

BOOK REVIEWS

MINERALOGY: TOWARDS THE TWENTY-FIRST CENTURY. Edited by K. C. Dunham and J. E. T. Horne. The Royal Society, 6 Carlton House Terrace, London, SW1Y 5AG, 1977. ix + 404 pages. £ 30 (U.K. addresses), £30.90 (overseas).

This book comprises the papers presented at a discussion meeting held April 7-8, 1976 and organized jointly for the Royal Society and the Mineralogical Society in celebration of the latter Society's centenary. It has also been published as *Phil. Trans. R. Soc. London*, A. 286, pp. 235-638, 1977. The papers are as follows: K. C. Dunham, Progress in mineralogy (summary only) (3 p.); S. E. Calvert, Mineralogy of silica phases in deep-sea cherts and porcelanites (14 p.); A. J. Easton, D. Hamilton, D. R. C. Kempe and S. M. F. Sheppard, Low-temperature metasomatic garnets in marine sediments (16 p.); H. Elderfield, Authigenic silicate minerals and the magnesium budget in the oceans (7 p.); R. G. Burns and Virginia M. Burns, Mineralogy and crystal chemistry of deep-sea manganese nodules (17 p.); F. A. Seifert, Reconstruction of rock cooling paths from kinetic data on the Fe²⁺-Mg exchange reaction in anthophyllite (7 p.); M. J. O'Hara and D. J. Humphries, Problems of iron gain and loss during experimentation on natural rocks: the experimental crystallization of five lunar basalts at low pressures (15 p.); B. J. Wood, The activities of components in clinopyroxene and garnet solid solutions and their application to rocks (8 p.); J. Nolan, Determination of specific component activities in tholeiitic melts (9 p.); C. D. Curtis, Sedimentary geochemistry: environments and processes dominated by involvement of an aqueous phase (16 p.); I. S. E. Carmichael, J. Nicholls, F. J. Spera, B. J. Wood and S. A. Nelson, High-temperature properties of silicate liquids: applications to the equilibration and ascent of basic magma (55 p.); J. V. Smith, Mineralogy of the planets (summary of the centenary Hallimond Lecture) (5 p.); G. M. Brown, Two major igneous events in the evolution of the Moon (11 p.); V. F. Buchwald, The mineralogy of iron meteorites (39 p.); J. R. Ashworth and D. J. Barber, Electron microscopy of some stony meteorites (12 p.); E. F. Stumpel, Sediments, ores and metamorphism: new aspects (19 p.); P. R. Simpson and J. F. W. Bowles, Uranium mineralization of the Witwatersrand and Dominion Reef systems (11 p.); T. J. Shepherd, Fluid inclusion study of the Witwatersrand gold-uranium ores (17 p.); C. C. Rundle and N. J. Snelling, The geochronology of uraniferous minerals in the Witwatersrand Triad (17 p.); J. C. Gilson, Medicine and mineralogy (6 p.); D. R. Bowes, A. M. Langer and A. N. Rohl, Nature and range of mineral dusts in the environment (16 p.); A. A. Hodgson, Nature and paragenesis of asbestos minerals (11 p.); F. D. Pooley, The use of an analytical electron microscope in the analysis of mineral dusts (12 p.).

The quality of the organizers and the reputation of the authors have resulted in the production of an outstanding volume which has much of interest for anyone working in mineralogy and related sciences.

BRIAN MASON
Smithsonian Institution

SEDIMENTE UND SEDIMENTGESTEINE Part II, Sediment-Petrologie (third ed.). By Hans Füchtbauer and German Müller. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, 1977. x + 784 pages, 341 figures. DM 88, approx. \$40.

Sedimente und Sedimentgesteine is the third edition of the second volume of a three-volume series that summarizes the entire field of sedimentary petrology. This second volume was published in German in 1970 and part of it in English in 1974 (see book review of English edition in *Am. Mineral.*, 61, p. 343, 1976). It has now been republished in its original German version with, however, an important addition: a complement section in the back of the book updates part of the subject through 1975.

This volume deals with sandstones, shales, conglomerates, carbonates, evaporites and authigenic minerals, and cyclic sedimentation. It is divided into seven chapters. The first chapter, *Exogenous Cycle*, and Chapter 2, *Principles of Nomenclature*, are very brief. They set the stage for what is to follow in subsequent chapters. The third and fourth chapters (*Sandstones, Conglomerates, and Breccias*, and *Siltstones and Shales*) are an extensive treatment of terrigenous sedimentary rocks. Chapter 5 (*Carbonate Rocks*) discusses particles, classification, diagenesis, and environmental indicators. Chapter 6 (*Sedimentary Rocks of Mostly Chemical and Biological Origin*) includes evaporites, silica, phosphates, iron and manganese rocks, ores, bauxite, pyroclastic rocks, and coal. Finally, Chapter 6 (*Cyclic Sedimentation*), a brief chapter, discusses vertical sequences.

The complement section at the end of the book, consisting of 46 pages of text, a bibliography and an index (a total of 58 pages) updates the subjects of sandstones, conglomerates, and carbonates.

This book has been written for the graduate student and for research workers and geologists in industry. From personal experience I know that the previous German edition made a great impact on students of geology and on professional geologists in German-speaking countries. The authors state in the preface that this soft-cover edition is meant for students.

This comprehensive and competently written and researched book is scholarly, well-organized, and well-documented; the subject is logically presented.

GERALD M. FRIEDMAN
Rensselaer Polytechnic Institute

QUANTITATIVE DATA FILE OF THE INTERNATIONAL MINERALOGICAL ASSOCIATION, COMMISSION ON ORE MICROSCOPY. Edited by N. F. M. Henry. McCrone Research Associates Ltd., 2 McCrone Mews, Belsize Lane, London NW3 5BG, England. 200 cards. £10, approx. \$18.

This compilation represents the fruits of the labor of the Commission on Ore Microscopy, organized in 1963 to establish standards for reflectance measurement and to publish modern quantitative data on the reflectance and micro-indentation hardness of

ore minerals. The first issue, ably edited by Dr. N. F. M. Henry of Cambridge University, consists of 200 cards covering 159 ore minerals alphabetically ordered and ranging from acanthite to zinkenite; it includes most of the common elements, oxides, sulfides, arsenides, and sulfosalts.

