

## BOOK REVIEWS

FELDSPAR MINERALS. Volume 1. CRYSTAL STRUCTURE AND PHYSICAL PROPERTIES. By Joseph V. Smith. Springer-Verlag, New York, 1974. xx + 632 pages. 248 illustrations. \$40.30 cloth.

This is the first volume of a set of three comprising a treatise on the feldspar minerals (and this includes reedmergerite and celsian) that contains all the up-to-date information on this important group of minerals that anyone would want to know. Subsequent volumes will cover the chemical properties, diffusion, morphology, twinning and intergrowth—volume 2; experimental phase equilibrium, thermochemistry, petrogenesis and natural occurrences—volume 3 (in preparation).

The first five chapters comprising 150 odd pages are devoted to a description and discussion of the crystal structures of the feldspars in general and in particular. The character and the effect of Al-Si ordering and cation bonding in the alkali feldspars, and the various models that have been proposed for the intermediate plagioclases, are discussed in detail. The remainder of the text is taken up with the description of other physical properties, including optical properties, both visible-light and electron-optical; spectral properties, including infrared absorption, nuclear magnetic, electron-spin resonance, Mössbauer resonance; and a host of other properties that include thermal expansion and conductivity, luminescence, and mechanical properties. Data are well presented in tables and graphs. Much of the text is taken up with detailed interpretation of these data and is illustrated with numerous plates and diagrams.

The methods and techniques used in determining the physical properties are briefly described. This is not to say that one can use this book as a text to learn the principles and apply the techniques, but it does help one to understand the quality and limitations of the methods, and aids in evaluating the data that are presented in the text.

A discussion is given at the beginning of chapter five on the effect of various crystal imperfections and geometrical crystal-structure phenomena on the X-ray diffraction record. Such phenomena as twinning (simple, regular, and irregular periodic); coherent strain; incoherent and coherent intergrowths; density-, transverse-, and longitudinal-modulation; and order-disorder are all considered. This first section of chapter five is the clearest and best-illustrated introductory development of these diffraction effects that I have seen, and, as it is general in its approach, I would recommend it to all students of diffraction even though they may have no interest in feldspars.

*Feldspar Minerals* is subjectively written, both in style and in the interpretation of the material. Those who know the author personally will hear him speak as they read his words. If there are conflicting theories or different ways of interpreting data, you will not be left in doubt as to which ones the author favors. This does not say that he does not give fair view to all creditable opinions, for this he does.

If you can afford the price of this book, I would highly recommend it for every mineralogist's bookshelf.

A. J. FRUEH  
University of Connecticut

THE MAJOR TERNARY STRUCTURAL FAMILIES. By Olaf Muller and Rustum Roy. Vol. 4 in the series Crystal Chemistry of Non-Metallic Materials. Springer-Verlag, New York, 1974. ix + 487 pages. \$29.30.

*The Major Ternary Structural Families* is the first offering, although the 4th volume, in a four-volume series of books on the crystal chemistry of non-metallic materials published by Springer-Verlag. As series editor and co-author of three of the volumes, Rustum Roy has expertly overseen the compilation of a large body of valuable structural information on all classes of inorganic, non-metallic compounds. The primary aim of the series is to present to the practicing materials researcher as well as to the graduate student in materials science, ceramics, geochemistry, *etc.*, "a comprehensive overview of the details of the crystal structure (including distortions, order-disorder, super-structure, *etc.*) of the [major structure] families involved, the compositions accepted into a particular structure (including limits of crystalline solution), the influence of pressure and temperature on the structure and the phase transitions involved, and lastly, the relation of important or useful physical properties to the structure-composition character."

Volume 4 of this series is specifically addressed to compounds with  $A_2BX_4$ ,  $ABX_4$  and  $ABX_3$  stoichiometries, with brief mention of the stoichiometries  $ABX_2$ ,  $A_2B_2X_7$ ,  $A_2BX_5$ ,  $A_2BX_6$ , and  $A_2BX_8$ . The first half of the book is divided into five chapters. Chapter 1 is a brief guide to the concepts and terminology used throughout the book. It is essential reading before the ensuing chapters and appendices can be effectively used. Chapters 2, 3, and 4 involving the  $A_2BX_4$ ,  $ABX_4$ , and  $ABX_3$  structure families, respectively, are each divided into three sections: (1) an introductory discussion of the major structure types within that family and their importance in the geological sciences and in materials science and industry; (2) a discussion of individual structures including cell parameters; space group; and structural details such as polyhedral arrangements, important interatomic distances, order-disorder relations (where appropriate), and distortions; and (3) interrelationships among the individual structures discussed in section (2) involving the effects of temperature, pressure, and composition changes. Chapter 5 concludes with a brief tabulation of additional "ternary" stoichiometries. The second half of the book consists of three appendices containing tabulated structural and compositional data on numerous structure types within the three major ternary families. An extensive list of references, a formula index, and subject index complete the 487 pages.

