

of deviations from perfect periodicity by X-ray scattering experiments had become a well-developed secondary area of diffraction research.

It is with this area of interest that Professor Guinier's book is concerned. The crystal structure problem is specifically omitted. Perhaps a third of the book is devoted to a very elegant and complete development of kinematic diffraction theory, and the remainder to the interpretation of X-ray scattering by materials not perfectly periodic. A careful distinction is made between imperfections of the first and second kinds—those which leave the diffraction maxima sharp but weaker with diffuse scattering, and those which cause line broadening. There are then detailed treatments of the various specific imperfections and their diffraction effects: particle size and strain line broadening, order-disorder phenomena in alloys, thermal motion, stacking faults, and low angle scattering. Scattering from liquids and gases is also discussed. Ample literature references are given, and an excellent English translation has been provided by Professor and Mrs. Lorrain.

It seems clear that this book will fill a need both of the researcher for a reference source and the advanced materials science student for a text. The reviewer knows of no other treatment of X-ray diffraction from imperfect materials as detailed and satisfying.

It is perhaps unfortunate that the book is limited to cases of X-ray scattering which may be interpreted in terms of the kinematic theory. The subject of the anomalous transmission of X-rays and its ability to reveal the shapes and relative orientations of imperfections in nearly perfect crystals has in recent years attracted much attention. This phenomenon may be understood only in terms of the Ewald-von Laue dynamical theory, which Professor Guinier chooses to mention only in passing. The discussion of thermal motion, its diffraction effects, and their interpretation could have been made more modern by mention of inelastic neutron scattering experiments.

The scientist interested in the general study of imperfections in solids by the scattering of radiation in general—X-rays, electrons, and neutrons—has a need for a text treating all of these closely related questions, and for that he must still wait. In the meantime, Professor Guinier's book constitutes a very useful partial fulfillment of that need.

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An Introduction to Crystal Chemistry. By R. C. EVANS, Fellow of St. Catharine's College and Lecturer in the Department of Mineralogy and Petrology, University of Cambridge. Second Edition. Cambridge University Press, 32 East 57th St., New York 22, N. Y. 1964. 410 pp. 16 × 24 cm. Price, \$9.50.

The first edition of this popular book appeared in 1939 and was reprinted in 1946, 1948, and 1952; it has been translated into French. Now reset in a larger format, the text has been rewritten and expanded; the nomenclature has been improved ("layer lattices" are properly called *layer structures*); the style has been polished (*co-ordination* remains hyphenated: bravo!); the figures have been skillfully redrawn, even though most of them still lack any indication of scale. The new edition, even more than the first, sets out to teach crystal chemistry "at an elementary level": it appears to be aimed at a hypothetical student largely ignorant of crystallography, for he must be taught that equivalent sites are related by symmetry (p. 196) and what the cell looks like in the various crystal systems (p. 401); yet he must be thoroughly familiar with such phrases as Bragg's law, Joule-Thompson effect, Boltzmann distribution, and Planck's and Madelung's constants.

After a review of the electronic structure of the elements, the four bond types are introduced together with some qualitative discussions: "lattice theory" of ionic crystals, valence bond and molecular orbital theories of the covalent bond, several theories of metals (Drude-Lorentz, Sommerfeld, Bloch, Brillouin), the theory of the van der Waals bond. The various atomic radii are compared. Then follows a systematic description of the significant features of a number of carefully selected crystal structures. Facts are confronted with theoretical predictions. Principles are well brought out, particularly Pauling's Five Rules for ionic structures. Physical and chemical properties are correlated with structure. The classification of crystal structures into "hetero- and homodesmic," and the further subdivision of the latter into "iso-, meso-, and anisodesmic" according as bonds differ in kind or in degree, which was the leitmotiv of the first edition, has proved unrealistic and is

wisely abandoned. This second part, which covers nearly three-quarters of the book, is by far the more satisfying.

Most of the adverse criticism I have to offer is peripheral. Here are some objectionable statements quoted from the appendix, followed by my comments between brackets: (1) "the edges of the cell . . . are taken parallel to the crystallographic axes" [it is the other way around; axes are chosen parallel to edges]; (2) "it is sometimes more convenient to describe trigonal and hexagonal structures in terms of a rhombohedral cell" [only *some* trigonal and *no* hexagonal structures have rhombohedral lattices; only for these would a rhombohedral cell be more convenient]; (3) "triclinic system relationship $a \neq b \neq c, \alpha \neq \beta \neq \gamma$ " [the definition of crystal systems stems from symmetry—it cannot rest on metric considerations; one should explain that the unequal sign \neq does not have its usual meaning, but stands for *not required to be equal*]; (4) "the clinographic projection, in which the structure is shown as viewed in a convenient direction from a point at infinity . . ." [if so, this is an *orthographic projection*, in no way different from what the author calls a "plan"].

