

incentive to start using invariant imbedding techniques on a large scale. A possible exception to this is in deep-penetration calculations, such as in shielding problems, where the large attenuations experienced can lead to numerical difficulties with more conventional techniques based on the transport equation.

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About the Reviewer: Gerald Pomraning has been a staff member of the Theoretical Physics Group at Science Applications, Inc., since 1969, following seven years of reactor physics work at General Electric and Gulf General Atomic. Dr. Pomraning received his PhD in nuclear engineering from the Massachusetts Institute of Technology in 1962. His current research interests are in radiative transfer and radiation hydrodynamics, with a continuing interest in neutron transport.

Environmental Radioactivity. By Merrill Eisenbud. 2nd ed. Academic Press, New York (1973). 542 pp. \$29.50.

The many persons who have made good use of *Environmental Radioactivity* by Merrill Eisenbud (McGraw-Hill) as a valuable reference and source of information on many subjects will be happy to know that this text is now available in Second Edition. It not only is reproduced by a new publisher (Academic Press) but in many respects is a new text containing a new section (Peaceful Uses of Nuclear Explosives), many new subject areas, and a number of additional tables, graphs, drawings, photographs, equations, etc., which make it an essential addition to the library of scientists, engineers, college students, and even administrators, many of whom have found the first edition a frequent reference. This second edition, with its 25% increase in pages, is now the latest in an interdisciplinary monograph series of 14 texts on Environmental Sciences. Because of its brief treatment of such a great variety of subject areas ranging from natural background radiation, its effects on man and his environment, the transport of radioactive contaminants in the air, water, and soil, radiation protection standards, the nuclear energy industry including mining, fuel fabrication and reprocessing, reactor operations and waste disposal, fallout, radiation accidents, peaceful applications of nuclear energy, and environmental surveillance, it is an almost essential first reference for one checking numbers, dates, mechanisms, working equations, reactor incidents, regulations, etc. However, by definition it would be of no value to the specialist such as the cosmic-ray physicist seeking information in his subject area, the meteorologist seeking information on micrometrology, or the nuclear engineer wishing information, for example, on the high-temperature gas-cooled breeder reactor. Each of these specialists, however, would find most useful information on a score of subject areas and especially as they relate to the subject of environmental radioactive contamination.

There are so many outstandingly good features of this book that one has to look hard to find things with which he disagrees or to which he objects. This reviewer, however, was given the feeling at times that the writer avoided pointing out some of the mistakes of the AEC and that he gave too little effort in relating the evidence of damage from low levels of radiation exposure and in making a strong case

for the linear hypothesis relating accumulated radiation dose to radiation damage. For example, the apparent disagreements between the magnitude of increase in malignancies among children who received *in utero* exposure from diagnostic exposure of the mothers, as found in Alice Stewart's Oxford studies, and among the Japanese children who had received *in utero* exposure when their mothers survived the atomic bombings of Hiroshima and Nagasaki were pointed out, but the important logical explanations that readily account for the differences were not given. The discussion on internal dose is factual and clearly written, but will be out of date when viewed in terms of the concept that body burdens and MPC values must be treated at best as only secondary standards and that the only reliable index and the one being used in the new internal dose handbooks of the International Commission on Radiological Protection (which will be published in the Fall of 1974) is the permissible annual dose commitment. This corresponds to a dose to the critical body organ that is numerically equal to the maximum permissible annual dose following any pattern of intake of a radionuclide.

This reviewer found only a few "half truths" or partially incorrect statements in the text. For example, it is stated that tritium originates in *two* ways in reactor wastes. Actually, there are a number of reactions that account for this radioactive contaminant. Another example of a partially erroneous statement is that the risk of terrestrial and marine applications of isotopic power generators can be *eliminated* by massive design of the containment and by restricting the locations in which the units will be used. This sentence could be made correct by replacing the word *eliminated* by *made insignificant*. In another example, the parent of the neptunium series of radionuclides is given as ^{241}Pu , presumably because it occurs earlier in this chain. However, the convention is to choose the longest lived controlling radionuclide as the parent element in a chain. The other three series of radionuclides (^{238}U , ^{235}U , and ^{232}Th) also had many short-lived precursors which long since have disappeared, but we do not consider them as the parent radionuclides.

This reviewer found remarkably few errors in the publication. In particular, he would note that on page 188 the ^{14}C body content of the average man is given as 0.1 Ci instead of 0.1 μCi .

Some of the chapters, such as the one on "Food Chain from Soil to Man" and the one on "Natural Radioactivity," are outstandingly good and offer the reader a wealth of useful information. The bibliography containing about 900 references will be most helpful to the reader wishing more information. In general, Merrill does an excellent job in consolidating a vast amount of information on environmental radioactivity.

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