

BOOK REVIEWS

SHORT CLASSIFICATION AND DESCRIPTION OF THE VARIOUS ROCKS. By A. B. Werner. Translated from German and facsimile of original text (1786) with an introduction and notes by A. M. Ospovat. Hafner Publishing Company, New York, 1971, x + 194 pp. \$13.95.

Everybody writes about Abraham Gottlob Werner (1749-1817) but hardly anyone reads him. Werner, after whom Cuvier wrote and whole societies named themselves, has passed into modern textbooks (thanks to Lyell) as a straw man whose fallacious views were finally and irrevocably refuted by Hutton and Playfair. Werner was not particularly original in emphasizing the sedimentary process (neptunism) or even in extending it to a primitive granite crust and interbedded columnar basalt. Yet he seems, more than anyone else, to have grasped the idea which we are even now barely beginning to accept—that there are lithological characterizations of the periods of earth history, and that the earth has undergone an evolutionary process of chemical (mineralogical) differentiation. Out of this historical rather than uniformitarian view came our geological time scale still bearing the stamp of Werner's hand (in our contemporary designation of the "Tertiary" for example).

The "Kurze Klassifikation" is the principle work in which Werner expressed the first of his two major ideas—on the concept of the geological time scale. His second major influence on the classification of minerals was developed in a youthful work "On the External Characters of Minerals" happily available since 1962 in an English translation by Albert Carozzi. Barely 28 pages, the "Kurze Klassifikation" was possibly the first work to generalize local descriptions of strata into a single world-wide system complete from the beginning to the present. It was a step toward rendering the system of Buffon into a practical method. Its timing is of some importance. In 1774 at the age of 25 Werner returned to the Bergakademie Freiberg to find the vulcanist position in full command. Desmarest's classic work establishing the volcanic origin of the basalts of the Auvergne had been written in the 60's. In 1786 Werner published the "Kurze Klassifikation." Hutton published in 1788. Historical geology took form through the first, physical geology through the second.

Alexander Ospovat is a historian of science who has spent many years studying Werner manuscripts and published works here and at Freiberg. His translation abundantly reflects his employment of three separate original printings as well as the Werner manuscript materials. His introduction and extensive notes are invaluable in correcting the Werner stereotype. For example, Werner never rigidly defined the sequence within the Floetz, and never thought that each species of Floetz rock was a simultaneous world wide deposit. These were excesses partly added by his followers but mostly attributed to him by his opponents. Two appendices, one a glossary of Werner's petrological terminology, the other of his geographical terminology, and a thorough bibliography, complete the work. This book should be regarded as a first edition in English of a crucial volume as well as a historical source and even a collector's item.

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COLOR UNDER GROUND: THE MINERAL PICTURE BOOK. Photographs by Lee Boltin. Text by John S. White, Jr. Charles Scribner's Sons, New York, 1971. 62 pages, 49 color photographs, \$6.95.

Minerals are very photogenic and it is not surprising that several mineral books have recently been published which exhibit the skills of photographers. One of the artists who has been highly successful in capturing the beauty of minerals is a free-lance photographer by the name of Lee Boltin. He has collaborated with John S. White, Jr. of the Smithsonian Institution, who wrote the text for *Color Under Ground*.

The sections of the book are devoted to Simple Crystals, Twins, Deformed Crystals, Aggregates, Inclusions and Patterns, Pseudomorphs and Replacements, and Pseudo-organic Aggregates. Accompanying each photograph is a description of the specimen and often some general comments about the mineral species. Whereas in most books, pictures are used to illustrate the text, in this "picture book" the reverse is true.

The quality of the photographs is excellent. The color is natural, the balance and composition are very good, and the sharpness and definition permit a careful study of fine detail. Lighting, which is always a problem in mineral photography, has been carefully controlled and only occasionally are any reflections seen from crystal faces.

