American Mineralogist, Volume 59, pages 634–639, 1974

BOOK REVIEWS

PROCEEDINGS OF THE THIRD LUNAR SCIENCE CONFERENCE. VOLUME 1. MINERALOGY AND PETROLOGY. Edited by Elbert A. King, Jr. *Geochimica et Cosmochimica Acta, Supplement* **3**, The MIT Press, Cambridge, Massachusetts, 1972. pages 1–1132, i–xxii, indexes. $32.00 per volume, $90.00 per set of three volumes.

The proliferation of journals in the geosciences and the wide dispersion of papers throughout these journals is making it increasingly more difficult for the specialist to keep in close contact with current events. It is a credit to NASA therefore and to the Lunar Science Institute that the policy of an annual publication that covers the up to date progress in the Lunar Sample Analysis Program is being continued. Data presented in these volumes represent well over 90 percent of the total number of papers published each year on the mineralogy and petrology of returned lunar samples. These volumes are at present, and will inevitably remain, the chief centralized reference source for the exo-petrologist, mineralogist, and meteoriticist concerned with lunar petrogenesis or with the search for terrestrial analogs.

The current volume contains 74 papers that cover the results gathered on samples up to and including Apollo 15. The introductory section of 100 pages deals with the geology of the Apollo 14 and the Apollo 15 landing sites. Papers dealing with the latter site are of particular interest because of the structurally sinuous Hadley Rille at the base of the 3,500 meter high Appenine mountains, and because of the associated lineaments that are present at the southeast boundary of the enormous multiringed Imbrium Basin. Papers on the geological setting are followed by lunar orbital photogeologic interpretations that include the observations of astronauts Roosa and Worden.

The remaining 1000 pages are a mineralogist's and petrologist's delight insofar as there is something for everyone. There are six contributions by the giants of the experimental fraternity, and these deal with both high P and T, and with low and variable fO_2 phase equilibria studies. These concerted efforts, although directed specifically towards an understanding of lunar petrogenesis, hold a wealth of information for the earth-bound petrologist. Papers on the electron petrography of Apollo 14 and Apollo 15 samples, melt inclusion studies, subsolidus vapor transport of alkalis, and U and K fractionation in pre-Imbrium crustal rocks follow.

An underlying philosophy of the Lunar Sample Analysis Program has been in the detailed characterization, not only of the wide variety of petrological rock types collected but also of detailed analysis of individual mineral phases. In the 21 contributions that follow, there are 3 papers that discuss the petrology of crystalline rocks; the remaining papers are devoted to three mineral groups: opaque minerals, pyroxenes, and feldspars. Within each of these mineral groups important new information is reported: for the opaque minerals there is evidence of subsolidus reduction of spinels, and of a new Fe-Ti-Zr oxide; for the pyroxenes the relationship of ordering to exsolution and to domain structure, and of the utilization of pyroxenes as recorders of lunar basalt petrogenesis; and for the feldspars, the report of Ba-K celsian-orthoclase, and the report of Fe^{3+} in plagioclase determined by Mössbauer spectroscopy.

A unique characteristic of the lunar regolith is in the abundance of glass shards, and of the much publicized glass beads. Analyses of these glass particles provide source information of the petrological rock types present at the lunar landing site, information of rock types foreign to sample site, and characterization of probable rock types not yet identified within the crystalline collection of returned samples. A large proportion of these glasses result by shock-induced melting. Low intensity shock phenomena, on the other hand, lead to both fragmentation of crystalline rocks and to variable degrees of shock metamorphic lithification. Metamorphic classifications of these resulting breccias, the petrology of lithic fragments, and the compositions of the glasses bonding these fragments are reported. In addition, this section also includes detailed descriptions of the petrology, chemistry, and structure of chondrules of lunar origin.

In the final section of this volume particle size distribution studies, mineralogy, petrology, and chemistry are reported for the fine and ultra-fine components of the lunar soils. The meteoritic components, and studies that relate to the production of excess metallic iron, and to the formation and structure of metallic iron mounds, are also covered. Shock deformation of silicates and of experimentally shocked counterparts of lunar minerals conclude the formal contributions.

A lunar sample inventory, an author index, and a detailed subject index are provided at the end of the volume.

The efforts by the editor and his board of associate editors are to be commended, as are the publishers for the high quality of printing and photographic reproduction.

