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BOOK REVIEWS

Atlas of Metamorphic–Metasomatic Textures and Processes. By S.S. Augustithis. Elsevier Science Publishing Co., Inc., P.O. Box 882, Madison Square Station, New York, N.Y. 10159, U.S.A., 1990, 228 + ix pages. US$177.25 (ISBN 0-444-88600-1).

The fundamental nature of metamorphic rocks was recognized in the early years of geology, now nearly two centuries ago. Nevertheless, it is only in the past two decades or so that metamorphic petrology has become a more or less quantitative discipline. This revolutionary change is chiefly the result of the development of the electron microprobe and reversible mineral syntheses at subliquidus conditions in the laboratory. Most (but not all) of what I was taught in courses on metamorphism as a graduate student 30 years ago is now seen to be trivial, inconsequential, or downright wrong. It is with this historical perspective that one must view Prof. Augustithis's latest epic: *Atlas of Metamorphic–Metasomatic Textures and Processes*.

The book consists of four parts: a text that comprises 17 short chapters (85 pages in all), an atlas of 371 black-and-white illustrations that average 7 × 10 cm each (mostly photomicrographs, but including a few field photos and four diagrams and line drawings), a list of 207 references, and two indices (author and subject).

Prof. Augustithis's thesis seems to be that only classical views and "gut-feeling" interpretations of mineral associations and textures will lead the researcher out of the petrographic wilderness. To me, much of what he presents is *déjà vu* – that stuff that largely awed me as a graduate student, but now has long been bypassed. Most of the wonderful things that have made metamorphic rocks fascinating subjects of study are ignored: phase petrology, partition coefficients, trace-element contents, isotope ratios, and the like.

I have many specific criticisms. Much of the text borders on the unintelligible. An example (a complete paragraph from the second chapter): "Considering the complex interrelations over-all pressure (load) increase with depth and stress independent to depth but dependent on crustal and orogenic movements, temperature increase with depth and temperature increase independently to depth but influenced by extraordinary loci; it is theoretically possible that as a result of pressure increase with depth and temperature increase with depth, a depth will be reached where melting could be theoretically possible". It is clear that no editor laid pencil to text or to figure captions. Then, much of the terminology is unique. I challenge the reader of this review to define topometasomatism, streptoblastic, parablastic, velonoblastic, malakton, autocathartic, or interleptonic space. I was able to find definitions of synantetic (= corona structures), leuchtenbergite (an abandoned term for clinochlore), epipysis (= apophysis) and anamorphism [= metamorphism (as opposed to weathering) used by Van Hise in 1904]. Adrift without definitions, the hapless reader is lost at the outset. Of 207 references, only 19 (9%) are less than 10 years old. Too many of Prof. Augustithis's interpretations are cast as statements of fact. Finally, many (most?) of the photomicrographs are recycled directly from the same author's *Atlas of the Textural Patterns of Metamorphosed (Transformed and Deformed) Rocks and their Genetic Significance*, published in 1985 in Athens. The reader who by chance bought the earlier work (in a sturdier binding and at one third the cost of the book here under review) will feel deceived.

No, I cannot recommend this book. For the same cost, buy a second-hand copy of Winkler's fifth edition (for the nuts and bolts of metamorphism), a copy of *Evolution of Metamorphic Belts*, J.S. Daly *et al.*, editors (for some of the really engrossing aspects of today's metamorphic petrology), and a dinner for two.

Tomas Feininger
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Victor Moritz Goldschmidt: Father of Modern Geochemistry. By Brian Mason. The Geochemical Society, Special Publication No. 4, 1992. 184 pp. The Geochemical Society, Division of Sciences, Mathematics and Engineering, Trinity University, 715 Stadium Drive, San Antonio, Texas 78212, U.S.A. US$40 (ISBN 0-941809-03-X).

At the outset, one must say that here is a very readable book, especially for those who have known the name of Goldschmidt and his work in geochemistry. Brian Mason has done a great service in recording, from so many sources, so many facets of Goldschmidt's life and work.

