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.

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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.

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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 discussed not as a structural entity but as a statistical relationship between the several protein complexes of the electron transport chain embedded in the nonrigid lipid matrix. These goals are farsighted and worth remembering but difficult to achieve because pertinent ideas and data are just emerging. In general, the authors address the theme of molecular mechanisms as well as the present literature allows. There is a fairly common consensus among them that the general tenets of the chemiosmotic framework for membrane energy transduction first laid down by Mitchell are now well established but that many of the chemical details are not yet understood.

A paper by Cox and Olsen on the organization of the electron transport chain in the thylakoid membrane is valuable because it is one of few reviews currently available that begins to deal with the issue of protein mobility and, in particular, with the transfer of electrons over large distances from photosystem II to the stromal membranes enriched in photosystem I.

Prince, O'Keefe, and Dutton summarize the data and ideas concerning the pathway and physical-chemical mechanisms of electron transport and proton translocation in the cyclic electron transport pathway of bacterial chromatophores. They discuss models to describe behavior of the components in the ubiquinone-cytochrome c_2 oxidoreductase. As they point out, making such models illustrates very well the difficulty of translating the general ideas of the chemiosmotic hypothesis into specific chemical mechanisms of transmembrane electron transport and proton translocation. A paper by Malkin provides a discussion of some analogous facets of the chloroplast electron transport chain.

Papers by Nelson and by Schlodder *et al.* provide a fine, up-to-date qualitative and quantitative discussion of the transduction of the H^+ electrochemical potential to ATP synthesis. Schlodder *et al.* discuss the problem of coupling and those of reversibility, kinetics, energization, and conformational-chemical changes in admirable detail. These two papers, along with a paper containing information on secondary structure by Sebald and Hoppe in volume 12 of *Current Topics in Bioenergetics*, can provide an up-to-date perspective on molecular details concerning the chloroplast coupling factor. Perhaps because of lack of space, Schlodder *et al.* do not discuss caveats that exist in the literature concerning the use of fluorescence quenching of 9-amino acridine as a probe of the transmembrane pH and the carotenoid band shift as a probe of transmembrane potential. A guide to the literature on this subject can be found in the book in a paper by Baltscheffsky *et al.*

The hope is expressed in the preface that the book could be used by advanced undergraduates and nonspecialists, a goal rarely achieved in multiauthor "topics" volumes. In the opinion of the reviewer, nonspecialists would find it difficult to follow most of the discussion in the book. It is, however, highly recommended for research workers in the fields of photosynthetic energy transduction, oxidative phosphorylation, and bioenergetics. It also can and should be used as a source of material by teachers of graduate courses in photosynthesis and bioenergetics.

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Igneous Petrology

Igneous Rocks of the British Isles. D. S. SUTHERLAND, Ed. Wiley-Interscience, New York, 1982. xvi, 646 pp., illus. $132.

Hadrian's Wall is built of (and on) the quartz dolerite of the Great Whin Sill, which occupies 12 different horizons of Carboniferous rocks across northern England; the Giant's Causeway of County Antrim displays the hexagonal cooling columns of the Tertiary Causeway tholeiite basalt; the Ordovician Borrowdale volcanics of the Lake District have been mapped in at least 26 different units; the volcanic centers and dike swarms of the famous Tertiary Province form the enchanted isles of Skye, Mull, Arran, Ardnamurchan, and Rhum in the Hebrides. Igneous rocks such as these account for a substantial portion of the scenery and history, both geologic and human, of the British Isles.

In response to such splendors of nature, British scholars played a central role in the development of modern geology and petrology: Hutton with his uniformitarianism; Nicol with his polarizing prism; Sorby with thin sections of rocks for microscopic study in polarized light; and in this century Holmes with his time scale, Read who hoped to have seen the most rocks, Bailey and the other "Mull authors" with their magma types, Tilley, Wager, Brown, O'Hara and others who elucidated the fractional crystallization and mixing of basic and ultrabasic magmas, and Moorbath and others who applied isotopic analyses toward the resolution of petrologic problems. Amid this wealth of native talent, only a few interlopers stand out as contributors to British petrology: Bowen of Washington for his strenuous and revolutionary application of the principles of phase equilibria to the evolution of Hebridean magmas, and more recently Taylor and Forester of Pasadena for their stable isotope studies of how Hebridean and other magmas interacted with their surroundings.

In short, the igneous rocks of the British Isles have themselves played a major role in the evolution of petrologic thinking, and they continue to do so. Hence the justification for such a descriptive book as this, many years in preparation by 37 authors. The main part of the book is a compressed field guide, arranged in chronological order and by district from the 3-billion-year-old Precambrian remnants to the 60-million-year-old Tertiary Province, all set out insofar as possible in the context of modern plate tectonics. A remarkable appendix describes the rocks petrographically with photomicrographs and drawings to illustrate textures. The hand of a respected and durable civil service, in the form of the Institute of Geological Sciences (IGS), is strongly evident in these descriptions of classic rocks. Chemical analyses and geochronology are given in other appendixes. Geochemistry and magma genesis are only briefly summarized in the main body of the text except in regard to the Tertiary Province, a foremost battleground for the testing of hypotheses on magma types, layered intrusions, magma mixing and unmixing, crustal and mantle melting, and hydrothermal metamorphism. The part of the book on the Tertiary Province contains an overview by G. M. Brown, who is currently director of IGS, and a chapter on magma genesis by R. N. Thompson, a leader among the new generation of warriors.

This is clearly a reference book, but in view of the classic thoroughness with which these important rocks have been studied, it is also inescapably a teaching resource that should be familiar territory to any aspirant in the field of igneous petrology. Old hands will renew acquaintance with the peridotite of The Lizard, the granites of Donegal, and the classic exposures of the Hebrides. They will re-encounter and perhaps better understand the rocks benmoreite and mugearite and learn to recognize the Skye Main Lava Series and the newer magma types such as Fairy Bridge and Preshal