BOOK REVIEWS

STATISTICAL MECHANICS—By K. M. Khanna, Asia Publishing House, Bombay, 1968, pp. 283, Rs. 18.00

The contents of the book may be briefly described in the following : Chapter 1 on 'Statistical Thermodynamics' is a short introduction to important basic notions of the subject. Chapter 2 on 'Quantum Mechanics and Statistical Mechanics' discusses briefly important notions of quantum statistics after a statement of basic postulates of quantum mechanics. Chapters 3 and 4 are devoted to the 'Ideal Bose Gas' and the 'Ideal Fermi Gas' respectively, Chapter 5 deals with gases in which interactions become significant. Chapter 6 reports briefly different theories of Liquid Helium after a short note on distinctive physical properties of Liquid Helium. Chapter 7 is on applications of Second Quantization Methods to Boson and Fermion systems. In Chapter 8, expressions for fluctuations of several thermodynamic quantities are calculated. Chapter 9 contains a short account on uses of Green's Functions in the subject. Some special problems are considered in Chapter 10. Besides these, nine appendixes on (i) Definite integrals, (ii) Natural constants (iii) Negative temperatures (iv) Quantum mechanical postulates on symmetries of wave functions for a system of identical particles, (v) Transition from quantum to classical statistics, (vi) Bose Einstein phase transition in an interacting system (vii) Creation and anhilation operators, (viii) Theory of Fermi liquid, (ix) Young and Lee theory of condensation.

From the above, it is clear that the book covers a good number of topics in the subject and also describes different modern techniques. Thus, the book will be considered as an useful text-book by the students of physics. As within a small compass a very long range of vast subject is covered, many important basic points could not be dealt properly. Even the basic question of the necessity of the subject has not been fully stressed. Though the book deals with a good deal of mathematical methods and notions used in the subject, yet due care has not been taken to avoid confusing lapses even in simple mathematical arguments as it will be clear from the following samples from the lot occuring in the book :

(1) 'none of the zeroes of G (i. e., roots of $G=0$) is real and positive. Therefore, Z_k the roots of G are complex'. But for the above inference the non-existence of negative real roots is to be demonstrated.

(2) $p(V, Z)=\frac{\bar{N}}{V}$ and "$\frac{\bar{N}}{V}$ is a constant $<\infty$. Hence changes cotinuously with Z for any V ". Unfortunately boundedness and continuity are not identical concepts in function theory.

(3) $\frac{p(T, Z)}{kT}=\lim_{V\to\infty} G$. " $\frac{p}{kT}$ in equation (7) is a continuous and monotonically increasing function of the activity Z. This means that G is an analytic function of Z for all Z in the complex plane and $\frac{1}{V}\log G$ is an analytic function". What is precisely meant by 'analytic function' here is not clear. In ordinary mathematics, a continuous, monotonically increasing function is not necessarily analytic.

Many topics have been reported without due care to explaining the important modern concepts and the working with them. So the book will be useful as a source of some information but will not help one to aquire the mastery in the subject. Of course, the references of some original works given in the book may be helpful to those who really want to learn the subject.

However, the author and the publisher deserve congratulation for making a book on higher physics like this available to our students.

M. D.

ADVANCES IN PLASMA PHYSICS. VOL. I—Edited by A. Simon and W. B. Thompson, Interscience Publishers, 1968, pp. 340, Price $ 14.95.

Plasma physics has developed in a number of fields, viz., controlled thermonuclear research, astrophysics, space science, direct conversion, ion propulsion, solid state etc., which are apparently quite distinct and unrelated. There is, however, a connecting link in the common plasma phenomena, and one would agree with the editors that more of inter-field communication than existing at present is very desirable. The book, prepared in this context, contains three review articles on plasma instability and one each on radiation from plasma, magnetosphere and magnetohydrodynamics.

In the first article entitled 'Radiation from Plasma' J. M. Dawson discusses the emission and absorption of radiation by a plasma in the absence of a magnetic field. An interesting feature is provided by the section on the scattering and coupling of waves by density fluctuations.

