BOOK REVIEWS

VECTOR SPACE AND ITS APPLICATION IN CRYSTAL-STRUCTURE INVESTIGATION, by MARTIN J. BUERGER. John Wiley and Sons, Inc., New York, 1959. xiv+347 pp., $6\frac{1}{8}\times9\frac{1}{4}$ in., 186 figs., 31 tables. Price $12.00.

With the publication of this book the crystallographer has available for the first time a complete one-volume reference and exposition on the Patterson function and the methods for its interpretation in crystal-structure analysis. The author, who has himself made numerous original contributions to the theory and practice of this intriguing field, gives the reader the benefit of his comprehensive knowledge and practical experience in a clear, readable style.

The book contains 15 chapters, the first being a brief statement defining the phase problem in crystal-structure analysis, and the last, a retrospective glance over the relationship of the material covered in the book to the crystal-structure field as a whole. The 13 other chapters provide a carefully developed groundwork of theory, judiciously interspersed with numerous practical examples. Chapters 2, 4, and 5 define the Patterson function and give in detail its characteristics and pitfalls, together with some of the means for avoiding the latter. Chapter 3 is entirely devoted to some interesting early examples of the use of Patterson maps in the solution of crystal structures. The wide scope of A. L. Patterson's original papers is once again demonstrated by the author's numerous references to them throughout the first few chapters. The importance of symmetry and its effects in Patterson projections and in Harker sections, as well as its use in the implication theory originally developed by the author, are covered in Chapters 6 and 7. Vector sets are introduced in Chapters 8 and 9, and their relationship to the Patterson function is clarified. Chapters 10 through 13 are devoted to the theory and practice of image-seeking and superposition functions in two and three dimensions. Numerous illuminating examples are given from original crystal-structure determinations by the author and his students. Finally Chapter 14 deals with the problems caused by the presence of substructures in complex crystals and suggests methods of attack in such cases.

At the end of each chapter there is an extensive bibliography, and the book contains a comprehensive index. Detailed tables together with many illustrations enhance the overall presentation. The general format is designed to assist both the student and the casual reader; typographical errors have been kept to a minimum and only a few minor ones were noted by this reviewer. The cover of the book, with its vector set diagram, is most attractive, and on the endpapers are reproduced the Patterson representations of the 17 plane groups (also given in Chapter 6, Fig. 12B).

Undoubtedly not everyone would agree with the author on all aspects of his presentation. The emphasis and space allotted to some subjects (*e.g.* implication theory) reflect the personal views of the author and are not necessarily to be taken as a guide to the relative importance of the various methods. Subject to this minor reservation, there should be general agreement that the book fills a real need and it should become a working volume in the library of anyone interested in crystal-structure analysis.

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PRINCIPLES OF MINERALOGY, by WILLIAM H. DENNEN. The Ronald Press Company, New York, 1959. v+429 pages. Price $7.50.

This new introduction to mineralogy has many original features. According to the author's preface its goal is "first, to provide students in geology and allied fields with a

mineralogical background that will aid them in studies where the nature of the solid state is an important consideration; second, to provide a text, nonmathematical in treatment, which is broad enough to provide a base for continuing mineralogical studies and detailed enough to bridge the gap now existing between introductory mineralogical work and advanced studies in crystallography, crystal chemistry, petrology, and geochemistry; and finally, to provide convenient descriptive material covering the more common minerals and mineral groupings for examples and laboratory reference."

The text is divided into seven chapters: 1, Symmetry (69 pages); 2, Fundamentals of Crystal Chemistry (26 p.); 3, Mineralogical Relations (29 p.); 4, Physical Characteristics of Minerals (26 p.); 5, Chemical Testing (24 p.); 6, Mineralogy (40 p.); 7, Mineral Descriptions (196 p.). There is also a 3-page table of atomic parameters in an appendix and subject and mineral indexes. The mineral descriptions cover about 150 species. Over 600 names are included in the mineral index, most of these appearing in the text only under the listing of "related minerals." Determinative tables are not included.

The opening chapters differ markedly from comparable chapters in other mineralogy textbooks. The first chapter, which in another book might have been entitled Crystallography, is clearly an adaptation of the first ten chapters of Buerger's *Elementary Crystallography*. As a consequence no reference is made to goniometry, crystal projection and many other subjects of importance. A distinguishing feature of the second chapter is a discussion of "The Architecture of Atoms," including reference to quantum mechanics, wave mechanics, the Pauli exclusion principle, and other matters not commonly referred to in connection with the treatment of chemical bonding in mineralogical texts.