Mason has the good fortune to have known the man about whom he writes, which allows him to bring to life a personality of greatness, without neglecting his weaknesses. Goldschmidt's work in laying the basis of geochemistry, from his recognition of the importance of ionic radius in determining the composition of silicates, to the recognition of the curious relative abundances first of the lanthanides, then of the elements of the periodic table, is so well known that it hardly needs comment.

What is less well known is the character of the man and his influence on those around him. This was especially important in the case of Goldschmidt, as the nature of Nazi persecution affected his life so greatly. It is fascinating to read of his dedication to his work and principles, always until the last moment before he was able to escape to a new environment. Work is only part of the man; Mason has given us an insight into the man.

A useful feature of Mason's arrangement is the very full "footnotes" given frequently, and which add to the interest of the story. Instead of cluttering the pages of the main text, they are placed in an appendix near the end of the book. This allows some quite extended potted biographies of other notable scientists. I found it most interesting to read something of men, then at the height of their profession, whom I had met in my student days.

Another good feature of the book is the simple presentation of technical data, which will make a good deal of sense to historians and other nontechnical readers. For the latter, a clear realization of the value of Goldschmidt's contributions to science thus becomes more evident.

To have known and worked with great men is a privilege; those of us who can look back on such a phase of life are most fortunate. Those who worked with Victor Moritz Goldschmidt were indeed fortunate. Perhaps his work and life can be epitomized in the statement of the British philosopher A.N. Whitehead: "The art of progress is to preserve order amid change, and to preserve change amid order".

The book is nicely produced with a very clear typeface; I would recommend it to anyone interested in great men, especially those connected with the earth sciences.

E.R. Segnit
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A Classification of Igneous Rocks and Glossary of Terms: Recommendations of the International Union of Geological Sciences, Subcommission of the Systematics of Igneous Rocks. Edited by R.W. Le Maitre. Blackwell Scientific Publications, 1989, 193 + xi pages. CDN$63.95. Distributed in Canada by Oxford University Press, 70 Wynford Drive, Don Mills, Ontario M3C 1J9 (ISBN 0-632-02593-X).

Do you need to verify a field boundary in the new IUGS (or "Streckeisen") classification of igneous rocks? No longer will you have to consult your yellowed issue of *Geotimes* from October 1973, look for your battered copy of *Episodes* from June 1989, or leaf through a recent petrology text. You will find the information that you need, and much more, between the covers of the single slim volume here under review.

It all began in 1958 on a suggestion by Ernst Niggli, growing a few years later into an IUGS project, first as a Working Group on Rock Nomenclature and, in 1968, as the Subcommission on the Systematics of Igneous Rocks. This interesting history is detailed in a Foreword by Prof. Albert Streckeisen.

The body of the book is divided into three parts plus appendices. Part A is a brief introduction only a page and a half long. Part B, "Classification and Nomenclature", outlines the philosophy and the nuts and bolts of the recommendations agreed to by the Subcommission for "igneous and igneous-looking" rocks. A sort of descriptive flow-sheet is presented that begins with pyroclastic rocks and tephra, goes on to carbonatites, then to lamprophyric rocks, and to melilitic rocks, to the charnockites, finally to arrive at the dominant plutonic and volcanic rocks. If you have gotten through all this without being able to classify a rock, "either the rock is not igneous or you have made a mistake" (p. 7). Aside from presenting clearly and with careful explanation the various Q–A–P–F–M, TAS, and other diagrams used to find the root names of rocks, many details are given. A few examples: M represents mafic plus accessory minerals; M is M less muscovite, apatite, and the carbonates (hence, M = colour index); m signifies mesoperthite-bearing, as in m-charnockite. Mineral qualifiers may be added as needed and should be given in order of *increasing* abundance. Thus, hornblende–biotite granite contains more biotite than hornblende, and orthopyroxene gabbro is crowded into the clinopyroxene corner of the plag–opx–cpx triangle. This convention goes against my training in metamorphic petrology. Dolerite and diabase are now synonymous. Melilitolite is plutonic, whereas melilitite is volcanic. And so on.