An attempt has been made to make the text understandable to the reader without scientific training. This is always a difficult task but it has been accomplished here with a good degree of success. Among the shortcomings of the book might be mentioned the following. On the front cover, the drawing of an octahedron modified by a cube is inverted. The book might have profited from a table of contents and a short introduction stating the type of reader for which the book was designed. A note in the explanatory material on the size of the specimens would undoubtedly be appreciated by many readers. The names given to the crystal forms (p. 10, 11) are sometimes unconventional, for example in the orthorhombic and monoclinic systems "prisms and base" is used to describe two prisms, and in the triclinic system "prisms and bases" is used where only pinacoids or pedions can occur. Of less importance is the confusion of "pyramid" and "dipyramid", but accuracy should not be sacrificed in order to make things simple. For photo 33 (rutile) the statement is made, "Crystals frozen in quartz are literally what this specimen shows." It would have been better to state that the rutile is enveloped by the quartz and avoid the concept of freezing. On page 8, the writers refer to "multifaceted crystals" when they mean crystals with many faces. The authors follow the usage of many mineralogists in referring to "distorted" crystals. Probably a more accurate term would be "malformed." It is difficult to know how precise one should be in a book designed for the general reader, and, for the most part, the authors have maintained a good level of presentation.

This picture book of minerals should arouse the interest of anyone interested in fine photography, in beautiful specimens, or wishing to acquire an introductory understanding of mineralogy. For photographers, there is a real challenge to attempt to attain the skill that has been shown by Lee Boltin in his photography. And finally, for the reader who only wants to admire beautiful specimens, the book presents a collection of photos which will give many pleasant hours of viewing.

LLOYD W. STAPLES
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MINERALE (Entstehung—Vorkommen—Bestimmung—Verwertung). By Rolf Seim. Neumann Verlag, Radebeul, Germany (DDR), 1970, 443 pages, M. 14.50 (\$4.00). Obtainable from Verlag J. Neumann-Neudamm KG 3508 Melsungen/Bez.Kassel, West Germany.

The author of this small, handsome, volume with the title *Minerals*, and the subtitle *Origin—Occurrence—Identification—Uses*, is a professor at the University of Rostock, East Germany. The book consists of two main parts. The first part (177 pages) is general mineralogy with sections on crystallography, physical properties, chemical composition, and origin. Most of the rest of the book consists of 282 individual species descriptions, arranged according to properties for purposes of identification. The illustrations are lavish for such a modest volume; 16 pages of color plates showing about 100 species, over 200 other photographs, and nearly 500 drawings.

The book is evidently intended primarily for distribution in the Deutsche Demokratische Republik (East Germany), showing that there must be a substantial number of mineral collections and amateurs among the 18 million inhabitants of that country.

A. PABST

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CRYSTALLOGRAPHY AND CRYSTAL DEFECTS. By A. Kelly and G. W. Groves. Addison-Wesley Publishing Co., Inc., Reading, Massachusetts, 1970. 428 pages. \$15.00

"Crystallography" implies different things to different people: symmetry theory, diffraction physics, X-ray techniques, crystal growth and morphology, and crystal chemistry. All of these areas, of course, are encompassed when the term is used in its true and broadest sense. The range of material is so wide that all aspects of the crystalline state cannot be adequately covered in a single undergraduate course. The customary marriage of material, when more than one topic is to be treated, is probably a combination of symmetry theory with X-ray techniques. The present text presents an alternative but equally logical combination of topics; symmetry, tensor description of crystal properties, and crystal defects. Such organization is based on the premise that "many properties of imperfections are unintelligible to the undergraduate if he lacks a *thorough* understanding of the idea of a lattice and of the crystal classes"—a point of departure which this reviewer thoroughly applauds.

The book is comprised of twelve chapters, of approximately equal length, which are organized into two Parts: *Perfect Crystals* (Lattice Geometry, The Stereographic Projection and Point Groups, Crystal Structures, Tensors; 137 pp) and *Imperfect Crystals* (Stress Strain and Elasticity, Glide, Dislocations, Dislocation in Crystals, Point Defects, Twinning, Martensitic Transformations, Crystal Interfaces; 234 pp). Five Appendices contain in addition discussion of such matters as matrix and vector algebra, the reciprocal lattice, and crystal structure data.

The early chapters contain a more thorough and rigorous treatment of symmetry than that of most texts on crystal properties. Detailed treatment proceeds through discussion of the point groups. Other than definition of screw axes and glide planes, the book stops short of plunging into space groups. However, the 17 plane groups and their equivalent positions are discussed. The treatment,

