NUCLEAR REACTOR THEORY

The Elements of Nuclear Reactor Theory

By Samuel Glasstone and Milton C. Edlund. Pp. vii+416. (London: Macmillan and Co., Ltd., n.d.) 35*s*. net.

SOME of the results of the research and development which were necessary in order to produce the atomic bomb have gradually been made available in scientific journals and in the well-organized volumes of the National Nuclear Energy Series. Hitherto, however, no comprehensive account has been given of the theoretical work underlying the design and operation of nuclear reactors. With the current interest in the utilization of atomic power and the establishment of a nuclear reactor as a valuable fundamental research tool, such a book is long overdue.

Dr. Glasstone and Mr. Edlund have most ably filled the gap with their recent book on nuclear reactor theory. This book is based on a course of lectures which is given at the Oak Ridge National Laboratories for graduates who are commencing work on the reactor research and development programme. As such it is written primarily for physicists and engineers but is of interest to all concerned with reactor design.

For those unfamiliar with the properties of neutrons and their interaction with matter four introductory chapters are provided. These deal with such fundamental concepts as nuclear structures, binding energy, energy-levels, cross-sections and radioactivity, culminating in a discussion of the fission process and a chain reaction. The book is restricted, on security grounds, to a discussion of 'thermal' reactors, which are reactors in which the majority of fissions are caused by neutrons the average kinetic energy of which is approximately equal to that of the atoms and molecules in the containing medium.

This introduction is followed by a detailed mathematical treatment of the behaviour of neutrons in matter. The slowing down of fast neutrons from fission is developed according to Fermi's continuous loss of energy model and their subsequent behaviour according to diffusion theory. The application of this work to the design and properties of homogeneous and heterogeneous reactors is given in two later chapters. A discussion on reflectors includes an indication of the value of the group diffusion method for describing the slowing down of neutrons. This is also considered in a chapter on the general theory of homogeneous multiplying systems.

It is gratifying to find that the authors have found space for this chapter and also for one dealing with the relation between diffusion theory and the more exact transport theory. Such considerations are essential in order to understand in what circumstances the simple treatment given earlier becomes invalid.

There are also separate chapters devoted to reactor kinetics, reactor control and perturbation theory. The effects of control rods and delayed neutrons are calculated, and brief mention is made of the effects of fission products and variation of reactor temperature. It is a pity that space could not be found for a discussion of the use of perturbation theory in treating the two latter effects, which are of considerable practical importance.

A comprehensive subject-index is provided, and at the end of each chapter there are several problems which are of practical interest. Sufficient declassified data are given for the reader to design reactors for himself and to determine their operating characteristics. Some scarcity of references is understandable in a book which is produced under security restrictions, but more references to experimental work which has been published might have been made.

This book can, however, be thoroughly recommended to those who are interested in reactors and wish to know more about their design, to those who are joining a reactor project for the first time and as a reference book to those who have managed without one for so long. P. W. MUMMERY

RECENT RESEARCHES IN PHYSICS

Reports on Progress in Physics

Vol. 16 (1953). Executive Editor: A. C. Stickland. Pp. iv+407. (London: The Physical Society, 1953.) 50*s*. net; to Fellows, 27*s* 6*d*. net.

THIS, the sixteenth in the series of now annual reports, differs little in outward form from its predecessor. As in Vol. 15 there are nine articles each dealing with advances in a particular field or branch of physics. The standard is high and the reports contrive to get more and more specialized. No longer can the physicist of average attainment or the specialist in a particular branch hope to gain easily by reading these reports an insight into interesting developments outside his present knowledge. The authors assume that their readers have more than a nodding acquaintance with their subjects, and they do not bother to give an adequate introduction or to explain fully and simply the terminology and methods used. Far too many aspects are covered in the one article, and it is obvious from the large number of references which accompany each report that only a few lines of text can be devoted to the work described in each of the papers referred to. Authors of future reports might be invited to provide more background material and to deal more broadly but critically with the important advances in the fields they choose to survey.

The present interest in solid-state physics is reflected by the comparatively large number of reports, five of the nine, dealing with various aspects of crystal and solid properties. The first, which is also the longest article in the volume, is by G. E. Bacon and K. Lonsdale and is devoted to a review of the application of neutron diffraction methods to the examination of the structure of solids. Now that neutron beams of considerable intensity are available from atomic piles, progress in the study of the interaction of neutrons with matter has been rapid in recent years. The report deals in particular with the way in which neutron diffraction has been used to supplement studies by X-ray diffraction, and with structural investigations involving light elements, distinctions between atoms of closely similar atomic number, and studies of magnetic materials.

The relation between the magnetic, optical, piezoelectric and elastic properties of crystals and their structural characters is discussed in a brief report by W. A. Wooster. This is a difficult subject and the experimental data are still inadequate, particularly in reference to the elastic constants, to justify more than broad generalizations. Dr. Wooster deals adequately with the material available. An admirable summary of work done mainly during the past five years on the Raman effect is given in the next report by A. C. Menzies. It is fitting that an article on this

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