Part C is a richly documented 90-page glossary of 1586 terms. Most are rocks names, but some general terms such as acid, alkali, colour index, and others are included. The glossary runs from A-type granite and abessedite, to zobtenite and zutterite, and includes such monstrosities as topatourbiolilepiquorthite. Not all are there, though, and some of my old pals (beerbachite, xerasite) have been left out. Each entry is accompanied by its source reference, the origin of the term, and where the term is to be found in each of three standard references (Johannsen, Tomkeieff, and Tröger). The 297 entries (19% of the total) accepted by the Subcommission are distinguished by boldface type. A five-page historical analysis, using tables and diagrams, shows the distribution of new rock names with time.

Part D is a bibliography of 787 references, of which only 15 (including one by pioneering Canadian T. Sterry Hunt), all flagged, have not been read by workers on the Subcommission. The references range from Pliny (77 AD) to Streckeisen (1978), and for each, the rock name therein introduced is given in brackets. A discussion that opens the bibliography deals with such trivia as the language under which new rock names have been introduced (English first, followed by German, then French), who introduced them (the winner, Johannsen),

and the principal journals and publishers of new rock names (*Journal of Geology* leads the pack with 109).

The book closes with three appendices: a list of the 50 or so circulars distributed by the Subcommission, the names of the 419 participants of the exercise (22 were Canadians), and the terms approved by the Subcommission. This last appendix is superfluous because all the approved terms are already signaled by boldface type in the glossary.

No index is given; however, as the book in itself is a sort of index, the table of contents (pages v-vi) fills the role adequately.

Clearly, this is a most useful book, and it should be at the fingertips of all hardrock and regional geologists. It is unquestionably the last word on the subject of the classification of igneous rocks. Nevertheless, a few comments are in order. A chapter on earlier classifications, especially the CIPW, and that proposed by Shand (which has immense didactic value), would have added background. No mention was made of the very practical classification proposed by O'Connor of the U.S. Geological Survey in 1965. A recent (1985) glossary on the shelf of many geologists, R.S. Mitchell's "Dictionary of Rocks", was not even mentioned. The text is generally well written, though in places it is repetetive. I found only one typo (SiO2, p. 29), but too many split infinitives.

In summary, put aside my nit-picking and consult this fine book, be it in the classroom, at the microscope, or (as I am now) in the field. You won't be disappointed, whether or not you like the "Streckeisen" classification.

Thomas Feininger
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IMA Catalogue of Software for Mineralogists. Edited by Dorian G.W. Smith. International Mineralogical Association, 1992, 197 pages. May be ordered from: IMA, c/o Prof. D.G.W. Smith, Department of Geology, University of Alberta, Edmonton, Alberta T6G 2E3. US$25 + $6 postage and packing. Payment to be made by international money order for US$31, payable to "IMA (WGDCA)". Soft cover (ISBN 0-88864-803-0).

What do SEXIE, SNOOPI, EELS and ESCHER have in common? All are computer programs with specific applications in mineralogy. A sourcebook of materials, such as the new IMA Catalogue of Software, is analogous to a telephone directory in that most users will refer to only a small proportion of the whole! The book was produced by the Working Group on Databases and Computer Applications of the IMA, following the circulation of questionnaires, which solicited information on relevant programs.

Having spent much of the past four months reviewing the status of computer databases in the Earth Sciences, and being (like many of us) a sometime programmer, I was curious to see how the editor handled the taxonomy of the software, which is as convoluted as many of the "real-world" applications the programs were designed to address. For readers who know exactly what they want, the author/source and software name indices will speed them to their goals. The majority will begin with the contents list, in which a vast range of software is funneled into 21 separate categories. Inevitably, there are some items that seem to defy classification, or that relate to two or more fields. This is acknowledged in the use of cross-references at the end of each section, in the repetition of a number of records, and in the inclusion of a "Miscellaneous" section with 40 entries.

