

BOOK REVIEWS

MINERALOGY OF ARIZONA. By John W. Anthony, Sidney A. Williams and Richard A. Bideaux. The University of Arizona Press, Tucson, Arizona, 1977. 241 pages, 114 figures, 4 tables. 7 maps. \$22.50 clothbound, \$9.75 paperback.

This is a comprehensive account of the mineralogy of Arizona, by three authors most qualified to provide it. It is divided into four parts: Introduction (6 p.); Arizona Mineral Deposits (24 p.) comprising sections in the porphyry copper deposits, the Bisbee and Mammoth-St. Anthony mines, the uranium-vanadium deposits of Monument Valley and the Cameron area, the "mine fire" minerals of the United Verde Mine, and Arizona meteorites; Catalog of Arizona Minerals (178 p.), literally from A (acanthite) to Z (zunyite); and Bibliography (27 p.). The book concludes with seven maps covering the state on which the mineral localities are (somewhat vaguely) spotted.

This book replaces *Minerals of Arizona* by F. W. Galbraith and D. J. Brennan (1959). It not only replaces, but it also greatly enlarges and improves it. It adds 224 mineral species to those recorded in 1959, of which 77 have not previously been reported in the literature. With the addition of these 224 species, the Arizona list now totals some 605—an imposing record by any standards. The value and interest of the book are greatly enhanced by the excellent color photographs of individual minerals provided by Julius Weber and Jeffery Kurtzman.

This book is indispensable for anyone interested in Arizona mineralogy, and deserves a place in any mineralogical library, amateur or professional.

BRIAN MASON
Smithsonian Institution

CAVE MINERALS. By Carol A. Hill. National Speleological Society, Huntsville, Alabama, 1976. xiii+137 pages, 108 photographs, glossary. \$15.00.

Cave Minerals is a literature survey detailing the observations on approximately one hundred known secondary cave mineral species, those aggregates formed *in situ* after the development of the cavernous void. Many of the approximately 460 references cite singular occurrences of the species. The sources date from the late 19th century through 1973. Minor emphasis is allocated to original observations by the author and previously unpublished communications by fellow speleologists.

Dana chemical groups structure the presentation into ten sections. The morphologies common to many of the mineral aggregates are reviewed, and simplified explanations of common sedimentary structures, the stalactite and the cave pearl for example, are presented in a lucid manner. The rarer structures, including cave rafts and blister-like speleothems, are similarly treated. Each species entry has the chemical, physical, morphological, and related recognition features in a concise tabular guide, followed by relevant literature citations. Geochemical discussions of the speciation and petrographic parameters of the sedimentary structures are cursory and irregularly balanced throughout the text, but this

reflects the technical level of available speleological literature rather than geochemical and crystallographic literature. The Dana system organization is disregarded in the mid-text, and approximately one half of the recognized "cave species" are clustered into an additional section titled "Other Minerals." Many, yet not all, of these relatively rare species are heavy-metal compounds associated with groundwater seepage in the vicinity of organic residues, bone breccias, *etc.* in the cavern environment. Included in this section, anomalously, are brief discussions on clastic aggregates, mud and sand "stalagmites," and primary sedimentary structures peculiar to gaseous cavities in lava flows. Hill notes that many lava tube caves yield a variety of silicate minerals derived from groundwater seeps, but fails to extend her discussion to the literature on the biochemical origins of nitrate and phosphate compounds leached from guano beds in lava cavities of the South Pacific. The final section of the text briefly discusses the enigmatic mineralogical phenomena relevant to recent speleological research. These include the genesis of aragonite in the standard atmosphere of caves, the role of microorganisms in mineral speciation, and absolute age dating of carbonate deposits in caves. This section, in particular, contains several somewhat dubious comments. "Regardless of additive ions or temperature, monohydrocalcite may be transformed into aragonite" is typical.

This volume was conceived as a singular survey of mineral deposit references in the speleological literature, and compiles the numerous obscure and fragmental sources into a single reference text. The oversight of at least one previously-published similar literature review (*Studies in Speleology*, Vol. 2, pt. 5) diminishes the purported originality of this text as a bibliographic guide to future researchers. Both the Hill volume and previous literature surveys perpetuate the usage of discarded, yet not formally discredited species nomenclature. Salmoite, for example, is one of several dubious "new species." The original citations have been referenced in such dated standards as *Dana's System*, but have been delisted by the more recent authoritative editions of *Glossary of Mineral Species* by Fleischer. The species list of the Hill volume is incompatible with the latter reference.

