BOOK REVIEWS

Introduction à l'Electrodynamique quantique. By Daniel Kastler. Vol. 6 of Travaux et Recherches mathématiques. 334 pp. Dunod, Paris, 1961. 68 NF. *Reviewed by Nicholas Chako, Queens College.*

IN the last ten years, a number of monographs and books on quantum electrodynamics have appeared in print, here and abroad. However, with one or two exceptions, the subject matter has been treated from the physicist's viewpoint. Since some of the principal difficulties encountered in the development and formulation of a self-consistent and logical theory are mathematical, it is unfortunate that mathematicians have neglected to concern themselves with the mathematical obstacles of the theory and to devise new methods for the solution of these problems.

In order to stimulate interest among mathematicians, and to bridge the gap—already wide—between the physicist and mathematician, Kastler has formulated, so far as rigor can be attained, parts of quantum electrodynamics in the language of modern mathematics. In this respect, this book is addressed primarily to mathematicians and mathematically inclined physicists familiar with the modern terminology of the Bourbaki school.

To facilitate reading of the main body of the book on the part of those unfamiliar with the Bourbaki school, Dr. Kastler has devoted the first three chapters and several appendices to the essentials of modern linear algebra and vector spaces. These parts contain a concise and clear exposition of the algebra and calculus of operators and their transformation (invariant) properties in various vector spaces, with different connections (topological properties), to the physical concepts of the theory. Of special importance are the sections dealing with the transformation and group properties of tensors (multilinear forms) in n-dimensional and Hilbert spaces in which the operators (especially the so-called creators and annihilators) are defined, and the essentials of spinor theory, which form the foundation for a quantum mechanical treatment of systems with infinite degrees of freedom.

The topics selected by the author include the second quantization of the Schrödinger equation, the Klein-Gordon equation and its generalization to a system of free neutral particles (free scalar field of fermions and bosons), the free Maxwellian field (vector theory of photons), and Dirac's theory of electrons and positrons including the influence of an external field. Two chapters are devoted to the main problem of quantum electrodynamics, the interaction of particles governed by the Dirac equation and the Maxwell equations, i.e., the theory of electron and photon interactions, and the construction of the field operators of the coupled fields from the free fields described in the preceding chapters. It is here that the principal difficulties of the theory are encountered, namely, the procedures of constructing the solutions of interacting systems from the free systems which involve divergent integrals. Although various procedures (renormalization) have been devised for eliminating these difficulties, the theory is still in an unsatisfactory state when particles other than electrons or photons are considered. The efforts of mathematicians in cooperation with physicists toward the solution of these problems would undoubtedly result in a better understanding of the natural world.

Finally, the author gives an analysis of the Compton effect, the scattering of an electron by an electron, electron-positron annihilation, and a brief account of Feynman's diagrams.

This formal treatment of quantum electrodynamics should appeal to the mathematician as well as the physicist on account of the precise and simplified presentation of the topics under discussion, especially the chapters devoted to free fields. On the other hand, the omission of a critical discussion and explanation of the subject matter acquired from experiments is a drawback for classroom use. However, we recommend it as forming the subject matter for discussion in a seminar course which would have the active participation of mathematicians.

Low Temperature Physics (5th ed.). By L. C. Jackson. 158 pp. (Methuen, London) John Wiley & Sons, Inc., 1962. $3.50.

Low-Temperature Physics. Summer School Lectures (Les Houches, 1961). C. DeWitt, B. Dreyfus, P. G. De Gennes, eds. 638 pp. Gordon & Breach, New York, 1962. Clothbound $20.00, paperbound academic and student's edition $9.50. *Reviewed by Peter Grosewald, The Pennsylvania State University.*

NOT unlike many other branches of science, the studies which are grouped under the title of low-temperature physics really could be as easily classified under half-a-dozen other titles; and as such, in order to keep up with current work, it would be necessary constantly to peruse the current literature. The first of the two books reviewed here is ideally suited as a substitute for the perusal of current literature for both the student and the practicing scientist whose interests lie

outside the field of low temperature/solid state, or for those who would like a convenient review or introduction to the discipline.

Jackson's book covers the topic, "physics of low temperatures", at some length in chapters 1 and 2 and devotes the other four to the physical properties of matter at low temperatures, covering liquid and solid helium and magnetic, electrical, and thermodynamic properties of solids. It was first published in November 1934 and has been modified and updated with the passage of time. Ideally suited as a refresher or as a general introduction to the field, it attempts to cram an entire discipline—without simplification—into a small book. The author has succeeded in this aim but at the cost of making a highly interesting subject seem cut and dried.

The Les Houches lectures, on the other hand, are meant for the specialist and to a lesser degree for the graduate working in a field related to that covered in a particular lecture.

The lectures cover current studies in a variety of fields, and in many cases the connection with low temperatures is somewhat tenuous. In fact, to quote J. Friedel (Défauts ponctuels et irradiation), "The study . . . at low temperatures is only a pretext to include this lecture in the series." More precisely, the 1961 session of the summer school was devoted to recent progress in physics at low temperatures and to the solid state. Dr. Pippard (Dynamics of Conduction Electrons) shows how—with hindsight—it is possible to use "classical" physics and arrive at a correct explanation of much of solid-state phenomena due to electrons. This is the longest lecture and covers its subject in great detail. Various aspects of superconductivity are covered in two separate lectures, while four are devoted to the magnetic properties of matter. Lectures on the properties of helium and the Mössbauer effect and its application to the study of internal fields (by Abragam) round out the collection.

Many of the works and papers in the journals now are narrow as to discipline and dry as to presentation; this certainly is not true of a lecture—or it shouldn't be—and the editors have been ultracareful here not to allow any of the liveliness to escape. Theoreticians and experimentalists will both profit from perusing this highly readable book. Between the covers of the two books reviewed here, the subject matter listed by J. G. Daunt in "Cryogenics" [Physics Today, April 1962, p. 26.] is quite adequately covered.

Non-Equilibrium Thermodynamics. By S. R. de Groot and P. Mazur. 510 pp. (North-Holland, Amsterdam) John Wiley & Sons, Inc., New York, 1962. *Reviewed by Sangil Choi, Institute for the Study of Metals, University of Chicago.*

It is indeed a pleasure to read an excellent text written by two experts in the field. The book is divided into two parts. In Part A, the authors discuss the general theory of irreversible thermodynamics incorporat-