SCIENTIFIC BOOKS

QUANTUM MECHANICS

Introduction to Quantum Mechanics, with applications to chemistry. By L. PAULING and E. B. WILSON, JR., pp. xiii + 460. McGraw-Hill Book Company, 1935. $5.00.

DURING a decade of rapid progress in quantum physics, great advances in our understanding of a variety of physical phenomena have been made. Heisenberg's uncertainty principle and Bohr's principle of complementarity of the wave and particle concepts have called for as fundamental revision of basic concepts as was made twenty years earlier by the special theory of relativity. The details of the whole system of complex spectra of atoms have been fairly well worked out. Molecular spectra, both diatomic and polyatomic, have been interpreted and made to yield valuable information about chemical valence forces. The dielectric and magnetic susceptibilities of matter are now quite well understood in terms of fundamental atomic and molecular constants. The character of the coupling between electron spins that is responsible for ferromagnetism has been elucidated. In nuclear physics the main features of α-particle radioactivity were first made clear by quantum mechanics, and the methods are being carried over into other problems with success, especially where the heavy particles are concerned.

In the meantime the teaching of the subject to American graduate students has crystallized to a certain extent along the lines of the book under review. After a brief introduction to the methods of classical dynamics and a review of the pre-1925 development of quantum theory the student is introduced to the methods of quantum mechanics by way of Schrödinger's wave equation applied to simple mechanical systems. Chapter III explains the method in concrete terms by fully working out the harmonic oscillator, while Chapters IV and V give the extension to three-dimensional problems with a full presentation of the theory of the hydrogen atom. Chapter VI presents the perturbation theory for systems with discrete energy levels. Up to this point the selection of material and general treatment is like the older text-book of Condon and Morse, with, however, the advantage that much more detail of the mathematical work is included which should make it more readily understandable to beginning students who are not trained in the classical boundary value problems of mathematical physics.

From Chapter VII on the book begins to assume more specifically the quality indicated by the phrase "with applications to chemistry" in the title. Chapter VII is devoted to the variation method for approximating the solution of complicated problems. Chapter VIII introduces the non-relativistic treatment of electron spin and Chapter IX the theory of electronic structure of atoms containing many electrons. The rest of the book, except Chapter XV, the last, is devoted to a clear and elementary introduction to problems of molecular structure. The last chapter gives a brief account of the more general aspects of the theory than those that appear in the main parts of the work—matrices, the uncertainty principle and the general transformation theory. Confining itself strictly to what may be called the more elementary and "anschaulich" methods the book gives a clear and accurate account of a great deal of the important progress of the last decade.

As a general criticism I think that it is a disadvantage to present the general transformation theory as an isolated topic at the end. If introduced in an elementary way and documented properly with worked-out examples the picture of a state as a vector in function space which receives different explicit representations according to the coordinate system used is not too difficult for the beginning part of the work. And it is extremely illuminating to consider some of the formal processes of the theory from this standpoint. There is a great temptation to lean too heavily on "wave" methods in teaching the subject. That was the worst fault of the book of Condon and Morse, which is unfortunately not remedied here.

Any criticism which comments on the things that are left out must be taken in the spirit that the reviewer is crying for more. Of course the authors had to stop somewhere. Perhaps we can hope for a companion volume to this one by the same authors. Or if not by them then by others who will not waste energy redoing what is here well done but in going beyond to a fuller treatment of the things which had to be omitted to keep this book within bounds. Ortho-para hydrogen is not fully treated. The dipole moment and magnetic susceptibility of matter, recent advances in chemical kinetics, the statistical mechanics of molecular assemblies and the use of spectroscopic data for entropy calculations, the special features of vibrations of polyatomic molecules like vibrational resonance in CO_2 and the barrier-penetration coupling of vibrational levels in NH_3—these are a few of the topics which should be included in a companion work to this, now that students of physical chemistry have been provided with an introduction to quantum mechanics

which takes them as directly as possible to the field of their special chemical interests.