The value of speleo-mineralogical literature surveys, including the Hill volume, is detracted by the generally nebulous descriptions, if any at all, of petrographic relationships. Moreover, it is frequently unclear if the "cave mineral" is an exposed bedrock component existent prior to the development of the cavernous void or a true secondary cave deposit. This problem is compounded by the failure of many early mineralogical references to describe the nature of the host strata, thereby not distinguishing between mineral assemblages in sandstone fissures, lava tubes, or larger cavities in hydrothermal ore veins from solutional limestone-dolomite caverns. Hill does not consider this problem and cites cave mineral assemblages independent of the host strata, and fails to note whether or not the host cave had a natural entrance or was exhumed during mining operations. This reviewer doubts the validity of this approach for a standard reference volume beyond previously-published review papers on the speleo-mineralogical literature.

PAUL L. BROUGHTON
Cambridge University

VOLCANISM IN AUSTRALASIA. Edited by R. W. Johnson. Elsevier Scientific Publishing Company, Amsterdam, 1976. 405 pages. \$23.25.

A wealth of new data and interpretations on the volcanic geology and geophysics of Australasia is contained in this volume, which is dedicated to the late G. A. M. "Tony" Taylor. The high esteem in which Tony Taylor is held is reflected by the quality of the 28 papers contained in this book, authored by more than three dozen of the most active earth scientists in that part of the world.

The papers cover a wide range of topics, ranging from Cambrian flood basalts of Northern Australia to the geophysics and geochemistry of the northeastern and eastern margin of the Indo-Australian plate. The book contains the first detailed accounts of recent eruptions in Papua, New Guinea (Bismarck arc, 1972-75; Karkar, 1974-75; and Bagana, 1970-75), as well as reviews of historical activity at Manam, Long Island, Tavurvur, and Tulu-man. Also discussed is the status of volcano surveillance in Papua, New Guinea, and at White Island, New Zealand.

A few papers should be singled out because of their obvious wide appeal and application. The report by D. J. Whitford and I. A. Nicholls describing and interpreting the potassium variations across the Sunda arc will be of interest to all those concerned with similar variations across volcanic arcs. The review by A. Ewart, A. Mateen, and J. A. Ross of the mineralogy and chemistry of Tertiary volcanic complexes in eastern Australia is a modern approach to difficult petrogenetic problems involving a wide range of calc-alkaline, alkaline, and peralkaline rocks.

There is little that I can find to criticize about the book. For one, such as myself, who is unfamiliar with the geographical details of Australasia, it would have been helpful if the Editor had included a map showing the location of all of the specific areas described in the book rather than the highly generalized index map that appears with the Preface. But shortcomings such as these do not detract from the importance of the book or its effectiveness as a memorial to Tony Taylor.

The cost of the book, by modern standards, is only moderately high, and the book is an obvious must for all earth science libraries. Despite its geographical focus, *Volcanism in Australasia* could rightfully belong in the personal collections of interested volcanologists the world over.

RICHARD S. FISKE
Smithsonian Institution

MAGNETIC PROPERTIES OF COORDINATION AND ORGANOMETALLIC TRANSITION METAL COMPOUNDS.

By E. and G. König. Volume II/8 (supplement to Volume II/2) in the series *Landolt-Börnstein: Numerical Data and Functional Relationships in Science and Technology*. Springer-Verlag, Berlin, 1976. xxxiv + 1163 pages, 421 figures. \$451.00.

This volume is the first of a series of supplements to volume II/2, which was published in 1966, and covers the publications in magnetic susceptibilities and electron-spin resonance from 1964 to 1968. Some compounds which are neither coordination nor organometallic compounds have been included for the purpose of comparison. Not included are numerous simple compounds of the transition group elements such as iron oxides, perovskites and perovskite-related compounds, spinels, hexagonal ferrites, and garnets (magnetic data on these compounds are given in volume

III/4). There is no general index, but the arrangement of substances is described extensively in the introduction, and the table of contents is very detailed and enables one to locate easily the data on a specific group of compounds.

One can only admire the prodigious amount of work involved in this massive data compilation. However, since most of the data are on organometallic compounds, this volume is of limited interest for most mineralogists.

BRIAN MASON
Smithsonian Institution

GEOCHEMISTRY OF VANADIUM. By Gernot Meincke. Vol. 11 in the series *Clausthaler Hefte zur Lagerstättenkunde und Geochemie der mineralischen Rohstoffe*. Gerbrüder Borntraeger, Berlin, 1973. 90 pages, 17 figures, 38 tables. Price DM 48. (in German).

This review of the literature places greatest emphasis on vanadium in the sedimentary cycle. A list of vanadium minerals is included. The older literature is covered fairly well, with some exceptions, but of the 234 citations of the literature, only 15 are to papers published in 1965 or later, and the latest reference is to 1970. This report is useful but requires supplementation by reference to recent work.

MICHAEL FLEISCHER
U.S. Geological Survey

LES MINÉRAUX DE BELGIQUE. By Joseph Mélon, Pol Bourguignon and André-Mathieu Fransolet. Lelotte, Dison, Belgium, 1976. 284 pages. 110 figures, 36 photographs (including 20 colored plates). 1200 Belgian frames (approximately U.S. \$30).