The 21 categories hold some 881 records (including the small number of rather arbitrary repeats, which could usefully be eliminated to make room for a proper applications index). The groupings can be itemized as follows: eight cover aspects of geochemical and mineralogical analysis, five concern aspects of mineral taxonomy, identification, chemistry, curation and teaching, two list a selection of databases and bibliographic software, two contain tools for thermodynamics and thermobarometry, and the remaining four groups access other calculations of interest to mineralogists. Individual sections vary from 6 to 197 records in size, but overlaps remain. The Catalogue is best viewed as a representative sampler of all relevant software: it would be naive to expect a complete analysis in under 200 pages. To cite a Canadian example: the Ontario MDI (Mineral Deposit Inventory) is the only such system listed for Canada, yet there are at least eight such regional MDIs across the country, plus associated files of literature, geochronological, geochemical and other data, all of potential or direct interest to mineralogists. Further, the commercial database programs in the listing are only a very small selection of the range of relevant products in this category. They were presumably cited because they are the choice of correspondents of the IMA project, and not necessarily because they are the "best" in the field. More surprising is the omission of the largest general-purpose bibliographic databases (GeoArchive, GEOBASE and GeoRef), all relevant to mineralogists, all of which are accessible on-line or in CD–ROM format.

Some of the best-represented topics include X-ray diffraction data processing (with, for example, at least 14 records relevant to determining the proportions in powdered mixtures), the display of crystal structures (29 records), and the reduction of electron-microprobe data. The latter is now a mature subject, although the listed mineral-specific routines concentrate on a few critical families of high petrological significance (amphiboles and pyroxenes). Further routines are applicable to microanalytical and surface-analytical data generated by EELS, laser Raman microprobe, PIXE, and other techniques. There are fewer items for data reduction in mass spectrometry, including SIMS. Factors that may account for this include a prevalence of system-specific, in-house

software in mass spectrometry labs, an emphasis on peak-stripping and on normalization to standards, and the composition of the scientific community alerted to the IMA project.

The perspective from the database portion of the software spectrum indicates that the subject matter is so wide, and the sources so many and variable (from major publishing houses with a dedicated staff of dozens to unpaid individuals with a single PC), that no review can ever be completely up-to-date or comprehensive. Earth scientists often display a gradual evolution of software enthusiasm, in which the long-term computer buffs are a minority. Others will write their own applications programs as students, and then, as their spare time and patience diminish, proceed to using departmental facilities, commercial programs and shareware. The Catalogue contains an eclectic mix of mainstream commercial programs and more specialized products. Some of the software is free; other items cost thousands of dollars. Most probably, there is "something for everyone". Where appropriate, prospective users should try to ensure that the format of their data will be compatible with the data-import capabilities of the software. The Catalogue provides applicable contact address, telephone and E-mail data to facilitate direct enquiries.

The Catalogue of Software makes a bold effort at capturing a snapshot of a dynamic field. No such work can ever be absolutely complete nor up-to-date, and it would be both churlish and futile to compile a list of omissions. Presumably the source text is stored in a database format suitable for updating to the next edition! It is a product of desktop publishing, with an adequately durable spiral-bound, glossy-cover format, and the price is right. It should find a place in the reference sections of libraries in all Earth Sciences departments, and on the shelves of all software enthusiasts and computer-intensive companies with mineralogical concerns.

Graham Wilson
Turnstone Geological Services Ltd.

Oceanic Basalts. Edited by P.A. Floyd. Van Nostrand Reinhold, New York, and Blackie Publishing Co., Glasgow/London, 1991, xv + 456 pages, £85.00 (hardcover) (ISBN 0-216-92697-1, ISBN 0-442-30411-0 in USA and Canada).

Basalt is the all-dominating rock type in the oceanic basins, which cover about two-thirds of the Earth's surface. Recent technical advances in dredging and drilling techniques have contributed to major research efforts on the oceanic basalts.

The new book draws together and reviews recent developments on the composition and evolution in the oceanic crust, magma plumbing systems, the significance of regional geochemical variations, experimental data, mantle-derived ultramafic nodules, and the structure, composition, and origin of various mantle sources and reservoirs.