while detailed, is a bit muddled in places. The reviewer, in particular, did not care for the discussion of point groups which describes rather than derives results, intersperses their description with discussion of forms and stereographic projections, and arranges the results by crystal system without any logical order of ascending or descending symmetry. The description of crystal structure encompasses the elements and a gamut of compounds which progress up to a complexity slightly more advanced (*e.g.*, corundum and calcite) than most comparable treatments. The space group is given for each structure described! The chapter on tensor formalism is lucid and well done, but is restricted to second-order tensors. Higher-order tensors are not defined and mention of fourth-order tensors never appears in connection with the considerable discussion of compliance and stiffness constants in a subsequent chapter. The remaining chapters on deformation and defects are by-and-large meaty and nicely done. They maintain good balance between discussion of metals and compounds. It is refreshing, for example, to encounter depiction of the atomic arrangement near a dislocation in sphalerite, or a twin boundary in calcite, rather than experience a discussion confined entirely to primitive cubic lattices or simple metal structures. The text is garnished by six plates, of up to three micrographs each which illustrate imperfections in real materials. It is a bit disconcerting to note that the sequence begins with Plate 6—until one realizes that the Plate numbers apparently refer to chapters within which the plates are not necessarily placed.

In assessing the merits of a new text, one is invariably led to compare it with existing treatments. The present book tackles formidable competition! Unusually superb texts exist for several of the areas with which the present volume deals—for example, Nye's treatment of tensors in *Physical Properties of Crystals* or Buerger's *Elementary Crystallography*. In such comparisons the present volume comes out second best. The price paid for breadth of coverage is invariably depth. While one cannot argue against mastery of symmetry and tensors being necessary of a full appreciation of defects, coverage of a broad range of topics paradoxically limits the extent to which each area may be developed, and precludes the bringing-to-bear of the full power of each on the others. (The same situation frequently obtains in the more traditional combination of symmetry with diffraction techniques.) Nevertheless, the present book makes a unique contribution in combining within a single volume material on symmetry, tensors, and a broad range of defects, while doing remarkable justice to each. The book should thus be especially useful as a textbook. Its utility as such is further enhanced by the inclusion of over 160 problems, nearly all of which are substantial and worthwhile exercises.

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PETROGRAPHIE DES ROCHES PLUTONIQUES DANS LEUR CADRE
GEOLOGIQUE. By E. Raguin. Masson et Cie, Paris, France, 1970. 239 p.

This work describes plutonic rocks as observed in nature. Experimental and chemical data are specifically excluded. Although no metamorphic rocks are described, the author adopted the adjective "plutonic" rather than "igneous" because descriptions of volcanic rocks are excluded, and because, in his opinion, many "igneous" rocks are partly metasomatic in origin. Raguin devotes one chapter each to granite, quartz diorite, alkaline syenite, calc-alkaline syenite and

monzonite, feldspathoidal rocks, gabbro, periodtite, and charnockite. Each chapter commences with a brief summary of the mineralogy, nomenclature, texture, and structure characteristic of the rock group, followed by descriptions, usually 1-3 pages, of a considerable number of occurrences. Simplified maps of most of the occurrences are included. The types of occurrences are divided into sub-volcanic, migmatitic, satellitic, and independent. Petrologic conclusions are drawn in some cases, but such reasoning occupies only a small part of the book. The book concludes with a brief summary of the conclusions suggested by field studies. Indices of rock terms and place names are included.

The book covers virtually all of the better known igneous complexes plus a selection of less known ones in France and French Africa. The presentation in most cases is admirably clear, although one wonders if all the information on the Skaergaard, for example, can really be meaningfully compressed into two pages of text plus two cuts. In some cases the choice of sources is rather mysterious. The Haliburton-Bancroft nepheline syenite belt is discussed on the basis of preliminary mapping more than 60 years old, although excellent detailed coverage less than 20 years old is available. Illiamausaq is labelled a "migmatitic complex" based on reconnaissance work by Wegmann, completely ignoring the older work of Ussing, and the recent work of Ferguson. Other rather blatant examples of the authors' prejudices occur. The metasomatic theory of origin of the Bushveld complex is given as much space as the magmatic differentiation theory. The classification system occasionally produces absurdities. Thus fenites are separated from feldspathoidal rocks, as are nepheline gneisses (Bancroft, Mt. Ilmen). The same criticism probably applies to any descriptive system however. For the most part the descriptions are clear and concise, the examples well chosen, and the bibliography (which is carried up to 1967) adequate, though not exhaustive.

