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BOOK REVIEWS

Proceedings of the Eighth Quadrennial IAGOD Symposium. Yvon T. Maurice, editor. Schweizerbart'sche Verlagsbuchhandlung, D-7000 Stuttgart 1, Germany, 1993, 900 pages, US$226.00 (ISBN 3-510-65153-7).

The Eighth Quadrennial IAGOD (International Association on the Genesis of Ore Deposits) Symposium was held in Ottawa in 1990. Technical sessions spanned five days and covered topics of interest to the various commissions and working groups of IAGOD as well as a number of thematic sessions. The symposium volume contains representative papers from all sessions with the exception of the session on Isotope Geochemistry of Mineral Deposits (although the level of representation is very uneven from session to session). According to the preface of this volume, convenors of the sessions also acted as compilers and associate editors for papers from their sessions. Papers from parallel sessions held during the IAGOD meeting sponsored by IGCP Projects 254 (Metalliferous Black Shales and related Ore Deposits) and 247 (Precambrian Tectonics and Ore Deposits) and the IUS/UNESCO Deposit Modeling Program are published elsewhere and are not represented in this volume.

My first and most lasting impression of this book is the very high standard of editorial work that has gone into it. Proceedings volumes such as this, representing authors from all over the world, are very difficult to produce, with their notorious problems of inadequate English, difficulty of maintaining communication with the authors, poorly produced figures, and widely variable standards of scientific investigation. A quick estimate from the table of contents indicates that as many as 65 or 70% of the authors in this volume probably do not speak English as a first language. It is a monumental task to create a uniform standard of literate, understandable and readable text from such a body of writing, and the editorial board has succeeded remarkably. Virtually all of the papers are written in clear English, and although there are occasional typos and minor grammatical difficulties, these are not common, nor obtrusive, and do not detract from the overall quality of the editorial work. The figures are generally well drawn and reproduced, and for those who want to delve into the many topics covered by this book, the quality and style of writing will generally not be a problem.

In reflecting the range of science presented at the IAGOD meeting, this volume, by necessity, covers a very broad spectrum of mineral deposits science. The range of subject matter, quality of the studies being reported, and the size and scope of the papers are all widely variable. Even within chapters, the papers often do not exhibit significant commonality of theme or scientific approach, and this makes systematic reading of the volume a daunting task. By and large, most readers will find this volume most valuable for its descriptions of deposits, areas and concepts that are not well represented in the English literature. The best of the articles are high-quality scientific articles reporting extensive data, with illustrations and photographs, and references. These papers are the scientific nuggets within the volume, and many of them would be welcome in any front-rank scientific journal (in fact, some of these studies have been reported, in part or in whole, elsewhere in the scientific literature). At the low end, some of the papers are little more than illustrated extended abstracts that present conclusions, but few supporting data. At least one does not have adequate location maps. Many other papers are reviews that generally do not report data but merely describe the data in words or on diagrams. The level of scientific interpretation in such articles is often rather limited, with little attempt at interpretation in terms of deposit models. In some cases, the level of geological description is so low that it is difficult for the reader to place the mineralization in any sort of genetic context or to decipher the interpretations of the authors in this regard.

The book is divided into 16 chapters, each representing a thematic technical session at the meeting. This makes for easy and convenient searching of the Table of Contents for topics of interest. Papers fall generally into one of three classes: i) papers dealing with deposit-level studies of individual deposits or mining camps; ii) review papers, either dealing with the regional aspects of some type of deposit, the metallogeny of a particular area, or an analysis of a particular process of mineralization; iii) theoretical or laboratory studies of mineralizing processes or methodology of economic geology. Many chapters contain a mixture of papers of these types.

Clearly, a detailed commentary on 77 papers spanning almost 900 pages is beyond the scope of this review. However, brief comments on the individual chapters will serve to give a flavor of the range of material covered, and the areas where readers with different backgrounds might find articles of interest.

Chapter 1, Tectonics of Ore Deposits, contains four papers. Two (Tomich, Kutina) deal with regional or global interpretations of lineaments *vis-à-vis* ore depo-

sition through time, and a third (Malinovsky *et al.*) deals with the structural history and extended depositional history of barite – base-metal deposits in Georgia. A fourth (Pell and Hora) looks at the rifting history of the southern Cordillera and relates this history to an extended history of alkaline magmatism and related mineralization. This paper, better than any other in this Chapter, successfully ties metallogeny to tectonic process.

