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BOOK REVIEWS

Gemstones of North America, Volume III (1997) by Captain John Sinkankas (USN, Ret.), Geoscience Press, Inc., Tucson, Arizona, pp. xvi, 526, 16 color plates by Erica and Harold Van Pelt. US$65 (hardcover). ISBN: 0-945005-22-9.

What George Frederick Kunz began in 1890, John Sinkankas has ably carried on and elaborated in this century, with *Gemstones of North America*, and indeed for a good part of the century. The book was first published in 1956, with a follow-up, Volume II, in 1976. Now there is a third and final installment, Volume III.

Until Kunz's publication of "*Gems and Precious Stones of North America*", acquaintance with these was limited to locals, to avid collectors and to specialists. His was the first book to list all the then known gem occurrences, and to do so in a popularly accessible way. Sinkankas continues this tradition. Nor is there anyone better qualified to do so. A facetter of world repute, he has specialized in cutting stones in the 2000 carat range, some on assignment for the Smithsonian Institution. An experienced gem miner, Sinkankas is also a bibliophile whose collection of geology and mineralogy books is housed at the Gemological Society of America. In addition to *Gemstones of North America*, he is the author of numerous books, including *Gemcutting, a Lapidary's Manual*, *Mineralogy for Amateurs* and *Prospecting for Gemstones and Minerals.*

In mentioning "books", one is tempted to add a qualifier. "Textbooks" would lend that soupçon of academic esteem, while "popularly accessible", on the other hand sounds slightly disparaging. "How much more difficult it is," says Sir Charles Lyell, in a private letter written while working on *Principles of Geology*, "to write popularly than for the scientific reader. Yet half of our "savants" think writing popularly a condescension to which they might descend, if they but would." As Lyell points out, it is no easy task to explain complex processes in clear, understandable, simple terms. Sinkankas is one of those fortunate writers who can. His *Mineralogy for Amateurs* has been widely used as a textbook, as well as a reference and introduction for those who are passionate about the subject, but who may lack academic grounding. Likewise, in *Prospecting for Gemstones and Minerals*, Sinkankas discusses not only the genesis of pegmatites but also how to deal with snake bite in the field and how to re-temper a chisel by holding it in the fire until the straw yellow color reaches nearly to the tip and then quickly quenching it in water. In short, he speaks from activity and experience, from learning put to lifelong and passionate practice; he stands well above the academic *versus* accessible dichotomy.

In its initial form, *Gemstones of North America* was conceived to be complete and self-contained. Yet the gem milieu, where only a handful of stones, perhaps even a single stone, may be tremendously significant, is a world of single finds and small-scale, artisanal mining. A new deposit is discovered, its pockets emptied, and the search moves on, all in a matter of months. So, in twenty years much can change, and in forty so much more. For this reason, Volumes II and III were designed to augment the first. Reorganization includes use of references within the text, and following each entry. Also, the content of Volume I was grouped into categories: "Principal Gemstones", "Important Gemstones", "Quartz Family Gemstones", "Rare and Unusual Stones", "Massive and Decorative Materials" and finally, "Organic Gemstones", whereas the organization is now strictly alpahabetical: for example, diamond (26 pages in Volume III, compared to 17 in Volume I) follows immediately upon danburite and datolite. The fact that one does not normally think of either of the two last-mentioned species as gemstones indicates just how meticulously Sinkankas covers the species. Any stone that has been cut into a gem, no matter how rare, receives mention. For the more significant gems such as, for example, Montana sapphire, whose marketability has been greatly enhanced in recent years by heat treatment, Sinkankas includes not only descriptions of the deposits and the stones, but also an historical overview of commercial mining ventures. Each locality where a specific gem has been found warrants entry; after every such entry, a bibliography leads the reader to published sources, as well as to the originators of personal communications made to Sinkankas in the course of his research. Over 400 different gemstones, including organic materials such as pearl, shell and amber, are cited. In addition to black and white photographs, and appropriate diagrams and maps, this volume includes 16 pages of superlative color photographs by Harold and Erica Van Pelt.

For anyone seriously interested in North American gems, this book is an essential companion volume to the preceding two. Sinkankas has performed an extremely valuable service in completing this ambitious project.

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The Nature of Diamonds. Edited by George E. Harlow. Cambridge University Press (in association with the American Museum of Natural History), 1998. 278 pages. US$27.50 (softcover, ISBN 0-521-62935-7); US$50 (hardcover, ISBN 0-521-62083-X).