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FUNGI

British Stem- and Leaf-Fungi (Coelomycetes). A Contribution to our Knowledge of the Fungi Imperfecti Belonging to the Sphaeropsidales and Melanconiales. Volume 1. Sphaeropsidales, to the end of the Sphaerioideae which have Colourless or Nearly Colourless Spores. By W. B. GROVE. xx + 488 pp. 31 text figures. Cambridge, England, at the University Press; New York, the Macmillan Company, 1935; $7.00.

AMERICAN mycologists who have used "British Rust Fungi," published by this author more than twenty years ago, will welcome the appearance of this new book. Though dealing with a different group of parasitic fungi, it resembles its predecessor in the view-point revealed, in method of presentation and in general appearance. Written to serve as a handbook in the British Isles, it will find a much wider field of usefulness, due to the extensive range of many of these organisms. It is to be followed by a companion volume which will cover the remainder of the Sphaeropsidales and Melanconiales. The Hyphomycetes will not be incorporated. The book is clearly printed on a good grade of paper and is attractively bound. It is inadequately illustrated, the few text-figures provided adding little to its usefulness. Good indices to host plants and to genera and species of fungi are given. Also there are included Latin diagnoses of twenty-four species described as new.

The author follows M. C. Cooke in the use of the old-fashioned and somewhat misleading name Coelomycetes. The older writer in his "Handbook of British Fungi," which appeared in 1871, discussed 200 species of these fungi. An indication of the tremendous increase in knowledge of the group is given by the statement of Grove that there are now 2,000 reputed British species. He calls attention to the economic significance of these fungi as "despoilers of our field crops, our orchards, and our woods," and emphasizes the fact that many fungi are actively parasitic only in their imperfect stage. The book is written, however, more from the standpoint of the mycologist than the plant pathologist. The descriptions of species stress morphological rather than pathological or cultural features.

Fifty genera are covered in this volume. Under each, the British species are arranged in definite sequence by host genera. Unfortunately, the host genera are listed alphabetically rather than systematically. This brings together the species occurring on species of a given host genus, but fails to place in proximity those to be found on related hosts. Each species is described briefly, and data covering host range, season of fruiting and distribution are incorporated. Relatively less space than usual is used in citation of exsiccati and other herbarium material examined. The author has been collecting these fungi for many years, and his personal collection of over 3,000 specimens has served as a basis for his work. In addition he has made the necessary comparisons with authentic materials in various historical herbaria. The book has the stamp, however, of having been written by a field mycologist rather than a herbarium worker. It fills a long-felt need for a handy reference work on these fungi.

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SPECIAL ARTICLES

BREEDING RUST-RESISTANT SPRING WHEATS

CALAMITOUS epidemics of stem rust occurred in 1904 and 1916 and again in 1935. Urediospores, overwintering in Texas, found optimum conditions for increase in their progress from south to north and finally the full force of the impact of the parasite fell upon the spring wheat fields of South Dakota, Minnesota and North Dakota. The loss in North Dakota alone, due mainly to rust, approached 100 million dollars. Before and following the epidemic of 1916 it was thought that catastrophes of this sort could be combatted by two methods, (1) the eradication of the common barberry, alternate host of *Puccinia graminis*, and (2) by breeding varieties of the other host, the wheat plant, which would be resistant to the parasite. After the 1935 epidemic, we know that breeding must be a major recourse.

Twenty years ago no variety of common wheat (*Triticum vulgare*) was known to have resistance to stem rust. The writers[1] discovered in 1917, in a durum introduction from Russia, plants of common wheat somewhat resistant to stem rust, which they selected and named Kota. Waldron crossed Kota wheat with Marquis, producing the Ceres variety, which has since become the principal hard spring wheat grown in the United States. Both the Kota parent and Ceres possess only moderate resistance to stem rust. While Ceres successfully withstood ordinary epidemics, it

[1] L. R. Waldron and J. A. Clark, *Jour. Amer. Soc. Agron.*, 11: 187, 1919.