BOOK REVIEWS

RADIATION AND HUMAN HEALTH. John W. Gofman. San Francisco, Sierra Club Books, 1981, 908 pp, $29.95

Among the recognized hazards of nuclear energy, psychological effects are judged sufficiently severe to require shutting down a commercial reactor. Gofman's book will surely exacerbate such public fears. He writes primarily for the layman, though claiming his book to be a valuable reference for physicians making intelligent decisions about diagnostic procedures. Of particular concern is his assertion that compensation lawyers can read from his tables the precise risk of cancer induction from a given dose of radiation. Because of a "methodological breakthrough" (which allows the discarding of all mathematics more difficult than solving proportions for x), now anyone with a high school education allegedly can comprehend matters previously dealt with by experts.

Gofman's crucial assumption is that the incidence of radiation-induced cancer, after a latent period, increases steadily until 40 yr after exposure, and then declines in symmetrical fashion. The long-term studies on which this conjecture is based have so far uncovered a half dozen cases of cancer occurring as late as 40 yr. From a curve drawn without mathematical justification, Gofman extracts numbers for calculating an extensive table of "conversion factors"; three significant figures are given although the first one is probably in error. With these "constants," one can determine the peak excess risk of cancer from the excess observed during a limited follow-up period. On this basis, Gofman makes some startling forecasts: 950,000 world-wide deaths will eventually result from the plutonium released in the atmospheric testing of nuclear weapons, with substantial numbers occurring by 1995. While this prediction cannot yet be tested, one can apply the method to data now available for epidemiological studies. If the universe is governed by Gofman constants, the probability of observing various actual results ranges from 10^{-9} to 10^{-3}.

Among other questionable assumptions about tumor biology, Gofman asserts that all solid tumors behave alike with respect to the relative excess risk per rad, despite substantial evidence to the contrary, which he does not refute. The wide variation in the risks estimated from different studies is attributed to the uncertainty in small numbers, the only reference to confidence intervals in 865 pages. To arrive at a best estimate, he combines studies that involve subjects of similar age group, regardless of whether thyroid carcinoma, thyroid adenoma, skin cancer, or brain tumors occurred. Although pooling data is not unprecedented (as in the trials of anticoagulants in myocardial infarction), Gofman violates a cardinal principle by ablating the denominators. He calculates the weighted mean of the peak percent increase per rad, weighted by the number of cancers observed, cancelling out all information about the number of subjects in the studies. Though he speaks of a "relative risk" as preferable to an "absolute risk" model, he does not use the customary definition for a relative risk ratio, so that standard statistical methods (e.g., for computing variance) cannot be applied.

Confounding variables are mentioned primarily to explain why effects predicted by Gofman are not observed. The lower cancer incidence in states receiving higher doses of cosmic radiation is ascribed to the lower doctor:patient ratio in such states, or to the fact that many Mormons reside in Utah.

The proportionality principle, or linear hypothesis, is frequently invoked—if 100 rads delivered to each of 1000 people cause 20 cancers, so would 10 rads to each of 10,000 people, or one rad to each of 100,000. Gofman tabulates for each age group the number of person-rads that will "guarantee" one excess cancer death. One wonders whether the people exposed to more than 400 rads at Hiroshima (up to four times the whole-body cancer dose) will each suffer several cancer deaths, or whether the effects of the superabundant rads will be distributed over those receiving a smaller dose. Gofman does not explain.

Clearly, this book is not a scientific work, but an antinuclear diatribe, peppered with such expressions as the "DNA repair gremlin," the "fraudulent threshold," the "genocidal potential" of small risks and "guinea piggery as public policy." It is important for physicians, especially those in the field of radiology, to be aware of this publication, because it attempts to discredit most of the standard risk calculations for ionizing radiation. Primarily, it is of interest to psychologists studying the effects of compartmentalization of the mind, for it illustrates how an impressively elaborate mathematical superstructure can be constructed on an obvious key fallacy.

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THE EVALUATION OF MEDICAL IMAGES (Medical Physics Handbook 10). A. Ll. Evans. Philadelphia, Heyden & Son, Inc., 1981, 125 pp, $28.00

This slim volume is one in a series of "medical physics handbooks." The author describes the book as ". . . an introduction to the field of image assessment applied to medical imaging." Although often dominated by discussions of x-ray images, there are ample references to the more noise dominated scintigraphic images. The book is organized in a very straightforward and coherent manner. Had I come across it in a bookstore the table of contents is such that I would have immediately purchased a copy. Nearly everything I've ever wanted to know concerning the description and evaluation of medical images is listed in the contents. Beginning with an introductory chapter, the book discusses (in a mathematical way) the basic concepts of contrast, resolution and noise as they apply to the perception of radiographic and nuclear medicine images. The next chapters cover point and line-spread functions and the use of the MTF for image evaluation; descriptions of image noise (auto correlation function and Wiener spectra); a section listing the various "figures of merit," which have been used in attempting to describe the "quality" of an image; a brief section on feature extraction and image enhancement; a chapter on the extraction of quantitative information from medical images, which includes a very short section in functional imaging and, as an example of the analysis of time varying images, a brief mention of radionuclide ventriculograms. Finally, there are two very interesting chapters concerning image evaluation and clinical efficacy, dealing primary with receiver operating characteristic (ROC) curves.

The book, as mentioned, is in the "Handbook of Medical Physics" series. As a handbook, it is a great success. It is exceptionally thorough, contains nearly every important fact a reader would wish to know, and has extensive references. As an ". . . introduction to the field of image assessment . . ." however, I am not