Here comes an elegant contribution to regional mineralogy, which every curator will want and every mineral lover will enjoy. The region is Belgium, and the authors are members of the Institute of Mineralogy of the University of Liège: emeritus, professor, and assistant, respectively. They are the successors of G. Cesàro and H. Buttgenbach; their book is a sequel to the latter's "*Les minéraux de Belgique et du Congo Belge*" (1947), which was the latest available inventory. In a way it is a supplement to the older work, which it brings up to date without any duplication of previously-known information, except for the sake of modernizing the symbolism. In the new book the Haüy-Lévy notation of crystal forms, which had ruled supreme in French publications for over 150 years, is at last abandoned and replaced, both in text and figures, with Miller indices. The systems of coordinates are standard in the *International Tables of X-ray Crystallography* and in American mineralogy textbooks. Gone, for instance, are the rhombohedral "axes de calcul" X, Y, Z , respectively directed along hexagonal $-a_3, +a_1, +c$ —a left-handed system responsible for much confusion! The labor involved in making the necessary transformations can readily be appreciated. Even mineral names have dutifully been changed to those recommended by the International Commission. Young mineralogists will be thankful for this access-made-easy to the literature on Belgian minerals. For an English-speaking geologist, reading mineralogical French never was a problem; deciphering unfamiliar symbols had been the stumbling block.

In the Foreword the authors remark that most Belgian minerals

have been studied during a period spanning less than half a century and ending around 1925, when morphological crystallography was the main concern. In order to settle questions left in doubt, they have undertaken original investigations: checking determinations, eliminating dubious species, entering X-ray data that have been obtained on specimens from Belgium. A folding index map shows that the southern half of the country, geologically the western end of the Ardenne-Rhine massif (mostly Paleozoic), is the source of most of the minerals. Only officially recognized species, identified with certainty, and presenting some interest, are included in the book: they number 180. Since 1947 fifty-one species, previously unknown in Belgium, have been found there. Special attention is devoted to the minerals that were discovered in Belgium; here they are: ardenneite, davreuxite, delvauxite, destinézite, fraipontite, halloysite, hopeite, koninckite, ottrelite, richellite, viséite, and willéite. (An even dozen—not bad for a “mineralogically underprivileged” country!)

Following an illuminating sketch of the geology of the territory, under the heading “The Geological Setting,” comes the systematic part, where the amount of information varies, of course, widely from species to species. For all of them, the chemical formula and the crystal system are given after the name; the crystal forms observed on Belgian material are listed there too. With a few justifiable exceptions, the structural cell is adopted when it differs from the old morphological one, and transformation matrices are given in a footnote. Literature references complete each description.

The presentation is a model of simplicity: the language is straightforward; the style, concise but always clear; the crystal drawings are very well reproduced or redrawn; the photographs in black and white are excellent; and the color plates on special paper make an exquisite album at the beginning of the book. (All the photos were taken by Fransolet.)

A few minor errors have managed to creep in. The most unfortunate slip—cinnabar and quartz are assigned to the rhombohedral system—is a left-over from the time “rhombohedral” designated all crystals belonging to a trigonal point group, regardless of its lattice symmetry.

Two useful appendices should be noted. One lists the species erroneously reported as having been found in Belgium (“benitoite” turned out to be a grain of carborundum in the slide!) The other is a carefully prepared 12-page index of the mineral localities; each entry gives the name of the commune and that of the province, followed by the list of species that occur there.

Publisher G. Lelotte deserves nothing but praise. The “sans sérif” types are most pleasing; the composition is unbelievably free from typographical errors; the book is up to the best standards. A striking book-jacket features the geographical outline of Belgium, cut out of a colored photograph of ardenneite in quartz and placed on a black background.

J. D. H. DONNAY
McGill University

GEOLOGY OF THE MIDDLE ATLANTIC ISLANDS. By Raoull C. Mitchell-Thomé. Gebrüder Borntraeger, Berlin, 1976. 382 pages (in English). DM 198.

This is volume 12 of the series *Beiträge zur Regionalen Geologie der Erde* and contains systematic descriptions of the geology of the Azores, Madeira, Selvagen, Canary, and Cape Verde archi-

pelagoes. The author's own published work in the region seems to be concerned entirely with the Cape Verde Islands, but he has a lively interest in all the island groups and is a master of the immense and unruly bibliography of the subject—he lists more than 800 titles extending over nearly two centuries and summarizes the contents of most. After summary chapters on the geography and geology of all of “Macaronesia,” each of the archipelagoes is treated in a separate chapter. In each such chapter separate sections are devoted to geomorphology, igneous rocks, sedimentary rocks, stratigraphy, paleontology, volcanicity, seismicity, tectonics, economic geology, and finally, geologic evolution.

