

dynatron regime, the resonance regime and the electronic regime. This is only appropriate since for frequencies higher than 600 mc./s. the magnetron provides larger outputs than those so far reported (except by Klystron described later) and has been used at frequencies upto 30,000 mc./s. ($\lambda = 1$ cm.) a value well above that reported for any vacuum tube. In view of its comparatively simple electrode structure the magnetron would seem to lend itself easily to theoretical treatment, but it has always behaved in an unexpected manner and defied all explanations offered so far.

The demand for larger power outputs at U.H.F. resulted in 1939 in the development of the Klystron based on principles of electric resonators and velocity modulation of cathode-ray stream which form the subject-matter of the first part of Chapter VI. The reviewer cannot help feeling that it would have been more helpful for an understanding of these principles had the author devoted more space to develop and discuss these at a greater length instead of giving rather concise accounts of various publications. In the latter part of this chapter a readable account is given of the work of Barrow, Brillouin, Southworth and others on wave-guides and horn radiators for providing directional beams at U.H.F.

An important feature of the book is the bibliography at the end of each chapter, the total number of references being 517; a welcome change, in the opinion of the reviewer, is the use throughout of the word 'tube' in place of 'valve' in an English publication. The brevity of Chapter I has not contributed to the clarity of the statements with regard to the feed-back principle.

It will be sometime before we will be in a position to appraise the stimulus given to this vital subject by the present war conditions. We have heard of the Radio Locator and the Radar. In the meantime Dr. Harvey has done a great service by making an exhaustive and disinterested survey of a field in which developments have been so rapid that critical judgment must necessarily be held in abeyance for the present.

The volume contributes an important book of reference for every worker in this most fascinating branch of electron physics and communication.

N. B. BHATT.

High Speed Diesel Engines. By A. W. Judge. Fourth Edition. Revised and Enlarged. (Messrs. Chapman and Hall, London), 1941. Pp. viii + 535. Price 25sh. net.

This book on "High Speed Diesel Engines" by A. W. Judge has run through another edition now, the fourth, and the author has taken advantage of this to make the book more up to date. This has resulted in an addition of 100 pages of more matter and a large number of diagrams. In recent years this book has come to be regarded as a text-book covering the entire field of the compression Ignition Engine in all its various applications and its value has been enhanced by these additions. The results of recent researches on fuel injection systems, the methods of cooling the

nozzle and protecting it and recent methods of engine governing have been incorporated. New types of automobile and aircraft engines and two cycle engines have been added. Under engines of the Railway type details have been given of the latest railcar and locomotive types of C.I. engines and an account of the performance of the railcar or locomotive to which they are fitted has been given. The subjects of supercharging and altitude performance and the ratings of fuels have been considerably enlarged. One other noteworthy feature of the book is that some of the accounts of earlier engines and the fuel injection systems which are now obsolete, have been retained so as to make them available to the student and designer.

The treatment is on the whole excellent considered from all aspects, theoretical, practical or descriptive.

Lessons in Elementary Analysis. By G. S. Mahajani. Third Edition. (Aryabhushana Press, Poona), 1942. Pp. viii + 298. Price Rs. 6-4-0.

This well-known book by Prof. Mahajani, which has now run into a third edition, is a very well-thought-out one, and forms an excellent introduction to the subject of elementary analysis as taught in Indian colleges. The standard reached may perhaps be correctly described as lying between the Pass and Honours courses in the several universities. We are glad to note that several deficiencies that occurred in the previous edition (like Balakram's problem) have been omitted in the latest edition. The other changes like the proof of the second mean value theorem on integrals, the note on Frullani's integrals, a more careful treatment of uniform convergence, and the addition of a larger number of exercises have all enhanced the value of the book.

The chief merits of Prof. Mahajani's book are the extreme clarity and coherence achieved in the development of the subject. The author has modelled his book on that excellent "Cours d'Analyse" of De la Vallée Poussin, and succeeded admirably in imbibing its spirit, and following its methods. But this book is no mere copy of Vallée Poussin's, for the field and range of topics are different as also the outlook, and a lot of care, ingenuity and discretion have been used in writing a book with limited objectives but of the high standard indicated by Vallée Poussin's course of analysis. Special mention might be made of the excellent treatment of mean value theorems, Taylor's theorem and uniform convergence. The several notes and exercises have been carefully chosen and serve to illustrate clearly the difficult points involved in the immediately preceding theory. There is plenty of rigour but not such as to spoil the clarity of presentation at the elementary stage, nor is the book made too easy at the cost of rigour. A fine balance has been achieved, and the result is an extremely valuable elementary introduction to analysis.