It's not every day that a reviewer for *The Canadian Mineralogist* can treat a book that has Marilyn Monroe, Liz Taylor, and Mae West in the index. *The Nature of Diamonds* affords the unique opportunity. This attractive, informative, and carefully produced book is edited by George E. Harlow, curator of gems and minerals at the American Museum of Natural History in New York City, and has been launched specifically to accompany a major exhibition at that museum on the world's most sought-after gemstone.

The Nature of Diamonds is the work of a dozen highly qualified contributors (introduced on two pages) and, according to the editor, is divided into three parts: 1) Scientific, 2) Historical and cultural, and 3) Technological. This reviewer found these divisions somewhat unclear, and further blurred by the arbitrary insertion of two lavishly illustrated sections on "The World's Great Diamonds" (11 pages, following chapter 4), and "Diamond Treasures of Russia" (7 pages, following chapter 7).

The text is divided into 13 chapters, averaging some 20 pages each. Chapter 1 characterizes diamond mineralogically, chemically, and physically. Many useful definitions are offered. This is followed by a detailed chapter on diamond coloring: natural, induced, and applied. Chapter 3 deals with the genesis of diamond, from its "conventional" origins in kimberlite and lamproite, to its occurrence in crustal rocks, astroblemes, and meteorites. A chronological tour of diamond discovery and production, beginning in India and ending in Canada, comprises chapter 4. Chapter 5 is an historical voyage that begins with the earliest mention of diamond (2nd century, BC), to the quantification of the modern brilliant cut (1914). The sixth chapter treats the use of diamonds in royal ornamentation from the 14th century to WW I, with closing words on diamond wedding rings. Chapter 7, rambling, superficial, and the least successful in the book, deals selectively with the diamond in English literature from Shakespeare and Marlowe to Trollope. Chapter 8, "Diamond Jewelry for Everyone" (well, at least for the moneyed, to judge by the examples), emphasizes the significance of the sudden plentitude of diamonds brought on by the development of the African diamond fields in the 1870s. A surprisingly sophisticated (although not mineralogical) analysis of how "diamonds and Hollywood movies are made for each other" constitutes chapter 9. This is followed by a short and weak chapter on diamonds in the 20th century. In chapter 11, we are returned to the field in a discussion of exploration (using indicator minerals), the evaluation and mining of deposits, and the recovery of diamonds from ore. Added are the diamond market, the shaping of gems, and the industrial use of diamonds. Chapter 12 covers diamonds as gemstones, and with some repetition of chapter 2, we are told of synthetic substitutes, artificial coloring, and gem enhancement by fracture filling. Also touched upon is the grading of gemstones by the four "C"s: carat, color, clarity, and cut. In chapter 13, we learn that annual world production is more than 500 million carats (100 tons!), of which some 80% is man made, nearly exclusively for industrial use. In all, only 25 million carats (5% of the total) are used in the gem trade. This final chapter closes with the manufacture and special uses of thin diamond films, anvil cells and other, more exotic (potential) applications of this most unique substance. Most chapters end with 10 or 20 up-to-date references. The book concludes with a detailed six-page index set in small print.

The Nature of Diamonds is well printed on semi-gloss paper of excellent quality. It features more than 200 illustrations that range from photos to drawings to diagrams. Photoreproduction is exquisite. Writing is generally clear, and the coordination of text and illustrations is well planned. A tip of the hat to the typesetters; I caught only two errors: "ocean" (rather than oceanic) geotherm on p. 54, and "drop" (instead of dop) on p. 232. Minor mistakes include an unrealistically low value for the density of continental crust (p. 50), contradictions in the density of diamond (3.51 on pages 9 and 12, 3.52 on p. 222), and inconsistencies between the phase diagrams of carbon given on pages 54 and 258. Figure 12 in chapter 13 is reversed. Then, the order of chapters is to be questioned; should not chapter 11 better have followed chapter 3? Also, the two richly illustrated sections could, in my view, have better been combined as a single chapter to follow chapter 6. My major grievance, however, lies with the presentation of the "Great Diamonds" (pages 105-115). In spite of being beautifully printed, it is unfortunate that the Hope diamond (45.52 carats) is larger than the Regent (140.5 carats). A line drawing of each of these wonderful gems at natural size under their portraits (plenty of room is available) would offset this shortcoming.

Who is this book for? The editor tells us that "the intent in *The Nature of Diamonds* is to provide a well-illustrated overview" (p. 2). To this end, the book succeeds eminently, my small admonitions in the preceding paragraph aside. Within the field, mineralogists will learn little new, although peripheral knowledge about diamond will be enhanced. Teachers of mineralogy may find the book helpful to recommend to students as an example of the relevance and usefulness of the subject.

