Frontiers of Physics Series

Theory of Superconductivity. J. R. Schrieffer. Benjamin, New York, 1964. xiv + 282 pp. Illus. $10.

An outgrowth of a series of lectures presented at the University of Pennsylvania in the fall of 1962, this volume is a highly creditable and useful addition to the series "Frontiers in Physics," edited by David Pines. Schrieffer is one of the three authors of the Bardeen, Cooper, Schrieffer, or the BCS, theory of superconductivity, which burst almost unheralded on the field of physics in 1957 as the first successful microscopic theory of superconductivity. Since then, the BCS theory has continued to provide great stimulus to those working on superconductivity itself, and, more remarkably, has provided inspiration as well to workers on nuclear structure, on more general many-body problems, and even on the fundamental particle problem. Accordingly, the publication of the present tome must be regarded as something of an event and as a coup for Benjamin and for Pines.

The book begins with a cursory description of the salient experimental facts about superconductivity, followed by a brief but useful discussion of the phenomenological theories. Chapters 2 and 3 together form one of the highlights of the book, with their lucid and authoritative presentation of, respectively, the pairing (that is, BCS) theory of superconductivity and various of its more important applications. The appendix provides the necessary background material on second quantization.

Chapter 7, "Field-theoretic methods applied to superconductivity," and chapter 8, "Electromagnetic properties of superconductors," represent the real meat of the book. To assist the reader to the high level of sophistication required for understanding the material presented in these chapters, chapter 4, "Electron-ion system," chapter 5, "Field theoretic methods in the many-body problem," and chapter 6, "Elementary excitations in normal metals," provide a good survey of and introduction to the literature of those parts of solid-state and many-body theory which underlie the theory of superconductivity in the form given to it in chapters 7 and 8.

Superconductivity is now an enormous subject in its own right, and it is, of course, impossible to cover it thoroughly in a book of 282 pages. The author, in effect, extends the scope of his book considerably by thoroughly annotating even the most cursorily treated topics with references to the literature. Even so, one can only regret the brevity of the treatment of the Ginsburg-Laudau-Gor'kov theory and the absence of the theory of type II and of impure superconductors, self-avowed though these omissions may be.

The author is obviously completely at home with the perturbative approach to quantum field theory and with all other formal matters pertaining to his subject and manages compact, clear, and elegant presentations of the formalism. On the other hand, the physical interpretations, although they are on the whole quite adequate, are not on the same high level of presentation and occasionally sink far lower. For example, on pages 25 and 26, the reader is led to think that the dynamical interaction between mates of a pair is essential for superconductivity, whereas superconductivity could occur even if that particular interaction vanished. The basic approximation of the BCS theory may be regarded as that of treating the motion of each pair in the *average* field of all pairs; the reason for its high accuracy is the large number of pairs with which a given pair interacts, of order 10^6 (p. 43), so that fluctuations in the pair field are unimportant.

The book is eminently suitable to be used as a text book in an advanced course on superconductivity for theoretically inclined graduate students. Moreover, it will be highly useful as an introduction and guide to the literature for more mature workers who are new to the field. Finally, it deserves a place on the bookshelves of all nonspecialist physicists for such intellectual delights as are truly provided by this book. One example is the description in section 2-4 of the path followed by the author in finding the famous BCS wave function for the ground state of a superconductor.

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Index to Nonopaque Minerals

Optical Properties of Minerals: A Determinative Table. Horace Winchell. Academic Press, New York, 1965. x + 91 pp. Illus. $5.

In *Optical Properties of Minerals*, minerals are plotted by key numbers on 31 semicircular charts. Each chart covers a range of n_y. Points within each semicircle correspond to particular values of the optic angle (2V), given by the azimuth, and to particular values of the birefringence, given by the radius vector. On pages facing these charts are listed the minerals whose mean indices are within the given n_y range. Each name is preceded by its key number and followed by a page reference to the description in Winchell and Winchell's *Elements of Optical Mineralogy* (pt. 2, 1951) or, if described later, by a reference to an abstract. If the mineral is represented in the 1960 edition of the Index to the X-ray Powder Data File (American Society for Testing and Materials, Philadelphia), the spacings of the three strongest x-ray powder diffraction lines and the card number are listed. The table is intended to include all nonopaque minerals known to 1962, though a few minerals usually considered opaque are also listed. Approximately 1300 mineral names appear in the index.

The 15-page introduction begins with a brief discussion of graphical schemes leading to the "preferred three-dimensional chart." The published charts are projections of slices through the "hemicylindrical coordinate field" onto the "cylinder base." Most of the introduction is devoted to advice on methods for obtaining values of the mean index, birefringence, and optic angle from thin-section observations. The author is optimistic about the possibility of making adequate estimates of mean index from the relief of a mineral as observed in thin section. No reference is made to dispersion, orientation, color, or pleochroism. It is expected that the user of this table will consult standard reference works or the literature for these and other properties to confirm an identification or to estimate the composition of a mixed crystal.

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