A section, misleadingly entitled "Crystal Structure and Morphology," deals with polymorphism and isomorphism. It is to be deplored that the word "isomorphous" is here redefined to mean *isostructural*, a well-established term presumably unknown to the author. The assertion (p. 193) that "in the cubic system . . . all crystals of a given class are morphologically identical" ceased to be correct in 1849 with the advent of the law of Bravais (to say nothing of its subsequent generalizations). Some readers will regret the omission of the new silicate chains; many will wonder why no mention is made of vitamin B₁₂ and proteins, these resounding successes of structure analysis. It is hard to condone the author's decision to delete all references to original papers, especially since the work reported is still so recent. (The good student will say, "What a beautiful story! *Who* ever found out, and *how*?") A three-page bibliography gives a partly annotated list of reference works, monographs, and textbooks.

I shall continue to recommend this book to chemistry students, but only after they have had a course in crystallography.

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The Gas-Phase Oxidation of Hydrocarbons. By V. YA. SHTERN. Edited by B. P. MULLINS, Deputy Chief Scientific Officer, Ministry of Aviation, Farnborough, Hampshire. The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. 1964. x + 710 pp. 16 × 24 cm. Price, \$28.50.

Professor Shtern's monumental work deals with the thermal reaction between hydrocarbons and molecular oxygen in the gas phase under slow oxidation conditions, *i.e.*, in the temperature range 200–600°. The approach is historical, and by so limiting his subject matter, the author is able to discuss essentially every study on the problem from the pioneering work of Bone in 1902, to 1960, the publication date for the Russian text. In addition, for the present translation, the author has made revisions which extend his literature coverage into 1962.

According to the author, there are three periods in the history of research on slow oxidation. In the first, which ended in the late twenties, emphasis was on end-product identification and non-chain mechanisms. There followed a short period in the early thirties, dominated by the Semenov school, from which emerged the concept of slow oxidation as a chain reaction with degenerate branching. The third period, which is still in progress, is characterized by studies of individual steps in the oxidation sequence, together with the development of detailed free-radical mechanisms for the over-all process.

Since the slow oxidation of hydrocarbons is not only of considerable fundamental interest, but also has broad industrial significance, a vast amount of pure and applied research effort has been expended on the system, especially on paraffin oxidation. Yet the reaction is so complex that even today only the initial stages can be considered firmly established. The author justifies his historical treatment of the subject by stating that the most meaningful conclusions concerning the mechanism can only be drawn when all of the available data are objectively evaluated. Certainly the method has the advantage of properly assigning prime credits for contributions to the field. To the English-speaking reader there is the added advantage of having thereby a detailed treatment of the important work of the Russian school of combustionists.

However, this reviewer is of the opinion that many chemists may find the author's detailed discussions of a long succession of now-outdated mechanisms a trifle tedious. There will be a tendency to move rapidly through the first seven chapters of the book which deal primarily with the history of paraffin oxidation, and focus attention on Chapter VIII, which is an excellent evaluation of contemporary ideas on the mechanism for paraffinic systems.

In comparison to the paraffins, relatively little work has been done on the oxidation of olefinic hydrocarbons, and these studies are covered in Chapter IX. There follows a short chapter bringing together the small amount of data available on the oxidation of naphthenic and aromatic hydrocarbons. The final chapter is devoted to problems of controlling hydrocarbon oxidation reactions, a subject of vital interest to chemists in the petrochemical field.

This reviewer would like to commend Professor Shtern for a work of high scientific scholarship, presented in general in a very lucid manner. The treatise will be of great value to anyone interested in the general field of slow hydrocarbon oxidation.

The text is well printed and relatively free of significant errors.

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Methods of Quantitative Inorganic Analysis. An Encyclopedia of Gravimetric, Titrmetric and Colorimetric Methods. By KAZUNOBU KODAMA, Nagoya Municipal Industrial Research Institute, Nagoya, Japan. Interscience Publishers, John Wiley and Sons, Inc., 605 Third Ave., New York 16, N. Y. 1963. xiv + 507 pp. 19.5 × 25.5 cm. Price, \$22.00.

Faithful to its title this book is encyclopedic rather than critically selective. The author's aim has been to "collect all published methods in the field of inorganic gravimetric, titrimetric, and colorimetric analysis" up to about the end of 1957. The nearly six-year hiatus between the most recent literature citations and the publication date was, in the author's words "caused by the work of checking and correction."

The book, printed in large, double-column format, comprises three parts. Part I, "General Considerations" (44 pp.), contains brief discussions of general analytical technique, electrolytic deposition, the principles of titrimetry, and the preparation of standard titrant solutions, and one page on general references to optical methods. Part II is devoted wholly (about 100 pp.) to "Organic Reagents in Inorganic Analysis," and it also includes a brief discussion of ion-exchange resins. Part III on "Determination of Elements" is really the *raison d'être* of the book. A separate chapter is devoted to each element (or very similar group of elements), the arrangement for the metallic elements being according to the classical hydrogen sulfide separation scheme. In each case the treatment follows the pattern: attack of sample, separation, and determination. The imperative voice is used, in conjunction with liberal employment of easily understood abbreviations, to very succinctly describe procedures in detail. All of the stable elements are treated, with the exception of oxygen.