These volumes are not within the price range that will allow for purchase by those casually interested in lunar petrology and mineralogy, but they are absolutely essential to the shelves of every geoscience library.

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PROCEEDINGS OF THE THIRD LUNAR SCIENCE CONFERENCE. VOLUME 2, CHEMICAL AND ISOTOPE ANALYSES: ORGANIC CHEMISTRY. Edited by Dieter Heymann. *Geochim. Cosmochim. Acta, Suppl.* **3**, The MIT Press, Cambridge, Massachusetts, and London, England, 1972. 1022 pages. $32.00.

Dieter Heymann, with the aid of 25 associate editors, put together this collection of 75 articles by 292 workers from lab-

oratories the world over. It complements Volumes 1 and 3 of the "Proceedings of the Third Lunar Science Conference" which deal respectively with the mineralogy-petrology and physical properties of the lunar samples. Volume 2 presents an enormous quantity of lunar chemical analyses which were obtained by a wide variety of analytical methods, most of which are here published for the first time. Major, minor, and trace element analyses; stable, radiogenic, and cosmogenic isotope abundance measurements; and carbon compound determinations are the foundations from which accompanying explanations and enigmas mushroom. This book follows Volume 2 of the "Proceedings of the Apollo 11 Lunar Science Conference" (1970) and Volume 2 of the "Proceedings of the Second Lunar Science Conference" (1971) and carries us from the mare regions to the lunar uplands and highlands. The Apollo 14 mission samples dominate this work although preliminary Apollo 15 results and additional data from Apollo 11 and 12 and Luna 16 missions are also reported.

Discussions revolving about the chemistry of the clearly differentiated lunar rocks and soils primarily focus on the physical and chemical evolution of the moon with a still incomplete but disentangling time scale for lunar events being provided by the geochronologists. In addition, evidence for the presence of extra-lunar material owing to meteorite and possibly cometary influx is presented. The interactions of the solar wind and lunar surface material are discussed in some detail and provide information about the cosmic flux as well as the moon itself. The presence of very low levels (ppb. range) of nonproteinous amino acid precursors continues to lend no evidence for the existence of biogenic lunar material. No investigator in these or previous lunar studies has yet documented the presence of free water on the moon. Abundance data for volatile and refractory elements reported in this volume continue to suggest that the moon was strongly depleted in volatiles relative to the earth—at least for the outer portion of the moon that has thus far been sampled. Many of the interpretations are being, and will continue to be, modified—indeed some will probably be abandoned—as investigators continue to produce more and better lunar sample analyses. Many of the data, however, will remain indispensable for years to come, if only because many samples were destroyed during analyses and are irreplaceable.

A lunar sample cross reference, an author index, and a subject index complete this bulky tome. The lunar sample cross reference only contains information from the 1970 and 1971 proceedings publications. The 1972 (*Third Lunar Science Proceedings* volumes) sample numbers are cross referenced at the end of Volume 3 ("Physical Properties"). These lunar sample cross references are of particular usefulness to lunar investigators. Although somewhat repetitive, it would be more convenient to have one complete sample cross reference to include information from all the 1970, 1971, and 1972 proceedings volumes, and to repeat this one list at the end of each of the three 1972 proceedings volumes. Lunar researchers have, are, and will continue to find ownership of this *Proceedings* volume almost imperative, and all science libraries should have this and all the other lunar *Proceedings* volumes on their shelves. The rapid pace of lunar research continues, however. Already since the publication of this book, a multitude of lunar abstracts have been published, for example in "The Apollo 15 Lunar Samples" (1972) and "Lunar Science IV" (1973), both edited by J. W. Chamberlain and C. Watkins and reproduced by the Lunar Science Institute. In addition, numerous reports by lunar investigators have recently appeared in a variety of specialty journals, and volumes 1, 2 and 3 of the *Proceedings of the Fourth Lunar Science Conference* (dominantly Apollo 16 results) are in press at the time of this writing and are scheduled to be published in December 1973. Because of this continued profusion of lunar reports, the scientist or student with only a casual interest in lunar science may wish to save his money for a few years when, doubtless after the first wave of Apollo 17 results have been reported, books in various specialities will begin to appear and summarize what we have learned and what remains unexplained from the tremendous scientific effort behind the Apollo and Luna missions.

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PROCEEDINGS OF THE THIRD LUNAR SCIENCE CONFERENCE, VOL. 3. PHYSICAL PROPERTIES. Edited by David R. Criswell. The MIT Press, Cambridge, Massachusetts, and London, England. 1972. 1106 pages plus indexes. $32.00.