As a synthesis of knowledge about the islands the book is rather less than successful, and one may wonder whether, with the enormous increase in published information, such success is any longer possible in an encyclopedic volume of this sort. In the end, most of the data have to be left out, and there is not even room enough in which to attempt to resolve—or justify preferences among—differences of opinion on the part of those who have generated the data. Although the author does occasionally attempt such resolution or justification, his text is for the most part rather like an extensively annotated bibliography. Very few readers will be interested in more than a very small part of it at any one time.

Many, however, will find it invaluable as an occasional reference and key to the literature; its utility for both purposes is immensely increased by its thoroughly systematic organization, splendid indices, and remarkably detailed bibliography. Large institutional and public libraries should certainly include it in their geological holdings.

FELIX CHAYES
Geophysical Laboratory
Carnegie Institution of Washington

AFAR DEPRESSION OF ETHIOPIA. Edited by A. Pilger and A. Rösler. Inter-Union Commission on Geodynamics Scientific Report No. 14. E. Schweizerbartische Verlagsbuchhandlung, Stuttgart, 1975. 416 pages, \$53.80.

The Afar region boomed to geologic prominence in the late 1960's with the recognition of its unique plate tectonic setting. It is not often possible to study two diverging plates on dry land, but here there are three, at the triple junction of the Nubian, Arabian, and Somalian Plates. The surge of interest following this recognition is illustrated in the combined bibliography for this book: of the 288 references to Ethiopian Geology, 240 have been published in the 1970's.

The 45 papers that make up this volume were presented in April 1974 at Bad Bergzabern, West Germany. This historic symposium brought together, for the first time, the large German and Franco-Italian teams that had been working quite independently in the Afar since 1968. These teams make up, respectively, 42 and 33 of the authors represented in this volume, and there are another 13 authors from other nations. All but 3 of the 45 papers are in English.

The Afar and adjacent areas are treated regionally in the first half of the volume, with 6 papers on magmatic and structural aspects followed by 11 geophysical papers. The second half divides the Afar in Northern, Eastern, and Southern sections with 5, 8, and 14 papers (respectively) on each section, although there is some geographic overlap. While these deal mainly with tectonics and petrology, some describe the strongly saline lakes of the Afar and

the Pliocene-Pleistocene geology of this region now anthropologically significant for the recent discovery of very ancient hominids. The volume closes with two papers under the heading "conclusions," but the reader will not find a paper summarizing the results of the symposium, coverage of the verbal discussions (which must have been lively), or even a general paper introducing the Afar region to those not already familiar with it. Instead, the editors have opted for rapid publication. They state that they "have tried to publish the manuscripts just as they were received," and have produced this substantial volume (plus a second dealing with Ethiopia's pre-Tertiary geology and with the 3 rift systems extending outwards beyond the Afar) only a year after the symposium. The reader will find a conglomerate of papers of uneven quality, rather than a cohesive treatment with neatly consistent maps and an index, but we are fortunate to have this valuable collection of current work on a fascinating area that was little known prior to this decade. The publisher might list the 12 fold-out maps and many line diagrams to justify the high cost of this paperback, but there are only 4 pages of photographs (black and white) and the buyer receives only 0.3 m² of printed page per dollar: an excessive cost by any standard.

TOM SIMKIN
Smithsonian Institution

GEMSTONES OF NORTH AMERICA, Volume II. By John Sinkankas. Van Nostrand Reinhold Company, New York, 1976. 491 pages, 110 illustrations, 16 color plates. \$30.00.

Volume I of this work was published by D. Van Nostrand Company, Inc. in 1959 (668 pages, \$15.00), and briefly reviewed in the *American Mineralogist* (vol. 45, p. 245, 1960). Volume II is primarily a presentation of data on sources of gemstones in North America discovered since 1959, although some "earlier information is repeated as is necessary to place matters in their proper perspective." The headings of chapters dealing with individual gemstones are the same in both volumes: Principal Gemstones, Important Gemstones, Quartz Family Gemstones, Rare and Unusual Gemstones, Massive and Decorative Gemstones, and Organic Gemstones.

The major portion of the book (359 pages) is a detailed account of new gemstone finds. The cut-off date is not given, but there are some 1975 references in the bibliography. This section is a "gem mine" of information. It is filled with detail such as when found and by whom, photographs of mines and outstanding specimens, sizes and qualities, and values of cut gems, changes in ownership of mining properties, and much more. Where possible, references are cited, but much of the information contained in this section is not in the literature but was obtained directly by the author.

An interesting and useful section of the book is entitled "A Brief History of North American Gemological Literature." Here one will find one of the few errors noted—the photographs of George F. Kunz and Waldemar T. Schaller, Figures 108 and 110, have been interchanged.

The bibliography (Appendix 1) occupies 88 pages and contains more than 2,661 entries. This extremely valuable section of the book is made even more useful by an index to the bibliography with the following headings: General and Regional Works; Guidebooks, Typographical Mineralogies and Catalogs: Historical; Locations; and Individual Gemstones. There is also a geographical and locality index, and a general index.