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New Minerals 1990–1994. By Joseph A. Mandarino. The Mineralogical Record, P.O. Box 35565, Tucson, Arizona 85740, U.S.A., 1997, 222 + ix pages. US$20 + $2 post, softbound (no ISBN given).

From the five-year period, 219 abstracts of new minerals approved by the Commission on New Minerals and Mineral Names (CNMMN) of the International Mineralogical Association are included. The author intends to publish future volumes in this series. The data include chemical formula, crystal system, locality, occurrence, general appearance, physical properties, chemical properties, crystallographic properties, name, comments, reference, and a crystal drawing (for one third of the descriptions).

Each description starts and uses a single page, except mrázekite, which uses two pages. Therefore, it is easy to find a mineral; however, this produces some white space. The headings in bold face facilitate quick access to the data. The printing and crystal drawings are clear on a high-quality paper. The number of typographic errors is very low, and four corrections are listed in *Mineralogical Record* **28**, 438 (1997). The use of the possessive ('s) with the mineral baumhauerite is grammatically incorrect, because only a person or legal body such as a company or trust can own an object.

Most of the data come from the reference(s); however, some data, such as streak, diaphaneity and tenacity, which are not in the paper, are taken from the submission to CNMMN. From calculations, some errors were found in the calculated density, subscripts of the empirical formula, and optical data of biaxial minerals. One additional fact requested by a collector was the name of the finder of new mineral species. Another useful fact, if available, would be the R-value for the crystal structure.

Descriptions of other minerals published in this period but not approved by CNMMN are not included. For instance, wadalite is abstracted from *Acta Crystallographica* in *American Mineralogist* **78**, 1317 (1993). This mineral is recognized as a species in the *Glossary of Mineral Species 1995* by Fleischer & Mandarino, the author of these abstracts.

Some associated minerals such as "apatite", "chlorite", "electrum" and "other" are always given in inverted commas; however, other names, such as amphibole, orthopyroxene, olivine, and plagioclase, are never given in inverted commas. There appears to be no system. It is better to give mineral species in bold face, mineral groups in italics, and other mineral names in normal type. The meaning of "norbergite chondrodite" is unclear. Both "manganoan-ferroan" and "cobaltoan nickeloan" are used, so one does not know if adjectival modifiers should be hyphenated.

The intensities of some of the X-ray powder-diffraction reflections are described with "*b*", "*d*" and "diff" without any explanation. A crystal system is given as hexagonal (trigonal); however, this is a unit-cell type. Trigonal is a crystal system based upon the essential element of symmetry as a three-fold axis. A list of possible space-groups is given for some minerals, whereas the space-group aspect is given for other minerals. The space group of padmaite is wrong, since the synthetic analogue of Hulliger gives *P*213, which is the space group of ullmannite.

Structural brackets are removed from most formulae, but not all. Instead of within a hydroxyl group, H is placed both at the beginning and middle of chemical formulae. In both crerarite and jolliffeite, the space group indicates disorder; however, the chemical formula gives the atoms separately. The *Z* for lunijianlaite is given as unknown; however, the number may be deduced by analogy with the isostructural mineral only 54 pages later.

The book is aimed at the collector, with emphasis on physical properties, and the micromineral collector, with the crystal drawings. This book shows that the CNMMN has done an excellent job in providing excellent descriptions of new minerals. The price is reasonable.

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Structural-Chemical Systematics of Minerals. By A. A. Godovikov (translated by I.A. Godovikov). Fersman Mineralogical Museum, Moscow, Russia, 1997, 240 pages.

The first 42 pages indicates why this method of mineral classification was chosen in contrast to the many different schemes that have been published in the past one hundred years. The subdivisions are based on the type of the bonding (metallic, covalent and ionic), and then on the strength of the bonding. The subdivisions used are type, quasitype, subtype, superclass, class, quasiclass, subclass, family, subfamily, series, group, and species. This classification groups together rutile, brookite and anatase (TiO_2 polymorphs) like the chemical classification of *Hey's Mineral Index* by Clark (1993). Therefore, the title is misleading, as structure has only a minor use after chemistry.

The next 151 pages orders over 3,000 mineral species in this classification and lists their structural formulae. Then, there is a 40-page alphabetical index of mineral species to their place in this classification.

The type is clear on inexpensive paper. The number of typographical errors is higher than normal; however, the number is not excessive if one considers that the author is using the Latin alphabet rather than the Russian alphabet. A number of minerals have an additional

unnecessary prefix such as "hydroxyl". A number of chemical analogues are given such as berryite-(Cu). It is not clear if these are natural, synthetic or hypothetical.