The book points up the neglected potential of purely descriptive methods of petrology. The ideas, many of them novel or controversial, are presented in a clear challenging manner, and easily readable style. The "flavor" of the book is very similar to that of Raguin's well known book "Géologie du Granite". The decision to exclude experimental and analytical results makes the book much easier to read, but makes it difficult to tie much of the information together, or evaluate its significance. The book lacks balance, both in viewpoint and in choice of subjects. This deficiency, plus a considerable number of erroneous or dubious statements concerning particular masses make the book unsuitable for beginning students. Advanced students and practising petrologists however will find it interesting and stimulating. The French is not difficult, and even those with a fairly elementary knowledge of the language could read the book without difficulty.

K. L. CURRIE

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VOLCANIC LANDFORMS AND SURFACE FEATURES: A PHOTOGRAPHIC ATLAS AND GLOSSARY. Edited by JACK GREEN and NICHOLAS M. SHORT. Springer-Verlag New York Inc., New York, 1971. 519 pages. \$32.00

The editors of this atlas state that it is intended to serve a wide audience, ranging from the professional earth scientist to the interested layman, and to be

both a reference atlas for workers in volcanology and a teaching aid in geology at secondary school and university levels.

The atlas is in three parts, the first of which is a short chapter by Arie Poldervaart entitled "Volcanicity and forms of extrusive bodies". This chapter discusses briefly many of the processes and products of volcanism and introduces the layman to a large number of volcanological terms.

The second part, which comprises most of the atlas, consists of some 400 photographs and their captions. The plates do represent a comprehensive survey of most volcanic landforms and surface features, as is perhaps best illustrated by the list of sections into which the editors have grouped them. These are: (a) phenomenology of eruption, (b) calderas, (c) volcanoes, (d) internal structure of volcanoes, (e) craters and maars, (f) tuff and cinder cones, (g) domes and laccoliths, (h) spines, necks and diatremes, (i) dikes and sills, (j) alignments of volcanic features, (k) general characteristics of flows, (l) mudflows and lahars, (m) features of pyroclastic deposits, (n) structures on lava flow surfaces, (o) upswellings and markings on laval surfaces, (p) block, aa, and pahoehoe lava surfaces, (q) columnar jointing, (r) pillow and ovoid structures, (s) volcanic bombs and ejecta craters, (t) textural aspects of volcanic deposits, (u) erosion features in volcanic rocks, (v) interaction of volcanism and vegetation, (w) geysers and hydrothermal activities, and (x) volcanism on the moon. It was surprising to find that a substantial number of the plates had no scale information in either the photographs or their captions. Furthermore, in some cases where the scale is given in the form of a representative fraction (e.g., 1:50,000) it clearly does not apply to the photograph at the scale on which it is reproduced in the atlas. Most of the captions are clear and informative but a number could certainly have been improved by editorial expansion and clarification.

The third part of the atlas is a glossary of volcanic geology which has been abstracted from the third edition of the *Glossary of Geology and Related Sciences* (American Geological Institute, in preparation) with additional material added by the editors to improve the clarity of some definitions. The glossary is accompanied by a list of references which are invaluable in cases where one wishes to determine the context in which a particular term was defined. This is apparently the most up-to-date glossary available to volcanologists and will undoubtedly be most useful.

All in all the editors have indeed produced an atlas which will be a valuable reference book for the professional earth scientist, and will be of substantial use as a teaching aid. The reviewer would highly recommend this atlas to earth scientists working in volcanology, although its price of \$32.00 may well result in its being largely restricted to reference usage in libraries.

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VOLCANISM AND THE UPPER MANTLE: INVESTIGATIONS IN THE KURILE ISLAND ARC. By Georgii S. Gorshkov (Translation by Charles P. Thornton of the 1967 Russian edition). Plenum Press, New York and London, 1970. xv + 393 pages, 97 figures, 45 tables. \$35.00.

Charles P. Thornton is to be thanked for making this important work more accessible to his colleagues. The result of Gorshkov's 20 years of study of Kurile volcanoes, the book is the first general work on the petrochemical and geophy-

sical characteristics of a "narrow" island arc, as compared with "wide" (Japan, Indonesia) island arcs. More importantly, the book is a documentation of Gorshkov's thesis that virtually all volcanic rocks have their origin in the upper mantle and that the crust plays only a very minor role in their evolution and composition. It is of interest that the book was written before the results were available of isotopic, geochemical, and experimental studies pointing to similar conclusions.

Included are chapters or morphology of the Kurile Island arc; seismic, gravity, and magnetic studies; basement geology; glacial geology; volcanic geology; petrography and chemistry of the lavas; comparative petrochemistry of other circum-Pacific island arcs, as well as of oceanic and intracontinental volcanoes; and a final synthesis of volcanism as a reflection of mantle structure and evolution.