The book is divided into four parts, with a total of 15 chapters. Part I (Structure) has chapters on the ophiolite model, surveying and sampling of the ocean floor, and structure of the oceanic crust. Part II (Processes) deals with the mineralogy and crystallization of oceanic basalts, experimental phase petrology, magmatic processes in oceanic ridge and interplate settings, and metamorphic and hydrothermal processes. Unavoidably, there is some overlap between the chapters on experiments and magmatic processes. Part III (Environments) comprises chapters on oceanic islands and seamounts, back-arc basins, and the Pacific, Indian, and Atlantic ocean crusts. No mention is made of the South Atlantic Ocean, and hence the Cameroun Line is omitted. Part IV (Sources) has chapters on stable and noble gas isotopes and oceanic peridotites. In each chapter, concluding statements sum up the pertinent features. Appendices A, B, C, and D have maps showing the geographic location, abundance of elements, isotope ratios in magmatic petrogenesis, and normalization factors for rare-earth and incompatible elements. The book has an exhaustive bibliography.

This would serve as an ideal textbook for graduate students and as a good reference source.

Venkat Raman
Chemical Abstracts Service

Petrology of Lamproites. By Roger H. Mitchell and Steven C. Bergman. Plenum Press, New York, 1991, xvi + 447 pages, $US75.00 (hardcover) (ISBN 0-306-43556-X).

With the discovery in the mid-1970s of a major new diamond pipe in lamproitic rocks in Western Australia, kimberlites have been regarded as not the only source rock for diamonds. Economic geologists and petrologists have focussed their attention on the distinctive properties of lamproites which, because of their unusual composition, were previously only of academic interest. Petrologists have come to realize that the lamproites possess isotopic signatures complementary to those of mid-oceanic ridge basalts, alkali basalts, and kimberlites.

The book is divided into ten chapters. Roger Mitchell wrote chapters on the lamproite clan (etymology and historical perspectives), potassic rocks and the lamproite clan, mineralogy of lamproites, geochemistry of lamproites, experimental studies, and on the petrogenesis of lamproites. Bergman has written the chapters on the description of lamproite occurrences, tectonic framework of lamproite genesis, petrological facies and igneous forms of lamproite clan, and diamonds, xeno-

liths, and exploration techniques. Chapters on the mineralogy and form are particularly valuable. The finely edited and well-written book has numerous tables and figures, excellent field photographs, and microphotographs of textures (some in color). The authors stress the importance of oxidation state but have failed to include the concentration of ferric iron in the analytical results. The book has a comprehensive bibliography.

Venkat Raman
Chemical Abstracts Service

The Concise Oxford Dictionary of Earth Sciences. Edited by Ailsa Allaby and Michael Allaby. Oxford University Press, New York, 1991, xxi + 410 pages, $US16.95 (ISBN 0-19-286125-5).

In over 6,000 entries, this dictionary provides authoritative and up-to-date definitions of terms from all the areas of earth sciences. The dictionary covers climatology, economic geology, geochemistry, mineralogy, oceanography, paleontology, petrology, and volcanology, amongst many other disciplines. It also contains brief biographical notes on the most important geologists. The book aims to define the terms in a lucid and clear way, with the task being descriptive rather than perspective. A larger font size, for both the headings and descriptions, would have alleviated much of the eye strain.

Venkat Raman
Chemical Abstracts Service

Diffusion, Atomic Ordering, and Mass Transport. Selected Topics in Geochemistry. Edited by J. Ganguly and S. Saxena. Advances in Physical Geochemistry, Vol. 8, Springer-Verlag, New York, 1991, xiv + 384 pages. $US 149.00 (hardbound) (ISBN 0-387-97287-0).

A major focus in the development of geochemical research in the past thirty years has been the application of classical thermodynamics to reconstruct the conditions at which the states of quenched mineralogical properties of rocks have equilibrated during the course of their evolution. Also, great efforts have been made toward the application of kinetic theories in order to develop an appreciation of the temporal details of geochemical processes.