Chapter 2, Paragenesis, contains eight papers, most of which report descriptive paragenetic studies of ore deposits ranging from granite-related veins in southern Israel (Itamar *et al.*) to the Fe–Cu–Co ores of Missouri (Hagni; Hagni and Brandom). This chapter will be of interest to students of "Olympic-Dam-type" deposits, with papers on Bayan Obo (Chao *et al.*) and Boss–Bixby (Hagni and Brandom). Petruk and Wilson present a descriptive review of the occurrence of silver and gold in volcanogenic sulfide deposits in Canada, and Brodtkorb *et al.* describe selenide–sulfide minerals in the Los Llantenes district, Argentina. The chapter is rounded out by a description of a computer system for mineral identification (Laudon and Hagni) and a report on experimental studies of coupled diffusion in the system ZnS–$CuInS_2$ and applications for paragenesis (Bente *et al.*).

Chapter 3, Ore-Forming Fluids in Inclusions, contains five papers. Three of these deal with fluid characteristics of specific deposits or deposit areas, the Los Ratones vein-type uranium deposit, Spain (Mangas *et al.*), the Colombian emerald deposits, (Guiliana *et al.*) and the Nigerian mineral belts (Akande and Kinnaird). The Nigerian paper is particularly wide-ranging and provides a good overview of Nigerian metallogeny. Shibue presents a theoretical consideration of the application of temperature-chlorite mixing diagrams, and Rankin *et al.* review the current state of development of ICP–AES techniques for direct geochemical analysis of inclusion contents.

Chapter 4, Fluorite and Barite deposits, contains four papers. Reviews of fluorite deposits in the former Yugoslavia (Vakanjac), fluid-inclusion data for fluorite deposits world-wide (Bredikhina and Obolensky) and fluorite deposits in the Rio Grande depression (Heyl) provide descriptive information on some specific deposits but little interpretation. In contrast, a study of Jurassic barite and fluorite deposits in Argentina by Brodtkorb and Barbieri provides a good geological summary of the district and interesting documentation of the role of seawater and volcanism in the formation of these deposits.

Chapter 5, Skarn Deposits, contains three papers, all well written and of scientific interest. Two are deposit-specific studies of magnesian skarns in Korea (Mariko and Yang) and iron skarns in China (Feng and Lai). The former is a particularly well-documented study, with good geological descriptions along with mineral chemistry and stable isotope data. A third paper is a regional study of the variations in skarn deposits along the Restigouche – Grand Pabos Fault in Gaspésie (Moritz *et al.*).

Chapter 6, Tin and Tungsten Deposits and Rare Metal Granitoids, contains ten papers that represent a wide range of scientific endeavor and contain a wealth of information for investigators interested in granophile deposits. Many of the papers contain very detailed deposit-level studies (*e.g.*, Cap de Creus rare-element pegmatites, Spain, Corbella and Melgarejo; Xinlu tin field, China, Chi *et al.*; Cornwall, Farmer and Halls; East Kemptville, Nova Scotia, Kontak). Two papers present very broad reviews of granophile mineralization (*e.g.*, Stemprok, Castor), and one paper deals with a theoretical consideration of physicochemical conditions of formation of tungsten deposits in Japan (Shibue). Overall, this chapter is one of the more informative in the book, with most papers containing enough data and interpretations to be scientifically satisfying.

Chapter 7, Ore Deposits in Mafic Rocks, contains four papers. The first is a theoretical consideration of the movement of chalcophile and highly incompatible elements in fluid phases in the mantle (Ryabchikov). The other three deal with kimberlite zoning (Garanin *et al.*), chromite in the Maryland–Pennsylvania Piedmont (Benoit and Sclar) and magnesite in Greece (Barbieri *et al.*).

Chapter 8, Ores and Metamorphism, contains three papers of widely contrasting character. Craig and Vokes describe textural relationships of pyrite that reflect metamorphism of pyritic ores, whereas de Figueiredo describes the effects of high-grade metamorphism on polymetallic ore associated with mafic and ultramafic rocks at the Serrote de Laje deposit, Brazil. Gross, in a paper that seems curiously out of place in this chapter, uses geological observation and *REE* chemistry to argue for a sedimentary origin of the Bayan Obo Fe–*REE* deposits in China.