The basic data, conveniently arranged on 15 × 21 cm cards, include:

mineral name and identification number
chemical formula (and analytical data if available)
symmetry and X-ray data (correlated with Powder Diffraction File Number)

VHN (Vickers Hardness Number)

Reflectivity data (in air and in standard oil at the standard values of 470, 546, 589 and 650 nm, and for most minerals in 20 nm increments from 400 to 700 nm)

Additional useful reference information includes the authors of the data, the provenance of the sample, the polishing method, the type of reflectance standard, and filter used and color values.

The Data File represents an important step in providing up-to-date, reliable, quantitative information on reflectance and hardness data of ore minerals and will no doubt become the international standard for such data. The format will permit expansion or updating of the file as new or more refined data become available. The File is a must for reference libraries and for those working on reflectance measurements.

JAMES R. CRAIG
*Virginia Polytechnic Institute
and State University*

CARBONATITE-NEPHELINITE VOLCANISM: AN AFRICAN CASE HISTORY. By Michael John Le Bas. Wiley-Interscience, 1977. 347 pages, 94 figures, 23 tables, 21 plates, and 2 appendices. \$48.

As the subtitle indicates, this is not a monograph on carbonatite-nephelinite volcanism in general. It is essentially a geological description of a small area (60 km × 60 km) on the shore of Lake Victoria, western Kenya, which is remarkable in its close association of six separate ijolite intrusions, eight carbonatitic intrusive centers in various stages of denudation, several styles of fenitization and extensive nephelinite-phonolite volcanism. These magmatic events range from Oligocene to Recent in age. Some of the complexes (Rangwa, Ruri, and Homa Mountain) are known to students of carbonatites through the earlier investigations of Pulfrey, Saggerson and McCall, while neighboring centers in Uganda described by Davies, King and others (Sukulu, Tororo, Bukusu, Butiriku, Budeda, Elgon, Kadam, Napak, and Toror) belong to the same petrographic province but are not included in this study. Surely there are few areas in the world, if any, better suited to an appraisal of the relationship between carbonatite and nephelinite magmatism.

Several authors have contributed to this volume. They were members of a research team from Bedford College, London (B. A. Collins and A. L. Findlay) and Leicester University (M. J. Le Bas, M. C. G. Clarke, J. A. Dixon, A. M. Flegg, and D. C. Rubie) who did the field work over a six-year period, 1963-1969. D. S. Sutherland collaborated on Homa Mountain. M. J. Le Bas took up the task of compiling the results, mainly from five Ph.D. theses which may otherwise have remained unpublished, and did so very skillfully. Contradictions and inconsistencies which may have existed

have been removed and the reader is presented with a coherent story. Descriptions of field relations and petrography can be very tedious, yet provide essential facts: this has been relieved by dividing the book into a series of 24 short chapters, some very short indeed, each headed by a brief abstract. The style of writing is lucid and the text is well illustrated, mostly by maps at different scales. This device obviated the necessity of a large map covering the whole area, presumably also cutting down publishing costs; it would have been interesting to learn whether a colored map exists elsewhere.

Alkaline complexes are striking for their similarity despite their diversity of rock types. Many old acquaintances from Alnö, Fen, Spitskop, Oka, Iron Hill, and Magnet Cove are met again here in Kenya. Features that appear to be somewhat exceptional are the high abundances of melanjite garnet in some of the ijolites and of wollastonite in urtite. Melilite shows interesting compositional differences in different rocks (uncompahgrite, turjaite, melilitite, olivine-melilitite). This is ascribed to temperature differences during crystallization and to metasomatism. Although no particular attention is paid to mineralogy, compositional data based on microprobe analyses of the rock-forming minerals are dispersed through the text. Among the less common minerals mentioned are nosean, monazite, eucolite, cebollite, bastnaesite, synchysite, and götzenite. Strontium isotope ratios and Rb, Sr, Ba, Zr, Nb, Y analyses of twelve representative rock samples are included, but the detailed discussion of the geochemistry is deferred for publication elsewhere. In an appendix 200 major oxide chemical analyses are given (most of them new).

The author has been able to draw up a detailed sequence of events between 22 and 1 m.y. ago, based on numerous K-Ar age determinations. What it amounts to is a repetition of the sequence ijolite (or melanephelinite)-carbonatite, with minor eruptions of phonolite. The fenitization effects associated with each phase could be better distinguished than in most other localities because they are not superimposed. Ijolite is magmatic, not an ultrafenite. The formation of nepheline syenite is ascribed to reaction between ijolite magma and its fenitized wall rock: an interesting hypothesis apparently supported by the field evidence. The carbonatites are considered to belong to a crystallization differentiation series between 600° and 100°C in the order sövite-alkivite-ferrocarbonatite-alkivite. Structurally the most remarkable feature in the area is the spiral-shaped system of carbonatite cone-sheets on Homa Mountain; however, no attempt is made to explain the mechanism by which it was formed.

There are a number of proofreading errors (*e.g.* diamantiferous on p. 3, 4, 7, 8, 10; divine for olivine on p. 97; transposition of lines at top of p. 216; chadocrysts on p. 218; N₂O for Na₂O on fig. 14.14; no scale on figs. 14.1 and 17.2 and incomplete legend on fig. 17.2). What is "ankeritic calcite" (p. 107)? More incomprehensible are the references (p. 9, 11) to a Kimberley-Pretoria (South Africa) carbonatite-nephelinite-kimberlite province of Mesozoic age. The "simplified classification" of carbonatites offered on p. 37 is not really new except for the introduction of the term ferrocarbonatite. This is useful and could be extended to include ferrosövite and ferrobeforsite; dolomitic carbonatite may not be important in East Africa but certainly occurs elsewhere.

In the last two chapters the relevant literature is reviewed and a genetic hypothesis formulated. A fundamental distinction is made between olivine-poor nephelinites which characterize the carbonatitic association and olivine-rich nephelinites associated with basaltic provinces. With regard to carbonatite the author favours the derivative "egg" rather than the "hen" concept but concludes, with

most recent observers, that there are "carbonatites and carbonatites" if so-called kimberlitic carbonatite is to be included. He considers volatile-rich alkaline ultramafic magma (carbonated melanephelinite), derived by small-scale melting and segregation at 100–200 km depth below a stable continental plate, as the most likely parent of several different magmatic associations characteristic of this tectonic environment.