Except in the sections dealing with chemical testing and mineral description there is little reference to observations, experiments or phenomena. The only historical reference noted appears on page 256, "the first mineral structure to be worked out (by W. H. Bragg) was that of halite." Even here there is no hint as to how the structure was "worked out." Such a treatment, emphasizing constructs and models, must give the beginner a rather distorted view not only of mineralogy but of science generally. In places it is unpleasantly reminiscent of attempts at popularization of some of the more esoteric aspects of physics so common in the mass periodicals in recent years.

It seems that the book has not been mineralogically edited. Incorrect dates are given for some of the standard works cited and the first, instead of the current, editions of Strunz, Tabellen and Hey's Index are referred to. Some mineral formulas, for instance that of colemanite, are not given in the best modern form. Though the diagrams of crystal structures are, on the whole, excellent and the inclusion of the skutterudite and columbite structures as well as others not usually found in mineralogy texts is most welcome, some of the crystal structure drawings are misleading or erroneous. Some structures, for example that of corundum, are shown by only a partial cell giving a faulty impression. The structure diagram of niccolite is misdrawn and mislabelled. A tabulation on page 105 improperly suggests that one of the cell dimensions of stannite must be double the corresponding dimension in chalcopyrite. On page 135 the impression is given that the terms *isotropic* and *anisotropic* are connected only with optical properties. In Fig. 1-42, copied from Buerger's *Elementary Crystallography*, the errors in the original have been retained. In this figure one of the symmetry diagrams is incomplete and four others violate the conventions stated in the text.

The decline in the art of crystal drawing, recently deplored by Professor Ramdohr (*Fortschr. Miner.* **37**: 27–35, 1959, p. 28), is painfully evident in this book. Many of the crystal drawings in the first chapter are poorly executed and some, especially the one at the upper right of Fig. 1-51 and the one in the middle of the upper row of Fig. 1-52, ought not to be acceptable even as the exercises of a beginner.

It is regrettable that the author in his eagerness to improve and modernize, has sought chiefly to discard and change and so has discarded most of the virtues of the older books along with many of their faults. Gains have been realized only at the cost of losses. Whether the former outweigh the latter may be questionable. Still, this book will be of interest to all who are concerned with the teaching of elementary mineralogy.

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GEMSTONES OF NORTH AMERICA, by JOHN SINKANKAS. xv+675 pages, 175 illustrations (6 in color). D. Van Nostrand Co. Inc., Princeton, N. J., 1959. Price, $15.00.

This book is written for the amateur mineral collector and lapidarist. Detailed descriptions and often maps are given that will direct the collector to little-known localities. Where it was possible for the reviewer to check against his personal knowledge, these were accurate and complete. The geographical and locality index will be a great aid to the tourist who is also a collector. Within the limits of the clientele to which it is directed, it is more accurate, authentic, and complete than most popular books on gemstones.

The professional mineralogist will find the book a great aid in answering questions posed by the layman.

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THE POWDER METHOD IN *X*-RAY CRYSTALLOGRAPHY, by LEONID V. AZÁROFF and MARTIN J. BUERGER, McGraw-Hill Book Company, Inc., New York, 1958. xv+342 pp., 6×9 in., Price $8.75.

"The powder method in *x*-ray crystallography" is a book that many mineralogists, chemists, metallurgists and ceramists have looked for in the literature of *x*-ray crystallography, published in English, and yet never have found. It represents a unique presentation of the method and its interpretation. It is at once comprehensive (complete), readable, practical and yet not too long nor encyclopedic.

After a brief treatment of elementary *x*-ray diffraction theory, two informative chapters deal with the design, adjustment and use of the powder cameras. A third chapter deals with the procedures for taking powder photographs. These five introductory chapters have a thread of continuity and are not a collection of disjointed facts and techniques.

Chapter 6 gives the fundamental equations relating to the interplanar spacings d_{hkl} to the cell edges and to the reciprocal-cell edges. The reciprocal lattice is discussed in chapter 9.

