doubtless be reviewed in therapy-oriented journals.) The other two chapters are on the assay of β^- and γ sources and statistics and error analysis. The authors have been poorly served by the editors, the typesetters, and the proofreaders. The references include none more recent than October 1975. Chapters are given in the Table of Contents by name and authors only, and subheadings are not given in outline form so the reader can determine what the chapter covers or where to find a particular subject. I shall comment specifically about the two chapters mentioned above.

The chapter on assay of sources begins with standards and a list of available NBS standards (several of the chemical elements are given incorrect symbols). There is no reference to the chapter on statistics and vice versa, but each rather develops solutions to the same topics. The chapter is thoroughly illustrated although two illustrations are reversed, and the caption for Figure 2 misquotes the source of the figure. The third section deals with beta counting, and a bit more space is devoted to liquid scintillation counting than to gaseous detection. For each, an outline of the setup, use, and quality control of a typical system is given. The names of the scintillators, POPOP and PPO, are not given correctly. The next section covers the assay of gamma sources by ionization chamber, by NaI(Tl) crystal, and by semiconductor detectors. The dose calibrator discussion is adequate. The section dealing with the NaI(Tl) detector describes different kinds of samples and different counter geometries in a somewhat disorganized manner. No mention is made of counter drift as a source of difficulty, and a typical block diagram is not given for either the NaI(Tl) or semiconductor detector systems, although there is a thorough set of diagrams in previous sections. No information is given concerning shielding these systems. The chapter's appendix gives formulae for the calculations of "spillup" and "spilldown" in dual nuclide counting (called dual "isotope" counting). A linear correction is used with a caveat that samples should have adequate count rates to avoid error propagation, but there is no mention of any further complications. The term "adequate count rates" is not defined even by reference to the statistics chapter. In summary, this chapter should be better organized and more explanation provided, and there are a few omissions.

The chapter on statistics begins with what I believe to be an inaccurate description of radioactive decay as being a random process. The randomness is in the nature of the decay process, not in our inability to measure the same result every time. The chapter was pleasantly thorough but, once again, lacked the attention of an editor and a proofreader. The link between the Poisson and the Gaussian distributions was omitted, leaving the reader to wonder from whence the Gaussian arrived. After the authors have developed their theme from the binomial through the Poisson to the Gaussian description using the same example, they note that the distributions can be compared. At the end of the Chapter, Figure 1 appears with no legend to indicate that it illustrates the sought-for comparison and the text does not refer the reader to the figure.

Propagation of error is nicely treated with examples. Hypothesis testing is discussed with the aid of some figures, which unfortunately do not match the text. An extra table was added and consequently all the text references to the tables are incorrect. Tests of randomness are next described. The editor should have organized the section with the relevant parts of the example appearing on the same page, so that sums were not "orphaned." In addition, an extra number has been inserted in the example between the text description of the problem and its solution. These difficulties and others, such as incorrect subscripting and superscripting, confuse the reader. The Poisson distribution discussion would have been more valuable had it been cross referenced to the previous chapter, and the paired source method could have been jointly described and given the same name in both chapters.

I hesitate to recommend this book as a reference on the topics I have discussed. Chase and Rabinowitz is an old standby and will have to continue to be so although certainly its treatment leaves a great deal to be desired.

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RADIATION DAMAGE TO THE NERVOUS SYSTEM: A DELAYED THERAPEUTIC HAZARD. H. A. Gilbert, A. R. Kagan, Eds. New York, Raven Press, 1980, pp 225, $30.00

This volume represents a good overview of an important issue—late effects of radiation on the nervous system, a topic of interest to everybody who deals with neurooncologic problems. The book is well edited and includes almost all relevant subjects ranging from diagnostic and dosimetric considerations to treatment of radiation brain necrosis.

The first two chapters are devoted to the experimental observations of delayed necrosis in normal animal brain and a review of clinical experience on irradiation injury of the human brain. W. F. Caveness has demonstrated that a dose of 8,000 rad in eight weeks to the monkey brain causes irreversible damage, which was not seen with 6,000 rad in six weeks. M. M. Mikhael correlated the CT findings of brain necrosis with the tumor dose based on isodose reconstruction maps in his chapter, "Dosimetric Consideration in the Diagnosis of Radiation Necrosis of the Brain." In "Imaging Techniques in Diagnosis" M. D. F. Deck presented eight case reports to show the variable appearances of brain lesions on CT scans as a result of delayed radiation injury to the brain. He has also observed various patterns of evaluation of delayed radiation changes; i.e., some lesions resolved either spontaneously or by steroid medication whereas others progressed to fatal radiation necrosis within or outside the brain lesion.