Muller and Roy assume at the outset that the "ternary" compounds included in their compilation are best considered in the ionic approximation and that the most important parameter necessary to describe an ion is its size. Although the vast majority of these compounds are oxides, for some unknown reason they have chosen the Shannon and Prewitt radii based on  $F^{-1}$  (crystal radii) rather than the "ionic radii" based on the size of  $O^{2-}$ . Consequently, many of the radii values will appear strange to those of us more familiar with the older Goldschmidt, Pauling, and Ahrens' radii or the more recent Shannon and Prewitt ionic radii. However, the accepted size of an ion is not of major concern so

long as the set of radii values are internally consistent and allow prediction of bond lengths by additivity.

Muller and Roy use these crystal radii values to resurrect Goldschmidt-type "structure field maps" which illustrate fields of "stability" for a given structure type in terms of the ionic sizes of the two major cations present. In addition, these diagrams contain useful information on polymorphic transformation as a function of temperature and pressure. A total of 19 such diagrams (3 for  $A_2BX_4$ , 8 for  $ABX_4$ , and 8 for  $ABX_3$  structure families) have been used to illustrate the interrelationships between and among the important structure types of the three major ternary structure families.

One of the most appealing and innovative features of this book is the introduction of a very useful type of coordination formula which contains information on (1) cation and anion coordination numbers, (2) crystallographically non-equivalent atoms, (3) site symmetries of the non-equivalent atoms, and (4) types of cations coordinating anions and their relative distances from the anions. Such formulae should be especially useful and time-saving to the spectroscopist concerned with the point symmetry of a particular cation in a "ternary" crystal structure or as a pedagogical aid to the student of "ternary" structure types.

Out of the approximate total of 275 structure types that are discussed, only the spinel, perovskite, and  $CaCO_3$  structure types are given detailed attention. The mineralogist will be disappointed by the terse treatment accorded the olivine and pyroxene structure types. Other mineral structures discussed in similar brevity are zircon, anhydrite, scheelite, monazite, barite, fluorite, rutile, wolframite, the  $SiO_2$  polymorphs, phenacite, hausmannite, wurtzite, sphalerite, corundum, and ilmenite. According to the authors the silicate structure types will be covered in more detail in another volume of this series.

The most disappointing feature of the book is the inadequate number of structure illustrations. The 26 drawings that are included have been taken from the literature, for the most part, and, therefore, are not uniform in style, symbolism, or utility. A bit more effort in this area would have improved the book considerably.

*The Major Ternary Structural Families* is primarily a reference book. As such it succeeds in assembling in compact fashion a large body of data on structure and compositional variations among ternary compounds, including pertinent literature references through the year 1971. It was not intended to be and is not a mineralogy or crystal chemistry text. This volume and the series as a whole are a welcome and long overdue contribution to the crystal chemical literature. Springer-Verlag have done their usual excellent job of type setting and figure reproduction on quality paper and also, as usual, have set the price at a level (\$29.30) that will preclude many individual purchases.

GORDON E. BROWN  
Stanford University

**METEORITES: CLASSIFICATION AND PROPERTIES.** By John T. Wasson. Volume 10, Minerals and Rocks. Springer-Verlag, New York, 1974. x + 316 pages, 70 figures. \$31.20.

