Perhaps the author should have expanded some of his topics that are not usually discussed in introductory physics textbooks— "The pursuit of precision," "Models for the scientific process," "The role of chance," and "The role of local situation."

In this book Anderson provides an excellent review of his subject.

The chapters in *Waves and Oscillations*, by R. A. Waldron, are "Elementary concepts"; "Reflection and refraction"; "Resonance"; "Interference and diffraction"; "Guided waves"; and "Topics in network theory."

Book 4 in the series attempts to consolidate, within 130 pages, a great deal about waves, oscillations, and network theory. If the material is totally unfamiliar to the student, this will not be a convenient book from which to learn it. There is little if any new material, but the author fulfills his declared purpose ". . . to point out the common features of and analogies between waves of different kinds . . ." where, by a wave, the author means ". . . something that can be treated by wave mathematics!"

It is presumed that the reader is acquainted with partial differential equations, and if unfamiliar, the introduction to Fourier series and Fourier transforms will not be appreciated by the student. The emphasis on the use of analogies is worthwhile, but some examples are treated in so cursory a fashion that any real depth of understanding without recourse to well-known texts is unlikely.

Elizabeth Wood sets out to provide an introduction to optical crystallography in the 17 chapters of the fifth volume, *Crystals and Light*: "Symmetry"; "Symmetry in crystals"; "Directions and planes, Miller indices"; "The three-dimensional crystal on two-dimensional paper"; "The thirty-two point groups: Crystal classes"; "The crystalline state"; "The relation between the symmetry of a crystal and the symmetry of its physical properties"; "The velocity of light in cubic and uniaxial crystals: Observation in crossed polarized"; "Uniaxial crystals in convergent polarized light"; "The polarizing microscope"; "The use of accessory plates: Determination of optic sign"; "Refraction of light in crystals"; "Biaxial crystals"; "Dispersion"; "Optical activity"; "Summary of the relation between optical properties and symmetry"; and "Absorption spectra."

Much of this book is concerned with developing the various symmetry properties of crystals, after which the physical properties are examined in relation to the symmetrical structure. The use of light, particularly polarized light for the study of structure is discussed at length, and a piece of Polaroid is included so that students can try the various demonstrations. Problems and questions are available at the end of each chapter, with answers provided one chapter later—a bit like the crossword in the daily newspaper which is resolved in the following issue.

The mathematics required is not difficult, but the subject is. For those who stick with it, they are sure to find this book rewarding, but only the unusual student will exercise this persistence. The author, a well-known crystallographer, has thoughtfully tried to make this subject, which is so meaningful to her, intelligible and exciting, but it is inherently hard going.

The avowed purposes of the Commission on College Physics in promoting this series seems eminently worthwhile. The usual textbook is necessarily confining and the Momentum Book provides an appropriate interface between the introductory text and the papers and treatises to which the more advanced student will turn. One might ask how well these first five books satisfied the criteria of the Commission and the editor? The first three should be distinctly successful. The latter two cover material that is very complex. The volume on waves is an inappropriate choice for the series. It would seem to me that the most successful books will be those in which contemporary physics is developed, by practicing physicists, at a level that can be understood by students in their first years of college physics, complemented by such overall case studies as that of the electron in which the work of many years is condensed into a coherent review. New titles planned for the series include: *Nuclear Models, An Outline of Solid State Physics, Nuclear Spectroscopy*, and *Temperatures, Very High and Very Low*. It would seem wise for the editor to keep in mind the existing books in The Science Study Series, which are available to college and secondary school students, often at considerably lower cost. It will be a challenge to future authors of Momentum Books to meet the criteria stated at the outset—". . . to provide lucid, accurate expositions of important topics in physics written at a level that is interesting and readily intelligible. . . ."

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A First-Rate Collection

Survey of Progress in Chemistry. vol. 1. Arthur F. Scott, Ed. Academic Press, New York, 1963. xii + 340 pp. Illus. $7.95.

This first volume of a new series publication contains seven excellently written articles that cover vastly different fields of chemistry. In the first, R. Schaeffer briefly expands the gamut of research tools now available to the modern chemist in his characterization of chemical compounds. The article stresses the application of nuclear magnetic resonance, mass spectrometry, x-ray diffraction, spectroscopy (ultraviolet, visible, and infrared), and optical rotatory dispersion to problems of chemical interest. Brief illustration is given of electron spin resonance and neutron and electron diffraction. Noteworthy is Schaeffer's diversified interests and experience as a modern inorganic chemist in applying these techniques (with the possible exception of optical rotatory dispersion) to his research investigations of boron compounds (including a single crystal investigation of $B_{10}H_{12}I_2$). Pertinent references are given for those readers who wish to gain further knowledge concerning the theory and use of these tools.

The second article, "High-temperature reactions," by another inorganic-physical chemist, A. W. Searcy, shows the importance of simple thermodynamic relationships in systematically yielding useful and sometimes unexpected information for various types of high-temperature reactions. Searcy first deals with the effect of temperature and entropy on reaction equilibria. He then shows that the behavior of metals at high temperatures depends not only on the properties of the metal but also on those of the nonmetal associated with it. This article is well documented, and detailed examples of thermodynamic applications are given so that the reader is made aware of complications that arise and simplifications that one can make in analyzing and correlating high-temperature reactions. The dangers and common pitfalls in using predictions from thermodynamic generalizations are pointed out.

The third article, "The implications of some recent structures for chemical valence theory" by R. E. Rundle (who recently died), exemplifies Rundle's role as an outstanding structural chemist whose major aims were to relate the compound's structure to its chemistry, to correlate structural features with those of other related compounds, and to rationalize the molecular parameters in terms of modern bonding theories from which useful and predictive information can be obtained.