These two scholarly volumes by John Sinkankas are a unique and invaluable reference and are a must in every gemological library.

GEORGE S. SWITZER
Prince Frederick, Maryland

MICROBEAM TECHNIQUES. Short Course Handbook, Volume 1. Edited by D. G. W. Smith. Mineralogical Association of Canada, CO-OP Press, Edmonton, Canada, 1976. v + 186 pages, 76 figures, \$7.50 (Canadian). Purchase from: Business Manager, Mineralogical Association of Canada, c/o Dept. of Mineralogy, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario, Canada M5S 2C6.

This Short Course Handbook on Microbeam Techniques is the outgrowth of a course held under the auspices of the Mineralogical Association of Canada, immediately preceding the 1976 Annual Meeting in Edmonton. It contains 6 sections, each representing the lectures presented during the course by 6 experts in the field. The title of the booklet (*Microbeam Techniques*) is somewhat misleading, since the topics covered are almost exclusively in the field of electron microprobe analysis, and only 3 pages are devoted to applications of the scanning electron microscope and the ion microprobe in mineralogy. The individual sections deal with instrumentation (J. C. Rucklidge); correction procedures (G. Springer); quantitative energy dispersive microanalysis (D. G. W. Smith); application of microbeam techniques to mineralogy (A. G. Plant); petrological application (D. B. Clarke); and applications in exploration, evaluation, development, and genetic aspects of ore deposits (D. C. Harris). In addition, some useful appendices list an atomic model energy-level diagram; symbols used in quantitative electron microprobe correction procedures; characteristic X-ray spectra for elements with $Z = 11$ to 92; mass absorption coefficient formulas; standards for electron microprobe analysis; data commonly used in electron microprobe analysis (e.g. characteristic X-ray wavelengths, critical excitation potentials, suggested standards); and statistical error curves.

The sections are competently and well-written, with many good illustrations and extensive lists of references. However, they invariably represent only very brief, elementary introductions into some of the major aspects of quantitative electron microprobe analysis and its application. Thus, this booklet does not go beyond the scopes nor contents of a number of good review articles and textbooks written in this field in recent years. Nevertheless, it is a useful addition to the libraries of all those interested in electron microprobe analysis and its application in the earth sciences. It will probably have particular appeal to students entering the field, not least because of its bargain price.

KLAUS KEIL
University of New Mexico

THE ALKALINE ROCKS. Edited by H. Sørensen. A Wiley Interscience Publication, John Wiley and Sons, New York, 1974. xii + 622 pages. \$58.00.

If you are at all interested or involved in the study of alkalic igneous rocks, almost any kinds, from strongly undersaturated to oversaturated, from mafic to felsic, volcanic to plutonic to metaso-

matic, you will wish to acquire this book. I suggest you do it soon, inasmuch as in the first year after its appearance its price increased by over ten dollars. Although this volatile inflation may reflect some of the genetic traits of alkalic rocks, hopefully it will be checked.

This book comes as a fitting climax to the appearance of a covey of books, monographs, and monographic papers on various alkalic rock types in the last decade, among the most noteworthy of which are:

- 1966: *Carbonatites*. Ed. by O. F. Tuttle and J. Gittins (Interscience).
The Geology of Carbonatites. E. Wm. Heinrich (Rand McNally).
- 1967: *Ultramafic and Related Rocks*. Ed. by P. J. Wyllie (John Wiley). Two sections (8 and 9) deal with kimberlites.
- 1970: *Alkaline Rocks: The Montereian Hills*. Ed. by G. Perrault. *Can. Mineral.*, 10, No. 3.
The Petrology of the Kimberlites. E. V. Frantsesson (translated by D. A. Brown) Australian Natl. Univ. Geol. Dept. Publ. 150.
- 1973: *Lesotho Kimberlites*. Ed. by P. H. Nixon (Lesotho Natl. Devel. Corp.).
"Lamprophyre, Semi-lamprophyre und anchibasaltische Ganggesteine," W. Wimmenauer, *Fortschr. Mineral.*, 51, 3-67.
- 1976: *The Alkaline Rocks of Canada*. K. L. Currie, *Geol. Surv. Can. Bull.* 239.
"Carbonatite Investigations, The Last Ten Years." E. Wm. Heinrich, *Int. Symp. Carbonatites, Brazil (in press)*.

For a polygenetic monograph *The Alkaline Rocks* is a very useable as well as useful book. Some 32 contributors are involved in a total of 35 articles organized into the sections: Introduction; Petrography and Petrology; Regional Distribution and Tectonic Relations; Alkaline Provinces; Conditions of Formation; Petrogenesis; Economical (sic) Geology. To these is attached an Appendix in two parts: (1) Classification and nomenclature of plutonic rocks, and (2) Glossary of alkaline and related rocks. Four exhaustive indexes conclude the work: rock names, subject, geographical, and author.