The chapter on volcanic geology includes brief accounts of the geology, petrography, and activity of the 160 individual volcanoes in the arc, and is illustrated with 45 sketch maps (which unfortunately do not have scales) and 25 photographs (which happily are better reproduced than in the Russian edition). The chapter on petrochemistry includes 207 analyses of Kurile lavas, which Gorshkov discusses by reference to Zavaritski variation diagrams. (For those unfamiliar with the Zavaritski method of petrochemical calculations, Thornton has given a concise summary in the translator's preface. For this reason, the book is useful as a demonstration of the Zavaritski method, which is not generally understood or appreciated by Western petrologists.)

It may be disappointing to some that Gorshkov, in this translated edition, could not have updated his concluding chapter and incorporated the content of some of his more recent papers, which draw appropriately from the results of modern experimental and isotopic studies and relate more specifically to mechanisms of the new global tectonics. Notwithstanding, the book is an important contribution to the origins of volcanism and will be of interest to all volcanologists, petrologists, and geophysicists concerned with problems of crust-mantle evolution.

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PRINCIPLES OF LITHOGENESIS: VOLUME 2. By N. M. Strakhov. (Translated by J. Paul Fitzsimmons; edited by S. L. Tomkeieff and J. E. Hemingway). Plenum Publishing Corporation, New York, New York, 1969. 609 pages. \$35.00.

Volume One of Strakhov's massive treatise on sedimentation appeared in 1967 and is concerned largely with the general effects of climatic factors on the sedimentary lithogenesis. The present volume is devoted to a detailed discussion of sedimentation under humid climatic conditions and as stated in the Preface its principal aim is to focus "on the conditions for, and mechanisms of, producing high concentrations of Al, Fe, Mn, P, CaCO₃, MgCO₃, SiO₂, C_{org}, and also on the laws governing the distribution of elements to form the geochemical background for their accumulation as ore deposits." Despite the strong geochemical character of this volume one will encounter in it hardly a single reference to ionic radii, equilibrium constants, etc., or scarcely a single chemical calculation. Notwithstanding my strong inclination toward theoretical geochemistry I do not intend the above statement to be disparaging but only to emphasize that Strakhov's approach in this matter is largely empirical. Disenchantment with Goldschmidt's

speculative scheme of sedimentary, chemical differentiation of elements based on their ionic radii, and other physiochemical properties has led Strakhov to interpret the data of sedimentary geochemistry in the wider context of climatic, topographic, tectonic, and biologic factors. The result of this endeavor is a cornucopia of ideas, admittedly not all of which are new or original, but which together form an integrated conceptual framework in which the modern sedimentary geochemist can profitably review his particular research.

The contents of the volume can be divided into three major parts. Chapters 1 and 2 are devoted to the mechanical and hydrodynamic aspects of sedimentation. Most of the attention here is given to the influence of topographic, climatic, and tectonic factors on the grain size, mineralogy, and sorting of sediments. This material will be familiar to most readers but it forms a necessary prelude to the following chapters. The factors involved in the migration and primary accumulation of sedimentary ores are discussed in chapters 3 through 7. Separate treatment is given to the triad Al, Fe, Mn and the tetrad P, CaCO_3 , MgCO_3 , SiO_2 as they are considered to be two genetically distinct groups of ores. The triad Al, Fe, Mn is described as a continental to near-shore assemblage formed under the influence of physiochemical factors which promote either mechanical sedimentation and/or direct chemical precipitation. The tetrad P, CaCO_3 , MgCO_3 , SiO_2 , on the other hand, is described as an offshore to pelagic assemblage which forms mainly under the influence of biological activities, that is, the nutrient cycle of the oceans and biological precipitation. For each group the occurrence of ore accumulations is discussed in relation to climatic factors, tectonic settings, and the evolution of the hydrosphere and biosphere. In the final three chapters (8-10) the role of diagenetic processes in ore formation is described and particular attention is devoted to the origin and paragenesis of concretions.

The data which underlie Strakhov's ideas have been distilled largely from the Russian literature. While this circumstance provides a valuable insight into Soviet endeavors in sedimentary geochemistry, it is also frustrating because most of the original citations are inaccessible to American readers and thus it is difficult to evaluate these data and the conclusions based them. My advice, therefore, is to read Strakhov for his ideas but to be wary of his conclusions.