This volume contains the eighty papers accepted for publication in the *Proceedings of the Third Lunar Science Conference* which did not logically fit into volumes one or two. These include discussions of results from the Apollo 15 orbital experiments and the scientific experiment packages placed on the moon during Apollo missions 11 through 15, as well as results of a very wide range of measurements made on returned lunar samples mostly from the Apollo 14 and 15 missions. Papers were submitted for publication about a month after the conference and were limited in length to 15 printed pages. All were refereed, and they are generally carefully and clearly written. The editorial work was good and papers are arranged in as systematic a way as possible considering their diversity. The printing is of good quality and convenient author, subject, and sample indexes are provided.

A partial list of topics covered includes orbital gamma ray studies of the distribution of radioactive elements on the lunar surface, X-ray fluorescence studies of major element distribution, radon emanation studies, and analysis of laser altimetry results. Three papers are devoted to analysis of orbital and surface measurements of the lunar atmosphere and two to the interaction of gases with the surfaces of lunar fines. Three papers discuss orbital and surface magnetic field measurements, while 12 discuss the magnetic properties of returned lunar samples. Two papers discuss lunar seismic data and five the elastic properties of returned lunar samples. Papers are also devoted to thermal conductivity of lunar fines, viscosity and crystallization in melts of lunar composition, photoelectron and secondary electron emission from the lunar surface, and lunar dust motion. Six papers are devoted to cratering and microcratering, while 14 are devoted largely to studies of particle tracks and other forms of radiation damage. Two additional groups of papers discuss optical spectra and electrical properties of lunar samples.

Despite the high quality of this volume and its rapid publication, much of the work reported is already seriously out of date. Our knowledge concerning the moon is currently increasing at an almost explosive rate. The *Proceedings of the Fourth Lunar Conference* are already available and the Fifth Lunar Conference will be held before this review appears. Therefore this volume is recommended largely for those who will

use it with corresponding volumes from the subsequent Lunar Conference Proceedings.

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THE OXIDE HANDBOOK. Edited by G. V. Samsonov. Translated from the Russian by C. Nigel Turton and Tatiana I. Turton. Plenum Publishing Company, New York, 1973. xi + 524 pages. $39.50.

This book provides the scientist and engineer with a useful reference to the data and literature on the chemical and physcial properties of the inorganic oxides. Mr. Samsonov has compiled extensive amounts of data, largely from the Russian literature, and presents them in the form of 66 tables orgainzed into the following sections: General Data; Stoichiometry and Crystal Chemical Properties; Thermal and Thermodynamic Properties; Mechanical Properties; Electrical and Magnetic Properties; Optical Properties; Nuclear Properties; Chemical and Catalytic Properties; Refractory Properties; Applications of Oxides in Technology; and Phase Diagrams of Element-Oxygen Binary Systems.

Overall the organization is good although in several sections tables of similar properties could have been combined more efficiently. For example, in the section on mechanical properties, combining the three tables on modulus of normal elasticity, shear modulus, and Poisson's Ratio would have been convenient for the user. This section also illustrates one of the major shortcomings of the book. There is an insufficient explanation of many of the properties being tabulated. For instance, what is the modulus of normal elasticity? Is it Young's Modulus, the bulk modulus, or a term used only by the initial investigator? References are given, so presumably the question could be answered by a reading of the original work, but certainly much of the purpose of the compilation is defeated.

A few of the tables seem unnecessary, such as the table giving the molecular weights and the weight and atom percent oxygen in the oxides. On the other hand, some important data are missing. For example, there are no *P-V-T* data for the volatile oxides except for some vapor pressure data at subcritical temperatures; although ionic radii are given, the more recent data giving the radii in terms of the ionic coordination are not; elastic constants available for a number of oxides at elevated temperatures and pressures have been omitted; an index for the volume would have been useful.

Despite these shortcomings, numerous data in the volume should prove useful and convenient to many researchers. I was pleased to find sections on thermal stability characteristics, color, critical properties, chemical and catalytic properties, and refractory properties that include solid phase reactions of the oxides and their resistance to molten metals and slags. The whole section on thermal and thermodynamic properties provides a good starting point for any thermodynamic calculations in oxide-bearing systems.