The Introduction by Sørensen considers the manifold definitions of alkalic rocks and defines them, for the volume, as those "... characterized by the presence of feldspathoids and/or alkali pyroxenes and amphiboles" (p. 7). Any definition of a chemically-characterized group solely on mineralogical parameters is fraught with pitfalls. Alkalic rocks have not only mineralogical but tectonic and kindred characteristics as well (as Sørensen acknowledges). On compositional and mineralogical bases, many carbonatites would not be classified as alkalic (personally preferable to alkaline, which has a specific chemical connotation) rocks. Yet despite the fact that most carbonatites consist of carbonates of Ca and Mg and contain little or no Na and K as we now find them, it does not mean that their parental fluids were similarly alkali-poor; rather that most carbonatitic fluids were depleted in alkalis via degassing and fenitization. This writer prefers Currie's definition that an alkalic rock is one that contains a feldspathoid mineral either in the rock itself or in the norm.

Section II (Petrography and Petrology) is very complete and useful. Melilite rocks, alkalic peridotites, kimberlites, and lamprophyres are not treated.

The quality of section III (Regional Distribution and Tectonic

Relations) is not uniform. Actually several of the articles belong more appropriately in section IV (Alkaline Provinces). The tectonic controls for Africa are traced by Bailey and by Mathias, and those for Siberia by Butakova. Barker's article on the alkaline rocks of North America adds little to his 1970 paper abstracted in the symposium on the Montereian Hills (and published in *Bull. Geol. Soc. Am.*, 80, 2369-72, 1969) and ignores the significant criticism of his paper by M. N. Bass (*Geol. Soc. Am. Bull.*, 81, 3492-3500, 1970).

Provinces specifically described include the Montereian, Southwest Greenland, Kola, Mongol-Tuva, Central Europe-France, and Nigeria-Niger. Alkalic rocks of oceanic islands also are described. Some significant omissions include Oslo, Angola-Southwest Africa, and Brazil.

Section V (Conditions of Formation) is a valuable detailed compendium of experimental petrologic results for alkalic systems plus data on fluid inclusions, trace elements, and Sr isotope ratios for alkalic rocks.

The section on petrogenesis (VI) is, because of the polyglot of genetic voices raised, rather uneven. The most interesting articles are by the Russians on the role of volatiles (Kogarko), and liquid fractionation (Kogarko, Ryabchikov and Sørensen), and on the role of metasomatic processes in alkalic rock petrogenesis (Borodin and Pavlenko). The summation for this section by Sørensen does little to synthesize a coherent general picture of alkalic petrogenesis, particularly with respect to contrasting hypotheses that attempt to relate the origins of these rocks with modern global tectonic models. None of the articles discusses the genetic implications of one of the most characteristic features of many (most?) alkalic rocks, i.e. their heterogeneity, on a regional, provincial, single intrusion, and outcrop scale.

The terminal article by Semenov on the economic geology of these rocks is skimpy. Notable omissions are any discussion of the manifold and complex ion-exchange and deuteric alterations of pyrochlore that plague its beneficiation, of fluorite deposits of central alkalic carbonatitic complexes, and of the utilization of carbonatites for Portland cement (Jacupiranga; Uganda).

The glossary is especially valuable. Some omissions noted include foskorite (phoscorite) and leucitolite.

Buy the book, if you can afford it; if you can't, at least read it.

E. WM. HEINRICH
The University of Michigan

STACH'S TEXTBOOK OF COAL PETROLOGY. SECOND COMPLETELY REVISED EDITION. By E. Stach, M.-Th. Mackowsky, G. H. Taylor, D. Chandra, M. Teichmuller, and R. Teichmuller. Translation and English revision by D. G. Murchison, G. H. Taylor, and F. Zierke. Gebrüder Borntraeger, Berlin, 1975. xii + 428 pages. DM 124.00; \$53.00

It is appropriate that this volume, which is really a treatise rather than a textbook, be reviewed in *The American Mineralogist* inasmuch as coal petrology, from its inception, has treated coal as a rock composed of many minerals. The analogy is particularly clear as vitrinite, the lustrous component of hard coals, is considered to be the groundmass in which other macerals (plant fragments—note the analogy to minerals) are imbedded. In contrast to the relatively consistent compositions of minerals, however, the macerals of coal are highly variable in both morphology and composition.

The *Textbook of Coal Petrology* has been assembled by six

outstanding authorities, one of whom, Professor Stach, published the first edition in 1935. This beautiful book is printed on high-quality paper; the 159 figures, 39 tables, and a color plate are attractive as well as informative. The translators of the chapters that were originally in German are to be commended for the excellence of their product.