I am afraid that most American readers will find Strakhov's treatise somewhat tedious. There are several reasons for this. Most of the examples cited in the text involve unfamiliar Russian geography and stratigraphic nomenclature. Also many of the illustrations are rather intricate and require constant referral to the legends. Finally it seems to me that many of Strakhov's ideas are repeated or restated too frequently. Despite these inconveniences I think a reading of Strakhov is well worth the time and effort.

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MASS TRANSPORT IN NON-METALLIC SOLIDS. British Ceramic Society, Proceedings Vol. 19, Published by the Society, Stoke-on-Trent, England, 1971, 283 p., £4.87.

Seventeen papers presented at a meeting of the Basic Science Section, Royal Aeronautical Society, London, December, 1969. Includes both experimental and

theoretical papers on diffusion in crystals, in particular oxides with fluorite structure. Earlier proceedings of interest to mineralogists, not previously reviewed here, include Vol. 18, 1970, on electrical and magnetic ceramics, and volume 13, 1969, on clay and other colloidal systems.

WILLIAM T. HOLSER

LANDOLT-BÖRNSTEIN: MAGNETIC AND OTHER PROPERTIES OF OXIDES AND RELATED COMPOUNDS. Part b. By D. Bonnenberg *et al.* Springer-Verlag. Berlin-Heidelberg-New York. 1970. 666 pages. \$123.60.

At first sight this book did not seem to me to be very useful to mineralogists and after reading it through, it is still obvious that large parts of it will never be used by the majority of mineralogists. But there are some mineral physicists, and their number is continually increasing, who will find this new volume of Landolt-Bornstein a very desirable, improved, and enlarged version of the older 1962 edition. About 150 pages of this were devoted to ferrites (cubic and hexagonal) and the non-iron-containing garnets. The same topics occupy over 600 pages in this volume of the new series. Not all of this increase is new data for the same compounds, but it is partly new compounds that have been synthesized and studied in the last decade.

In addition to susceptibility, saturation magnetization, and Curie point, there is a lot of information about optical spectra, paramagnetic (not very much) and ferromagnetic resonance, and Mössbauer effect. There is valuable data about phase equilibria in magnesium-iron and magnesium-manganese-iron oxides, and electrical properties of quite a few oxides.

The generic name "ferrites" refers to the mixed iron and other metal oxides crystallizing in the spinel structure. In the new series, the same section is headed "spinel" and about one-third of it now deals with new information about non-iron-containing spinels like the oxides, sulfides, and tellurides of chromium, and oxides containing less common elements like germanium, rhodium, gallium, etc. The major problem in most of the spinels is cation-distribution between non-equivalent sites, and it would be of interest to see how mineral magnetism, in association with crystallographic, optical and Mössbauer data, can provide a very detailed picture of site-occupation and local site-symmetry.

The section on non-iron-containing garnets is dominated by the properties of rare-earth garnets, where iron has been replaced by aluminum or gallium. For the average mineralogist, the value of this section lies in understanding the effects of local site symmetry on the optical and resonance properties. The section on hexagonal ferrites, however, would be of interest mostly to microwave physicists and not to mineral physicists.

Each section is preceded by a very well-written introduction. Only some basic grounding in physics will be required to appreciate the introductory remarks. The printing, of course, is impeccable and in conformity with the high publishing standards of Springer-Verlag. The volume will be a good addition to a library. The individual buyer will most certainly be deterred by the enormous price.

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LEAD ISOTOPES. By Bruce R. Doe. Springer-Verlag New York Inc., New York, N. Y., 1970. 137 pages. \$10.40.

The monograph is basically a review of the status of lead isotopes till a few years ago. However, the quantity of data incorporated is so vast that it will be of great use to geologists for a long time.

The three subsections of the monograph are very appropriate. In the section U-Th-Pb dating, it is interesting to note that the author has dealt with virtually all the minerals used in dating. I think it is remarkable that in a section of this length (23 pages) he has been able to present case histories as well as development techniques. However, the geologist could have been given a little more "feeling" about contamination problems and resultant errors in ages. The subsection on common lead is probably the most impressive section of this monograph. A very broad range of analyses from various laboratories (not all normalized to one standard) have been considered to create a base for discussion of moon rocks to island arc volcanic rocks. This subsection might have been more impressive if some indication had been made that interlaboratory-instrumental bias becomes very important in interpreting common lead data. The final subsection on radioactive lead isotopes, although brief, summarizes the available data and indicates the nature of work in this field.