As is true for virtually every phase of the earth and planetary sciences, the study of meteorites has been characterized by a remarkable explosion of information and ideas over the past 12 years. Perhaps uniquely, however, not one high-quality introduc-

tory textbook on meteoritics has appeared during this span. The avowed purposes of this book are both to fill this vacuum and also to provide a new and better scheme of meteorite classification. The result is, on balance, a good book but one which is much too short to do justice to either purpose. A brief introductory chapter on the solar system, and the role meteorites play in understanding it, is followed by a 28 page chapter on classification. All the other properties of meteorites and the possible processes they may represent—major, minor, and trace element chemistry, mineralogy, petrology, cooling rates, metamorphism, shock and brecciation, stable and radio isotopes, particle tracks, formation ages, formation intervals, space erosion and exposure ages, cosmogenic nuclides, terrestrial ages, orbits, fall and recovery, organic constituents, densities, porosities, mechanical, thermal, electrical and optical properties—are covered in 140 pages. A final (example) chapter is a synthesis of the pertinent data in an attempt to solve a specific problem: the origin of the ordinary chondrites.

The only fundamental change in meteorite classification proposed by Wasson concerns the iron meteorites. These are entirely reclassified into 16 groups based on "structure and concentrations of the elements Ni, Ga, Ge, and Ir". It is Wasson's contention that prior classifications based solely on structure (specifically the width of kamacite lamellae) or Ni content are invalid because these single parameters are incapable of genetically grouping the iron meteorites. But, in the space he allots himself, Wasson fails to demonstrate: (1) that he is actually utilizing structure and Ir content in his groupings; (2) that his other parameters really do produce discrete groups; or (3) that his classification is clearly genetic.

Similarly the various chapters on properties and processes almost all suffer from their brevity. Some concepts used are not fully explained. Some complexities and ambiguities are not fully discussed. And conclusions are often neither defended nor defensible (in terms of the discussions presented). These shortcomings are at least partially offset by the author's impressive breadth of coverage and his use of over 800 different reference citations throughout the text for those who insist on amplification. In fact, as a convenient and reasonably comprehensive guide to the literature on meteorite research, this book has no equal.

The final section of the book contains appendices of computer printouts listing all well-classified meteorites according to group, with alphabetical cross-referencing. For each meteorite the most important chemical data bearing on classification are given, together with references to the pertinent papers on chemistry and classification.

In summary, advanced students and newcomers to research in meteoritics will be delighted with the appendices and the extensive reference citations, but they will probably retain serious reservations about the author's proposed classification scheme. Students looking for an introductory text will not be so delighted but, as the saying goes, "it's the only game in town"—and not such a bad game at that.

R. F. FUDALI  
The Smithsonian Institution

**EL CAOLIN EN ESPAÑA—CARACTERÍSTICAS, IDENTIFICACIÓN Y ENSAYOS CERÁMICOS.** By E. Galan Huertos and J. Espinosa de los Monteros. La Sociedad Española de Cerámica y Vidrio, Arganda del Rey, Madrid, Spain, 1974. xix + 230 pages (in Spanish).

This small and attractive volume provides an elementary introduction to the science and technology of kaolin clays. The subject matter falls into three main parts. The first part describes the structure and chemistry of the kaolinite group minerals, the usual methods of clay mineral analysis (X-ray, DTA, TGA, electron microscopy) and the results obtained for the various minerals of the kaolinite group. The second part discusses the formation and evaluation of kaolin deposits, and the occurrence and size of the kaolin deposits of Spain. The third part deals with ceramic applications and describes the standard tests for ceramic kaolins proposed by the Grupo de Trabajo de los Caolines Españoles (G.T.C.E.), which fall into four main types: granulometric, mineralogical, chemical, and technological. The last group of tests covers deflocculation, slip casting, mechanical resistance, water absorption, shrinkage, and color.

G. W. BRINDLEY  
*Pennsylvania State University*

THE STRUCTURAL CHEMISTRY OF PHOSPHORUS. By D. E. C. Corbridge. Elsevier Scientific Publishing Company, Amsterdam, 1974. xiii + 542 pages. Dfl. 250.00; \$96.20.

The present work reviews structural studies of phosphorus containing systems to about mid 1972 and, although primarily based upon the results of single crystal studies by diffraction methods, spectroscopic and paper chromatographic results are also reviewed. This work follows the theme presented in Corbridge's "The Structural Chemistry of Phosphorus Compounds" in Vol. 3 of *Topics in Phosphorus Chemistry*, Interscience. This new review has been reorganized with the number of pages extended from 306 to 424 and the number of references increased from 1330 to 2649. The major increase in material has been in metal-phosphorus coordination complexes and phosphorus-containing organic systems. The line cuts and drawings are particularly well done. A number of tables with average bond lengths and angles present data for easy assimilation.