This book is useful for mineralogists and inorganic chemists interested in structural formulae and chemical classification.

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Handbook of Mineralogy. III. *Halides, Hydroxides, Oxides*. By J.W. Anthony, R.A. Bideaux, K.W. Bladh and M.C. Nichols, Mineral Data Publishing, Fulfillment Services Inc., 1955 West Grant Road, Suite 230, Tucson, Arizona 85745, U.S.A., 1997, ix + 628 pages, US$100 plus $6 shipping and handling, hardbound (ISBN 0-9622097-2-4).

This is the third volume of a proposed five-volume series of mineral data sheets. Volumes 1 and 2 are reviewed in *The Canadian Mineralogist* (**29**, 175-176; **33**, 1155). After a brief introduction and a one-page explanation of the format, the book presents summary data on 628 halide, hydroxide and oxide minerals. The entries are in alphabetical order by mineral name. The treatment is pure democracy: one mineral, one page. Each mineral is described by crystal data, physical and optical properties, cell and X-ray data, chemistry, relationships with other species, occurrence, association, distribution, origin of the name, type material and selected references. In general, the scholarship of the authors shines. The data are current to mid-1997.

The intention of the Handbook is "To gather in convenient form the data critical to identification of all mineral species and to provide relatively up-to-date references containing information central to the definition of each species". The chemical, optical and X-ray data alone accomplish this goal. I question, however, whether the straitjacket format is entirely appropriate to a specialist readership. Further, the X-ray powder patterns and chemical analyses are inadequately referenced. We are left to verify which (if any) of the several literature citations was the source of the data. Unfortunately, the handling of mineral series is also weak. By restricting the definition to "Isomorphous with complete substitution and continuous variation of properties and composition", the authors skirt the more important questions of partial miscibility. Two examples: we find that ilmenite "Forms three series, with ecandrewsite, with geikielite, and with pyrophanite", but the economically important higher-temperature series with hematite is not mentioned. Magnetite "forms two series, with jacobsite, and with magnesioferrite", but as a member of the spinel group, it can form at least partial series with the many other (at least 20) spinel minerals or end-members. The listing of localities under the heading Distribution reads like an inadequate collector's guide. Although errors are few, one that I noticed is that the chemical analyses of bismoclite do not correspond to the formula, but rather to daubréeite. No discussion is offered of the discrepancy or whether these are distinct species. On a positive note, the many calculated chemical compositions offer useful and immediate direct comparisons with the mineral analyses in the adjacent columns.

This is a specialist reference volume. To make the most of it, however, you will need a list of the minerals of specific groups (pyrochlores, spinels, *etc.*), and some means of identifying minerals from chemical formulae, this, of course, in addition to background knowledge of mineralogy.

The volume is well prepared, on acid-free paper. I cannot subscribe to the statement in the Acknowledgements (iii) of "typographically elegant printed pages". The presentation of many analyses in broken columns is an unfortunate choice, which detracts from the pleasure of using the book. However, I enjoyed leafing through this work, even though I must accept that in the computer age, a book of this sort is technologically obsolete. Some mineralogists might be hesitant to purchase the Handbook because the equivalent information for the entire five-volume set could be available on a single CD-ROM with search and cross-reference capabilities. How does this book relate to others in the field? As a compact and efficient complement to catalogues of mineral names and chemical data, the density of information will make the Handbook a useful reference for many years.

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Palaeosurfaces: Recognition, Reconstruction and Palaeoenvironmental Interpretation. Edited by M. Widdowson, Geological Society, Special Publication 120. Geological Society Publishing House, Unit 7, Brassmill Enterprise Centre, Brassmill Lane, Bath, BA1 3JN, UK or AAPG Bookstore, P.O. Box 979, Tulsa, Oklahoma 74101-1979, U.S.A., 1997, 330 pages. US$107/£64 hardbound (US$53/£32 for members of the Geological Society) (ISBN 1-89779-57-8).

According to the principle of reading circles, scientists gravitate into groups that read and cite each other's works without reference to other reading circles, like spinning galaxies scattered across the sky. Reading circles have been in retreat with the current trend toward the internet and interdisciplinary studies in geological sciences, well exemplified by

recent research on impacts and extinctions. This edited volume presents a good example of a reading circle dealing with paleosurfaces from the perspective of geomorphology, laterite geology, geological unconformities and continental tectonics. Although its scope is broad, somehow, none of these papers managed to intersect with reading circles concerned with paleosols, soil science, paleoclimate modeling or biological weathering. For those of us coming from these circles, this compilation is like visiting a foreign country. As novelist L.P. Hartley has reminded us, "they do things differently there".