Whether the author succeeded in his aim "to establish the field relations and petrological processes involved in the evolution of carbonatitic and nephelinitic magmas in a type area, to show that such magmatism can develop independently of basalt magmas, and to suggest that carbonatite-nephelinite magmatism is a normal product of partial melting deep in the upper mantle which can happen beneath any continent in the world," will have to await judgement until someone has made a detailed comparison of all carbonatite-nephelinite provinces. Meanwhile this book is a very important contribution to the subject and is recommended to all petrologists.

W. J. VERWOERD
Geophysical Laboratory

METEORITE CRATERS. Edited by G. J. H. McCall. *Benchmark Papers in Geology*, Vol. 36. Dowden, Hutchinson, and Ross Inc. Stroudsburg, Pa. (Halsted Press), 1977. 364 pages. \$35.00.

This book is a compendium of 29 papers dating back to 1931, describing twelve proven, eight probable and one possible meteorite impact craters (according to the editor's classification scheme), and in some cases their associated meteoritic and shock-metamorphosed materials. A final page carries scanty descriptions of sixteen other craterforms of enigmatic origin. Six of the papers are abridged and 2 plus are merely editorial summaries. Editorial comments on all the papers are interspersed through the book and the editor also attempts to synthesize data from other pertinent papers not included in this volume. The avowed purpose of such a collection is to bring together key papers in the field as a practical solution to the "critical" retrieval problems caused by the vast, dispersed, and in the case of many older papers, simply inaccessible literature.

The quality of the selected papers ranges from excellent to "why did he resurrect this old chestnut?" Two-thirds of them should be readily accessible in their original publications and most of the remaining third could be "retrieved" without undue strain in this age of interlibrary loans and the ubiquitous Xerox machine.

The only term for the editor's contribution that comes readily to mind is "sloppy". His comments on the included papers are often little more than paraphrases—with metric units substituted for the original English units. Aside from the redundancy generated, this gives the editor the opportunity to erroneously convert the diameter of Bosumtwi Crater from 6½ miles to 17 kilometers and the diameter of the included lake from 5 miles to 13 kilometers. The section on Aouelloul Crater, flatly asserted to be based on the editor's translation from the French of a paper by Monod, is largely a summary of part of a much later paper that I co-authored (Fudali and Cassidy, 1972), and contains some wild inaccuracies. A short editorial summary paper on the Wabar Craters, supposedly taken from an excluded paper by Krinov, is almost an exact duplicate of the Wabar description in the included Krinov paper. Not only have the most comprehensive and informative papers on Roten Kamm (Fudali, 1973) and the Pretoria Salt Pan (Fudali *et al.*, 1973) been omitted, but the editor is apparently unaware of

their existence. The editor also seems unaware of the facts regarding many of the structures he has classified. For example his criteria for class II structures (probable) is that they be obvious craterforms that exhibit shock metamorphism. But of the eight structures he so classifies, indisputable shock effects have *not* been found to date at three—Roten Kamm, the Pretoria Salt Pan, and Talemzane. And at a fourth—New Quebec—only one small piece of float (glassy impactite) has been found. Finally, an interesting and important crater which does meet these criteria, Tenoumer (Fudali, 1974), is inexplicably excluded from class II and from consideration in this book. The net effect is to leave me wondering how many of the sections with which I am less familiar have been done as carelessly.

Considering the uneven nature of the (already published) selections, the unfortunate editorial contribution, and the price, I do not believe the cause of convenience is well served by this book. But then I may not be entirely objective in this assessment.

References

- Fudali, R. F. and W. A. Cassidy (1972) Gravity reconnaissance at three Mauritanian craters of explosive origin. *Meteoritics*, 7, 51–70.
 — (1973) Roten Kamm: evidence for an impact origin. *Meteoritics*, 8, 245–257.
 —, D. P. Gold and J. J. Gurney (1973) The Pretoria Salt Pan: astrobleme or cryptovolcano? *J. Geol.*, 81, 495–507.
 — (1974) Genesis of the melt rocks at Tenoumer Crater, Mauritania. *J. Geophys. Res.*, 74, 2115–2121.

R. F. FUDALI
Smithsonian Institution

THE MINERALOGY OF THE DIAMOND. By Yu L. Orlov. Translation of "Mineralogiia Almaza" 1973. John Wiley & Sons, New York, 1977. x + 235 pages. \$28.50.

Perhaps a more apt title would have been "The Physics and Mineralogy of the Diamond," since Orlov has assembled in one small volume (208 pages) a great deal of information concerning the classification, chemical composition, crystallography, physics, genesis, and occurrence of diamond.

Although the author indicates the text was updated since publication of the Russian edition, it is apparent that, apart from a cursory addition of a few references between 1973 and 1976 in chapter X on the genesis of diamond, little has been added. This is somewhat of a pity as it "dates" the work. In terms of kimberlite and diamond genesis considerable information has been obtained since 1973, and judging by some of the references cited by the author he was undoubtedly aware of these later works. Nevertheless, as a source of references concerning diamond prior to 1973 it is possible that Orlov has made a major contribution.

The text as a whole is well written and is extremely readable, with relatively few typographical errors. The discussion of the different varieties of diamond is well illustrated with photographs that aid in clarifying the text. Especially useful to non-Russian scientists is the information describing which diamond varieties are found in the various Russian kimberlites. One obvious drawback of this section is the limited access Orlov has had to examine parcels of diamonds from localities outside Russia. It would have been convenient if there had been a table listing varieties, types, and characteristic properties for the classification Orlov proposes.

The chapter concerned with the structure of diamond is a concise history of the arguments that have raged concerning the correct assignment of symmetry to the diamond. Also discussed is the hexagonal modification of diamond—lonsdaleite. Interestingly, Orlov accepts Skinner's (1957) average value for the cell dimension of diamond over that obtained by Lonsdale (1947) and Wright (1965). The latter authors used a Kossel line X-ray diffraction technique that has inherently greater accuracy than that used by Skinner.

In discussing the presence of chemical elements in diamond a glaring omission is the absence of any discussion regarding sulfur. This section would also have been improved by some form of table listing the various elements, their concentrations, and varietal diamond types.