An article by H. P. Furth deals with the minimum-average-B stabilization for eliminating hydromagnetic flute instabilities and other flutelike modes. It gives the advantages of the stablizing process, describes the main configurations having the minimum-average-B property, presents some experimental results and discusses the possibility of using the stabilization in controlled fusion research. Drift waves and drift instabilities are covered by N. A. Krall. The derivation of the dispersion relation for an inhomogeneous plasma is followed by a discussion of drift modes as well as uniform plasma modes modified by drifts. The effect of collisions on drift motions in producing instability is considered. A thermodynamic approach to plasma instability is treated by T. K. Fowler. The concept of free energy (i. e., the energy *in* a plasma, which can be transferred to fluctuations) is developed with regard to both unbounded and bounded plasmas, and the usefulness of the conecept in making intuitional assumptions for experimental data is illustrated.

F. L. Scarf describes the structure of the magnetosphere and discusses the presence of thermal plasma, energetic particles and waves in it, a considerable portion of the material being collected from the Journal of Geophysical Research; a number of data obtained by artificial satellites are furnished.

The longest article in the book is by T. R. Brogan on the plasma MHD power generator. It starts with a broad and informative introduction, describes the electrical properties of seeded working fluids, and gives the design and performance of different kinds of MHD generators. Due emphasis is placed on certain topics such as superconducting field coils and rocket-driven MHD generators.

While congratulating the editors of the book for presentiug the developments of plasma physics in several different contexts in one volume, one feels that the purpose of the book would have been better served if it could, through the articles, give exposition to the interconnections between the various types of plasma study and the possibility of their cross-fertilization.

J. B.

ELECTRON WAVES AND RESONANCES IN BOUNDED PLASMAS—by P. E. Vandenplas. John Wiley & Sons, Inc., New York, 1968. Pp. xiv+222. Price $ 11.50.

The development of plasma physics has, uptil now, been characterised by a greater emphasis on theory than on experiments. In this context the book by Prof. Vandenplas on the interaction of bounded plasmas and electromagnetic radiation is of special significance in the sense that it deals with an aspect of plasma physics, in which both theoretical and experimental investigations have been carried out and detailed comparison between theoretical derivations and observational data is possible. The treatment is restricted to the cases for which the motion of ions is neglected and the Poynting vector of the incident electromagnetic wave is perpendicular to the axis of the system.

The book starts with a brief review of the basic concepts and general experimental techniques. The discussion is highlighted by a critical assessment of the moments method. However, the review is not quite comprehensive , for example, the microwave bridge technique is not at all mentioned.

The model of a condenser with infinite plates and with its vacuum dielectric partially replaced by a uniform plasma slab is studied, using fluid theory, in the cold and hot plasma limits. Some relevant experiments are described and the behaviour of high frequency plasmoids is explained. The linearized Vlasov's equation is solved to give the impedance of a plasma slab. Next, the hollow cylindrical plasma is investigated and it is shown that average plasma densities can be obtained by the main resonances of cylindrical structures. The effects of asymmetry in the hollow structures are also discussed.

The scattering of a plane electromagnetic wave by a magnetized cold plasma column is studied, particular reference being made to the configurations in which the magnetic field is either parallel or perpendicular to the axis. It is worth noting that the high frequency effect due to axial velocity of the plasma column is also covered. This is followed by an investigation on the hot non-uniform plasma column, which reveals the temperature or secondary resonance spectrum. The influence of a steady magnetic field is mentioned. Non-linear effects connected with temperature resonances as well as resonances of a cold plasma are discussed.

Finally, it is shown how the resonance properties of plasma systems are used in plasma diagnostic techniques, namely the metallic and dielectric resonance probes, and in the study of resonant radiation by plasma-dielectric coated antennas. There is an interesting section on general considerations relating to resonances and anti-resonances of cold plasma systems.

The monograph serving as an introduction to an important branch of plasma physics would be of considerable help to research workers intending to enter this field.

J. B.