By and large, it is a refreshing journey, with emphasis on the ancient landscapes of Australia (Twidale), India (Widdowson, Gunnell, Walsh, Subbarao), and Africa (Bowden). The contributions on Europe surprise with comparably old landscapes exhumed in such unlikely places as the French Alps (Battiau-Queney), southwest Poland (Migoń), southern Sweden (Lidmar-Bergström) and Ireland (Coxon & Coxon). Ancient landscapes out of equilibrium with the current landscape have long been a geomorphic theme in Gondwanan countries. The extension of this idea to the glaciated northern hemisphere is perhaps the most fundamental contribution of this book.

Like a diversity of local travel guides, the different contributions to this edited volume also give other perspectives. Also described are high terraces of surprisingly similar middle and late Miocene, and mid-Pliocene age in Spain (Molina Ballesteros, García Talegón, Vicente Hernández) and Bolivia (Kennan, Lamb, Hoke). There is also an account of intrabasaltic paleosols by a palynologist (Jolley) and analyses of land surfaces using digital elevation data (Ringrose, Migoń) and remote sensing (White, Drake, Walden). Only with the chemical analysis of paleosols (McAlister, Smith, Widdowson, Walsh, Subbarao) did I recognize some pedological influence. Even here the data were clustered by type, rather than within profiles as is customary in soil science. The editor has been successful in his aim "to encompass the widest range of contributions and views upon the subject of palaeosurfaces". Nevertheless, emphasis lies primarily on the "recognition" of the subtitle, with little of substance on "reconstruction and paleoenvironmental interpretation" of paleosurfaces.

A unifying thread of many of these approaches is application of modern techniques to the study of ancient landscapes. Even so, the individual chapters vary enormously in this respect as well. The book is not a smooth high-tech flight, but a rather bumpy road at times. Perhaps this is because I felt duty-bound to read every paper. You might enjoy it by more random sampling. Several tidbits caught my own eclectic eye as of unusual interest. For example, I was taken aback by tropical paleokarsts of Permian age in Western Australia (Twidale) and of Tertiary age in Ireland (Coxon & Coxon). The use of stages of quartz weathering to assess the antiquity of Spanish soils struck me as novel and more widely useful approach (Borger). Still, this collection of papers would not be worth US$107 to me; I suspect that most of these volumes will end up in libraries.

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Rock-Forming Minerals in Thin Section. By Hans Pichler and Cornelia Schmitt-Riegraf (translated from the German by Leonore Hoke). Chapman and Hall, 115 Fifth Avenue, New York, N.Y. 10003, U.S.A., 1997. 220 pages, US$156.50 (hardcover), US$34.50 (softcover). ISBN 0-412-64460-6.

The market for books to aid the undergraduate and beginning graduate student in thin-section petrography is already pretty well filled. A glance at the lab bench and what's available in my university library reveals no less than a dozen volumes, ranging from Rogers & Kerr (1942) through DHZ's Introduction (1992), plus three or four in French. To break into this gorged market would require a truly superior product. In my view, *Rock-Forming Minerals in Thin Section* by Pichler and Schmitt-Riegraf falls short of the mark.

This book, published originally in German in 1987 and now translated by Leonore Hoke, is divided into three parts. The first, a scant 27 pages, is a brief review of optical crystallography. The second part, running descriptions of some 116 rock-forming minerals, takes up about 137 pages. A 44-page section of appendices, chiefly in table form, concludes the body of the text. The book closes with a page of 40 references, and a four-page index. An eight-page insert of excellently reproduced color photomicrographs follows page 134.

The first part of the book is at best an overview of optical crystallography, no more than a refresher for the initiated. Certainly it is inadequate to serve as a text for the subject.

Mineral descriptions in the second part are apportioned into opaque (seven minerals), isotropic (16), uniaxial positive (9), uniaxial negative (15), and biaxial (69). Arrangement of minerals within these groups is not clear. For example, under uniaxial negative minerals, one starts with an oxide (anatase), passes to four trigonal carbonates, then back to an oxide (corundum), on to two silicates (vesuvianite and tourmaline), a phosphate (apatite), and ends with six silicates. Within the biaxial group, one finds cordierite followed by the aluminosilicates, staurolite, wollastonite, chloritoid, the epidote group, and so on. The name and formula of each mineral are followed by its thin-section characteristics: form, cleavage, twinning, color, indices of refraction, *etc.*, to end with

occurrence and paragenesis. Crystal drawings (most taken from Trögger) with optical elements and, in some instances, black-and-white photomicrographs or thin-section drawings, accompany the descriptions.