Chapter 9, Metallogeny of the Bohemian Massif, contains two papers with good geological descriptions of what is considered to be Variscan volcanogenic mineralization in the former Czechoslovakia.

Chapter 10, Hydrothermal Activity, Juan de Fuca Ridge, contains only one paper, a discussion of sulfide melts in basalts that argues for a magmatic origin for some sulfides in this area (Akimtsev *et al.*). This paper is in no way representative of the technical session, which included many American and Canadian authors. Most of this well-known research has by now been published elsewhere, and much of it has been incorporated in the results of the ODP Drilling at Middle Valley.

Chapter 11, Genetic Relationships of Ores in Sedimentary Rocks, consists of four papers on four very different types of deposit. Two papers describe epigenetic mineralization, Mississippi-Valley-type mineralization in southern Poland (Blajda *et al.*) and

vein-type mineralization in sediments of the Lower Rhine Basin (Redecke and Friederich). A general review of iron-rich exhalative sediments, drawn mainly from previously published sources, is given by Gross. Finally, Loukola-Ruskeeniemi *et al.* provide a very good description and geochemical study of a late Proterozoic copper deposit in Finland, which they interpret to be of Besshi type.

Chapter 12, on Manganese, consists of a single paper on the origin of ferromanganese crusts in the central Indian basin (Rao), an interesting paper that, unfortunately, inadequately represents the range of interesting topics covered by this session at the meeting.

Chapter 13, Genesis of Vein and Lode Gold Deposits, contains eight papers that exhibit some of the most consistently high-quality scientific content in the book. Seven of the papers are descriptive papers on gold districts of various characters, ranging from mesothermal to epithermal and Carlin-type. Most follow the format of characterizing the district mineralization as a whole, followed by a focus on a specific deposit (generally the largest) for deposit-level characteristics. The geographic range is very wide, and includes gold districts in the North China Platform (Lin Baoqin *et al.*), Japan–Taiwan (Ishihara and Watanabe), eastern Europe (the former Czechoslovakia, Pertoldova *et al.*, the former Yugoslavia, Percival *et al.*), the Urals (Murzin *et al.*), Karnataka, India (Pathan and Riyaz Ulla) and the northwestern Baltic Shield (Bjørlykke *et al.*). The eighth paper is a detailed study of the structural setting and paragenesis of gold in the Patchway mine, Zimbabwe. The standard of presentation for most of these papers is very high, with abundant data that are generally well presented and interpreted in terms of genetic models.

Chapter 14, Distribution and Metallogenesis of Metallogenic Provinces, contains eight papers dominated by Russian and Chinese authors. This chapter reveals a number of approaches to the study of metallogeny. Maslennikov, Senetsyn, and Barros and Rao, respectively, describe regional variations in the setting and timing of mercury, diamond deposits and emerald deposits, respectively. Popov and Stromov present an hypothesis based on gravimetric and seismic studies in which certain Cu–Ni, Fe–Ti and Au deposits are related to irregularities in the Moho surface. Other authors present regional interpretations of the metallogeny of broad tectonic environments (*e.g.*, Tethys, Petkovic). The chapter ends with three papers dealing with metallogeny of various parts of China, and these may be of interest to western readers as an introduction to the mineralization in these regions. However, none contains sufficient detail or new data to be useful at more than a very regional scale.

Chapter 15, Precious Metals in Supergene Environments, contains only a single paper on gold placer deposits in the Yukon.

Chapter 16 contains 11 papers that sample the general sessions at the meetings. No two papers deal with even remotely similar topics. Of particular note are two high-quality articles describing the epithermal precious-metal system at the Mayflower mine, Montana (Cocker) and tourmalinites associated with massive sulfides deposits in central India (Bandyopadhyay *et al.*), which provide good new data and interesting interpretations.