Considerable discussion is given to the presence of N_2 in diamond. Since this element is the major impurity in most diamonds and also appears to govern many of the physical properties, such discussion is reasonable. However, at the present time the most recent studies generally agree that the platelets in type 1a diamonds are not due to N_2 . Where the N_2 is and what constitutes the platelets is a major problem in the physics of diamond.

The largest chapter (V) is concerned with the morphology of diamond. This is perhaps the major research topic of Orlov and a previous book he wrote was on this topic. In this chapter he answers some of the Russian critics of his previous work.

In reviewing previous work Orlov is generally objective, but in other aspects a considerable amount of subjective thought is presented as fact. For example, many mineralogists would be hesitant to accept that green spots on diamond are the result of diffusion by elements into the diamond. Orlov's dismissal of an origin by proximity to radioactive minerals is not altogether in keeping with geological evidence. Also, the absence of reference to many non-Russian pioneers of kimberlite and diamond work is inexcusable. Typical of this is the reference to Vladimirov *et al.* (1976) concerning the use of the diopside—enstatite geothermometer and the Al_2O_3 —enstatite geobarometer. Undoubtedly Boyd (1973) and MacGregor (1973) should have been credited. Also, when discussing the separation of mineral inclusions in diamond into two parageneses little note is made of the first observation of this division by Meyer and Boyd (1968, 1969, and 1972).

One or two other errors have crept in. For example, the American, Kimberlite, and Black Lick kimberlites (not Ick as in the text, p. 160; also Sinkankas not Sinkansas) are northeast of the Prairie Creek kimberlite, Arkansas and not south. Where are the reports of recent diamond-bearing kimberlites in Spain (p. 161)? Not all kimberlites in Africa are Mesozoic (p. 162), and the presence of diamonds in kimberlite dikes has been known for a considerable time, and not just recently as stated on p. 163. Also, phyllites are hardly "strongly metamorphosed" (p. 165).

However, I would be remiss to harp on the errors and inaccuracies in the text and not praise the author for his excellent compilation of data and facts regarding diamond. It is probable that further works on the physics, chemistry, and mineralogy of diamond will rely heavily on this text as a source reference. For this reason, as well as the general readability and the author's wide knowledge of the Russian diamond literature, I recommend this text for anyone interested in diamond research.

HENRY O. A. MEYER
Purdue University

CRYSTAL STRUCTURE DATA OF ORGANIC COMPOUNDS. By Wolfgang Pies and Alarich Weiss. Volume 7, Part f of *Landolt-Börnstein: Numerical Data and Functional Relationships in Science and Technology*, edited by K.-H. Hellwege and A. M. Hellwege. Springer-Verlag, Berlin, 1977. xxvi + 778 pages, 14 figures. DM 780, approx. \$343.

See reviews of volume III/7, parts a, b, e and g (*Am. Mineral.* 59, 1142; 61, 344; 61, 817). Part f extends the coverage to 4079 oxy-compounds of Cr, Mo, W, Mn, Tc, Re, Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, and Pt (not including simple oxides or hydroxides, which were covered in part b). For each compound the formula, space group, cell dimensions, cell content, calculated and observed specific gravity, and (if available) structure type, crystal form, and refractive indices are given. The data content per page is high, but the price of the volume is a severe limitation on possible purchases.

BRIAN MASON
Smithsonian Institution

LAUE ATLAS: PLOTTED LAUE BACK-REFLECTION PATTERNS OF THE ELEMENTS, THE COMPOUNDS RX AND RX_2 . By Eduard Preuss, Bernhard Krahl-Urban and Rainer Butz. Edited by Kemforschungsanlage Jülich. John Wiley and Sons (Halsted Press), New York, 1974. 432 pages. \$49.50.

This book presents a new and simplified method for the orientation of single crystals, based on the direct comparison of Laue patterns with Laue diagrams plotted by a computer. It is intended for solid-state physicists, crystallographers, mineralogists, and other scientists who are engaged in materials science involving crystal orientation. Chapter 1 is a survey of the main properties of periodic structures. Chapter 2 discusses diffractions by crystals in terms of Bragg's Law, and outlines the intensity calculation used in the computer program. Chapters 3–5 describe the crystal structures of the elements and of the most important RX and RX_2 compounds. The plotting program is given in Chapter 6 and the orientation of single crystals is treated in Chapter 7. Chapter 8 (plots of Laue patterns of the elements) forms the bulk of the book (p. 76–349), followed by Chapter 9, RX compounds (p. 350–380) and Chapter 10, RX_2 compounds (p. 380–429). This book should be especially useful to metallurgists and other scientists working on elements and alloys.

BRIAN MASON
Smithsonian Institution

ANNOTATED BIBLIOGRAPHY OF MINERALS NEW TO THE PENNSYLVANIA LIST, 1965–1974. By Juliet C. Reed. The Mineralogical Society of Pennsylvania, 336 Rockland Road, Wayne, Pennsylvania 19087. 83 pages. \$2.75, plus \$0.50 postage and handling.

This book has been sponsored and subsidized by the Mineralogical Society of Pennsylvania, a largely amateur group of mineral collectors; the Society previously sponsored *The Mineralogy of Pennsylvania, 1922–1965*, by Arthur Montgomery (reviewed in *Am. Mineral.*, 56, 364, 1971). After a brief introduction, and a useful section on mineralogical nomenclature, the main part of the book consists of an alphabetical listing of 56 species, ranging from

acanthite to violarite. For each species the following data are provided: locality, host rock, collector, identifier, literature references, and references to the species in selected textbooks and handbooks. Thirteen of the species have been found on burning culm (refuse) banks at anthracite mines in NE Pennsylvania. This is a very useful publication for anyone interested in regional mineralogy, and for those wishing to collect in Pennsylvania.

This book, and Arthur Montgomery's *The Mineralogy of Pennsylvania, 1922-1965*, are free to any library on request to the Society.

BRIAN MASON
Smithsonian Institution

MINERALOGISCHE TABELLEN, 6th corrected edition. By Hugo Strunz with the collaboration of Christel Tennyson. Akademische Verlagsgesellschaft Geest und Portig K.-G., Leipzig, 1977. vii + 621 pages, 101 figures. 47 DM, approx. \$23.