Perhaps the major value of the book is that it supplies an easy entrance into the Russian literature on oxides. Over 750 references, many of them Russian, have been compiled largely from other smaller compilations on specific topics and to a lesser extent from the original references. Unfortunately because of this method of compilation the original source for a specific set of data may be difficult to find; therefore, evaluating the quality of the data may also be difficult because you don't know when and by whom the data were collected.

Because of its price and its deficiencies, the book will not find its way into the collections of many students or professionals. It contains valuable data and will be used frequently in most scientific communities, but it should most probably reside on the library reference shelf.

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BOOK OF MINERALS. By Albertus Magnus. Translated by Dorothy Wyckoff. Clarendon Press, Oxford, 1967. xlii + 309 pages. £4.20, $14.25.

Many readers will recall hearing of Albertus Magnus (*circa* 1200 to 1280 A.D.) in their study of the history of the Middle Ages. Some will be familiar with the translation of the spiritual classic "Of cleaving to God" attributed to him; far fewer will know of his contributions to science. In recent years his scholarly works have been rediscovered. Amongst the many translations and commentaries, the following are of interest to us: Strunz (1951–1952) published a brief account, in German, of the mineralogy of Albertus Magnus; Sister Virginia Heines (1958) published an account, in English, of his "Little book on Alchemy"; and, most recently, Sister Jean P. Tilmann (1971) has written an appraisal of his geographical works.

Professor Wyckoff has translated his "Mineralia" as the "Book of Minerals" and has produced a scholarly treatise which will fascinate and captivate the reader. This book has been known under various titles: *Mineralia*, *De mineralibus*[1], *Liber mineralium*, *Lapidarius*, *Liber de mineralibus et lapidibus*, and *De mineralibus et rebus metallicis*. Professor Wyckoff has chosen the title "Book of Minerals" as most fitting to characterize this treatise.

Albert was a principal figure in the scholastic movement which was then involved in the controversy over the teaching of Aristotle's work at the University of Paris. His commentaries on the work of Aristotle include books on plants and animals. Although Albert believed that the so-called "Lapidary of Aristotle" existed, he never found one, so he felt obliged to write one of his own and to fit it into his concept of the structure of Aristotelian thought. *Mineralia* was the result of his endeavors. This book was based to a large extent on what he had read in the works of others but also to a considerable extent on his own store of observations. As an official of the Dominican order, he traveled, principally on foot, throughout the province of Teutonia. Observations made on these travels strongly influenced the presentation of the contents and the interpretation of their significance. Professor Wyckoff gives detailed information on these matters.

[1] This is the title the book is listed under in the seventh edition of *The System of Mineralogy by James Dwight Dana and Edward Salisbury Dana* as revised by Charles Palache, Harry Berman, and Clifford Frondel, John Wiley and Sons, Inc., N. Y., 1962, vol. 1, p. 65.

The contents of this book are:

Book I. Minerals
- Tractate i. Stones in general
- ii. The accidental properties of stones

Book II. Precious stones
- Tractate i. The cause of the powers of stones
- ii. Precious stones and their powers
- iii. The sigils[2] of stones: How they are to be discussed, how many kinds there are, and what is known of them by experience.

Book III. Metals in general
- Tractate i. The substance of metals
- ii. The [accidental properties] of metals

Book IV. The metals individually
- A single tractate

Book V. Minerals that seem to be intermediate between stones and metals.
- A single tractate

To this have been added five appendices:

A: Aristotle
B: Lapidaries
C: Astrology and magic
D: Alchemy
E. Identifications of minerals and rocks

and a bibliography and index.

The scholarly work of Professor Wyckoff throughout the book is evidenced by the many footnotes, the interpretation of passages for the reader, the explanation of the meaning of words in the old literature, and the preparation of the five appendices.

The translation of this book has greatly enriched the collection of original sources available to historians of science, particularly those concerned with mineralogy, lithology, and economic geology.

References

HEINES, VIRGINIA S. C. N. (1958) *Little Book on Alchemy*, a translation of the *Libellus de Alchimia* attributed to Albertus Magnus. Berkeley, California, Univ. California Press, p. xii + 70.

MAGNUS, ALBERTUS. *De Adhaerendo Deo*. Translated by Elizabeth Stopp from a 15th century Latin manuscript attributed to St. Albert the Great. London, A. R. Mowbray and Co., Ltd., new ed., 1954, 52 p.