I have distinctly mixed feelings about this book. In the spectrum of Proceedings volumes arising from large international scientific conferences, this book certainly ranks near the top in quality of editing and presentation, and attempt to faithfully represent the range of scientific discussion at the meeting. However, given the wide variation in the quality and coverage of the various topics and the even greater variability of the level of science in the papers therein, it is clear that this is not a book that belongs on every mineral deposits professional's shelf. There are some scientific gems in here, and some topics that record a generally high level of scientific endeavor (notably on the topics of skarns, granite-related mineralization and gold). However, because the book covers such a diverse range of topics, it follows that few subjects are treated in depth or detail, and most users will probably not find sufficient material in their field(s) interest to justify the price. In any event, at US$226, the price is certainly prohibitive for most individuals. Nonetheless, this wide-ranging volume does belong on the library shelves of institutions and perhaps large companies concerned with mineral deposits science on a global scale. It provides access to well-written, clearly illustrated accounts of mineral deposits in all corners of the world. Many of the areas and ideas are not otherwise represented in literature that is readily available to western geologists.

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CIS Energy and Minerals Development: Prospects, Problems and Opportunities for International Cooperation. Edited by James P. Dorian, Pavel A. Minakir & Vitaly T. Borisovich. Kluwer Academic Publishers, Dordrecht, The Netherlands. Published in cooperation with East – West Center Program on Resources: Energy and Minerals, Honolulu, Hawaii. 1993, 366 pages. US $119.00. ISBN 0-7923-2323-8.

CIS Energy and Minerals Development comes at a time when employment opportunities for geoscientists

have been disappearing. It shows that a new frontier for mineral and energy exploration and development is rapidly opening. The Commonwealth of Independent States (former Soviet Union), which possesses some of the world's largest reserves of hydrocarbons and minerals and has the best potential for future development, is enthusiastically, even aggressively, seeking joint ventures. CIS, specifically, is made up of Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Belarus, Russia, Tajikstan, Turkmenistan, the Ukraine and Uzbekistan. To get the most from this useful book, have an up-to-date atlas handy, since the text gives little help in locating areas and specific prospects discussed.

Relatively little first-hand information has been available for several decades about the geological, economic and political characteristics surrounding the former Soviet Union's mining industry. *CIS Energy and Minerals Development* fills the gap. The book is composed of 20 chapters written by individuals or teams of experts from the CIS member countries and neighboring countries of the Pacific rim. The chapters are grouped into three sections: 1) The Commonwealth Mining Industry, 2) Regional Issues and Affairs, and 3) International Trade and Relations. Part 1, The Commonwealth Mining Industry (Chapters 2–6) documents the occurrence and distribution of mineral deposits, their state of development, and their future prospects. In Part 2, Regional Issues and Affairs (Chapters 7–12), the Armenian and Kazakhstan mining industries are briefly described; four chapters follow on the Russian Far East, which has been mapped geologically only on a reconnaissance level. Part 3, International Trade and Relations (Chapters 13–20), was prepared by specialists from countries along the Pacific rim, primarily Australia, but also Japan, China and New Zealand. The authors focus on the economic and political factors of the Russian Far East that must be considered in setting up any new joint venture. The insights that these chapters provide may come as a revelation to many readers. They did to this writer!

CIS Energy and Minerals Development appears to have been carefully edited. However, the reader soon becomes aware of repetition, as the various authors discuss the problems facing any new joint venture: desperate shortage of finance, poor infrastructure, low productivity, obsolete technology, no pricing system, and, above all, little protection for the investor's interest, especially the need to convince the joint venture operator that they hold free and clear title to their concessions. These problems are familiar to anyone following recent events in Russia in the popular media.

This book provides valuable resource material for a course in mineral economics. Economic geologists will be grateful to Allen Clark and G.V. Sekisov for classifying mineralogenic provinces and mineral deposit types in the Russian Far East. Their extensive use of geological sketch-maps and tables is a great help to the reader not likely to be familiar with this area. Mineral economists will appreciate Douglas Ritchie's application of models of working ore deposits in Australia and South Africa to unevaluated areas in the Russian Far East. The East–West Center's Program on Resources and Minerals has done a valuable service in publishing this timely, informative book.

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Martin Frobisher's Northwest Venture, 1576–1581. Mines, Minerals, and Metallurgy. By D.D. Hogarth, P.W. Boreham, and J.C. Mitchell. Published by Canadian Museum of Civilization, 100 Laurier Street, P.O. Box 3100, Station B, Hull, Quebec J8X 4H2. CAN $21.95.