It should be embarrassing to those who research in the field that in some areas of inorganic phosphates the progress between the two reviews has been at best modest. The author has perhaps been too loyal to the original authors in presenting their unrefined results and rationale for these in terms of covalent and/or ionic bonding. Those experienced in phosphate structural work will be able to ascertain which structures are worth redoing, but the novice could be misled.

Although exhaustive reference sources of this type are valuable as the first step in ascertaining the thrust of the development in a field, they also rapidly become dated. Current empirical and semi-empirical studies, unfortunately too recent for careful consideration in this present work, indicate that there is considerable internal consistency in the local bonding geometry. Future reviews should not try to be as comprehensive but should concentrate on the degree of consistency, bond to bond, from one structure to another.

Lastly, the text, tables, and bibliography contain a number of obvious errors that should not have survived careful proofreading.

C. CALVO  
*McMaster University*

ROCKS AND MINERALS. By Joel E. Arem. Bantam Books, New York. 159 pages. \$1.45.

This introduction to minerals and rocks, though brief and in a popular vein, is thoroughly competent and reads well. Topics in-

roduced in the early part of the book include the structure of the atom, bonding, crystal structure, physical properties of minerals, and symmetry. The central portion is devoted to mineral and gem descriptions. Rocks, both lunar and terrestrial, are treated in the last portion. A table of mineral properties and an index are included but a list of suggested references, regrettably, is not. The high point of the book is the quality of the photographic illustrations. They are particularly effective in the rendering of luster and texture. Although individual photographs occasionally suffer from the lack of scale or poor reproduction, the selection is one of high quality and eye-appeal.

This book has much to offer at a remarkably low cost.

CARL A. FRANCIS  
*Virginia Polytechnic Institute  
and State University*

USE OF LOCAL MINERALS IN THE TREATMENT OF RADIOACTIVE WASTE. Technical Report Series No. 136, International Atomic Energy Agency, Vienna, 1972. 113 pages. \$4.00.

This book is the outcome of a 1969 meeting of the International Atomic Energy Agency on "The Use of Local Minerals in the Treatment of Radioactive Waste." It contains much practical information for developing countries using locally available minerals to manage radioactive waste safely. The book may also be of value to industrialized countries facing the increasing demands of nuclear power plants in order to meet energy requirements.

The first chapter (pages 3 to 30) summarizes many potential minerals of use in waste treatment, and major mechanisms of the reaction between radioactive components and minerals. This part compiles much data valuable for beginner and expert alike. Chapters 3 and 4 deal with field sampling and laboratory preparation of minerals used for radioactive waste. Chapters 5 and 6 describe several installations in various countries which use clay minerals on a large scale to adsorb and immobilize radio elements from the waste. Chapter 7 evaluates the technique economically on the basis of the total operating and capital costs. Reading this book is a stimulating experience.

This is also a broad-brush review of some aspects of applied mineralogy. A mineralogist, particularly a clay mineralogist seeking the practical application of minerals in waste treatment, would find it an excellent reference. It is inexpensive and should be in all geologic, environmental, and nuclear engineering libraries.

WEN H. HUANG  
*University of South Florida*

GUIDA MINERALOGICA D'ITALIA. By Vincenzo de Michele, with the collaboration of Matteo Boscardin and Giuseppe Scaini, photographs by Carlo Bevilacqua. Novara, Italy: Istituto Geografico De Agostini S. p. A., 1974. 2 volumes, 216 and 192 pages, several hundred colored photographs and maps. Plastic-coated cloth. L.24,000 (ca \$37.00).

In every way a delightful pair of matched volumes giving a pictorial guide to many dozens of Italian mineral localities accompanied by succinct statements of local geology, petrology, type of occurrence, mineralogy, and the special minerals for which each deposit is famed. It is not necessary to know one word of Italian to appreciate visually the worth of these volumes, but fortunately words of science tend to derive from the same roots so that it is possible to learn much from the text even if one does not command a Romance language.