The present volume brings together a variety of current research on transport in systems of geochemical interest from atomic to outcrop dimensions. A proper understanding of the process of diffusion in minerals and melts is important in the quantitative evaluation of the time scale of evolution. The book is divided into 13 chapters, each written by many contributors. The various chapters include: molecular dynamics and diffusion in silicate melts, Ising models and geological applications, electrostatic properties of minerals, compositional zoning and cation diffusion in garnet, diffusion of ions in olivine, nuclear microanalysis, pressure-enhanced diffusion of aluminum and silicon and oxygen isotope exchange, experimental constraints on the role of hydrogen in diffusion of oxygen and hydrogen, strain-enhanced diffusion in feldspars, mechanisms and kinetics of exsolution, grain-boundary diffusion kinetics in silicate and oxide minerals, thermal diffusion in petrology, and quasi-stationary state approximation to fluid/rock reaction.

Each chapter contains a summary and a brief review of the works in that particular field. The book is highly recommended for use by specialists in the area. The quality of presentation and editing are excellent.

Venkat Raman
Chemical Abstracts Service

Silicate Crystal Chemistry. By Dana T. Griffen. Oxford University Press, New York, 1992, ix + 442 pages (hardcover) (ISBN 0-19-504442-8). $US 55.00

The Mineralogical Society of America has been publishing a number of volumes in the series *Reviews in Mineralogy.* These are very comprehensive on a single subject, and each has accompanied one of the Society's short courses. Also, there exist many detailed monographs. Because of their specificity of subject matter, none of these is suitable as a textbook for graduate courses in crystal chemistry. This volume on Silicate Crystal Chemistry is intended to fill the gap between such comprehensive professional reference works and several popular undergraduate mineralogy textbooks.

The book is divided into two parts. Part I, on the systematic crystal chemistry of silicates, consists of eight chapters on the silica polymorphs, feldspars, micas, pyroxenes, amphiboles and nonelastic biopyriboles, aluminum silicate polymorphs, olivines, and garnets. Part II has four chapters on crystal concepts, instrumental methods, models of atomic bonding in mineralogy, and phase diagrams. There is an Appendix summarizing the unit-cell data for ambient conditions.

The text focusses on the principles of crystal chemistry and crystal structure as they apply to the major groups of silicates. Graduate-level students and teachers will find this an invaluble and a useful book.

Venkat Raman
Chemical Abstracts Service

Heavy Minerals in Colour. By Maria A. Mange and Heinz F. W. Maurer, Routledge, Chapman & Hall, New York, 1992, 147 pages, US$79.95, CDN $99.95 (hardcover) (ISBN 0-412-43910-7).

The purpose of this manual is to illustrate microscopic identification of transparent heavy minerals in grain mounts. Part I contains the relative significance of factors affecting assemblages of heavy minerals in sediments (hydraulic effect, grain size of heavy minerals, chemical stability of heavy minerals), their application and limitations, commonly used laboratory methods and auxiliary techniques, numerical analysis, and some examples of the application of heavy mineral studies.

Part II contains descriptions of 61 transparent heavy mineral species, including those which are commonly authigenic in sediments. Emphasis is placed upon detrital morphology and diagnostic features: habit, colour, pleochroism, birefringence, extinction, interference figure, elongation, distinguishing features, and occurrence. Each mineral description is accompanied by one or more colour plates. Besides a list of references, there is a mineral index, a general index, and a table for mineral identification.

The quality of the colour plates is excellent; however, these colour photographs make the price of the book expensive. Diallage is incorrectly given mineral species status, and the mineral formulae are occasionally written in unusual manners. The order of the minerals in the descriptive section is unique, so that the index must always be used to find a given mineral. The infrequent user will have difficulty in finding the length of the scale bar. Because only transparent minerals are discussed, such important opaque heavy minerals as ilmenite, goethite and hematite are omitted.

This book will find a place in a laboratory that deals with the microscopic identification of heavy minerals, and also in an earth sciences library. The book represents reasonable value for money.

Peter Bayliss
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Zeolites of the World. By Rudy W. Tschernich. Geosciences Press, Inc., 12629 N. Tatum Boulevard, Phoenix, Arizona, U.S.A., 1992, 576 pages, $84.95 (hardcover) (ISBN 0-945005-07-5).