Martin Frobisher's Northwest Venture, 1576–1581. Mines, Minerals, Metallurgy is an intriguing, well-written, and thoroughly documented account of the circumstances surrounding Martin Frobisher's three voyages to Baffin Island, mining activities undertaken there, and an in-depth examination of problems associated with assaying and processing the mined "ore".

The first of these voyages, in 1576, was in search of a Northwest Passage. Assays carried out on a sample of "black ore" collected from the shores of Frobisher Bay during that voyage indicated a high gold content. This led to intensive activities to mine these deposits during second and third voyages, in 1577 and 1578. The third voyage was a major undertaking involving more than four hundred men and more than twenty ships. Eleven hundred and thirty-six tons of "ore" were mined and loaded for shipment to England. One ship carrying one hundred and ten tons of "ore" was wrecked off the west coast of Ireland. In addition to mining, plans were made for the establishment of a small settlement.

Assay results, however, were highly variable. Subsequent assays and attempts to process the ore from the later voyages failed to bear out the initial high assay results, and the mined rock proved to be virtually worthless.

This book presents the results of the authors' tenacious research of the extensive records and reports pertaining to this venture, and studies and comparisons that they have conducted of the rocks at the Baffin Island mining sites and samples recovered from the ore-processing site at Dartford, England, and from

Smerwick Harbour in Ireland, where the ore-carrying ship Emanual was wrecked. Mining and metallurgical practices, which then were in their infancy, are discussed. Biographical information provides insight into and "brings to life" many of the main people involved in the venture.

The authors inquire into the exact nature of the so-called black ore. Was it distinctive from the rocks nearby? Did the various mines supply more than one type of ore? How much gold and silver really was in it? Why were the assay results so variable?

In collating answers to these various questions and the circumstances surrounding this endeavor, the authors have produced a very readable, authoritative, and fascinating account of one of the first attempts at mining in North America by Europeans.

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GIA Diamond Dictionary (Third Edition, revised). By John H. Hummel, Ph.D., editor, Gemological Institute of America. 1660 Steward St., Santa Monica, California 90404, 1993, 275 pages. US $79.50 (ISBN 087311-026-9).

This is the third edition of the GIA Diamond Dictionary, which first appeared in 1960. This edition contains new and expanded categories, including information on new mines, notable new diamonds and new technologies. In alphabetical order, the GIA has amassed a great deal of information on diamond, covering all aspects of the diamond trade. The book is laid out in easy-to-read form, with over 100 color photographs and dozens of maps and drawings covering sources of diamond, cutting, sales, equipment and value. The individual entries are concise and easy to read, a good place to start for anyone doing diamond-related research.

The information is concise and up to date, including references to areas in the Russian Federation. The reader would be hard pressed to not find reference to any known significant stone, names of which are cross-referenced, and current ownership is mentioned where known. The twenty-five pages of appendices (A through H) list notable diamonds not fully described in the text, a two-page list of American diamonds, and color and clarity grading scales with GIA, CIBJO, Sean D.N. and AGS comparisons.

I found this to be an excellent reference to help sort out the multitude of diamond simulants and misnomers with which one comes in contact in the day-to-day practice of identification and cutting of gemstones. The dictionary is printed on high-quality, non-glossy paper, is concise and easy to read. The book is, in my opinion, useful as a collection of data, but it is not a comprehensive treatment of any particular aspect of diamond information. It will make an excellent source-book for preparing public talks on the diamond business as well as a quick and ready reference for anyone writing a general paper on this fascinating subject. This is a reference book more suited to the practicing jeweler or gemologist than as a textbook. It makes for excellent "coffee table" reading, but at a price of in excess of CAN$120, it is perhaps on the expensive side for gift giving or student use.

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Hey's Mineral Index. By A.M. Clark. Chapman & Hall, London, 1993, 852 pages, US$79.95, hardbound (ISBN 0 412 39950 4).

This volume is the third edition (now retitled) of Hey's *An Index of Mineral Species & Varieties Arranged Chemically* that first appeared in 1950. Subsequently, there was a second edition and several appendices, the most recent being in 1974. Since then, the number of valid species has increased markedly to about 3500, about 600 of which have heen defined in the last decade alone, primarily as a result of an unprecedented amount of research and the availability of new instrumental techniques. The time is right for the appearance of this third edition.