The book is divided into five chapters: (1) Introduction and historical survey (4 p.); (2) Fundamentals of coal petrology (170 p.); (3) Origin of the petrographic constituents of coal (63 p.); (4) Methods and tools of examination (71 p.); and (5) Applied coal petrology (79 p.). The list of references is extensive if not complete, and the subject index (15 p.) is quite detailed, adding to the usefulness of the book. I see little point, however, in the complex numbering system applied to each title and subtitle; for example, "2.221.22 Vitrinertite" and "4.233.12 Procedure."

I do not agree with the views of several authors who, in some places, seem to ignore their own data to construct interpretations based upon preconceived ideas. Perhaps this ignoring of data is caused by too much emphasis being placed on petrology and too little consideration being given to coal chemistry. A prime example occurs in Chapter 1 where Professor Stach (p. 4), solely on the basis of his petrologic observations, notes the discovery of "natural radioactive coalification" and ignores a series of publications by others since 1960 that illustrate, on the basis of extensive chemical studies, that such radiation does not lead to true coalification.

Other examples may be found in the discussion of the origin of coal in Chapter 2:

Example (p. 33): "Putrefaction (fermentation) only occurs under reducing conditions when anaerobic bacteria consume the oxygen of organic substances transforming them into hydrogen-rich bituminous products. . . ." This is supposition, because anaerobic processes do not deoxygenate coal-forming substances, which in turn do not support bacterial activity. As an example, lignite contains approximately 25 percent oxygen. In all likelihood, the bituminous products probably are derived from the lipids of the plants and especially from the lipids produced by the aquatic organisms of the peat-forming swamp.

Example (p. 37): ". . . lignin and cellulose are transformed into humic materials. . . ." Evidence for the extensive contribution of cellulose, implied in this statement, is still lacking.

Example (p. 37): ". . . volatile products consist predominantly of carbon dioxide and water along with some methane (from the methoxyl groups in lignin)." Perhaps, but anaerobic degradation of cellulose is by far the most important source of methane.

I could continue, but suffice it to say that the authors of this chapter have a responsibility to the reader to provide a more accurate discussion or at least to indicate alternate theories.

The concept of microlithotypes (Chapter 2, p. 108) is not clearly defined and will confuse the novice. The same can be said for the overabundance of descriptive petrologic terms, which is enough to discourage any beginner in coal petrology.

Although I have found Chapter 5 to be particularly valuable, it too, has shortcomings based on preconceived ideas. Thus, on p. 327, the destruction of gas and petroleum in regions where "warm" geothermal conditions prevail is suggested. Hydrocarbons, especially methane, are thermodynamically among the most stable of organic compounds, and I cannot visualize their destruction at "warm" temperatures. Is it possible that petroleum or gas never formed in the regions in question? Contrary to the statement on p. 329, gas deposits are not necessarily related to the rank of the coal of an area; methane may actually be produced microbiologically during the earliest stage of coalification.

The *Textbook of Coal Petrology*, then, can best be characterized as a treatise in which the authors are strong in petrology and weak in geochemistry. If this can be remembered, the volume will make an excellent reference.

One more point: I find it hard to imagine why the work of J. A. Simon and C. E. Marshall on the strength of coke has not been cited, or why the fundamental studies on minerals and trace elements in coal by T. Stadnichenko and P. Zubovic did not warrant mention. As references through 1974 have been listed, key studies dating back 25 years deserve recognition.

In spite of the weakness of chemistry and geochemistry, I can recommend this book as a reference and compendium of data and suggest that it be used in context with the *International Handbook of Coal Petrography* published by the International Committee on Coal Petrology in 1963.

IRVING A. BREGER
U.S. Geological Survey

ANALYTICAL METHODS FOR USE IN GEOCHEMICAL EXPLORATION. By R. E. Stanton. John Wiley and Sons, Inc., New York, 1976. 54 pages. \$4.50.

The title of this 54-page booklet, *Analytical Methods for Use in Geochemical Exploration*, reflects properly its content. Simplified colorimetric, atomic absorption, X-ray emission and emission spectrometric methods are given for those elements which are of interest in geochemical exploration.

The author selected these methods for their simplicity in sample preparation and actual chemical analysis and also for their acceptable precisions. This book is an updated version of the 1966 edition, which dealt exclusively with colorimetric analysis. In this edition are included new methods that are extensively used at the present time, the atomic absorption technique being most important. For several elements, more than one method is given. A short chapter on statistics, even though of a general nature, is particularly well-tailored for the material in this book. The chapter dealing with colorimetric determinations of Bi, B, Mo, Pd, Pt, Th, Sn, W, and V is straightforward. An interesting chapter on "Cold Extraction Methods of Analysis" deals with extraction of As, Co, heavy metals, Pb, Ni, and Zn. In this chapter the author points out the need for the occasional determination of "the amount of an element that is readily available rather than, or in addition to, its total content in the sample." Analyses using atomic absorption techniques are given for Cd, Co, Cu, Fe, Pb, Mn, Ni, Te, Zn, Ba, Sr, Be, Ca, Cs, Li, Mg, K, Ru, Na, Au, Hg, and Ag. The chapter on X-ray fluorescence describes As, Se, Te, Bi, Au, Pd, and Pt determinations. Emission spectroscopy is only briefly discussed.