D. R. Groothuis and N. A. Vick ("Radionecrosis of the Central Nervous System") presented several key issues along with four case reports dealing with radiation damage to the central nervous system. They also reviewed the neuropathological changes of radionecrosis of the brain and found that the characteristic vascular abnormalities correlated poorly with the demyelination and necrosis but that coagulation necrosis was the most extensive and irreversible type of damage. M. S. Edwards and C. B. Wilson suggested a new direction in the treatment of radiation necrosis in their chapter "Treatment of Radiation Necrosis." They discussed the efficacy of surgical and/or medical treatments of radiation necrosis, and surgery appeared to be a life-saving measure. In the future this approach should be ideal in many patients. T. J. Kinsella et al. have discussed uncommon problems of radiation damage to the cranial and peripheral nerves. The dose-fractionation schedule and volume irradiated are considered to be the major determinants of damage, often caused by poor radiation technique and unacceptable dose inhomogeneity.

Based on survivors of childhood leukemia, M. A. Bleyer and T. W. Griffin have examined adverse late effects of disease and its treatment. The apparent late sequelae following chemo-radiotherapy were: (1) decreased intellectual function; (2) necrotizing leukoencephalopathy; and (3) mineralizing microangiopathy with dystrophic calcification. They found that the risk and severity of delayed neurotoxicity are directly proportional to the number of therapeutic modalities used; e.g., intrathecal (IT) methrotrexate (MTX), high-dose intravenous MTX, and radiotherapy. Correlation between the risk of leukoencephalopathy and cumulative dose of IT MTX were discussed, i.e., chemotherapy given with radiation intensified damage to normal tissue. "Effects of Irradiation on the Hypothalamic and Pituitary Regions" by G. E. Richards is an important but controversial and complex topic. Well-designed, prospective, and careful studies will be needed in the future to correlate various factors such as age at treatment,

tumor location and extent, radiation technique and dosage, and concurrent chemotherapy and dosage, since many factors could affect the outcome of treatment.

The final two chapters cover spinal cord injury. A.R. Kagen et al. discussed the tolerance of the brain and spinal cord to injury by radiation, and W.J. Brown and A.R. Kagan compared myelopathy associated with megavoltage irradiation and remote cancer.

The one most important defect that the readers will find in this volume is the study of long-term performance status on brain tumor patients. The literature suggests that the favorable long-term performance of the cured brain tumor patients who received radiation alone is better compared with the results with combined chemo-radiotherapy.

In summary, as the editors indicate, the volume focuses attention on the current and future risks of radiation for neural tumors, and the diagnosis and treatment of irradiation injury. It is a lengthy synthesis of an extensive literature and reviews two decades since Lindgren's work *On tolerance of brain tissue and sensitivity of brain tumors to irradiation.* In view of the valuable and extensive literature review contained in the volume, it will be eminently useful for all specialists including radiation and neuro-oncologists.

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MEDICAL DIAGNOSTIC IMAGING SYSTEMS: TECHNOLOGY AND APPLICATIONS. B. Hamilton, Ed. New York, F & S Press, 1982, 240 pp, $39.50

This book attempts to assess the current status and future developments of the medical imaging industry, by providing, according to the "Introduction," ". . . a comprehensive review of the diagnostic imaging field . . . (and) . . . an assessment of the potential, both diagnostic and commercial, of the new advanced imaging equipment and techniques under development today." The target audience is not identified, but the book appears to be oriented primarily toward businessmen, investors, hospital and government administrators, and other "non-imaging-specialists," who want to be aware of advances in the rapidly evolving field of medical imaging, and how, when, and where to spend or invest their money during the next decade.