The five tables in the first appendix that treat the opaque, isotropic (two tables), uniaxial, and biaxial minerals, list these minerals nearly exclusively in the order in which they are treated in the text. The tables are therefore of limited use in tracking down unknowns. The 16 other tables, too numerous to list here, range from useful (mean index of refraction *versus* birefringence), to superfluous (optically biaxial minerals with nearly uniaxial behavior). The second appendix gives the Streckeisen diagrams of the igneous rocks. The last appendix offers 38 line drawings of microscopic mineral and rock structures.

My criticisms of this book are numerous. In the opening part on optical crystallography, the working distance of a 25-power objective is about 1.6 mm, not 160 mm (p. 3). The 160 mm is the microscope tube-length for which the lens is designed. Also, "aperture width" (wrongly expressed in mm) is the numerical aperture, a dimensionless number. Figure 19c shows parallel (not oblique) extinction, and the section shown in the middle row of Figure 25 is cut obliquely (not perpendicular) to an optic axis.

In the main descriptive part, some important rock-forming minerals are absent: ankerite, catapleiite, clintonite, halite, kornerupine, lizardite, margarite, mullite, periclase, and all the orthoamphiboles. Then, dispersion is nowhere given its due. This useful parameter is helpful both in identifying unknowns, and in nailing down the member of a series (the orthopyroxenes, for example, where from En to Fs dispersion ranges from $r < v$ to $r > v$ and back to $r < v$). The division of optically positive and negative members of a solid-solution series along the abscissa rather than the ordinate renders the corresponding diagrams difficult to interpret at a glance (Figs. 79, 115, 199, 135, and 193). On the rudimentary Michel-Lévy chart (An_0 – An_{82}; p. 134), extinction angles for plagioclase outside the range An_{12} – An_{25} depart significantly from angles on charts that I've used (successfully) for 40 years. Why have 10 pages (8% of the descriptive text) been devoted to zeolites, when the authors state (p. 134) that "they cannot be differentiated by microscopic methods alone"? Many mineral formulae do not follow convention. For example, wollastonite is given as $Ca_3[Si_3O_9]$. Although reference is made to the IMA Subcommittee on Amphiboles (p. 96), its recommendations are ignored when placing barroisite and katophorite with the hornblendes, and omitting such widespread members as edenite and pargasite. The absence of a birefringence color chart is inexcusable. Finally, the organization of the book and its tables for identification just aren't helpful for the novice. Only the first table in Appendix 1 is modestly useful. Missing are tables that list common rock-forming minerals in order of increasing mean index of refraction, in order of increasing birefringence, biaxial positive minerals in order of increasing $2V$, and on and on. Rogers & Kerr had already applied this user-friendly approach more than half a century ago in their text published in 1942.

Contestable statements include the following. Melilite is a "desolidified pyroxene" (p. 57). Quartz occurs "in all magmatic rocks which are silica saturated, therefore ubiquitous in magmatic rocks" (p. 62). Orthopyroxene more Fe-rich than hypersthene does not occur in nature (p. 81). "The principle pyroxene in alkaline magmatic rocks is diopside" (p. 88). Phengite occurs in high-grade metamorphic rocks (p. 107). Orthoclase is "always cloudy" (p. 126). "Increasing Ca-content leads to increasing width in the albite-twin lamellae" (p. 129). The replacement of anorthite-rich plagioclase by albite and calcite is spilitization (p. 132). "Zeolite has the lowest refractive index of all minerals" (p. 135). Aenigmatite is "related to the amphiboles" (p. 143). Extinction of staurolite "occurs mostly in bases and cuts which are symmetrical" (p. 153). "Zoisite replaces the albite component in plagioclase in low- to high-grade metamorphic rocks" (p. 156).

In addition, one finds several typos or style errors. Some are: "Chabasite" (p. 43), "isotypic crystals" (p. 44), "low-temperature paramorphoses" (p. 60), the use of "spindle stage" (p. 124), "Becker line" (p. 134), and "nobbly schists" for knotted schists (p. 147, 148).

To conclude: in its usefulness, completeness, and accuracy, *Rock-Forming Minerals in Thin Section* lags far behind competing well-established works in the field, books in which minerals are arranged chiefly along structural lines (orthosilicates, sorosilicates ..... non silicates) and arrangement by optical properties are relegated to tables. The organization of Pichler's and Schmitt-Riegraf's book is just not user-friendly and will prove frustrating to the student petrographer. The professional will want a more comprehensive reference.