Having been an appreciative user of this book since the first edition appeared in 1941, I opened this sixth edition with keen anticipation. Yes, it is considerably thicker than the fifth edition, and I looked eagerly in the index for such recently-described minerals as pyroxferroite and tranquillityite. They were not there! Comparison with my copy of the fifth edition then revealed that this so-called sixth edition is an exact photocopy of the previous edition, save for the substitution of sixth edition for fifth edition at two appropriate places in the Preface, and a new title page. The additional thickness results from the use of a different grade of paper. So if you already have the fifth edition you don't need the sixth. However, if you don't have the fifth edition, then the sixth provides a comprehensive listing of all well-characterized minerals up to 1969, including the reference to the first describer and the year of description, the chemical formula, symmetry, cell dimensions, cell contents, and short explanations of the structure type.

BRIAN MASON
Smithsonian Institution

CLAYS AND CLAY MINERALS IN NATURAL AND SYNTHETIC SYSTEMS. By Bruce Velde. Elsevier Scientific Publishing Company, P. O. Box 211, Amsterdam, The Netherlands, and 52 Vanderbilt Ave., New York, NY 10017, 1977. 218 pages, 50 figures, 3 tables, 418 references. \$25.50.

This book attempts to present a general outline of clay petrology. Both clay minerals and zeolites are included. In general the approach is to plot the compositions of natural clays on composition diagrams, such as the ternary diagram $M^+R^{3+}-2R^{3+}-3R^{2+}$ and then to draw tie lines between compatible phases. Compatibility under given P - T conditions is inferred from phase relations found in hydrothermal experiments and from natural associations. The hope is that the phase diagrams thus constructed can be used to describe clay mineral petrogenesis.

This chemiographic approach implies that the synthetic and natural assemblages used to construct the diagrams were at equilibrium. How do we know they were at equilibrium? The author offers two practical criteria: (1) for synthesis experiments run between 200° and 400°C, run times must be at least one month; and (2) for natural minerals, neoformed phases are probably stable, whereas detrital clays frequently represent conditions found at the

source area. Using these criteria the author feels it is possible to establish the "effective stability" of an assemblage even though the assemblage may not represent a true thermodynamically stable equilibrium.

The author cautions that the phase diagrams may not be correct; and the reader may well beware, since the approach ignores reaction kinetics. From the reviewer's experience, a run time of one month is often insufficient to approach equilibrium. For example, measured rate constants suggest that a K-beidellite starting composition would take 6 years to approach the probable equilibrium assemblage of illite, kaolinite, and quartz at 260°C and 2 kbar pressure. With such sluggish rates, the path of the reaction becomes important. The use of metastable phases formed after one month of reaction along this path leads to incorrect diagrams.

A second criticism concerns the use of the coordinates $M^+R^{3+}-2R^{3+}-3R^{2+}$ to represent clay systems. Such a simplification does not distinguish between different interlayer cations, and interlayer chemistry has recently been found to be an important variable for describing clay petrogenesis. Finally, it would have been interesting had the author used thermochemical approximations to help delineate reaction boundaries. On the other hand, we are warned that "... the intent of this essay is not perfect symmetry nor total rigor..." The approach is practical, whereas a more rigorous approach of similar scope may not be possible.

DENNIS EBERL
*University of Illinois
at Urbana-Champaign*

ELEMENTARY THERMODYNAMICS FOR GEOLOGISTS.

By B. J. Wood and D. G. Fraser. Oxford University Press, New York, 1977. xii + 303 pages. \$12.50 cloth, \$6.50 paper.

According to the preface the authors' intent is to "introduce the uninitiated reader to a rapidly growing branch of geology without a lengthy initial treatment of classical thermodynamics" and "that the reader will be able to use this book as a work-shop manual for the subject."

The book consists of seven chapters: Introduction and definitions, Standard states activities and fugacities, Multicomponent solids and fluids, Geothermometry and geobarometry, Silicate melts, Behaviour of trace components, Estimation of thermodynamic data, Thermodynamic properties of gas (Appendix). Most chapters end with a summary, problems, and solutions to the problems. The text is reproduced directly from typescript on a rather poor-quality paper.

The authors' approach is somewhat parochial. Except for the graphite-diamond equilibrium, virtually all of the worked problems involve only binary or multiple oxide phases. There are, unfortunately, no examples of problems concerned with aqueous equilibria or of reactions involving both silicates (or oxides) and sulfides, not problems involving changes in oxidation state, *i.e.*, fO_2 , dependence. There is only a miniscule discussion of calorimetry. This reviewer found the chapters on silicate melts and trace components the most useful.

Several factual errors were noted. Among the more blatant are:

- p. 23. C_p does not approach a constant at high temperatures, C_v does. Equation 1.27 is only a rough approximation to the behaviour of C_p at high temperatures.
- p. 25. Example 1 is bound to confuse the student. It starts out with

the incorrect premise that an absolute value can be assigned to H_{298} . It cannot! The value $-937146 \text{ cal mol}^{-1}$ is actually $\Delta H_{f,298}^0$ of low albite, *i.e.*, the enthalpy of formation from the elements at 298.15 K. If we assume that the value of H_{900} , which the authors intended to calculate, was the enthalpy of formation, then to $\Delta H_{f,298}^0$ we must add $\int_{298}^{900} \Delta C_p dT$ where ΔC_p means C_p (albite) $- \sum C_p$ (component elements).

- p. 39 Equation 1.53 needs some explanation as to how one converts the term $(V-V_{ox})$ into the same units as entropy.
- p.-43 Item 6 is a rather incomplete statement of the Third Law. Analbite and ice are both *pure* crystalline phases but their entropies are not given by $\int_0^T C_p/T dT$. This function gives only the change in the entropy between 0 and T .
- p. 82. In pure FeO the entropy is *not* solely thermal. At 298 K approximately 20 percent of S_{298}^0 is due to the ordering of the magnetic moments of the Fe^{2+} ions.

Despite these criticisms, this book should find use as an auxiliary text for a senior undergraduate course in petrology in that it shows the beginning student how quantitative solutions to complex equilibria may be calculated, provided that accurate thermodynamic data are available.

Inasmuch as the introduction presupposes no previous exposure to thermodynamics, the omission of a reference to a standard text in the bibliography seems surprising, and I believe that a student without some previous exposure to a standard course in thermodynamics will not really be able to use it as a "shop manual."