Zeolites of the World is a very impressive compilation of mineralogical data on zeolites that would be a good reference book for professionals in the field of zeolites or minerals. Although the author does not explore the industrial uses of zeolite in depth, the book would still be very useful for industry-based researchers who are interested in the characterization of man-made zeolites. The book is more suited to be a reference book than a textbook, but could be employed as a supplementary text for a graduate-level course in zeolite or silicate mineralogy. This book may be very loosely divided into three sections: a short introductory section containing definition, origins, cleaning techniques and industrial uses of zeolite, an extensive section giving information about each of the zeolite species, and a final section that contains a list of abbreviations, zeolite synonyms, and the references.

The first nine pages provide a very nice introduction, in which the author defines what zeolite minerals are and reviews the naming of various species. The analogy of a zeolite framework to the walls and ceilings of a house in which people and furniture may be moved is a very good illustration of the ion-exchange capacities of zeolites. The author's presentation of the rules suggested for the naming of natural zeolite species by the Commission on New Minerals and Mineral Names of the International Mineralogical Association and applications of these rules to existing zeolites is very useful. Even if readers disagree with the author about whether a mineral name should be obsolete or not, it is nice to have the criteria presented and consistently followed. A list of obsolete names and synonyms for these names is given in the back of the book. The list of zeolite-like minerals and ancillary minerals is also very useful, but should have been expanded to include some of the feldspathoids.

Although this reviewer does not have a mineralogical background, the chapter describing the various geological origins of zeolites was considered very informative and easily understandable. This chapter explained well the occurrences of zeolites and ancillary minerals. Similarly, the chapter on cleaning mineralogical specimens was very informative. Additional information specific to the cleaning of individual zeolite species is contained in the section about that species.

The majority of the book is devoted to the various species and is organized extremely well. For each species the name, chemical formula, type localities, obsolete names, synonyms, nomenclature, structure, morphology, identification, cleaning, origin, and occurrence are listed. This reviewer particularly appreciated the pronunciation guide for the species name. The author has obviously spent a tremendous amount of time collecting and collating all the information that is included in the sections devoted to each species. The data are quite extensive and cover the subject area well. For example, four different types of twinning for harmotome are discussed and illustrated by means of over 20 illustrations.

Overall, the book is very well written, and the organization is extremely effective. The reader may examine only the section on a particular species or group of minerals or compare a number of sections to differentiate zeolite species. The 300 optical and scanning electron micrographs, 50 of which are in color, are excellent. The micrographs might have been improved

by including a bar scale, but in all cases the reader can estimate the size of the features by reading the figure caption. The list of zeolite synonyms is also useful because zeolite names commonly vary, especially in the older literature. The book is current and includes information about some of the recently discovered zeolites such as boggsite, montesommaite, and tschernichite.

Susan Q. Hoyle
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A Guide to Understanding Crystallography. By Jennie R. Smith. Crystallography, Dept. A, Box 12, Fairfax, Virginia 22030, U.S.A., 1991, 176 pages. US$20.00 (softcover).

This book covers the area of morphological (external) crystallography, such as elements of symmetry, crystal forms, crystal habit, crystal systems, crystal classes (point groups), Bravais lattice, Miller indices, twinning, Hermann–Mauguin symbols, and cut-out crystallographic models to be made.

There are many good diagrams to indicate crystal forms and crystal habit, and to show crystals with multiple forms. The comprehensive section on twinning clearly shows many different types of twins in all of the crystal systems. The section on stereographs is exceedingly brief. The main modern use of axial ratios in a standard setting to index X-ray powder-diffraction patterns with an unknown unit cell is not mentioned. The book is devoid of mathematical relations, such as crystal systems with essential elements of symmetry, and crystal classes with elements of symmetry through a point (point groups). A few errors in spelling (*e.g.*, ullmanite for ullmannite, sphalerote for sphalerite, Bravis for Bravais) and terminology (molecule structure) were noted.