The author modifies the empirical valence theory of G. N. Lewis by defining a chemical bond as the sharing of an electron pair *among two or more atoms* and extends it to embrace molecules that seemingly violate the classical Lewis rules. Rundle discusses in detail how electron-deficient compounds, certain transition metal complexes including metal carbonyls, and so-called outer *d*-orbital compounds such as PCl_5, SF_6, polyhalide ions, and noble gas fluorides follow the principles of bond delocalization and make use of all the low energy valence orbitals. He uses molecular orbital symmetry arguments to show that, for the latter compounds, the outer *d*-orbitals are not utilized appreciably for σ-bonding but do play an important role in providing π-bond character. He also concludes that the rare gas rule is seldom violated, except in transition metal compounds where valence orbitals may be sterically shielded.

Examples are given to show the importance of steric and multiple bonding factors in determining molecular configuration. In the case of molecular systems for which no Lewis-type structures can be written, the advantages of molecular orbital formulation over ligand field and valence bond treatments in utilizing molecular symmetry arguments to describe the ground state electronic configuration of compounds are demonstrated.

Rundle's article spans much of the part of inorganic chemistry that has been directly influenced by his own research productivity, and it provides a penetrating insight into his own scientific philosophy.

The fourth article, by W. F. Little, is a comprehensive and lucid account of the chemistry of "metallocenes" as it has evolved since the discovery in 1951 of the sandwich compound ferrocene. The reader cannot help but be impressed by the tremendously rapid development of this exciting new field of organometallics, which has created intense interest and research activity among inorganic, organic, and theoretical chemists. Little gives a detailed discussion of the different types of known metallocene complexes, their preparations, and their characterizations by physical and chemical techniques. This review is extremely well documented and offers the reader an excellent opportunity to see modern chemistry in action.

The fifth article, by K. W. Wiberg, is "Oxidation-reduction mechanisms in organic chemistry." In it Wiberg demonstrates extremely well how important it is to critically evaluate different types of evidence in reaching conclusions concerning possible mechanisms of reaction. He illustrates the power of the use of isotopes in elucidating organic reactions and at the same time makes the reader aware of the dangers involved in interpreting results. He discusses in detail the implications of the kinetic hydrogen isotope effect for different chemical reactions and shows that reactions involving cleavage of bonds to hydrogen need not give a large isotope effect. A presentation of different type mechanisms (ester, hydride transfer, hydrogen atom abstraction, electron abstraction, displacement, and addition-elimination) follows, with detailed examples. Wiberg points out that a knowledge of reaction mechanisms not only leads to a better ability to control the products and improve the reaction yields but also enables one to devise new synthetic methods. The article is well documented.

The purpose of the sixth article, "The chemistry of biological energy transfer," which is by W. P. Jencks, is to give the nonbiological chemist an up-to-date understanding of the remarkable chemical processes that occur in living organisms. In particular, the reader is introduced to biochemical terminology and to the mechanisms by which metabolic energy is generated, transferred, and utilized. Although not written in layman's language and not as easily digestible as a novel, this article presents a wealth of fascinating concepts and information.

In the last article, "The structure of the Grignard reagent and the mechanisms of its reactions," R. M. Salinger gives a thorough and well-documented review of the present knowledge of this ubiquitous reagent. It is significant that there are still a considerable number of conflicts and ambiguities concerning its structure(s) and reaction mechanisms that need to be resolved.

Arthur Scott, the editor of this volume, is to be congratulated for getting together a first-rate collection of manuscripts. I found all of them definitely interesting and gained from them a better appreciation of the tremendous diversity of research aims and interests.

The illustrations used in this book are very good and there are very few typographical errors. That the explosive nature of present-day research quickly outdates information is illustrated in several instances—the structure E for $C_3H_4(CH_3)Co(CO)_3$ (p. 100) now has been conclusively shown to be an (allylic) $Co(CO)_3$ interaction, while the presumed $Ru_2(CO)_9$ and $Os_2(CO)_9$ compounds (Table II, p. 99) have been recharacterized as $Ru_3(CO)_{12}$ and $Os_3(CO)_{12}$. The Jahn-Teller Theorem is not applicable to the MO correlation diagram for the assumed ethane-like $[(CH_3)_3Al]_2$ structure of D_{3d} symmetry (p. 94) since the E_u level would be half-filled resulting in a totally symmetric ground state. Structure (CLII), on page 203, which should have the dimethyl carboxylate groups attached to the olefin coordinated to the nickel, has been verified by an x-ray examination.

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Crystallography

Crystallographic Data on Metal and Alloy Structures. Compiled by A. Taylor and Brenda J. Kagle. Dover, New York, 1963. vi + 263 pp. Paper, $2.25.

The text of this book consists of a half-page introduction. The data are given in three tables covering (i) alloys and intermetallic compounds (2300 substances); (ii) borides, carbides, hydrides, oxides, and nitrides (700 substances); and (iii) crystal structures of the elements (77). The data tabulated are system, structure type and powder file data, space group, lattice constants, and cell content. For the elements the "x-ray density" is also given. In each table the arrangement is alphabetical by the first letter of the chemical formula, but in Table 2 the compounds in each chemical category are grouped together.

The definition of intermetallic compound on which Table 1 is based must be very broad. Not only are numerous sulfides and sulfosalts included but even halides are found in Table 1. The basis for selection is not readily apparent. For instance, one finds KCl and NaI