RICHARD A. ROBIE
U.S. Geological Survey
Reston, Virginia

MINERAL RAW MATERIALS. Edited by F. Bender. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, Germany, 1977. v + 136 pages, 51 figures, 15 tables. DM 48, approx. \$25.

This book is the proceedings of an international symposium held in Germany in October 1976. After an introduction (4 p.) it consists of the following chapters: Raw material supply—challenge and chance for economy and state (8 p.); Exploration for and exploitation of crude oil in the Federal Republic of Germany (6 p.); The role of oil and natural gas in the energy balance (4 p.); Natural gas supplies of the future (14 p.); Modern methods for the exploration and planning of lignite deposits (15 p.); Uranium availability and where and how to find additional supplies (11 p.); Coal, its world-wide availability and importance (27 p.); Sand, gravel, and related raw materials (14 p.); The technical and economic significance of the most important non-metallic mineral raw materials to modern industry (11 p.); An earth scientist's view of metallic resources (19 p.). Each chapter is authored by a specialist in the respective field. The title is somewhat misleading, since except for the chapter on uranium, the book is concerned only with non-metallic mineral raw materials, and mainly with fuels. The price is high for a softbound book of 136 pages. No index is provided.

BRIAN MASON
Smithsonian Institution

OPHIOLITES. By Robert G. Coleman. Springer-Verlag, New York, 1977. ix + 229 pages. \$31.30.

During the past decade, interest in ophiolites has increased enormously. The rocks of "Steinmann's Trinity" have been known for many years as a field association of serpentinite, diabase-spilite, and chert. The advent of plate-tectonic theories in the 1960's coincided with renewed studies of ophiolite assemblages at classic localities such as the Troodos complex in Cyprus, the Papuan ophiolite in New Guinea, and the Vourinos complex in Greece. These studies reinterpreted the ophiolite assemblage as representing allochthonous blocks of oceanic crust thrust onto continental rocks by crustal plate interactions. More recent field studies and international conferences (The Penrose Conference on Ophiolites in 1972 in the western United States and the Symposium on Ophiolites in Moscow in 1973) have produced new and valuable information and achieved some consensus among geologists as to the definition and general origin of ophiolites. The publication at this time of the book *Ophiolites* by R. G. Coleman is a noteworthy event, coming at a stage of critical transition from broadly descriptive studies to more detailed and problem-focused studies that must characterize the next stage of geologic research on ophiolites.

The general style and presentation of the subject is attractive and very readable with considerable balance in subject matter. There are chapters on igneous and metamorphic petrology, ore deposits associated with ophiolites, and the geologic character, plate tectonics, and emplacement tectonics of ophiolites. The book concludes with a lucid presentation of the complex geologic, tectonic, and petrologic nature of four examples: the Bay of Islands, Troodos, Semail, and Papua ophiolites.

Throughout the book, there is a general absence of dogmatism regarding the subject. This is emphasized in the subtitle for the book: *Ancient Oceanic Lithosphere?* The author repeatedly reminds us that there are no examples of ophiolites currently being obducted onto plate margins and that the arguments for ophiolites representing oceanic lithosphere must be by analogies. Likewise, he is careful to point out the many gaps in our knowledge on the chemical and physical properties of ophiolites, the serious problems associated with metamorphism and alteration of many of the rock units, and the difficulty in finding critical contacts in many areas as a result of structural complications. He does, however, clearly lead us through his own carefully considered conclusions, some of which will be disputed by other specialists on ophiolites. These include the following: the ophiolite assemblages are polygenetic and the tectonized peridotite at the base of the sequence cannot represent the refractory residue left from the melting event that produced the overlying gabbros and lavas. The peridotites are, however, the residua of much older partial melting and deep-seated metamorphism. The younger gabbros are comagmatic with the sheeted dikes and lavas, a conclusion that is based on geochemical similarity despite the scarcity of well-exposed contacts between gabbro and sheeted dikes or of field relations showing dike sequences clearly intruding the deeper levels of gabbro. The composition of the parent magma for the gabbro-diabase-lava sequence has not been determined. The author argues forcefully that pervasive metamorphism and alteration of bulk composition prevent a successful chemical classification of ophiolites based on our present understanding of the compositions of the sheeted dikes and lavas. He rejects the idea of a separate spilite magma type, and on the other hand he accepts the idea that plagiogranite rocks are true igneous differentiates of gabbro. I do not concur with his tentative acceptance of the idea that high-aluminum low-chromium chromite in peridotite indicates high-pressure equilibrium, whereas low-aluminum high-chromium chromite represents a low-pressure equilibrium. This is clearly not the case in Canyon Mountain,

Oregon, Cuba, and the Philippines. In these places high-aluminum chromite occurs very near the gabbro-peridotite contact and, by analogy with oceanic crust models, at a depth of only about 6 km. High-aluminum chromite also occurs within the cumulate gabbro section in the Bay of Islands ophiolite in Newfoundland, which also is not of high-pressure origin.

Students of ophiolites will find the book especially valuable for its focus on the principal areas of needed research. One cannot help but be made aware of the repeated observations that field relationships in many areas remain poorly known, that geochemical studies on complete sequences have not been published, that systematic mineralogical studies of sheeted dikes have not been made, and that cyclic units and compositions of cumulus phases have not been worked out in the cumulus sections of gabbro. The authoritative manner in which the author has outlined the present status of research on ophiolites should help to influence and mould the course of investigations over the next several years. Some of this needed data is beginning to appear in studies completed too late to appear in the present volume. Some examples include the careful study on the internal structure of the Troodos ultramafic rocks by R. P. George, the petrologic studies on the Bay of Islands by John Malpas, the study of the seismic properties of the Bay of Islands ultramafic rocks by N. I. Christensen, and the current work on the Semail ophiolite by Ian Gass and J. D. Smewing and by C. A. Hopson, E. H. Bailey, and R. G. Coleman himself. As a guide for future studies of these rocks, *Ophiolites* is an invaluable book for careful reading and consideration. It also serves as an excellent introduction to the subject for the student as well as for the general reader.

BENJAMIN A. MORGAN
U.S. Geological Survey
Reston, Virginia

MANUAL OF MINERALOGY, 19TH EDITION, By C. S. Hurlbut and C. Klein. John Wiley and Sons, New York, 1977, xi + 532 pages, \$19.95.