The book is aimed at the amateur mineral collector, so that all the topics are introduced very slowly, with lots of background material and discussion. Advanced complications are slowly introduced at the end of the chapters, and the index is relatively short, so that the book is difficult to use as a reference. An advanced mineral collector will find this book useful, especially the section on twinning. The book could also be used by an undergraduate who has lots of trouble with morphological crystallography.

Peter Bayliss
Australian Museum

Gems & Gemology. A Retrospective of the 80's. Edited by Richard T. Liddicoat and Alice S. Keller. Gemological Institute of America, 1660 Stewart St., Santa Monica, California 90404, U.S.A., 1990, 110 pages. Hard-bound printing of Gems & Gemology, vol. 26, No. 1, US$34.95 (ISBN 0-87311-023-4).

Proceedings of the International Gemological Symposium 1991. Facing the Future. Edited by Alice S. Keller. Gemological Institute of America, 1660 Stewart St., Santa Monica, California 90404, U.S.A., 1992, 192 + xvi pages. US$34.95 soft-bound; $49.95 hard-bound (ISBN 0-87311-024-2).

Most mineralogists would agree that up until about 20 years ago, gemology was primarily a descriptive science. The quantitative aspects rarely advanced beyond the determination of selected optical properties (*e.g.*, indices of refraction, dispersion, absorption spectra), or physical properties (*e.g.*, specific gravity), primarily for purposes of gem identification. The last 10 years, however, has seen an "explosion" of sophisticated techniques being applied to the field of gemology, *e.g.*, infrared absorption spectroscopy, electron microprobe, Raman spectroscopy, cathodoluminescence, nuclear magnetic resonance, microthermometry. The reasons for the use of these techniques are: (1) new and better ways to grow synthetic gems have made their detection from natural stones much more difficult; (2) improved methods of gemstone enhancement (human processes that improve the appearance or durability of a gem) by means of irradiation, heat or chemical treatments, or by various "filling techniques", have made recognition of these procedures important for purposes of valuation, and (3) modern methods of studying natural gem materials yield data applicable to synthesis, as well as to exploration for new natural deposits.

The two volumes under review contain all the information most mineralogists could possible use, at least initially, to bring them up-to-date in the rapidly advancing field of gemology, which is becoming increasingly sophisticated. The *Retrospective* volume contains five feature articles (chapters), four of which are of direct interest to mineralogists, and all of which are written by leaders in their fields: enhancements and their detection (by R.C. Kammerling, J.I. Koivula and R.E. Kane); synthetic gem materials (by K. Nassau); new technologies (E. Fritsch and G.R. Rossman); and gem localities of the 1980s (J.E. Shigley, D.M. Dirlam, K. Schmetzer and E.A. Jobbins). The articles are all extensively referenced; the article on gem localities, for example, contains over 200 references (all but 10 are post-1980) to practically every significant occurrence of gems in the world.

The *Proceedings* volume is the record the International Gemological Symposium, held in Los Angeles, June 20-24, 1991 – the largest gathering of industry professionals (over 1800 participants) ever assembled. The volume includes: (a) the text of two oral presentations by international diamond experts Gerald Rothschild and Maurice Tempelsman, primarily related to aspects of economic marketing in the diamond industry;

(b) comprehensive abstracts of about 160 presentations on all aspects of gems and jewelry, many of which are highly technical and of direct interest to modern mineralogists; and (c) in-depth summaries of ten informative panel discussions (*e.g.*, research on treatment and synthesis of colored stones; advanced instrumentation).

Both volumes are exquisitely produced, with full-color illustrations, in a large (21 × 28 cm), two-column format. They are a credit to the Gemological Institute of America, the most prestigious organization dedicated to the educational aspects of gemology in the world. Although much of the material covered is of an economic nature, it is an excellent complement to the scientific aspects. For as little as $69.90, it is possible for mineralogists to catch up on the technical aspects of gemology and, at the same time, develop a feeling for the future direction of this field. And, finally, not only do I recommend the purchase of these volumes, but I also recommend that more mineralogists get involved with the fascinating field of gemology. It is a natural extension of their profession and one in which they have the training with which to make important contributions.

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