The conciseness of the treatment, and the comprehensive literature coverage (up to the end of 1957), are exemplified by the fact that the chapter on iron occupies only nine pages, and yet there are 96 references to the colorimetric determination of iron plus 85 additional references to other methods. As a rough estimate, the total number of literature references must be upwards of 10,000.

The treatment is restricted to the classical gravimetric and titrimetric methods, and, aside from spectrophotometry, nephelometry, and flame photometry, physical methods are not included. Only titrimetric methods based on visual end-point detection are described. One can appreciate that the author had to restrict the scope of the treatment in order to complete this tremendous task. Nonetheless, potentiometric end-point detection surely has become "classical," and because methods based on it are not considered, some of the best titrimetric procedures for determining the transition metals have been omitted.

However, this is only a minor flaw in a work which is truly remarkable for the vast amount of information it presents in so relatively few pages.

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BOOKS RECEIVED, November 1964

- HALVOR N. CHRISTENSEN. "Body Fluids and the Acid-Base Balance. A Learning Program for Students of the Biological and Medical Sciences." W. B. Saunders Co., Philadelphia, Pa. 1964. 506 pp. \$6.50.
- J. G. CUNNINGHAME. "Introduction to the Atomic Nucleus." American Elsevier Publishing Co., Inc., 52 Vanderbilt Ave., New York, N. Y. 1964. 220 pp. \$9.00.
- ALFRED DEL VECCHIO, Editor. "Concise Dictionary of Atomics." Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. 1964. 262 pp. \$6.00.
- JOHN DALTON. "A New System of Chemical Philosophy." Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. 1964. 168 pp. \$6.00.
- European Atomic Energy Community—Euratom. "Proceedings of the Conference of Methods of Preparing and Storing Marked Molecules—Brussels, Belgium, November 13–16, 1963." The European Atomic Energy Community, 51–53 rue Billiard, Brussels, Belgium. 1964. 1359 pp. \$20.00.
- ROBERT GOUTAREL. "Les alcaloïdes stéroïdiques des Apocyanocées." Hermann, 115 Boulevard Saint-Germain, Paris VI, France. 1964. 289 pp. 48 F.
- E. J. HOFFMAN. "Azeotropic and Extractive Distillation." Interscience Publishers, John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1964. 324 pp. \$14.00.
- EARL K. HYDE, ISADORE PERLMAN, and GLENN T. SEABORG. "The Nuclear Properties of the Heavy Elements." I. "Systematics of Nuclear Structure and Radioactivity." Prentice-Hall, Inc., Englewood Cliffs, N. J. 1964. 407 pp. \$15.00.
- EARL K. HYDE, ISADORE PERLMAN, and GLENN T. SEABORG. "The Nuclear Properties of the Heavy Elements." II. "Detailed Radioactivity Properties." Prentice-Hall, Inc., Englewood Cliffs, N. J. 1964. 698 pp. \$25.00.
- EARL K. HYDE. "The Nuclear Properties of the Heavy Elements." III. "Fission Phenomena." Prentice-Hall, Inc., Englewood Cliffs, N. J. 1964. 519 pp. \$18.00.
- G. J. JANZ, A. T. WARD, and R. D. REEVES. "Molten Salt Data. Electrical Conductance, Density, and Viscosity." Technical Bulletin Series, Rensselaer Polytechnic Institute, Troy, N. Y. 1964. 180 pp. \$2.50.
- J. S. KUCK. "Simultaneous Rapid Combustion. Microchemical Research Papers of Mirra Osipovna Korshun." Gordon and Breach, 150 Fifth Ave., New York, N. Y. 1964. 560 pp. \$27.50.
- GERALD LITWACK and DAVID KRITCHEVSKY, Editors. "Actions of Hormones on Molecular Processes." John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1964. 583 pp. \$17.00.
- G. B. MARINI-BETTÒLO. "Thin-Layer Chromatography. A Scientific Report of the Istituto Superiore di Sanità, Rome." American Elsevier Publishing Co., Inc., 52 Vanderbilt Ave., New York, N. Y. 1964. 232 pp. \$11.75.
- WOLFGANG PFLEIDERER and EDWARD C. TAYLOR. "Pteridine Chemistry. Proceedings of the Third International Symposium held at the Institut für Organische Chemie der Technischen Hochschule Stuttgart, September 1962." The Macmillan Co., 60 Fifth Ave., New York, N. Y. 1964. 535 pp. \$15.00.