observed thermopower phenomena by introducing multiple bands and multiple scattering processes, and finally an excellent treatment of the "giant thermopowers" related to the Kondo effect. This is particularly welcome since he has kept this treatment consistent with his earlier mathematics.

The last chapter of Barnard's book is a significant contribution to the field because it provides the most up-to-date review of recent experimental and theoretical work done in thermoelectricity in metals. It is essentially a review article covering work on the whole range of metals and alloys from alkali and noble metals to transition metals and rare earths. The references are fairly complete up to the time of publication. He treats the alkali metals and alloys in some detail where theory and experiment seem more compatible, and then threads his way carefully through the forest of the more complex metals, transition metals, and so forth, commenting briefly where there are some glimmers of correlation between theory and experiment. Particularly helpful are the abundant reproductions of experimental data plots—the complexity of thermopower behavior cannot be adequately communicated in any other way.

The book is, then, an excellent introduction to the theory and experiment of thermoelectric power in metals and alloys, adequate to bring a person with a basic understanding of solid-state physics to the point of reading current literature in the field. It provides, moreover, an excellent review of the experimental work done up to the time of publication.

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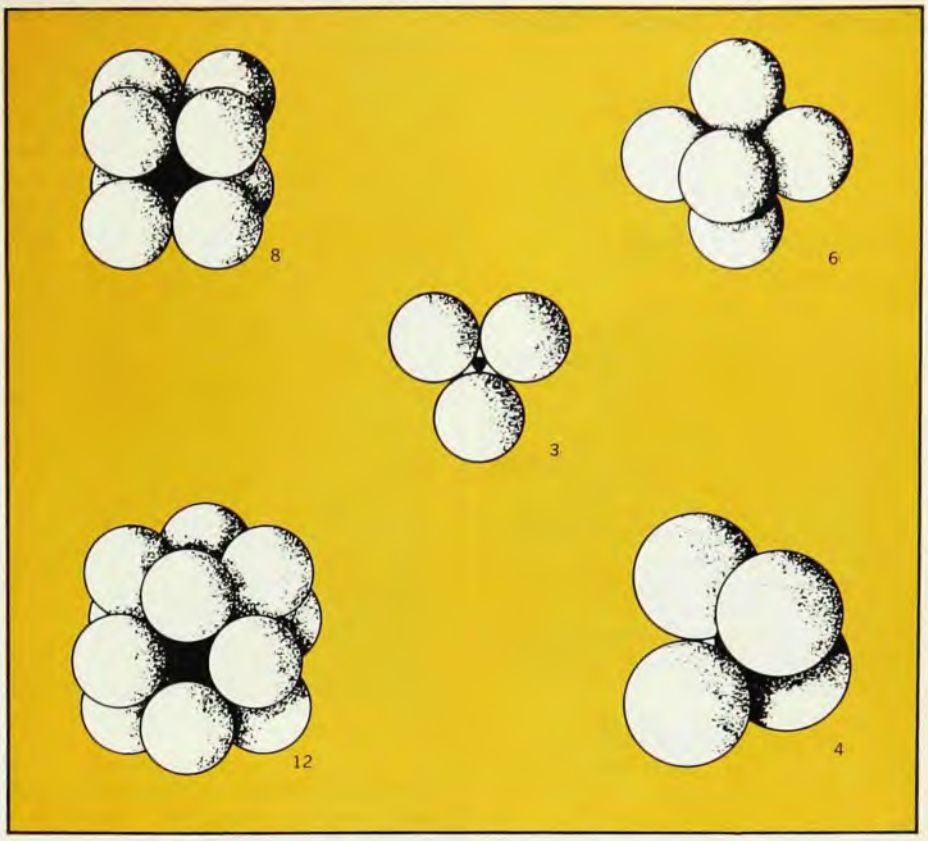

Geometries of 3, 4, 6, 8 and 12 anions surrounding a central cation are illustrated with packing diagrams. From *Crystal Structures, A Working Approach*, by H. D. Megaw, reviewed here.

Crystal Structures: A Working Approach

H. D. Megaw
563 pp. W. B. Saunders, Philadelphia 1973. $19.50

The structures of crystals—the repetitive arrangements of atoms in three-dimensional space—are fundamental to solid-state science. There exists a rich literature of crystal structure information, mostly derived from diffraction experiments with x rays or neutrons, and various compilations and indexes make these data very accessible to the *cognoscenti*. Unfortunately, the specialized notation and jargon serve as barriers for many. Too often the crystal structure is misunderstood or ignored in a study of a physical property.

Helen D. Megaw, lecturer in physics at Cambridge University, is well known for her studies of oxide and silicate structures, phase transitions and ferroelectric crystals, and as author of *Ferroelectricity in Crystals*. She is also interested in better crystallographic education. This book, *Crystal Structures: A Working Approach*, "is written for readers with no previous knowledge of crystallography but with a reasonable general background in the other physical sciences." It is a textbook for self-teaching, complete with numerous exercises. References to the original literature take the place of formal answers. By excluding almost everything about how structures are determined, Megaw is able to set forth a remarkable amount of material on the results for actual structures and on how to use symmetry to describe them.