Volume one displays a wire silver on the dustjacket, volume two a quartz crystal group. The endpapers are a tinted reproduction of an engraving from Strange's 1778 work on the volcanic phenomena in Veneto, showing a famous exposure of basaltic columns near Vestenanuova, Verona. Inside, the volumes are equally attractive, using glossy paper throughout to allow sharpest reproduction of the color illustrations and modern typography for easy reading. The author is both logical and direct. After a brief review of the major contributions to the mineralogy of Italy, and a table of map symbols, the localities are taken in regional groups, beginning in the Alps and working south to Zovon near Padua in Volume one, and in Volume two, to Calabria in the "toe" of Italy, thence across the Strait of Messina to Sicily, and finally to the Island of Sardinia. Elba is treated under Tuscany. As is logical and/or convenient, one or more localities may be treated together, especially if sharing a common genetical relationship in the deposits. Brief remarks are made on why the locality is worthy of notice, where it is, and how one gets there, the last being made plain by an accompanying colored map showing contours, hydrography, glaciers, volcanoes, *etc.*, plus roads and cultural features. Extensive areas of mineralization are shown in stippled patches while opencuts, quarries, and underground workings are indicated by appropriate symbols. The main text remarks are directed toward local geology to explain the setting of the deposit, followed by remarks on the deposit itself and the minerals found therein, with emphasis on those of special interest, and with sizes of crystals given. The photographs of specimens, taken largely from examples in the collections of the Museo Civico di Storia Naturale in Milan, should prove most helpful to collectors who wish to more accurately localize specimens in their own collections that merely bear a regional designation. An especially attractive feature of this work is the use of photographs depicting collecting grounds, typical terrain, mine workings, views of quarries, *etc.*, many of which are quite beautiful. At the close of Volume two are a bibliography (general and regional), an index of localities, and an index of mineral species and varieties.

The authors are to be congratulated on producing not only the first important modern topographical mineralogy of Italy but also one that is handsome, factual, and above all, useful.

JOHN SINKANKAS

A GUIDE TO MINERAL COLLECTING AT FRANKLIN AND STERLING HILL, NEW JERSEY, WITH NOTES AS TO THE HISTORY, GEOLOGY, AND FLUORESCENCE. By Ervan F. Kushner. 1974. (Ervan F. Kushner Books, 5 Colt Street, Paterson, New Jersey 07505) 91 pages, foldout map. \$4.50.

Few localities have kindled so much interest among mineral collectors as the Franklin-Sterling Hill district of northern New Jersey. This latest contribution to the mineralogy of the area is a popularized, interesting, and informative book which is liberally illustrated with historical and mineralogic photographs. The text is well written and is sound scientifically, even though it lacks documentation of several points.

The book is subdivided into five principal sections: (1) a retrospective summary of the events at Franklin and Sterling Hill, (2) the rock formations at Franklin and Sterling Hill, (3) theories relating to the origin of the ore bodies at Franklin and Sterling Hill, (4) the minerals at Franklin and Sterling Hill, (5) fluorescence of Franklin and Sterling Hill minerals.

Part (4) represents the bulk of the text (62 of the 91 pages) and contains information on more than 250 mineral species (composition, morphology, cleavage, color, *etc.* with mineral associations and remarks on the names, occurrence, and nature of specimens). This guide is clearly a labor of love by one whose avocation for many years has been Franklin-Sterling Hill mineralogy. The text is well edited but does contain a few errors (calcite and apophyllite are included among cubic minerals on p 79 and manganhedenbergite is listed as  $\text{Ca}(\text{Mg})(\text{SiO}_3)_2$  on p. 37).

This book is a must for the amateur Franklin-Sterling Hill aficionado but even the professional mineralogist will find it interesting and educational (for example—learn what is not an eleemosynary institution—p. 13).

JAMES R. CRAIG  
Virginia Polytechnic Institute  
and State University

### List of Books Received

GEOHERMAL ENERGY. By Edward R. Berman. Energy Technology Review No. 4. Noyes Data Corporation, Mill Road at Grand Avenue, Park Ridge, New Jersey 07656. 1975. xi + 336 pages. \$24.00.

GEMSTONE AND MINERAL DATA BOOK. A Compilation of Data, Recipes, Formulas, and Instructions for the Mineralogist, Gemologist, Lapidary, Jeweller, Craftsman, and Collector. By John Sinkankas. Collier Books, Macmillan Publishing Co., Inc., New York, 1974. v + 346 pages. \$4.95, paperback (first published, hardback, 1972, by Winchester Press).

HANDBOOK OF GEOCHEMISTRY. Volume II/3. Executive Editor, K. H. Wedepohl. Springer-Verlag, New York, 1972. \$81.80.