

BOOKS

The series of '**Nuclear Engineering**' Monographs published by Temple Press Ltd. (London), publishers of the well-known monthly journal of that name, is intended for university and technical-college students, research assistants and qualified technicians who require a broad understanding of those topics of nuclear engineering outside their own field of study. Realizing that the depth of treatment in the specialist works is too great and the cost too high, the publishers have aimed at meeting the requirement of low cost and, at the same time, providing a broad treatment ranging from elementary principles to up-to-date summaries of more advanced theories.

Elementary nuclear physics, by W. K. Mansfield (2nd impression, 1959; 15s.) covers the basic physics of reactor design in an elementary manner. It starts with a résumé of the relevant parts of atomic physics and then develops the idea of the nucleus, with its structure, its various forms of energy, and its reactions with bombarding particles. A chapter on radioactivity follows, with the inclusion of the basic phenomena of fission, leading to a discussion of the interaction of neutrons with matter and the conditions required to produce a nuclear chain reaction. The last two chapters deal respectively with the effects and the detection of nuclear radiations.

The treatment of the subject matter is highly concentrated, the reader being led from one concept to another with little interruption for detailed explanation or even justification of the facts presented. Thus chapter 2, on the nucleus, begins with a section on nuclear theory, dealing successively with meson theory, the nuclear shell model and the liquid-drop model, and then explains with examples the equivalence of mass and energy. This leads to the concept of the nuclear binding energy and definitions of the processes of fusion and fission. Nuclear reactions in general are then discussed, followed by the special case where the residual nucleus is left in an excited state. After this, beta emission and alpha emission are dealt with briefly (the following chapter deals more specifically with radioactivity), and the chapter ends with a few words on spontaneous fission. All this occurs in less than nine pages of readable type, complete with explanatory diagrams. Approached in this way, a large number of specialized terms are defined and explained, in accordance with the author's aim of giving the terminology and essential principles of nuclear physics, to enable other engineers and physicists to understand the language and the arguments of the specialist. It is perhaps worth pointing out that the subject is indeed *nuclear* physics, with a strong bias towards practical applications, and the reader who wants to know about *high-energy* physics will not be helped a great deal. All the same, he will find information here on a number of the ideas and modes of expression, such as elastic and inelastic scattering, cross-sections, particles and waves, that have now been carried over from the study of nuclear matter to the study of mesonic matter.

As a book for quick reference, aided by an adequate index, this seems very good. Its usefulness as an introduction to the subject could probably be improved, however, by the inclusion of a bibliography of the most useful books giving fuller treatment.

This last criticism cannot be levelled against another book in this series, **Nuclear reactor instrumentation**, by M. W. Jervis (1961, 15s.). In some 70 pages, an effective summary is given of over 100 technical papers and books on this subject, all of which are listed at the end, grouped by chapters. Adding his own knowledge as a senior engineer with one of the British nuclear-power consortia, the author has divided his account into eight chapters, beginning with an introduction outlining the requirements in the light of the basic kinetics of a reactor. The remaining chapters cover temperature instrumentation, power measurements, safety systems, measurement of neutron flux, 'burst cartridge detection', telemetering and gas-analysis instrumentation, and health-physics instrumentation.

The treatment is necessarily brief, but sufficient to give a good idea of the special requirements and the difficulties as well as the various ways in which these have been met and overcome. Indications are also given of the directions of future development. This is obviously not a specialist's book, but seems basically well suited to the purpose of this series of monographs. As an instructional book, however, its value is diminished by the type of slipshod writing that is all too common among specialists over-familiar with their own subject. Critics of the present standard of English technical composition will find many examples here to support their views, though it is probably sadly true that most of the book's readers will not notice them. Even they, however, may wonder at a sentence such as: 'However, this indication would be masked by the background activity of activities in the coolant due to particulate matter and to the induced activity of the coolant'!

Fast reactors, another volume in the series, by R. G. Palmer and A. Platt (1961, 15s.) is much better from this point of view. True, the English reader is put off by the use of the word 'fissionable' on the first two pages, but happily this gives way to 'fissile' for the rest of the book, and the omission of the hyphens that would clarify (and draw attention to!) the long strings of words used as adjectives is regrettable but not uncommon.

In content, this volume seems more specialized, though this is no doubt mainly a reflection of the greater artistry of the subject matter, and the treatment is more mathematical. Successive chapters, covering some 90 pages in all, give first a general introduction to the subject and then details on the choice of materials, sodium technology, fast reactor statics, fast reactor dynamics, and heat transfer in liquid metals.

Fast reactors have the double attraction of being able to consume plutonium produced by the present type of nuclear power station and of being able to 'breed' new fissile material. These properties, and their limitations, are clearly explained in the introduction, and anyone who still thinks that this type of reactor is some kind of perpetual-motion device for producing something out of nothing should surely read this chapter (it has hardly any mathematics). As a matter of interest, the authors remind us that the Experimental Breeder Reactor I (EBR I), in the U.S.A., was the first nuclear reactor in the world, of any type, to produce electricity, now rather more than ten years ago.