There is a very clear exposition of the properties of space groups and crystallographic symmetries, of crystal coordinate systems and of geometrical transformations. Megaw discusses the structures of perhaps 300 substances with several dozen of them set down in precise detail. These include the most important simple structures, and this part of the book will be a convenient handbook for many workers. There is a rather broad discussion of chemical bonding and crystal-structure theory, but brevity sometimes leads to oversimplification.

In the discussion of the NaCl- and CsCl-type structures and the radius-ratio criterion for coordination number, Megaw follows many others in regarding as anomalous a NaCl-type salt with anion and cation of nearly equal size; she suggests that covalent bonding may give an explanation. In fact, the change of bond distance with coordination number is a bigger effect than the slight difference in Madelung sums for these two structures, and the CsCl-type structure must be regarded as the anomalous one for any radius ratio according to the simple ionic model.

The discussion of correction of bond lengths for thermal motion is marred by an incorrect definition of *riding*, and it fails to explain the role of phase correlation in this calculation. The reader might well skip this section.

These defects are more than compensated by the clear exposition of a great deal of information concerning structures and their relation to physical properties, phase transitions and chemical bonding. There is careful attention to nomenclature and to some of the difficulties concerning orientation. There is little chance that physicists will accept the crystallographers' definition of *lattice*, but perhaps they can be convinced that CsCl is not body centered. Anyone interested in the structure of a trigonal crystal should read of the incredible errors concerning choice of axes in quartz, and take heed. Other strong points are extensive indexes of authors, formulas and

subjects, and a very well arranged and annotated bibliography of books and research papers.

This book is strongly recommended to the scientist who wants to teach himself how to read crystallographic research papers, to the student who wants to learn about space groups, and to the teacher who needs a text for a crystallography course for noncrystallographers. Parts of it might also benefit some experts in structure determination who need to learn how to relate their results to other physical phenomena.

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Quantum Theory of Chemical Reactivity

R. Daudel
162 pp. D. Reidel, Dordrecht, Boston
1973. $23.50

Electronic theories of organic reaction mechanisms have led to radical changes in the logical structure of organic chemistry over the last several decades. More recently, the use of quantum mechanics to place qualitative concepts on a quantitative (or, at least, semi-empirical) footing has been a popular and productive area of research. In fact, the field has been so popular and productive that a critical review of methods and conclusions is sorely needed. Unfortunately, this short book is too narrow in scope to fill that need.

It is an English translation of the third volume in a series by R. Daudel of the Center of Applied Wave Mechanics in Paris. The first two volumes, published in English by Pergamon Press, dealt with theoretical chemistry and electronic structure of molecules. The third volume focuses on applications of these principles to intermolecular forces, interactions between nonbonded atoms, equilibrium constants in solution, transition-state theory and organic rate constants.

Results are summarized, with references to earlier volumes in the series or to the original papers for methods of calculation. This approach could be attractive to those who are already familiar with the theoretical techniques and even more so to those who do not want to be familiar with the theoretical techniques. However, Daudel's treatment is much too brief, in many cases consisting of merely a sequential listing of specific results. The chapter on organic rate constants, for example, covers 154 references in less than 36 pages. This condensed format leaves little room for general discussion or critical evaluation, which gives the reader no perspective for assessing the broad range of reaction types and varying degress of empiricism in the calculations. Reading this chapter is similar to reading only the abstracts of journal articles—informative but not enlightening.

The chapter on statistical-mechanical formulations of equilibrium constants and rate constants is also confusingly abbreviated. Moreover, it is curiously outdated, in that it ignores the existence of computers, aside from references to a few recent calculations. A classical thermodynamic treatment would be simpler and more relevant, because most of the calculations omit partition functions and focus on energy differences.

The best section of the book is the one dealing with intermolecular forces. Although recent advances are not covered, theoretical models are discussed in adequate detail, and a good review is given of such topics as dispersion forces and charge-transfer complexes.

The prose style is somewhat awkward, which may be due to a poor (or too literal) translation. The translator was apparently not familiar with the subject matter, as the book contains much unorthodox terminology ("monomolecular stages of reactions") and a few amusing typographical errors ("thermomolecular stages of reactions").

This book may be useful as a guide to some of the literature on chemical applications of quantum mechanics. However, its high cost and brevity preclude a favorable recommendation.

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The Master of Light, A Biography of Albert A. Michelson

D. M. Livingston
376 pp. Scribner's, New York,
1973. $12.50

Among biographers of A. A. Michelson, Dorothy Michelson Livingston has a unique qualification—she is his daughter. She has included information about his personal life and stories he told to her that are not available elsewhere. A non-physicist herself, she has relied heavily on physicists who were familiar with her father's work and with the field of optics in general, as well as archivists, historians of science, writers and editors. Thus, this thorough biography is the fortunate combination of the efforts of many people, resulting in a valuable reference work as well as a very readable story about one of America's great scientists. The photographs