STRUNZ, HUGO (1951–1952) Die Mineralogie bei Albertus Magnus. *Acta Albertina, Regensburger Naturwissenschaften*, **20**, no. 1, 19–39.

TILMANN, JEAN PAUL O. P. (1971) An appraisal of the geographical works of Albertus Magnus and his contributions to geographical thought. *Mich. Univ., Geogr. Pub. No.* **4**, p. xi + 190.

WYCKOFF, DOROTHY (1958) Albertus Magnus on ore deposits. *Isis*, **49**, pt. 2, no. 156, 109–122.

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[2] Seals

MODELS IN STRUCTURAL INORGANIC CHEMISTRY. By A. F. Wells. Oxford University Press, New York, 1970. xi + 186 pages. $8.00 cloth; $4.00 paper.

Intended as a practical supplement to his *Structural Inorganic Chemistry*, Professor Wells' *Models* is far more than the how-to-do-it student manual modestly presented in the Introduction, being in fact a thorough topological-geometric introduction to structure. Structural inorganic chemistry is an architectural subject in Dr. Wells' books and papers, and the models he is concerned with are tangible constructions which he believes necessary for the understanding of inorganic chemistry—an approach with which this mineralogist is entirely in sympathy. The manual is designed for the university, but the author suggests that the models may be profitably constructed by beginners in the schools. Perhaps. For college geological programs, this material is at the junior-senior to first year graduate level.

After a survey of general principles, there is a systematic development of structure models presented as a series of assignments from the first problem (using rods of equal length, to find the simplest arrangements of points in which each point is joined to three others) to the sixth "Miscellaneous" structure involving columns of face-sharing tri-capped trigonal prisms.

The models are of "polyhedra, repeating patterns (2D and 3D nets), sphere packings, tetrahedral structures, and octahedral structures" and they are constructed from balls and spokes, spheres scaled to packing dimensions, and coordination polyhedra. However, this is not a manual of instructions about glue or drills or hacksaws, but rather about angles, connectedness, patterns, and forms. A final section of additional notes is an explanation of each of the problem-assignments intended for consultation after their completion—an answer section. Appendices on polyhedra, plane nets, three dimensional nets, and symmetry provide, in skeletal form, the mathematical and conceptual prerequisites for an independent working through of the book.

Teachers of mineralogy, research workers in structural crystallography, and amateurs of crystals, but especially students struggling to develop the capacity for three-dimensional intuition, will long stand in Professor Wells' debt for this admirable little volume.

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THE GROWTH OF CRYSTALS FROM LIQUIDS. By J. C. Brice. Volume XII, *Selected Topics in Solid State Physics*. Editor, E. P. Wohlfarth. North-Holland/American Elsevier, Amsterdam, London and New York, 1973. xiii + 379 pages.

With the recent advances in modern solid state technology, crystal growth of useful materials has become an attractive field for scientists. Synthetic crystals of quartz, ruby, and garnet have been grown up to one inch in size, and their crystal quality is far superior to that one can obtain in any naturally occurring mineral. At the same time, the demand for such crystals to serve as research materials in geology has been increasing. Indeed, it is becoming almost essential to produce crystals of

the synthetic counterparts in order to attain a meaningful understanding of the various mineralogical properties.

If a beginner at growing crystals of geologically important minerals is associated with a crystal growing laboratory, he can obtain valuable advice from experienced people. However, if he has to start from scratch, it will be very difficult since much of the previously published information is scattered through the literature of inorganic chemistry, solid state physics, ceramic engineering, and electronics.

We therefore welcome this condensed book by J. C. Brice which covers the whole area of topics pertinent to this field.

In the author's words, this book is divided into chapters covering the basic concepts, the growth theories, and the techniques involved. Those who are primarily interested in growth theory may benefit from the first half of the book. It well summarizes, for readers with a background in advanced physical chemistry, the considerable efforts that have been made during the past decades toward understanding the mechanisms of crystal growth. I would like to add, however, that the average mineralogist may find some of the mathematical treatment in these chapters beyond his limit of comprehension.

In the last half of the book, the currently existing techniques for crystal growth from liquids are described. The chapter on solution growth at high temperatures (over 800°C) may be of particular interest to mineralogists. It is often easy to grow small euhedral crystals for research purposes using this method, and a large number of naturally occurring minerals are stable only at subsolidus temperatures.