There are, however, one or two points on which improvement is desirable. The introduction to integration through the notion of an area appears incongruous in a book which

is professedly rigorous. The area under a curve has no being apart from its definition as an integral, for, in Mathematics all being is of a logical character and hence area as a geometric intuition cannot be taken for granted. It would have been of great value to the student if a short introduction to the theory of integral had been appended, and also the distinction between primitive and integral (Cauchy or Riemann) dealt with more exhaustively. Again Ex. 3 on p. 83 should not have found a place in the book; it is characteristic of loosely written text-books which pay no attention to rigour.

These blemishes apart, we have no hesitation in recommending this book as an excellent introduction to elementary analysis.

K. S. K. AND B. S. M.

Wave-Mechanics. (Sukraj Rai Readership Lectures, 1939-40.) By V. V. Narlikar, (Patna University), 1942. Pp. vii + 160.

This account of wave-mechanics is based on a series of eight lectures delivered by the author, and presents a birds'-eye-view of the development of the subject and its broad principles. The topics treated are as follows:—classical mechanics, theories of Einstein and Bohr, Schrödinger's theory, transformation theory of Dirac, relativistic theory of the electron, theory of radiation and nuclear forces. The first seven chapters are of an expository nature while the remaining two chapters constitute a sort of report on the topics dealt with under them. The earlier expository part is in the historical order of development, viz., classical mechanics, old quantum theory and the new quantum mechanics, and such a development has its own advantages as well as disadvantages. A historical treatment would perhaps have been inevitable in the earlier days of quantum mechanics when the theory itself was in a flux, but now that we have a sort of a satisfactory finished product it would be hard to justify such a treatment. In the three chapters on Waves and Particles, Matrices and Waves, and States and Observables, there is a repetition of ideas which has the danger of hiding the essential principles of wave mechanics under the mass of a number of alternative but equivalent mathematical representations. The distinction between non-relativistic and relativistic quantum mechanics is nowhere presented clearly in the book. Thus the postulates of the Dirac theory of the electron as given on p. 104 are definitely defective. Also the mention of the positron on p. 61 in company with a number of other collision problems which can be treated non-relativistically serves to give the wrong notion that the theory of the positron is also non-relativistic.

As the author himself admits the treatment in many places is "too sketchy and scrappy". As examples we might mention the following:—

(i) The treatment of group theory and group representations on pp. 148-52 appears superfluous inasmuch as no attempt is made to apply it even to a single problem. After giving this account of four pages in a book on Wave Mechanics it appears like an anti-climax to say at the end that "one of the most important applications of groups is in the study of crystallography".

(ii) The conclusion that the highest atomic number is 92 from the bare remark (p. 115) that "out of 136 possible rotations only 91 left the interaction term of two electrons unchanged" savours of Eddington's epistemological considerations, and can hardly be considered a proof.

(iii) The remarks (p. 123) on the nature of light are rather loosely worded. To the question "What is light, waves or particles?" the author returns the answer that it is neither. The correct answer, however, is that it is both since, according to the principle of complementarity, a complete description of natural phenomena may require the use of two points of view mutually contradictory. As regards the definition of light the author remarks (p. 124), "Those who know the mathematical theory can do without the definition which is not precise enough. Those who do not understand the theory will not be enlightened by the definition, because it is too technical". This looks like unnecessary mystification, and gives an altogether wrong idea of the quantum theory of radiation.

(iv) The phrase "inside the electron" appears in many places in the book. This is perhaps a picturesque way of describing the neighbourhood of the nucleus, but it is rather loose terminology since it suggests that the electron is not necessarily a fundamental particle.

At the end of each chapter is found a list of references for further study, and this is bound to be of much value. But, surprisingly enough, we nowhere find a reference to Pauli's article on Wave Mechanics in the *Handbuch der Physik* which and Dirac's book are commonly considered to be the two best expositions of the general principles of quantum mechanics. We also notice "Yukawa" spelt as "Ukawa".

In spite of such imperfections we must confess we have enjoyed reading this book. In the earlier expository part, the author has successfully diagnosed the difficulties of beginners in quantum mechanics, and given full and clear expositions of these topics. The several summaries interspersed here and there in the book are bound to be of value to many students. The examples chosen to illustrate the theory are taken from out of a wide field and serve a very useful purpose. The book is written in a racy style abounding in analogies, and illustrations which serve to make difficult mathematical topics more easily understood.