It can be clearly seen that these reactors have little in common with the 'conventional' type of power reactor

in which the neutrons arising from fission of the uranium are slowed down as quickly as possible by a moderator. Not only is the technology very different, arising primarily from the need for very high heat output from a relatively small volume and from the use of liquid metal as a primary coolant, but a different way of thought would appear to be necessary. Certainly little of the data acquired in the study of thermal reactors is of direct use to designers of fast ones, and much experimental work with 'zero-energy' assemblies and experimental reactors is necessary before even a prototype power reactor can be operated.

The accent in this book is on theory, but much of the necessary data, particularly accurate values for the cross-sections as a function of neutron energy for all the materials of interest in a reactor, including impurities, are not known; even if they were, the equations would very often still not be soluble with present-day computers. The approximations, aided by experiments as necessary, that are described here give an interesting confirmation of Prof. Van Hove's recent assertion, that although we can successfully use nuclear forces we do not really understand them. The authors state, for instance, that for the important determination of the distribution in energy of neutrons after inelastic scattering, 'frequent recourse has to be made to theory based on nuclear models', but of course these models are at present far from exact.

However, much progress has clearly already been made in this field, and references are made throughout the book to the various fast reactors and experimental assemblies already constructed. It is unfortunate that, since the text dates from around 1960, much new information is missing (particularly on the successful operating experience with the Dounreay Fast Reactor) but the clear way in which the subject is presented should make it relatively easy for anyone sufficiently interested to bring himself up to date. A slightly intimidating page and a half of 'notation' immediately after the preface proves to be quite helpful, and there is a useful bibliography for each chapter.

A. G. H.

Introduction to structural problems in nuclear reactor engineering, edited by J. R. Rydzewski (London, Pergamon Press Ltd., 1962; 84s.) is volume 2 in Division VII of the 'International series of monographs on nuclear energy' under the general editorship of J. V. Dunworth. It includes contributions by J. M. Alexander, R. W. Bailey, G. H. Broomfield, A. H. Chilver, P. B. Morice, N. W. Murray, R. W. Page, J. F. Poynor, J. Przemieniecki, E. A. Richards, D. F. T. Roberts, J. R. Rydzewski, and H. Tottenham.

Covering the basic aspects of structural engineering for nuclear reactors, the book starts with a short review of the main nuclear reactions and the most common types of reactor, and continues with a discussion of the constructional materials used and the influence of nuclear radiation on the physical properties of the materials.

After an exposition of the construction of pressure vessels in mild steel, with some details on the various welding techniques, there are several chapters which deal with the mathematical analysis of structural problems,

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namely: the elastic analysis of statically indeterminate structures by means of matrix methods with the aid of digital computers, the elastic behaviour of steel and plates, a theory on thermal stresses, the plasticity and creep of metals, the design of special grillages, the evaluation of stresses in reactor pressure containers, the flexibility of gas ducts.

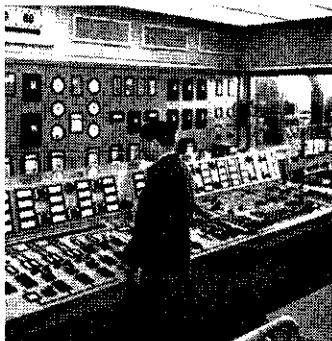
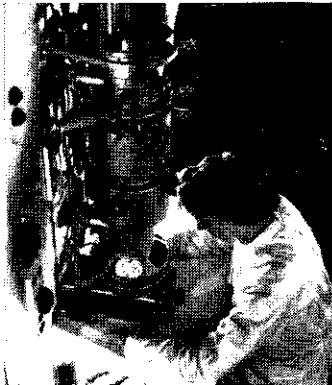
In the last chapter the essential principles of experimental stress analysis by means of models, strain gauges and photoelasticity are treated; an appendix gives some ideas on the application of concrete for the construction of large pressure vessels.

The book concentrates on fundamentals; specific problems are quoted, or outlined, but for their practical solution readers are referred to the more specialized publications cited in the ample bibliography at the end of each section. Owing to the change of author from one chapter to another, there is a certain amount of repetition, particularly in those chapters dealing with the use of computers in the analysis of structures.

Although in principle written for people embarking on the design of nuclear reactors, the book could also be of real interest to any structural engineer, since a number of the theories and ideas included are immediately adaptable to applications in many other fields of mechanical design.

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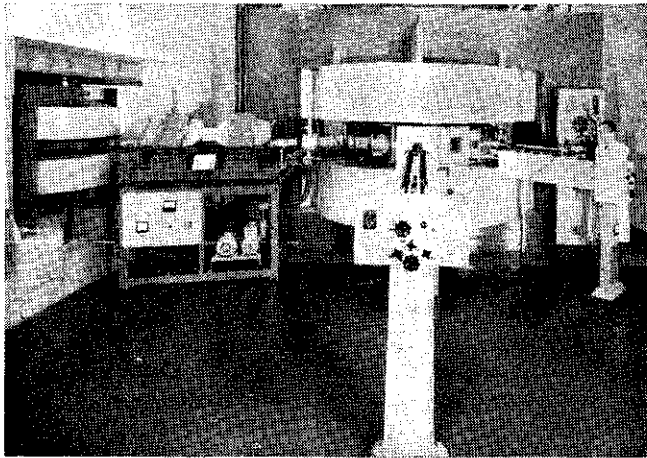
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