

BOOKS

Physics of nuclear kinetics, by G. Robert Keepin (Reading, Mass., Addison-Wesley Publishing Co. Inc., 1965 ; \$ 12.50).

Let us firstly clear up the only criticism of this excellent book, and that is of its highly misleading title. The book is, in fact, concerned with neutron-induced fission and in particular those aspects of the process that enable the author to deal in the second half of the book with the subject of the kinetic behaviour of nuclear reactors. Whilst the book is intended principally for reactor physicists and engineers, it contains a substantial amount that is of interest to the physicist studying neutron-induced fission as such (always of course within the energy range of neutrons present in a nuclear reactor).

The first half of the book deals in detail with the observed results of fission, namely the energy, mass, and charge distributions of the products, the properties of the prompt and delayed neutrons and gamma rays, and the nature of the fission-product decay chains that lead to delayed neutron emission. Full descriptions are given of the experimental techniques necessary for these observations, and the resulting data are carefully evaluated. In somewhat less detail, these results are compared with theoretical predictions and the more important discrepancies between experiment and theory are discussed. Because of the similar effects on the kinetic behaviour of nuclear reactors of delayed neutrons and neutrons produced by the action of fission-product gamma rays on deuterium and beryllium, the latter processes are also discussed in detail.

The rest of the book is firmly the province of the reactor technologist, who will find a very complete account of nuclear reactor kinetics theory and topics such as the experimental determination of reactor kinetics parameters, reactor noise analysis, reactor transfer function and their implications for reactor stability.

One of the incidental impressions left by this book derives from the description of the fascinating and somewhat hair-raising series of experiments carried out at Los Alamos on remotely controlled metal spheres (12-20 cm in diameter) of each of the major fissile species — 'the world's smallest chain-reacting assemblies'. Amongst the experiments performed have been the assembly of these spheres into the 'above-prompt-critical' region, and the experiments are a fine example of the work of experimentalists who, having faith in their own calculations, have gone ahead and obtained a wealth of high-quality information.

Dr. Keeping's book is well written, and well produced. The reference lists are exhaustive and completely up-to-date.

C. R. Symons

Classical charged particles — Foundations of their theory, by F. Rohrlich (Reading, Mass., Addison-Wesley Publishing Co. Inc., 1965 ; \$ 12.50).

As the author says in his preface, 'despite the great efforts of such men as Lorentz, Abraham, Poincaré, and more recently Dirac', the classical theory of charged particles 'is usually regarded as a lost cause'. The author feels, however, that 'with the present state of our knowledge we are able to look back at this theory, to put it in its right perspective, and, above all, to complete the unfinished work of the past'. He therefore has a well-defined programme ; moreover, his aim, in which he succeeds, is to

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convince us that this chapter of physics, though unappreciated, is coherent and attractive.

The book begins with two very short chapters: in the first, the author explains the role of theory in physics by analysing certain common terms such as 'domain of validity', 'scientific prediction' and 'scientific explanation'; he defines the relationship between various theories; this heralds the fact that in the rest of the book there is constant reference to the quantum theories associated with the subject. The second chapter gives, in the space of 18 pages, the history of the main contributions to the subject under review. This makes the reader want to go on.

In chapter III the foundations of classical mechanics (Newtonian and relativistic) are viewed in connexion with the Euclidean, Galilean and Lorentz invariance groups. The principle of equivalence is carefully studied, together with its most recent experimental tests. A brief glimpse at the field of general relativity is followed by a thorough discussion of Mach's principle and of causality. The last seven pages of this chapter deal with conservation laws and should be read by all physicists*.

Chapter IV (46 pages) is devoted to a long study of the covariant and non-covariant forms of the Maxwell-Lorentz field. Naturally, one finds the invariant functions D , D_0 , D_r , D_p , which are used to obtain the different potentials (retarded, advanced...). The derivation of the Maxwell equations from a Lagrangian is then shown, and how to form the energy-momentum tensor. Finally Lorentz and gauge invariance are studied. This chapter may well discourage the uninitiated reader on account of its abstract nature, but it is essential to read it in order to understand what follows. After the first 75 pages the reader may well be rather spoilt, but 'physics without tears' is a utopian dream and it is preferable to make necessary effort; the gulf between the classical theory of charged particles and quantum electrodynamics will be bridged without difficulty. It should be mentioned here that the book contains a great many exercises which the author has inserted at appropriate points.

Chapter V (18 pages) deals briefly with electromagnetic radiation and studies the case of radiation in a synchrotron.

Chapters VI and VIII are devoted to a close study of charged-particle dynamics. In my opinion, this is the most interesting part of the book; on the other hand, the part dealing with polarized particles (3 pages) seems to be rather sketchy.

The originality of the book is emphasized by the comparison made in its last two chapters between the theory it presents and corresponding quantum theories, on the one hand, and other kinds of field, on the other. Subjects such as charge conjugation and time reversal are studied. The book contains two most appropriate appendices on space-time in special relativity and in general relativity, and two detailed indexes.

This is a book that may be put beside Jackson's *Classical Electrodynamics*, since it covers different ground. It will be read with interest (and fairly quickly) by those who have studied quantum electrodynamics without taking the time to read 'the classics', and will give them a more intuitive grasp of certain problems, such as normalization. It will also serve those who wish to enter the quantum world with a solid classical background. Whoever reads it will have no regrets: this is an excellent book.

H. B.

* How many physicists are familiar with the conservation of currents or of energy-momentum, yet do not realize that they are both derived from Emmy Noether's theorem?