The original edition of "Dana's Manual" was written in 1848 by James Dwight Dana. The fact that the present edition is the 19th testifies both to the continuing popularity of the book, and to the willingness of various authors, namely William E. Ford (13th and 14th editions), Cornelius S. Hurlbut, Jr. (15th through 19th), and Cornelis Klein (19th) to keep it up to date.

The character of the book may be due to this continued process of revision: it is comprehensive, rather than intensive. Virtually every subject pertinent to mineralogy is discussed, including history of the science, traditional morphological crystallography, X-ray crystallography, crystal chemistry, physical and optical properties of minerals, systematic mineralogy (according to Dana's classification), an introduction to petrology, and determinative tables for hand-specimen identification of minerals. Naturally, with a coverage this broad, no single subject can be dealt with at length. Instructors who use the book as the basis for an introductory course will probably desire to supplement it in their favorite fields. Nevertheless, the authors have managed to present and explain most of the important concepts in each field. The writing is concise and understandable, and illustrations are generally clear and useful although a few of them contain too much detail.

Besides considerable reorganization and rewriting, the 19th edition differs from the 18th chiefly in the addition of descriptions of

the crystal structures of individual minerals. The lack of such up-to-date, concise descriptions has been a serious deficiency not only of introductory textbooks, but of reference works of mineralogy. The descriptions are accompanied by illustrations which are good on the whole, considering the limitations of two-dimensional representation of structures. This edition also includes a section on phase equilibria. The crystal-chemistry section has been expanded and a table of ionic radii added.

Although updating of the book has been commendable, a few sections still retain some obsolescent material. The discussion of external forms in the crystal systems is perhaps overly exhaustive, and probably not many will use the blowpipe and chemical tests in an age of readily available X-ray and optical techniques. A short section on determination of crystal structures has been added, but it is doubtful if anyone could obtain from this book a clear idea of the process of finding the unit-cell shape, size, and contents, and atomic arrangement of an unknown crystal. Space groups are discussed, but there is no mention of how they are determined, or how they are used in determining and describing crystal structure.

Dana's *Manual* will undoubtedly continue to be a popular introductory text, and a valuable reference for geologists and amateur mineralogists.

ERIC DOWTY
Princeton University

SEVENTH CONFERENCE ON CLAY MINERALOGY AND PETROLOGY IN KARLOVY VARY. Edited by J. Konta. Univerzita Karlovy Vary, 1976. 496 pages, Kcs 70.

This nicely printed and bound volume contains sixty-two of the papers presented at a three-day conference held in Karlovy Vary, Czechoslovakia, in the fall of 1976. Most of the papers are in English (mainly very good English), a few are in German and Russian, and one is in French. This conference was the seventh in a series of triennial conferences which aim at bringing together clay mineralogists and petrologists from Czechoslovakia and neighboring countries; in 1976 there was a sprinkling of participants from further afield including two (J. L. White and myself) from the USA. It is interesting to see the growth of this triennial meeting since 1964 as judged by the size of the Conference volumes: 1964, 135 p; 1967, 145 p; 1970, 160 p; 1973, 414 p; and in 1976, 497 p. Evidently clay mineralogy prospers in east European countries as well as in west.

The topics in the present volume cover a broad spectrum. The majority can be classified under the headings of mineralogy, geology-petrology, geochemistry, and soil science. Not surprisingly in view of the importance of the ceramic industries in Czechoslovakia, many papers deal with kaolinite and include studies of the geology of kaolinite formations, the dehydroxylation kinetics, the mechanism of dehydroxylation, hydrothermal synthesis, organic reactions, Three papers, which include my own introductory lecture, deal with order-disorder and polytypism in layer silicates. Any selection of particular topics for special mention must involve a personal bias, but having acknowledged this, I can now mention the interesting paper of J. J. Fripiat on the surface properties of clays, in which he reviews the relations between surface charge, surface area, and surface reactions, all of which influence (or control) many of the technological applications. The nature of the clay minerals in the cement of oil- and

gas-bearing sandstones is discussed by Kulesza-Wiewiora and Myslinska; they point out the presence of kaolinite (dickite), illite, and chlorite, and essentially no water-swelling minerals; the results are correlated with the porosity of the rocks. Perhaps the most useful comment I can make concerns this series of publications as a whole. It has been growing now for twenty years under the editorship of Professor Jiri Konta, who must be congratulated for its progress. It opens a window to clay-mineral studies in countries and areas which are less accessible through other channels.

G. W. BRINDLEY
Pennsylvania State University

STRUCTURE DETERMINATION BY X-RAY CRYSTALLOGRAPHY. By M. F. C. Ladd and R. A. Palmer. Plenum Press, New York, 1977. xvi + 393 pages. \$29.50.

This text is designed to be used by a senior to first-year graduate student class in introductory X-ray crystallography. As such it follows rather standard development, with two beginning chapters on symmetry theory followed by chapters on fundamental diffraction relations with one devoted entirely to intensity relations, followed by four chapters dealing with general aspects of crystal structure analysis, the last of which is a review of several representative structure analyses. Although the sequence of development is rather standard, the emphasis placed on various aspects is not, and this has both positive and negative results insofar as its use in mineralogy-geology courses in X-ray diffraction is concerned.

In mineralogy curricula symmetry theory is generally emphasized, starting at the introductory mineralogy level, where a major part of most courses is devoted to it in comparison with the study of solids in chemistry and especially in metallurgy and ceramics curricula. It is essential that students have a firm grounding in symmetry theory through at least space groups in order to be able to handle the kinds of X-ray diffraction problems normally encountered by X-ray mineralogists. Thus it is a real pleasure to see in this text more than the usual token introductory review of symmetry relations. A full 98 pages is devoted to the subject. The flavor is decidedly a familiar mineralogical one, with even a brief mention of the measurement of interfacial angles and the use of the Wulff net. Furthermore, the remaining text makes full and ample use of the developed symmetry theory. The mineralogical flavor is continued in the subsequent chapter dealing with pre-structure analysis of the crystal, where several pages are devoted to elementary aspects of examination of crystals with a polarizing microscope. The treatment is only introductory to be sure, but is representative of the consistency with mineralogical needs. One aspect of the symmetry treatment which might cause some readers some problems is the unfamiliar symbolism associated with many variables, for example the use of d^* for the reciprocal of d , but with the exception of that example beginning students should have few problems.