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Rock-Forming Minerals. 2B. *Double-Chain Silicates* (2nd edition). By W.A. Deer, R.A. Howie & J. Zussman. The Geological Society, London, 1997, 764 + xii pages, CDN$218. Distributed by AAPG Bookstore, P. O. Box 979, Tulsa, Oklahoma 74101-0979, U.S.A. (ISBN 1-897799-77-2).

When the first edition of "DHZ" became available in 1962 and 1963, petrographers world-wide were astounded by the richness of optical, structural, analytical, experimental, and paragenetic information

so suddenly made available in a compact compilation. Not only was the material abundant, but it was also concisely organized and conveniently presented. Now, three decades later, the second edition is rolling off the press. Already volumes 1 and 2 and half of volume 5 are available. The work here under review is the second part of volume 2: Volume 2B, *Double-Chain Silicates*.

The recent spectacular progress in the geological sciences is reflected in the enormous advances in silicate mineralogy. This is manifested by comparing the content of the new edition with the corresponding content (the amphiboles) of the first edition. Here are the figures: 172 pages have ballooned to 764; 189 chemical analyses are now 514 in number, and 36 figures have multiplied elevenfold to 399! The hornblende group alone has gone from 51 pages with 7 pages of references, to 365 pages with 46(!) pages of references. The timing of the second edition is ideal, too. Had it appeared a year earlier, it would have missed the new (again) IMA nomenclature of amphiboles [Leake *et al.* (1997): *Can. Mineral.* **35**, 219-246].

Volume 2B begins with an 18-page Introduction, which in itself offers to a beginning student (or a rusty professional!) a splendid overview of this complex family of rock-forming minerals. This is followed by six chapters: Mg–Fe–Mn–Li amphiboles (114 pages and covering all the orthoamphiboles), Calcic amphiboles (479 pages), Sodic–calcic amphiboles (39 pages), Sodic amphiboles (70 pages), Biopyriboles (13 pages) and Other double-chain silicates (deerite and howieite, 17 pages). A six-page subject index concludes the volume.

Surprisingly, the authors state in their introduction that ". . . optical determinative methods are now seldom used for amphiboles". This is needlessly negative. The microscope offers the best first cut: to recognize the presence of amphiboles. It allows one clearly to distinguish ortho- from clino-amphiboles, and then the judicious evaluation of color, pleochroism, extinction angle, optic sign, dispersion, twinning, and associated minerals, will take the petrographer a long way on the path to positive identification. On the other hand, some petrographers may find this book daunting because of the overwhelming volume of material. Using Volume 2B to track down a sample of grunerite is akin to using field-artillery pieces to hunt sparrows. In this respect, the first edition was more user-friendly.

Where did I find *Double-Chain Silicates* wanting? Perhaps its greatest weakness lies with the graphical illustrations; they appear to have been designed by artists, not mineralogists. Most have ordinate and abscissa scales on only one side and along the base, rendering the diagrams difficult to employ quantitatively without doing some on-the-spot draughting. The grids that made the diagrams of the first edition so wonderfully clear are mostly gone (except on Figs. 84, 109, 208, 261, and 382). To make my point, I invite the reader to compare Figures 59, 63 and 66 of the first edition with the corresponding Figures 28, 57, and 97 of the second.

The growing availability of the electron microprobe has led to an exponential increase in the number of mineral analyses. For the amphiboles, this is a double-edged sword because of the probe's inability to distinguish ferrous and ferric iron, or to detect (OH) or H_2O. These components may influence classification. The assignment of Fe^{2+} and Fe^{3+} by stochiometric calculation can be an exercise in smoke and mirrors. Compounding this shortcoming, fewer and fewer petrologists today work out the optics of their analyzed amphiboles. Quel dommage!

Another pique is the omission of basaltic hornblende. It's not even in the index (although other banished amphiboles such as crossite and uralite are). Looking further, one does find "oxy-hornblende", though citations are strewn through more than 300 pages of the text. This is unfortunate, because basaltic hornblende is a widespread and distinctive phase in many lavas and pyroclastic rocks. In small grains, it may easily be misidentified by the inexperienced petrographer. Concentrating the scattered data on a single page would render a service.

The somewhat uncertain and politically correct references to asbestos (pages 15, 86, and 692-693) are disappointing. The statement (referring to asbestiform varieties of amphiboles) that "great care is needed in their handling and use since the inhalation of asbestos particles constitutes a serious health hazard" makes one wonder if it is safe to study uncovered thin sections of amosite.