The identification of all the reflections in a powder photograph is of fundamental importance. C. Runge in 1917 clearly recognized that a solution to this problem could be found using the methods of Number Theory. The real use of Number Theory however was not made until 1948 by Hesse, and further modified in 1949 by Lipson. Stosick (1949) used linear Diophantine equations for indexing the powder photographs. The authors present an excellent treatment of analytical methods for indexing powder photographs including that of Hesse-Lipson and that of Ito. These methods are illustrated with worked out examples.

Students will be very grateful to the authors for the clear presentation of the material in the chapters on the "Reduced Cells and Their Application" and "Homogeneous Axes and the Delaunay Reduction."

The last four chapters deal with (1) methods of identifying substances, (2) sources of errors in measured spacings, (3) the practice of attaining accuracy, and (4) the appearance of the powder photographs, all presented in the lucid style so characteristic of this book.

Four useful tables make up the appendix. A very convenient time-saver is the table for the conversion of d to Q.

In this reviewer's opinion this book is a close approach to an ideal treatment of the subject.

GEORGE T. FAUST

CLAYS AND CLAY MINERALS, Edited by ADA SWINEFORD, National Academy of Sciences, National Research Council Publ. 566, vii+360 p., Washington, D. C., 1958, Price $4.50 (Proc. 5th Natl. Conf. on Clays and Clay Minerals, Urbana, Illinois, October 8–10, 1956).

This volume contains the papers presented at the 1956 conference held at the University of Illinois. The 27 papers listed below are published in full:

"Analysis of consistencies of kaolin-water systems below the plastic range."—Robert B. Langston and Joseph A. Pask
"Water vapor sorption on lithium kaolinite"—R. Torrence Martin
"Altered siliceous volcanics as a source of refractory clay".—L. B. Sand and L. L. Ames, Jr.
"Filtration theory for oil-well drilling fluids."—D. T. Oakes
"Surface conductance of sodium bentonite in water."—H. van Olphen and M. H. Waxman
"Diagenetic modification of clay mineral types in artificial sea water."—U. Grant Whitehouse and Ronald S. McCarter
"Glauconitic mica in the Morrison formation in Colorado."—W. D. Keller
"Density and structure of endellite."—Fred L. Pundsack
"New data on sepiolite and attapulgite."—Fred A. Mumpton and Rustum Roy
"High temperature phases in montmorillonites."—George Kulbicki
"A discussion on the origin of clay minerals in sedimentary rocks."—Charles E. Weaver
"Statistical relationships of minor constituents of some nontronites."—Joseph A. Kornfeld
"Effects of a synthetic resin on differential thermal analysis of loess."—J. B. Sheeler, R. L. Handy, and D. T. Davidson
"Clay mineral distribution in the soil areas of Arkansas."—C. L. Garey
"Muscovite weathering in a soil developed in the Virginia Piedmont."—C. I. Rich
"Clay mineral distribution in the Hiawatha sandy soils of northern Wisconsin."—B. E. Brown and M. L. Jackson
"Clay mineralogy of Pennsylvanian sediments in southern Illinois."—Herbert D. Glass
"Clay minerals at a Pennsylvanian disconformity."—Jane A Dalton, Ada Swineford, and J. M. Jewett
"Clay mineralogy of Recent sediments from the Mississippi Sound area."—I. H. Milne and W. L. Shott
"A kinetic study of the dehydroxylation of kaolinite."—G. W. Brindley and M. Nakahira
"Heterogeneity in montmorillonite."—James L. McAtee, Jr.
"Layer charge and interlamellar expansion in a muscovite."—Joe L. White
"Experimental structure factor curves of montmorillonites."—Edward C. Jonas
"Random interstratification in organophilic bentonites."—James L. McAtee, Jr
"Gravimetric determination of monolayer glycerol complexes of clay minerals."—Earl B. Kinter and Sidney Diamond
"Surface areas of clay minerals as derived from measurements of glycerol retention."—Sidney Diamond and Earl B. Kinter
"Temperature stabilities of montmorillonite- and vermiculite-glycol complexes."—W. F. Bradley, R. A. Rowland, E. J. Weiss, and C. E. Weaver

Mineralogists and petrologists will be pleased to find the itinerary of the field trip in

the area near Urbana included in this volume. About one-third of the papers are concerned with physico-chemical studies on clay systems. The rest deal with topics on the mineralogy and petrology of clays and soils.

