larger society. Much of the material is familiar to historians, but not in this context, and Perkins's overview unites the narrative.

Aside from minor quibbles and professional disagreements about matters of interpretation (which are not important in a short review) my qualms about the book have to do with the arrangement. The separation of the philosophical and conceptual framework of entomology from the account of the applied work tends to diminish and to blur the effect of deep-seated ideas upon research strategies and may tempt readers who would profit from it to skip the theoretical material. I would urge them not to. The relegation of economic factors, particularly the transformation of the American farm under the impact of mechanization and the flood of farm chemicals, to the later chapters also detaches an important part of the story from its proper place. There are, though, good reasons for these choices, and *Insects, Experts, and the Insecticide Crisis* deserves the careful attention and consideration of anyone interested in how science and scientists act in our society.

THOMAS R. DUNLAP
Department of History, Virginia Polytechnic Institute and State University, Blacksburg 24061

Theories of Chemical Bonding

Electrons and Valence. Development of the Theory, 1900–1925. ANTHONY N. STRANGES. Texas A&M Press, College Station, 1982. xii, 292 pp., illus. $28.50.

The historical development of the concept of valence and its relationship to the nature of the chemical bond constitutes the principal theme of this book. That the chemical bond is electrical in nature followed from J. J. Berzelius's dualistic electrochemical theory, enunciated in 1811; that structural considerations also were of crucial importance for organic compounds became clear during the succeeding three decades and highlighted the shortcomings of Berzelius's theory. Only after Hermann von Helmholtz argued persuasively in his famous Faraday Lecture of 1881 that if atoms exist positive and negative "atoms of electricity" must also exist, and only after Svante Arrhenius proposed his electrolytic dissociation theory in 1887, did chemists have their attention drawn anew to the fundamental importance of electrical binding forces. J. J. Thomson's discovery of the electron in 1897 provided the essential ingredient for putting the theory of the chemical bond on a firm experimental foundation.

The author treats Thomson's contributions at considerable length, including Thomson's momentous demonstrations in 1906 that the number of electrons in an atom is relatively small, on the order of its atomic weight. He then turns to the reception of Thomson's work by chemists: Thomson's discovery of the electron, at times supplemented with his picture of Faraday tubes of force linking two adjacent atoms, constituted the central element in unitary polar theories of chemical bonding developed between 1898 and 1907 by Walther Nernst, Richard Abegg, William A. Noyes, and William Ramsay. Abegg's well-known "rule of eight"—that all atoms possess a maximum of eight electrons available for bonding—assumed particular importance during this period as well.

The next stage in this electrostatic approach to bonding involved the basic assumption that the chemical bond results from the complete transfer of one or more electrons from one atom to another. This view was developed in America before 1915 especially for organic molecules by K. George Falk and John M. Nelson at Columbia University and Harry S. Fry at the University of Cincinnati, followed by Julius Stieglitz at the University of Chicago and Noyes at the University of Illinois. The failure of chemists to find Fry's electronic isomers or "electromers" ultimately undercut this unitary electrostatic theory. More important in this respect, however, was the emergence of a dualistic approach to bonding—that nonpolar forces involving no electron transfer had to be considered side by side with polar forces. This view was advanced in 1913 by William C. Bray and Gerald E. K. Branch at M.I.T. and by G. N. Lewis at Berkeley.

Lewis ultimately emerges as the central figure in this history: His concept of the shared electron-pair bond, whose origin can be traced to his cubical static atom of 1903, was first published in 1916. This concept reconciled polar and nonpolar theories by tracing the bonding in both cases to a pair of electrons shared by the two bonded atoms. Its meaning was conveyed pictorially by representing the bond as a pair of dots. By 1923 Lewis's theory had become embedded in the minds of most chemists, although its deeper meaning had to wait until the emergence of quantum mechanics a few years later.

An intriguing theme throughout his book is the interplay, or lack of interplay, between contemporary developments in chemistry and physics. Chemists and physicists were interested in very different consequences of atomic and molecular structure in the period in question—the former focusing on valence and bonding, the latter on spectra. Chemists consequently showed little appreciation for contemporary advances in theoretical physics, even for Niels Bohr's model of 1913. The author's account of how Lewis changed his attitude toward the Bohr atom from antagonistic to supportive between 1913 and 1923 constitutes a significant contribution of this book.

Its major shortcoming perhaps can be traced to the author's lack of attention to the secondary literature, especially in the history of physics. Cognizance of this literature, for example, would not have led him to cite J. J. Thomson's 1919–1920 views on atomic structure approvingly. It seems that the author did not even draw on the *Dictionary of Scientific Biography* for important insights into the work of the figures he discusses. It is to be hoped that he will continue his researches and explore in more detail some of the avenues his valuable book opens up for historical investigation.

ROGER H. STUEWER
School of Physics and Astronomy, University of Minnesota, Minneapolis 55455

Photosynthesis

Electron Transport and Photophosphorylation. J. BARBER, Ed. Elsevier, New York, 1982. xvi, 288 pp., illus. $89.75. Topics in Photosynthesis, vol. 4.

This volume is the fourth in a series on photosynthesis. The first three concentrated on chloroplast structure and function, primary processes of light harvesting and energy transfer, and photosynthesis in relation to model systems. The themes suggested for the present volume concern the mechanisms by which redox energy is converted to adenosine triphosphate (ATP). In this vein, an editorial summary proposes that central consideration in the book be given to spatial interactions between functional protein complexes in the photosynthetic membranes, mobility of proteins, and protein complexes in a fluid membrane matrix. Furthermore, it is suggested that the Z-scheme for the electron transport pathway of green plants and algae should be