mean that there have not been changes in this material, for there have been many in both organization and content. Rather, it reflects my feeling that the material presented does not reflect the state-of-the-art of nuclear imaging at a depth that would be satisfactory to the nuclear medicine specialist. Some examples: The discussion of resolving time covers only nonparalyzable models and does not include the phenomenon of pulse pileup. Semiconductor detectors are covered in a single page. The discussion of imaging devices still begins with a description of rectilinear scanners, which may not be used in most nuclear medicine facilities now. In the discussion of Anger cameras, there is no mention of diverging, converging, or slant-hole collimators. Modern (past decade) improvements in camera design are covered in a single paragraph. There is no mention of image artifacts, or of concepts relating to performance testing and quality assurance of nuclear imaging devices. There is a one page discussion of cyclotrons and PET imaging devices, but nothing on SPECT, or on other computer applications in nuclear medicine imaging.

None of this is meant to reflect on the overall quality of the book, which is excellent. Also, it should be noted that basic physics concepts of relevance to nuclear medicine, such as radiation interactions, are treated with clarity and depth. Rather, my remarks simply reemphasize the fact that this is a "therapy oriented" book, with nuclear medicine receiving relatively less consideration. Specialists in radiation therapy (both physician and physicist) will want to have a copy of this book available for ready reference at their desks, particularly in light of the many substantive changes from previous editions. For their interests, the coverage of diagnostic x-ray and nuclear imaging is probably about right. Nuclear medicine and diagnostic x-ray specialists will find a laboratory copy of this book to be useful as a reference for general radiological physics concepts and for occasional questions relating to the physics of radiation therapy. They will require additional material, however, for more substantial coverage of the physics of their specialties.

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