The figures illustrating the basic schemes of the procedures are precisely and artistically drawn. Tables containing basic information such as selection of insulating materials, heating elements, thermocouples, and solvents useful for both low and high temperatures are particularly helpful for the beginners in the field. In addition, the compilation of approximately one thousand references is particularly useful.

Since this book is written as a selected topic in solid state physics, most examples are naturally taken from the established procedures for the growth of materials useful for solid state applications, such as metals, GaAs, niobates, and oxides. Zircon and beryl are the only silicates mentioned. The reviewer believes that more data for the silicate crystals are available elsewhere. Therefore, for all those earth scientists who are presently engaged in the study of the complex properties of silicates, and thus wish to grow such crystals, this book is not necessarily a good source of immediate information.

However, it will still be a valuable shelf item for experimental mineralogists in general, since the basic principles and techniques are the same regardless of the varieties of the compounds.

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THE GRAPHICS OF CRYSTALS (GRAFIKA KRISTALLOV). By A. G. Bulakh. Publishing House Nedra, Moscow, 1971. 112 pages. (In Russian).

As stated in the editor's foreword, this booklet fills a gap in Russian crystallographic literature. Most existing manuals of morphological crystallography are sold out and partly outdated (as in North America), and Bulakh's book updates the science and art of measuring and portraying crystals in a very efficient way. The need for a modern manual of morphological crystallography is obvious—this branch of crystallography is far from being obsolete, as many geologists, and even some crystallographers, tend to believe. New minerals and new chemical compounds, new crystal forms and combinations, genetic aspects of mineral morphology, and many other miscellaneous topics will always be interesting and important subjects of crystal morphological studies.

The contents of the book are best demonstrated by the headings of its seven chapters: elements of crystallography, types of goniometers, measuring crystals on a goniometer, processing of the results of crystal measurements, methods of crystal calculations, drawing of crystals, and rotation and changes in orientation of crystals.

The first chapter covers the coordinate systems and orientation rules of the different symmetries, spherical coordinates, and crystal projections. Understandably, no general crystallographic background is presented; it would be over-simplified when short enough, and generally superfluous in this kind of manual. The other chapters lead the reader systematically through the whole process of morphological examination of crystals, showing different methods and approaches to the individual tasks as they are met in the course of work. All steps are well illustrated on examples of actual calculations or drawings of different mineral species, and with many diagrams of instrumental settings. This makes the manual very useful even to students not initiated to the study of crystal morphology in regular courses.

The few critical comments we have coincide, partly, with the editorial criticism as given in the foreword. The identity of morphological and structural settings of crystals is not such a must as asked for by the author; in some situations it is impossible, and in others undesirable. The changes in crystal orientation and consequent symbol transformations could have been treated in more detail. However, we do not find anything wrong with giving preference to the drawing of crystals from gnomonic projections. The most controversial part of the booklet is the three-page treatment of determining the orientation of *anhedral* crystals, which deals, *i.a.*, with large *subhedral* crystals, and small *euhedral* but skewed crystals (Table 21). The editor considers the treatment inadequate; we think it does not belong in this manual at all, since it falls mainly into the realm of X-ray crystallography.

A pleasant surprise, for a Soviet publication, is the negligible number of misprints. The list of references gives a fair sampling of Russian morphological literature of the fifties and sixties, with only a dozen western-language quotations.

All the preceding comments should not detract from the overall competent and easy-to-follow treatment of the subject in the booklet as a whole. An English translation would be handy, but the extent of market for it is, regrettably, questionable.

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MINERAIS DO BRASIL—MINERALS OF BRAZIL. By Rui Ribeiro Franco, Alsedo Leprevost, João José Bigarella, and Aurélio Bolsanello. 1972. 3 hardbound volumes, 21 × 28 cm, xxxvii + 426 pages, with 869 color plates. (bilingual) University of São Paulo Press, in cooperation with Editora Edgard Blücher Ltda., Caixa Postal 5450, Rua Peixoto Gomide, 1400, São Paulo, Brazil. Price, including air express to any destination, $50.00.

The color plates are the principal feature of this work. The brief bilingual introduction has a section on useful minerals, which includes a discussion of Brazil's position with respect to various mineral commodities. Then the principal physical properties of minerals, including optical properties, are described, with examples. Neither this part of the compilation nor the introductory material for each chapter is intended to be a comprehensive or systematic treatment of mineralogy or minerals.

