Book Reviews

Radioactive Wastes. Their Treatment and Disposal. By J. C. COLLINS, General Editor. J. Wiley, New York; Spon, London, 1960. 237 pp. 46 illustrations. $8.00.

Eight British scientists and engineers, with practical experience in radiation protection and radioactive waste disposal, collaborated in writing this book. Mr. J. C. Collins, general editor, now a Lecturer in Civil Engineering at Manchester University, was formerly a member of the Health and Safety Branch of the U. K. Atomic Energy Authority. The other contributors ably represent the competence and experience of several responsible agencies: Ministry of Housing and Local Government, Atomic Weapons Research Establishment, Atomic Energy Research Establishment at Harwell, Water Pollution Research Laboratory in Stevenage, United Birmingham Hospitals, and Department of Chemical Engineering, University of London. Mr. R. H. Burns, who wrote two of the ten chapters and is coauthor of a third, is recognized internationally for his work in the field of liquid effluents treatment.

This book summarizes the basic knowledge and practical technology of present-day treatment and disposal of radioactive wastes, and the attendant problem of safeguarding the public health. The first four chapters deal with the fundamentals of radioactivity, methods of detection and measurement, radiation hazards, methods of radiation protection, and the sources of radioactive wastes. These subjects are treated in some detail. The remainder of the book describes specific practices in the storage of high-level liquid wastes; the treatment of low-level liquid wastes; the disposal of partially decontaminated low-level liquid effluents to the sea and to surface streams; the disposal of low-level solid wastes on land and at sea; and the discharge of partially decontaminated stack effluents to the atmosphere. Frequent references to practices in the U. S., and elsewhere, are made for comparison and a number of case histories are analyzed to describe the mechanisms of dispersion, dilution, and reconcentration in the environment and the possible radiation exposures to man resulting therefrom.

The discussion of waste treatment and waste disposal practices is treated with particular reference to British experience with low-level radioactive wastes. In this respect, the book is valuable and useful because it reflects the conservative but realistic philosophy on which their practices are based. They take a straightforward approach to evaluating potential hazards of a given practice and obtain the necessary factual knowledge to confirm their assessment before disposal operations begin. Their approach is unique in that they consider hazards to man only, and not potential hazards to the environment that might lead to so-called ecological effects.

Notwithstanding their success in developing solutions to the low-level waste problem, a fact to which this book attests, the far more important question of what to do with high-level wastes is dismissed with a statement "that they present a great potential hazard and storage under strictly controlled conditions is required." For this reason, the title is misleading: it might better have been "Low-Level Radioactive Wastes—Their Treatment and Disposal."

Disposal of radioactive liquid effluents to the ground—practiced in the U. S. at Hanford, Idaho Falls, Savannah River, and Oak Ridge—is discussed briefly and only brief mention is made of land burial of radioactive solid wastes. Thus, the geologic and hydrologic factors which control accumulation and movement of radionuclides in the ground are not discussed, and other environmental features which limit ground disposal practices are not considered.

The U. K. Atomic Energy Authority conducted extensive environmental surveys before and after the commencement of disposal operations in the River Thames and in the Irish Sea. Failure to describe this very excellent work prevents the reader from drawing his own conclusions as to the effectiveness of their disposal practices. Analyses of hypothetical situations based on simplified assumptions are useful and necessary, but are not a substitute for the results of actual field investigations.

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Controlled Thermonuclear Reactions. An Introduction to Theory and Experiment. By SAMUEL GLASSTONE AND RALPH H. LOVBERG. Van Nostrand, Princeton, New Jersey, 1960. 544 pp., $5.60.

This book is a guide to fusion research in much the same way in which the well-known book by Glasstone and Edlund (1952) was a guide to theoretical nuclear reactor research. It was sponsored by AEC and prepared under the auspices of its Office of Technical Information. It was again composed by Dr. Glasstone, a skillful and widely experienced professional technical author, and Dr. Lovberg, an expert in fusion work, who has been associated with the Los Alamos group of Project Sherwood since 1955. It differs from Glasstone-Edlund in that it covers both theory and experiment. A greater difference is in the respective fields. In 1952, the theory of nuclear reactors was safely established in its main outlines. Unfortunately, this is not true for either theory or experiment in fusion. There are three

main objectives of fusion research: (1) thermonuclear neutrons, (2) sustained reaction, (3) gain of energy. Not even objective (1) has been achieved in an unobjectionable fashion and any prophecy as to when objectives (2) and (3) will be achieved seems to be premature at the present time. The wave of optimism and glamor which in 1958 surrounded the declassification of fusion research in the U. S., the U. K. and the U.S.S.R.—the three countries which carried on and are still carrying on *big* research on fusion—changed to an appreciation of the great difficulties which face thermonuclear work. Secrecy and isolation lead to a peculiar slang in fusion work, characterized by (Greek) nicknames for equipment and renaming of even familiar concepts. All this made it difficult for outsiders (even for physicists!) to judge intelligently progress in this field. This book will help greatly in explaining what has been accomplished.

The book contains thirteen chapters. A brief introduction is followed in Chapters II and III by a description of the basic nuclear-physical conditions and possible approaches for attaining a thermonuclear plasma. Energy balance considerations, the idea of magnetic confinement of a hot plasma, and the various field configurations (pinch, stellerator, mirror, astron) for such a confinement are given. The conditions for a power producing fusion device (after reaching objective (3)!) are briefly discussed. Chapters IV, V, and VI discuss elementary plasma theory, describing formation and heating of plasmas, and "plasma diagnostic techniques." Almost half of the book is contained in the next five chapters (VII to XI) discussing the major systems of magnetic confinement (pinch, etc.). Chapter XII describes energy losses and sealing laws, while the final Chapter XIII, based on a draft by Dr. Suydam, deals concisely with parts of stability theory.

A merit of the book is its easy readability and clarity. It is also the first book which covers in a comprehensive manner all the major devices and approaches in fusion work on the international level. Therefore, the book will greatly contribute in disseminating the information accumulated particularly in the "big" projects in the U. S. and abroad. However, on the whole, the book lacks originality and, except for the last chapter, is not very critical. The connection between past and current gas discharge and ionospheric research is not established. For this we cannot blame the authors entirely, since most of the many enthusiastic and devoted people working on Sherwood projects, on whose reports this book is based, are not concerned about this connection. In many cases people were too rushed to even use existing knowledge.

The treatment is mostly correct. In some places, however, the tendency to be elementary has led to some inaccuracy, as for instance in the discussion of the interaction of radiation with plasma, where the Compton scattering has not been taken into account. The discussion of the effect of the magnetic field on electrical conductivity is somewhat misleading. Also the habit of Dr. Glasstone to number all paragraphs does not permit adequate emphasis of the really important points.

These criticisms notwithstanding, the book will contribute importantly to the general renaissance of plasma physics. Fusion did for plasma physics what the transistor did for solid state physics.

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(*About the Reviewer: Eugene Guth is a well-known physicist who in recent years has been on the director's staff at Oak Ridge National Laboratory, where he has also served on the ORNL Sherwood Steering Committee.*)