The index is marginal at best. So many topics discussed in detail in the text aren't included. Some examples are geobarometry (Al in hornblende), geochronology (K-Ar and $^{40}Ar/^{39}Ar$), symplectite, eclogite, charnockite, blueschist, whiteschist, and on and on. In fact, I would propose that once the second edition of "DHZ" is complete, the publishers issue a single and truly exhaustive index to all the "DHZ" works (1st and 2nd editions of *Rock-Forming Minerals* and the two editions of *An Introduction to the Rock-Forming Minerals*). Such an index would be a well-thumbed reference!

A few outright errors occur. The abscissa in Figure 28 should read: 100Mg/(Mg + Fe + Mn). The formula for the dispersion of anthophyllite–gedrite (p. 21; see also pages 86 and 234) is incorrect. The symbols in

Figure 201 aren't identified. Optical data for hornblende no. 6 (Table 11) are wrong, and the indices of refraction of glaucophane no. 14 (Table 27) are impossible. The alpha color of howieite is brown (not "drown", p. 751). Then, what are "preiswerkite" (p. 309) and "the thorough-going alkali amphiboles" (p. 616)?

In summary, this book is compulsory for serious petrographers. Furthermore, if you have volumes 2A and 2B, do as I have done: put aside the first edition of vol. 2. The new edition has rendered the old one obsolete. In more than 20 years as a reviewer of books in the geological sciences, this is the first occasion on which I've made that statement.

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Rock-Forming Minerals. 5B. *Non-Silicates: Sulphates, Carbonates, Phosphates, Halides* (2nd edition). By L.L.Y. Chang, R.A. Howie & J. Zussman. The Geological Society, London, 1996, 383 + viii pages, £75. ISBN 0-582-30093-2. Available from Geological Society Publishing House, Unit 7, Brassmill Enterprise Centre, Brassmill Lane, Bath, Somerset BA1 3IN, U.K. and from the AAPG Bookstore (see previous review).

DHZ has become CHZ, at least for volume 5B of the second edition of *Rock-Forming Minerals*. Here Prof. W.A. Deer of Cambridge has been replaced by Prof. L.L.Y. Chang of the University of Maryland, U.S.A. Nevertheless, in the Introduction we learn that: "Responsibility for the series *Rock-Forming Minerals* as a whole remains with D., H. and Z."

Volume 5B covers sulfates (written by J. Zussman), carbonates (L.L.Y. Chang), and phosphates and halides (both by R.A. Howie). These mineral groups constituted almost precisely half of volume 5 (Non-Silicates) of the first edition (187 of 371 pages). However, volume 5B is about the same length (383 pages) as was all of volume 5. This serves to demonstrate the ballooning knowledge of these minerals directly applicable to petrology. Much of the increases comes out of isotopic studies, ocean-floor exploration, and drilling in the deep sea.

The format of volume 5B follows that of the first edition, but there are some differences. Five carbonates (azurite, cerussite, malachite, nyerereite, and smithsonite), only mentioned in passing in the earlier work, are now treated in some detail. For all minerals, the sections on paragenesis have been broadened, and references (carrying through 1994) are not only far more numerous, but of wider scope, too.

The carbonates, in particular, have been given a more modern treatment. I do not say this to belittle the attention given to the other mineral groups. Rather, this wholesale revamping reflects the extraordinary recent advances in carbonate mineralogy as well as the vitality of Prof. Chang, who has done ground-breaking research on this group of minerals over the past three decades. DHZ are to be praised for having chosen this energetic and highly qualified coworker. (*Editor's note*: we are indeed fortunate to count Dr. Chang among our group of Associate Editors).

A few notes on the chemical analyses are in order. It is unfortunate that no analyses are given for azurite, cerusite, fluorite, malachite, or smithsonite. These are not insignificant minerals. Also, the user should be aware that many respectable older analyses given in the first edition have been left out of volume 5B. Then, for many carbonate analyses in volume 5B, CO_2 has been calculated from stoichiometry. This is not without pitfalls (*viz.* the analysis of gregoryite in Table 38, with a total of 102.4%).

Errors of fact or typography are few. The heading of Table 18 has a typo, and neither pH nor pE are listed under Abbreviations and Symbols (p. iv), although Eh is. I was delighted to read in the Preface (p. vii) that "... light microscopy remains the basic general tool underpinning all other methods ..."

Volume 5B is an indispensable reference for the active petrographer in spite of its substantial cost. The sewn binding assures that the book won't fall to pieces even after decades of use. The truly systematic user may wish to insert photocopies of some of the chemical analyses of the first edition for the sake of completeness.

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