The first chapter contains brief descriptions, of the basic principles of various imaging modalities (radiologic, CT, nuclear, ultrasound, and thermography), and a chapter describing areas of clinical applications for each modality follows. Chapter 3 provides a profile of the industry, listing the various manufacturers of medical imaging products and their share of the market, based on 1976-78 statistics. Chapter 4 describes briefly the current sources of research support (industry versus government agencies) but does not provide data either in absolute dollars or relative amounts.

Chapters 5-14 cover a broad spectrum of advanced imaging systems by categories, including x-ray (5 and 6), CT (7 and 8), nuclear (9 and 10), ultrasound (11), thermography (12), NMR (13), and miscellaneous (14), and they may be considered the "meat" of the book because they provide the basis for predictions of future developments in the medical imaging industry. Some 40-plus "new" systems or ideas are described in varying detail, ranging from systems that already are in clinical use (e.g., digital fluorography) to some that exist only on paper (e.g., a new design for high-speed CT, based on the "simple solution" of using a "rotating cathode filament with a fixed, large circular anode"). Most of this material was prepared by the book's author, with some contributed chapters and only the latter are provided with references.

The final chapter (15) attempts to project, on the basis of the preceding chapters and certain assumptions regarding government control of expenditures, etc., what the marketplace share will be for various conventional and advanced systems for each year from 1981-1990. Detailed breakdowns are given by product area, but the bottom line is that various "advanced systems" are predicted to account for about one third of dollars spent for medical imaging systems by 1990. The book closes with a bibliography (unfortunately, not referenced to corresponding chapters), a list of acronyms and major manufacturers, and an index.

Generally speaking, this book is technically accurate and free of typographical errors, but it does not contain a great deal of information useful to medical imagers or imaging scientists, except perhaps for those at the administrative level. The descriptions of technologies and systems are below that of the specialist's level, and many of the "new" systems described have been around for some time (e.g., DSR, ultrasonic holography, coded aperture imaging). Possible new information for imaging specialists includes marketplace and industry profiles and brief descriptions of some of the more unusual "imaging modalities of the future" (e.g., microwave scanners, heavy ion radiography, and impedance cameras). The book could have filled a need for those in business who are investors or are administrators. In my opinion, however, it fails to meet this objective for two reasons: (a) unevenness of coverage, and (b) lack of *critical* commentary and insight into the potential value of the various advanced systems described.

Regarding the first criticism, for example, in the description of basic principles in Chapter 1, conventional x-ray generators and tubes are described reasonably well, but film-screen systems are only mentioned in passing, and image intensifiers are not mentioned at all. In Chapter 2, under applications, conventional roentgenograms receive a scant half page, plus a table listing parts of the body that can be imaged with x-rays, which is essentially a list of all the major portions of human anatomy. No insight is given as to the value of conventional x-ray imaging, and why it is currently the most important of the many modalities discussed. Conventional fluoroscopy, angiography, cineangiography, etc., all receive only passing notice, if any at all. By comparison, nearly two pages are devoted to applications of thermography with much more detailed discussion (which, by the way, is more than adequate for this little-used technology).

Several important current and proposed imaging technologies are not mentioned, e.g., the Anger tomoscanner and 7- or 12-pinhole tomography for nuclear imaging, the Picker digital chest scanner, and the Fuji metal halide image receptor plate. Such systems are of at least as much importance in medical imaging as, for example, heavy ion radiography. One major problem area for the 1980s, mass storage of digital image data, is mentioned only in passing and the one sentence dismissal of permanent magnets as a practical alternative for NMR imaging is another major deficiency.

The second criticism, lack of *critical* commentary on the various "advanced" imaging systems that will supposedly account for one-third of the market by 1990, applies to most of the chapters on advanced imaging with the notable exceptions of Chapters 6 and 8. Some of the systems are described in tones that one expects to find in product promotional literature or grant proposal abstracts. Expressions such as ". . . early diagnosis of cancer . . ." are used to describe the potential value of some systems, with no justification that this would be the principal value of the proposed system, or, even if it were, that the system would offer any significant advantages over current systems for achieving this objective. One x-ray system is described as providing images with the "minimum possible x-ray dose," without mentioning that poor resolution and quantum noise will severely limit its range of potential diagnostic applications. A major application of DSR, according to the author, will be for mass screening for lung cancer, a statement that seems to have been offered with little or no concern for cost or practicality.