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then takes up electron processes, e.g., band theory, by analogy with the phonon case. Some readers will consider such an approach interesting, particularly the similarity of the mathematical formalism, while others may regard it as merely repetitious. In many instances, a topic is introduced by describing the pertinent theoretical treatment, which is usually begun by stating the assumptions required for each calculation, in most instances quite clearly. However, the author does not, in a strict sense, follow with a derivation of the results. Perhaps it is correct to say that he comments on the derivation, often pointing out the approximations used, mathematical tricks employed, etc. Once a theoretical result is presented, its relation to the whole of solid-state physics is described. It is this description of how each result is related to the rest of the field that makes the book decidedly useful; but again, since so much of it involves interpretation, it is bound to be controversial. While much of the contents may be regarded as theoretical solid-state physics, experimental results are not slighted, particularly when experimental results are available which can be compared directly with the theoretical treatments. It is not a book to be read casually. A thorough knowledge of solid-state physics and of quantum mechanics is required of the reader. Thus, it will be useful mainly to graduate students and experienced researchers.

Boundary and Eigenvalue Problems in Mathematical Physics. By Hans Sagan. 381 pp. John Wiley and Sons, Inc., New York, 1961. \$9.50. Reviewed by T. Teichmann, General Atomic Division of General Dynamics Corporation.

BOUNDARY and eigenvalue problems play such an important role in physics and engineering that almost every general book in these fields contains some discussion of them, quite apart from the number of definitive volumes devoted exclusively to these topics. In discussing a new book of this kind, one must therefore ask what special features, if any, distinguish the content and make it particularly useful or interesting.

The aim of Sagan's book is to provide a self-contained and relatively homogeneous introductory graduate course. The opening chapters deal with variational problems and with the partial differential equations connected with them, particular attention being paid to boundary conditions. Problems of existence and uniqueness are also discussed quite extensively, as is the superposition principle, and to some extent, separability. The next group of chapters treat trigonometric and more general Fourier series, and the boundary value problems out of which they arise. The general theorems about second order differential equations are proved by a method (due to Pruefer) utilizing polar coordinates in the phase plane. A conventional discussion of Legendre and Bessel functions is then followed by a careful description of the external properties of eigenvalues, including numerical procedures due to Rayleigh, Ritz, and Weinstein. The book concludes with

discussions of spherical harmonics and Green's functions.

The style is lively and readable. Numerous examples are presented both in the text and as exercises (answers being given to alternate ones). The various topics are discussed in a logically connected way which is based, wherever possible, on the variational foundation of the problem. While this reviewer would have liked to have seen a more detailed discussion of separability, and at least a mention of characteristics (for instance, in connection with D'Alembert's problem), there is no doubt that this book will serve a useful function as an introductory graduate text.

Free Radicals in Biological Systems. Symp. Proc. (Stanford U., March 1960). M. S. Blois, Jr., H. W. Brown, R. M. Lemmon, R. O. Lindblom, M. Weissbluth, eds. 387 pp. Academic Press Inc., New York, 1961. \$14.50. Reviewed by Joseph G. Hoffman, University of Buffalo.

LIKE most fields in borderland sciences, the subject of free radicals in biological systems is growing rapidly. There are two main reasons for the especially rapid growth here. First, there is a wealth of information accumulated from purely biochemical research in the past. The second is the availability of electron-spin resonance and other physical techniques for testing ideas and inferences. From the combination of ideas and techniques, whole new areas of exploration are opened.

The 29 chapters by 62 contributors presented in this highly commendable symposium afford a timely survey of the various experimental methods and results. There is a wide diversity of topics simply because the borderline field is vast. There are chapters on the time changes of free-radical concentration as a result of enzyme action. There is the broad subject of metal valence in enzymes and the changes of valences: some of the chief metals are copper, iron, and molybdenum. There are photosynthetic processes; and, in another direction, the photodynamic processes associated with dyes, plant pigments, and carcinogenic hydrocarbons. These are but a few of the topics to which must be added in any enumeration the big subject of ionizing radiation effects.

The topics are presented with uniform excellence, which makes it hard for a reviewer to mention any one chapter for illustration. For example, Augenstein and co-workers describe thermoluminescence of irradiated proteins, which are given massive doses of gamma rays at very low temperatures and then are observed for emission of optical radiation as the temperature rises. The conclusions are that thermoluminescence depends on chemical composition and not on the crystalline state of the proteins, and also that there are nonrandom centers from which the optical radiation arises. These conclusions lead to the concept of a large organization of the charge distribution in macromolecules.

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