Mineralogical courses in X-ray diffraction tend to be oriented toward either in-laboratory experience or at least practical data interpretation, and it is in this region that many will find this text deficient. Diffraction relations for selected kinds of instrumentation are hardly more than mentioned. Approximately four pages are devoted to the precession and Weissenberg methods, for example, which is barely enough to explain their general natures. The Laue method and indexing of oscillating-crystal photographs are given slightly more space, but these methods are not much used.

The lack of treatment of experimental techniques is carried over into structure analysis, where the methods of measurement of intensity data and theory for correction for various factors are only introduced.

The sections on principles of structure analysis describe adequately the necessary introductory theory. A very positive aspect of this section is the emphasis on analyses of structures using simple examples. The final chapter is entirely devoted to examples. There is therefore, unfortunately, little space available for an in-depth analysis of techniques and theory and, for example, mineralogists who are often concerned with refinements of known crystal structure would prefer other than just an introduction to the general nature of the least-squares technique.

In general this text would find application in formal beginning-level graduate lecture courses in X-ray diffraction, especially those dealing primarily with crystal-structure analyses as opposed to geometry of X-ray diffraction. The full development and use of symmetry theory throughout would make it especially valuable to mineralogists. However, extensive supplementary material would be required in any course where experimental results were obtained and interpreted. The many specific and simple examples, together with the well thought-out and extensive end-of-chapter problems would at the very least make this text a valuable adjunct to existing introductory crystal-structure analysis textbooks.

DONALD R. PEACOR
The University of Michigan

KRISTALLE—WIE SIE WIRKLICH SIND—FORM, FARBE, FEINBAU. By Werner Lieber. Christian Weise Verlag, Munich, West Germany, 1977. 128 p., 74 b&w photos, 54 color photos, 51 line drawings. DM 36, approx. \$18.

This new, lavishly illustrated book delves into the fascinating oddities of the mineral kingdom and explains them in a simplified text augmented by suitable diagrams and photographs. It consists of three major sections, the first primarily dealing with aggregates as well as individual crystals, the second on the nature of atomic structure in crystals and its relationships to form and properties, and the last on color and its various manifestations and their causes. These headings do not, however, indicate fully the scope of each of the sections, for considerable ancillary matter is also introduced. For example, in the first section appear discussions of associations and parageneses (albeit very brief), pseudomorphs, etch and solution marks, and bent or otherwise "distorted" crystals.

The second section adheres fairly closely to its central theme of fine structure in crystals but also includes a substantial treatment of the confirmation of structures by X-rays, their application in crystallographic investigations, defects, causes of "scrolled" crystals in clays and serpentines, and the direct relationships of several physical properties to structure. The third section similarly treats more than color, giving, in addition to an excellent discussion of color centers, material on inclusions and "sand" crystals. This last section is remarkable for a series of splendid color photographs of a succession of color-zoned slices taken from a crystal of Malagasy tourmaline and accompanied by a diagram correlated to the zoning.

While a list of 29 references is provided, it does not include the outstanding work of D. P. Grigor'ev, *Ontogeny of Minerals* (1965) nor the popular work by W. B. Sanborn entitled *Oddities of the*

Mineral World (1976), both of which address themselves to the same theme. Werner's book is both handsome, beautifully and pertinently illustrated, and, even to non-readers of German, a worthwhile addition to the library.

JOHN SINKANKAS
5372 Van Nuys Court
San Diego, California 92109

CRYSTAL GROWTH 1977: Proceedings of the Fifth International Conference on Crystal Growth, Cambridge, MA, July 17-22, 1977. Edited by R. L. Parker, A. A. Chernov, G. W. Cullen, and J. B. Mullin. (Also published as Vol. 42 of the *Journal of Crystal Growth*.) North Holland Publishing Company, Amsterdam, 1977. xvi + 662 pages. \$152.25.

1976 CRYSTAL GROWTH AND MATERIALS: A Selection of Review Papers Presented at the First European Conference on Crystal Growth ECCG-1 and Materials Symposium, Zurich, Switzerland, September 12-18, 1976. Edited by E. Kaldis and H. J. Scheel. Published as Vol. 2 of *Current Topics in Materials Science*, North Holland Publishing Company, Amsterdam, 1977. xvi + 917 pages. \$122.50.

These volumes represent the two most recent major crystal-growth meetings. The international Boston ICCG-5 meeting was run along conventional lines with plenary and triple parallel sessions, and 92 of the 265 talks presented are included in the proceedings. At the European Zurich ECCG-1 meeting only the invited talks were presented orally, the 130 contributed papers being given in poster sessions. The proceedings contain extended versions of 28 out of the 48 invited talks.

This difference in approach leads to a significant difference in the

proceedings. The ICCG-5 papers, averaging seven pages each, give brief reviews of the current state of a wide variety of areas and research topics. The ECCG-1 papers, averaging 33 pages each, give extended reviews (in much more detail than was presented at the meeting) on a more limited range of topics. There is a considerable overlap.

A number of the articles in both volumes are of direct relevance to the mineral/rock scientist. Particular examples occurring in both volumes include the detailed treatment of the capture of inclusions by Chernov *et al.* and the observation and simulation of step structures on NaCl crystals by Bethge *et al.*; the ECCG-1 reports are the more detailed. Oswald and Günter give some examples of topotactic crystallization in ECCG-1, and in ICCG-5 there is a review of natural crystallization by Sunagawa and a report by Lang on the observation of defects in diamond by cathodoluminescence topography.

Either volume would surprise the scientist who has paid no attention to the field of crystal growth for some years. There has been a maturation process occurring on many fronts. Most notable is the successful interpretation of growth processes and growth defects by a variety of computer simulations, leading to new insight into the atomic processes at work; another good example is the superbly controlled growth of large crystals, *e.g.*, a 250 gm flux-grown yttrium iron garnet crystal (respectively Gilmer *et al.* and Tolksdorf in both volumes). There have been similar strides in nucleation and growth, in the application of hydrodynamics to the understanding of growth instability, and in the field of crystal characterization. It is perhaps for the overview of such developments that these books can best be recommended to readers of *The American Mineralogist*.

KURT NASSAU
Bell Laboratories