Like the earlier editions, this one consists of two parts (ignoring the pronunciation index in the second edition, which is now dropped); however, there have been major changes. The first part now consists of the *Alphabetical Index of Mineral Species, Varieties and Synonyms* that has been moved from the back of the earlier editions to the front of this edition and significantly expanded, so that it now constitutes 782 pages (92%) of the book. This section not only includes names of valid species (in bold type), varieties and synonyms, but also misspellings, Germanic variants, mixtures (*e.g.*, alaskaite), selected meteorite (*e.g.*, aerolite, agramite, nelsonite) and rock (*e.g.*, allite) names (if they end in *ite* and are likely to be confused with minerals), glasses (*e.g.*, Darwin glass, tektite), organic materials (*e.g.*, clarain), gemological varietal and trade terms, both natural and synthetic (*e.g.*, copal, maw-sit-sit, fabulite), and various other names (*e.g.*, dynamite!) (most of these examples were also in earlier editions). I estimate the total number of entries at about 15,000.

For the valid species, significantly more data are given now in comparison with the earlier editions. Typically, the following are presented (exceptions exist, as in the case of minerals known from antiquity): chemical composition; original reference; type locality; origin of the name; system and other crystallographic data, including the Powder Diffraction File (PDF) file number; mineral-group affiliation; synonyms; and a brief commentary, where warranted, on various aspects of the data. On occasion, the commentaries can be extensive, *e.g.*, in the cases of goethite and lillianite, the commentaries consist of about 200 words, and 6 and 10 references, respectively. Even in the case of synonyms, varieties and mixtures, commentaries are frequently 100 words in length. Owing to the limited availability of Dana's *System of Mineralogy* (6th ed., 1892), essential references to older literature found in that volume (and older editions of Dana) are now given in abbreviated style.

The second part of the book (70 pages) contains the very useful *Chemical Classification* of the valid species, *i.e.*, the mineral names are grouped into the categories of elements and alloys, oxides, carbonates, *etc.*, with subdivisions based on the same scheme as used in earlier editions.

The preparation of this imposing volume was clearly a laborious and monumental task, for which all mineralogists must be thankful, not only to Dr. Clark, but to all those who assisted him (including The Natural History Museum, London, for its support) and, of course, the late Dr. M.H. Hey. It is more that just an index; rather, it is a mineralogical nomenclature encyclopedia that will be an indispensable reference. If I were asked, "What is the scientific half-life of this volume likely to be?", my answer would be "Eternity". This is based upon the fact that the volume: (a) has taken over the function of supplying the early references previously available in the early Dana editions mentioned above; and (b) was produced, and will be maintained, on a computer file that can be easily updated. If there is one drawback to this volume, it is its weight (2.13 kg) and awkward size (30 × 21.5 mm; the European A4). However, I consider these drawbacks minor considering the pleasant and effective presentation that encourages perusal, the high quality of the production (handsome binding, good-quality paper), and the very reasonable price.

During the 20 years since the last appendix, the field of mineralogical nomenclature compilation in English has been the domain primarily of M. Fleischer, and more recently M. Fleischer and J.A. Mandarino (*Glossary of Mineral Species*), and E.H. Nickel and M.C. Nichols (*Mineral Reference Manual*); both of these more recent compilations appeared in 1991 and were reviewed in this journal (Vol. 29, Part 3, pages 599-600). Both of these volumes contain about 4000-4500 entries; however, they are clearly concerned only with mineral species (and important varieties). One might ask: "Does the appearance of this new edition of Hey portend the demise of the compilations by Fleischer and Mandarino, and by Nickel and Nichols?" The answer is "Absolutely not"; both will retain their importance and international status. Although all three volumes have attempted to follow the recommendations of the Commission on New Minerals and Mineral Names (CNMMN) of the IMA, and they have been successful in some notable circumstances (*e.g.*, the rare-earth minerals), all entries are by no means identical. Examples in which entries for valid species differ significantly include, for example, gersdorffite, halloysite, moissanite and molybdenite. Thus all mineralogists will find it prudent to consult constantly all three references for the opinions of these world-class authorities.

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