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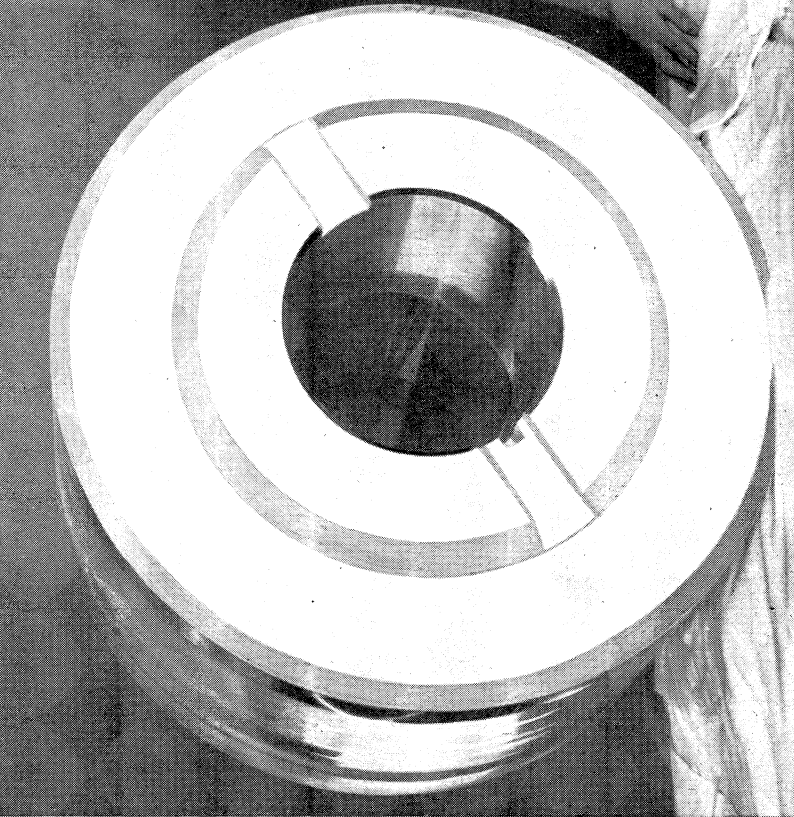
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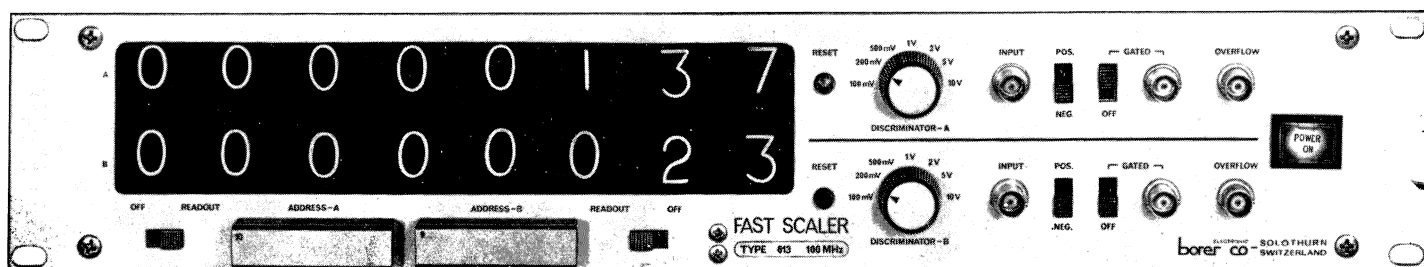
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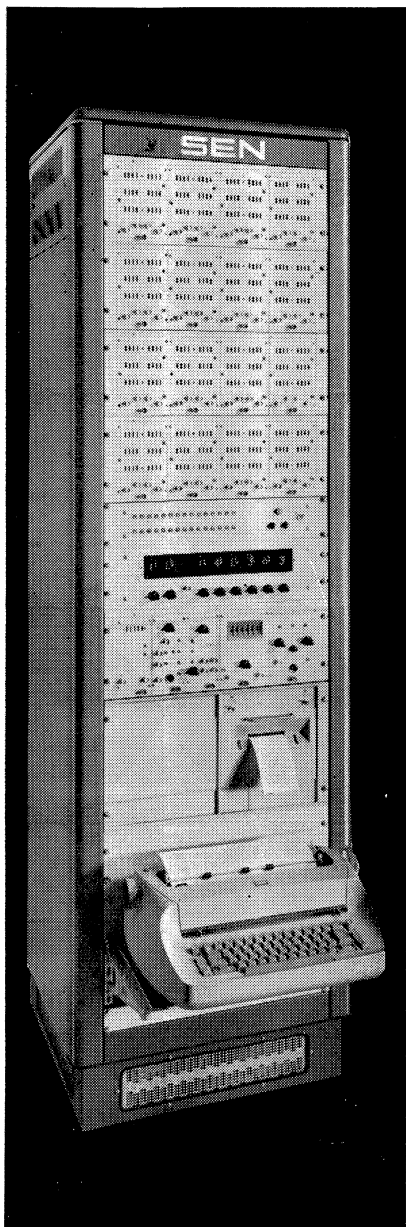
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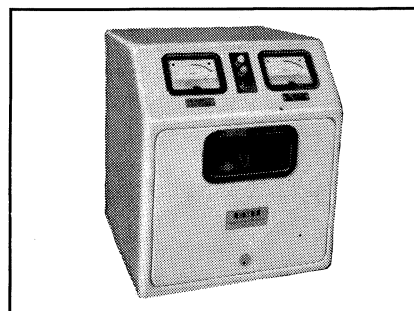


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