The minerals themselves are covered in 10 chapters arranged more or less in accordance with most textbooks of mineralogy, beginning with the elements in Chapter 1 and ending with organic compounds in Chapter 10. The plates of each chapter are preceded by a very brief discussion (1/4 to 1 page) of the minerals illustrated in that chapter.

The publisher had had such a work in mind for many years and with the aid of the authors mentioned above has been able to accomplish it. Rui Ribeiro Franco is the dean of Brazilian mineralogists and academic gemologists. He has taught gemology and mineralogy at the University of São Paulo for many years and has edited the journal *Gemologia* for a comparable length of time.

He and his distinguished colleagues from Paraná are eminently qualified to make a comprehensive and representative selection of the minerals of Brazil. The 869 plates printed in the three volumes were selected from some 5000 color pictures available to them. The samples photographed are mostly in four outstanding university and government museums, but a few unusual specimens are in private collections. Some of the species are unique to Brazil.

The authors and publishers have outdone themselves; I know of no treatise published anywhere half so lavishly illustrated with color plates of minerals. Many of the plates have a high quality consonant with the idea of the work and the painstaking selection of minerals and localities to be represented in it; for example, the beautiful agates of Plates VII-71 to 74; the green tourmaline crystal, IX-81; natrolite, IX-319; sodalite, IX-273; crystalline rose quartz, VII-27; and many others.

Unfortunately, the same cannot be said of many of the other plates. A part of the difficulty is due to reflection and/or transmission of color from the background, which gives a color to the photograph quite different from the intrinsic color af the specimen. For example, the faces of the galena crystal of Plate II-18 have a blue-green nonmetallic sheen quite different from the metallic gray characteristic of galena. Plates VIII-9 and 10 of clear (colorless) quartz have taken on a permeating sky blue and azure blue color, respectively, because of their backgrounds.

Vagaries of illumination appear to be responsible for other inaccuracies of color in the prints. For example, the "blue" topaz of Plate IX-25 was photographed on a black background but the print has a color very like that of kunzite. The lower left half of the specimen of Plate IV-35 reminds one of carnotite impregnating sandstone, whereas the other half vaguely resembles chrysocolla or disseminated azurite in the same material. Neither part really suggests the "iridescent hematite" of the title.

Some of the plates, such as IV-3 appear to be decidedly out of focus.

Ordinarily new editions or revised reprintings of works of this nature are not undertaken. If one should be called for in this case many of the specimens should be rephotographed, preferably by a professional photographer with extensive experience in taking color pictures of minerals and rocks, which is a truly difficult job at best.

On the whole, however, this compilation is a valuable reference work for the mineral species and mineral localities of Brazil. With the increasing entry of Brazilian minerals into world markets, any individual or organization interested in them as cabinet specimens or gem minerals would do well to have a copy of this most comprehensive treatise for information on Brazilian localities, and for comparison of minerals among these localities as well as with minerals from those from other countries.

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LIST OF BOOKS RECEIVED

DIVING AND DIGGING FOR GOLD. By Mary Hill. 2nd ed. Naturegraph Publishers, Inc., Healdsburg, California 95448, 1974. 47 pages. $1.50.

THE DYNAMIC EARTH: TEXTBOOK IN GEOSCIENCES. By Peter J. Wyllie. John Wiley and Sons, Inc., New York, 1971. 416 pages. $17.50.

GLOSSARY OF MINING GEOLOGY. By G. C. Amstutz. Elsevier Publishing Company, Inc., Amsterdam, 1971. 196 pages. $15.50. In English, Spanish, French, German.

HYDROTHERMAL SYNTHESIS OF CRYSTALS. Edited by A. N. Lobachev. Translated by Albin Tybulewicz. Consultants Bureau, New York, 1971. 153 pages. $20.00.

INTRODUCTION TO EXPLORATION GEOCHEMISTRY. By A. A. Levinson. 1974. Applied Publishing, Ltd., Box 5546, Postal Station A, Calgary, Alberta, Canada T2H 1X9. xiv + 612 pages, 198 figures, 36 tables. $25.00; students, $16.00.

JOURNAL OF CRYSTAL AND MOLECULAR STRUCTURE. Vol. 3, No. 1. Plenum Press, London and New York, 1973. Annual subscription (6 issues) $30.00 plus $2.00 postage).

THE NATURE OF THE STRATIGRAPHICAL RECORD. By Derek V. Ager. Halstead Press, New York, 1973. xvi + 114 pages. $9.50.