As a monograph, this is really an outstanding contribution to lead isotope research. The survey of Soviet literature is probably the most remarkable aspect of this book, and it has been long overdue. The extensive bibliography is probably one of the most useful aspects of this book and will be used extensively. This monograph will certainly become a "must" reading for geologists and researchers in this field and with the typical Doe style of writing, it makes it so much easier.

A. K. SINHA

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X-RAY EMISSION WAVELENGTHS AND KEV TABLES FOR NON-DIFFRACTIVE ANALYSIS. Prepared by G. G. Johnson, Jr. and E. W. White. ASTM Data Series DS46. American Society for Testing and Materials, Philadelphia, Pa., 1970. 48 pages. \$5.00.

The booklet consists of four pages of introductory text, two long tables, and one periodic chart. The text is confusing, since much of it was copied from another publication by the same authors and does not apply. The tables are of considerable practical interest, especially to users of energy-dispersion X-ray equipment. The periodic chart provides wavelengths data only. A similar chart with energy data would have added to the value.

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MODERN METHODS OF GEOCHEMICAL ANALYSIS. Edited by Richard E. Wainerdi and Ernst A. Uken. Plenum Press, New York-London, 1971. 397 pp. \$22.50.

To review a book unfavorably is an unpleasant but sometimes unavoidable chore. This book suffers from the unfortunate tendency among geoscientists to work "in a vacuum," unaware of the efforts of contemporaries in other specialized fields. It will give the uninitiated a distorted and narrow perspective and it offers little to the knowledgeable geochemist.

The twelve chapters are only loosely related and of varying interest. The first, an introduction, incompletely delineates the subject and fails to unify it. The last, "Mass Spectrometry" by Weber and Dienes, is one of the best, but like the rest, suffers from narrow specialization—it deals only with carbon and oxygen isotope analysis and the rudiments of spark source mass spectrometry. Most applications of mass spectrometry in geochemistry are not discussed.

A chapter on statistics includes most of the elementary concepts useful to the geochemist, and gives some practical illustrations of their value, but fails to emphasize the enormous dependence of almost all instrumental methods on the clean logic of statistics and ignores the common place perversion of this logic by the inexperienced, for whom, presumably, the book is written. A chapter on chemical analysis and sample preparation is trivial: the ten references cited are of limited value to the practicing geochemist and do not provide the overview that a novice needs. The works of Hillebrand, Lundell, Sandell, Jeffery, Maxwell, and a dozen others who have written the basic literature in this field are not cited.

A section on ion-exchange chromatography shares the characteristic of superficiality with the rest of the book. Most of the information on analytical colorimetry is available in instrument company brochures and standard handbooks. The most widely used silicate rock analysis schemes using colorimetry, those of Riley and of Shapiro and Brannock, are not mentioned.

Chapter 7, "Optical Emission Spectroscopy," will be of interest to an unknowledgeable reader but tells little about important new developments (*e.g.*, the contributions of Joensuu, Suhr, and Govindaraju) and tends to underestimate the capabilities of the technique. A statement on atomic absorption achieves its objective "to describe the method and give a brief outline of its use for the analysis of silicates," but nothing more.

Chapter 9, on X-ray techniques, repeats in abbreviated form the content of earlier texts. New developments and the widening possibilities of X-ray analysis in geochemistry are not adequately discussed. For example, reference to the important contributions of Norrish and his coworkers is lacking. Chapter 10, on radiometric techniques, although competently written and interesting, fails to define the role of radiometry within the art of geochemical analysis.

Chapter 11, written with the editors' coauthorship, will be informative for anyone without knowledge of nuclear activation analysis, but cannot serve as any sort of permanent guide. No effort is made to indicate the dependence of nuclear activation on the other geoanalytical techniques: methods of calibration and standardization and the difficulties associated with them are given little attention.

Among topics in geochemical analysis not considered at all are thermal methods (DTA, TGA, etc.), gas chromatography, mass spectrometry as used in geochronology and in the analysis of organic minerals, flame photometry, atomic fluorescence, and classical and rapid chemical methods for silicate analysis.

Possibly the title has been unfortunately chosen. "Some topics in geochemical analysis," might have been more appropriate, and if the various chapters had been set in a knowledgeable and perceptive framework, a useful contribution might have been made.

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