Mineralogists and petrologists and others interested in clay mineralogy will find this volume as indispensable as its predecessors.

GEORGE T. FAUST

OUR MINERAL RESOURCES, by CHARLES M. RILEY, John Wiley & Sons, Inc., New York, 1959. x+338 pages, 102 figures. Price $6.95.

This is a clearly written and well illustrated text for elementary economic geology.

The author states in the preface that the book is designed both as a text for an introductory course in economic geology for the training of professional geologists, and as a text for a "cultural" course in earth sciences intended to acquaint non-geology students with the mechanism of ore genesis, occurrence and production. The author admirably fulfills the second purpose, but falls somewhat short of accomplishing the first.

The book is divided into two main sections with six appendices: (I) Metallic Minerals, (II) Nonmetallic Minerals.

Chapter 1, Principles of Ore Deposition, is by far the most outstanding contribution of the text. The author manages in a most able way to condense the literature on this subject without violating the integrity of the substantive matter. However, the later chapters lack development, and thus impairs the effectiveness of this section.

Chapters 2 through 9, respectively, discuss ore deposits of Iron; Aluminum; Copper; Lead and Zinc; Tin and Tungsten; Gold and Silver; Nickel, Chromium and Platinum; and Uranium and Vanadium. Chapter 10, Miscellaneous Metals, including information on Manganese; Mercury; Molybdenum; Cobalt; Titanium; Antimony; Magnesium; Beryllium; Bismuth and Cadmium is too encompassing and too brief to be effective.

The second section includes brief resumes on Ground Water, Coal, Petroleum, Rock Building Materials, Gem and Gemstones and Miscellaneous Nonmetallic Minerals. Again, development of substantive matter is sacrificed for brevity's sake and the section possesses a rather limited discussion of general uses, occurrences, characteristics and localities of nonmetallic minerals.

The six appendices are welcome additions and include a Glossary, List of Chemical Elements, Geologic Time Scale, List of Valuable Nonmetallic Minerals and a short General Reference.

In the reviewer's opinion this book will meet the needs of colleges and small universities which have a pre-geology curriculum and/or survey courses in earth sciences. The text is also recommended as supplementary reading to augment courses in Conservation.

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INTERNATIONAL TABLES FOR *X*-RAY CRYSTALLOGRAPHY. Vol. II, Mathematical Tables. Editors: J. KASPER and K. LONSDALE. xviii+444 pages, with 39 figures. Published for the International Union of Crystallography by The Kynoch Press, Birmingham, England. Price £5 15s. Members of learned scientific societies may obtain personal copies for £3 10 s.

Volume II contains the following sections:

1. Introduction
2. Basic mathematics
3. Crystal geometry

4. Diffraction geometry
5. Physics of diffraction methods
6. Fourier synthesis and structure factors
7. Special topics
8. Miscellaneous exponential and trigonometric tables
9. Dictionary of crystallographic terms in English, French, German, Russian and Spanish.

INDEX OF CRYSTALLOGRAPHIC SUPPLIES. Second edition, 1959, edited by A. J. Rose, published by Commission on Crystallographic Apparatus of the International Union of Crystallography, 125 pages+xxvi, paper bound, $10\frac{5}{8}$ in.$\times 8\frac{1}{4}$ in. Price $2.50 per copy shipped by surface mail; bank check or postal money order (C.C.P. Paris 6168-45) should be made payable to Société française de Minéralogie et de Cristallographie (I.U.Cr.), 1, rue Victor-Cousin, Paris 5^{e}, France.

Contents: I. *List of Equipment and Suppliers:* The material is classified in 11 categories corresponding to its use: supply of crystals, sample preparation; physical, morphological and optical properties; microradiography; x-ray spectrography; determination of crystal structure by x-ray, electron and neutron diffraction; physical and chemical analyses, and computations. A brief specification is sometimes included. The main office of the suppliers is given and only materials that are commercially available are listed.

II. *Literature References:* reference to publications on the interpretation of experimental data, e.g., charts, tables, technical documents; books on crystallography published since 1903; a list of crystallographical periodicals.

III. *Advertisements.*

IV. *Addresses of Manufacturers and Suppliers:* including branches in other nations (up to 10).

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Philips Laboratories
Irvington-on-Hudson
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