Analytical procedures are presented in a disarmingly simple fashion. However, to perform these analyses in the manner described requires some laboratory experience, and for procedures given for more advanced instrumentation even more experience is needed. The author indicates that the colorimetric method requires the least expensive equipment; for other methods more capital layout is needed.

This book, because of its practical approach to the analysis of materials of geochemical interest, should be a useful reference in laboratories where analyses of such materials are performed.

EUGENE JAROSEWICH
Smithsonian Institution

GEOCHEMISTRY OF MOLYBDENUM. By Ismet Uzku. Vol. 12 in the series *Clausthaler Hefte zur Lagerstättenkunde und Geochemie der mineralischen Rohstoffe*. Gebrüder Borntraeger, Berlin, 1974. 226 pages, 26 figures, 75 tables. Price DM 120. (in German).

This thorough review has more than 700 references, nearly 40 percent of which are to papers published during the period 1965–1971. It includes a section on molybdenum minerals (p. 13–25) and one on trace amounts of molybdenum in minerals (p. 26–66). The geochemical behavior of molybdenum in the magmatic cycle and in the sedimentary cycle is discussed in detail. Although there are minor lapses, such as failure to cover most of the U.S. literature on molybdenum in coal, the report is valuable and highly recommended.

MICHAEL FLEISCHER
U.S. Geological Survey

METALLOGENY AND GLOBAL TECTONICS. Edited by Winfred Walker. Volume 29 in the series *Benchmark Papers in Geology*. Dowden, Hutchinson and Ross, Inc., Stroudsburg, Pennsylvania, 1976. 413 pages. \$27.00.

Global tectonics provides a unifying theme for many aspects of geoscience, and the practitioners of metallogeny (that sub-discipline of economic geology concerned with the origin of metal deposits) have been among the first to jump on the bandwagon. The selection of true benchmark papers on the topic is indeed difficult, because time has not provided the vantage point of a long baseline to aid in their evaluation. It is not surprising that 80 percent of the benchmark papers chosen were published after 1960. On the other hand, the intense current interest and the wide variation in sources of material will make any compilation useful to geologists, like this reviewer, who are trying to cope with a rapidly proliferating literature.

By far the longest paper, and the one that sets the tone for the entire volume, is a 35-page referenceless extract from Y. A. Bilibin's 25-year-old book, *Metallogenic Provinces and Metallogenic Epochs*, presenting the philosophy that ore deposits are integral parts of the overall geologic environment and that their habitats in

time and space can be deciphered in relation to the systematic evolution of crustal rocks. Many of the 31 benchmark papers are represented solely by abstracts, pertinent extracts, or even by single figures, a commendable tactic in view of the ground to be covered. Except for a short article by De Launay, all the papers are in English. A few of the maps from Russian references are not very clear; otherwise, the reproduction of illustrations and text is satisfactory. Only one author, J. Pereira, appears on more than a single paper.

The book presents an unusual mix of articles. This reviewer has studied ore deposits for a quarter of a century, making extensive use of a fine earth-science library, yet almost half the papers were new to me. The items included are clearly a personal choice of the editor. Another editor, any other editor, might well have prepared a book under the same title that duplicated only a very small fraction of the selections. Most of the papers present models or syntheses of a great deal of other information and may well be of interest to petrologists, stratigraphers, and structural geologists as well as to economic geologists. Significantly, however, articles submitted for the recent symposium *Metallogeny and Plate Tectonics* (1976, edited by D. F. Strong) cited remarkably few of Walker's choices for "benchmark papers." Thus *Metallogeny and Global Tectonics* is in no sense the comprehensive collection of critical references that the Benchmark Series Editor, R. W. Fairbridge, advocates. In many respects, the goal of the series would have been promoted by adding a selected annotated bibliography occupying perhaps 10 percent of the pages, perhaps modeled after J. D. Ridge's excellent summaries in the AIME's Graton-Sales volumes published in 1968.

I am pleased to have this volume on my bookshelf; it is an interesting, diverse, and unique collection, and it will not be displaced by more focused reviews if such appear. Some of the most enjoyable aspects of the volume are the commentaries by the editor on each group of papers; these commentaries reveal that, though the publications often seem far from the topic when considered alone, they do form part of a carefully planned presentation.

Although global tectonics has influenced some aspects of metallogeny dramatically, the state-of-the-art appears to be one of helping to locate exploration offices rather than drill sites.

P. B. BARTON, JR.
U.S. Geological Survey