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BOOK REVIEWS

High Resolution Transmission Electron Microscopy and Associated Techniques. By Peter R. Buseck, John M. Cowley, and Leroy Eyring. Oxford University Press, New York, 1988, 645 pages, CAN $105 (hard cover), $69.95 (paperback) (ISBN 0-19-504275-1, 0-19-504262-6).

I approached this book from two directions. First, as a mineralogist familiar with high-resolution transmission electron microscopy (HRTEM), but with particular questions of theory and application for which I wanted clarification, and secondly, to see how well the book would serve a mineralogist wanting to find out about the technique from the start. I found the book extremely successful on both counts.

The work begins with six very accessible chapters on the theory underlying TEM, including a welcome digest of Cowley's fuller text. This provides the graduate student and the mineralogist alike with a thorough review, as well as an answer to specific questions of technique that are theory-dependent.

One important lesson in HRTEM that it is easy for a mineralogist to overlook in the delight of taking a structurally recognizable image, is that HRTEM images are not always intuitively interpretable, and model calculations are essential to confirm an interpretation. This book devotes almost 60 pages to the theory and examples of image calculation. Following this are chapters describing applications in mineralogy, solid-state chemistry and material science. Although somewhat restricted by the use of examples almost entirely from the authors' laboratories, there is quite enough scope to show any intending user the kinds of information available through the use of HRTEM, and the limitations of the technique.

Having learnt the theory and discovered the usefulness of HRTEM, you will want to know how to get a result. Chapter 12 does just this, with some particularly clear and useful advice on practical electron microscopy and the all-important procedures for aligning the instrument. The only deficiency I found is in the consideration of beam damage to mineral material. Whereas the major issues of this topic are discussed, they are spread throughout the book. It is a pity that the wealth of experience of the contributors was not drawn together into a section on electron-beam damage.

Overall, the book is very well presented, although a few graphs lack axis labels. It is up to date, and should stay so through the next generation of microscopes. This book will be the authority on HRTEM for some time and represents excellent value for money. It is most appropriate for the specialist's personal library, as a source and reference work for all mineralogists, and as a text for advanced study.

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Advances in X-ray Analysis (volume 34). Edited by C.S. Barrett, J.V. Gilfrich, I.C. Noyan, T.C. Huang and P.K. Predecki. Plenum Publishing Co., 233 Spring St., New York, N.Y. 10013, U.S.A., 1991, 743 pages. US$115 (ISBN 0-306-44003-2).

Seventy papers are given in the *Proceedings of the Thirty-Ninth Annual Conference on Applications of X-ray Analysis* held during August, 1990, at Steamboat Springs, Colorado. The X-ray fluorescence (XRF) part was subdivided into the following sections: (a) surface and near-surface X-ray spectroscopy, (b) determination of low-level concentrations by X-ray spectrometry, (c) long-wavelength X-ray spectrometry, (d) XRF data reduction, (e) XRF instrumentation and techniques, and (f) geological and other applications of X-ray spectrometry. The part on X-ray diffraction (XRD) was subdivided into the following sections: (a) solid-state and position-sensitive detectors for XRD, (b) qualitative and quantitative analysis of phases by XRD, (c) nonambient application of diffraction, (d) crystallite size - strain analysis, (e) thin film and semiconductor characterization by X-ray diffraction, and (f) analysis of stress and fracture by diffraction methods.

Since there are so many papers in this volume, it is not practical to comment in detail; what follows are some general observations. Each of the twelve sections appears to be given equal treatment. There are seven papers on quantitative analysis; these cover most of the present research areas and problems. Topics include evaluation of the JCPDS Powder Diffraction File, use of digitized diffraction-pattern data-base, analysis of fly-ash, calibration of size-segregated aerosols, corrections for preferred orientation, use of pellets, and mass-absorption-corrected data. The different papers cover state-of-the-art type research and, in general, make a valuable contribution to the literature. Some papers are of a higher standard than others, as

would be expected in any volume of proceedings. Many of the papers presented at the conference are not published in this volume.

The reason for the rapid publication of the proceedings is that the camera-ready method was used. The negative effect of this process is that the density of the printing varies, the size and type of the characters are different, and there are slight variations in the format. Nevertheless, editing has been careful, with running titles and authors' names on every pair of pages. Both a comprehensive subject index and author index complete the volume. Scientists interested in X-ray analysis by both diffraction and fluorescence will wish to consult a number of papers in this volume. The price of this volume compared to other scientific books is reasonable in today's marketplace. Every scientific library should purchase this volume.

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Structure Reports 1989, Volume 56A. G. Ferguson, General Editor, J. Trotter, Section Editor. Published for the International Union of Crystallography by Kluwer Academic Publishers, Dordrecht, Holland, 1991, 300 pages, £40.00 (hardbound) (ISBN 0-7923-1078-0).

It is always a pleasure to open a new volume in a long-established and much used set of reference books. Volume 56A, covering the structural crystallography of metals and inorganic compounds, is no exception. The most striking feature, to one long accustomed to constant reference to the earlier volumes of *Structure Reports*, is the economy of space in presenting all the essentials of a crystal structure in a minimum format, which is both simple and clear, with ample white space (1029 full structures in 260 pages plus 12 pages of partial structural data). A useful feature is the grouping of related phases, *e.g.*, hydrides, carbides, borates; this is very convenient for workers in specialized fields. In general, the reports give the formula, the literature reference (including first and last pages), space group, cell parameters, and a list of coordinates and the structure type (where relevant), plus a drawing and a brief summary of interatomic distances where these are useful. Where items have been adequately described previously, there is no unnecessary repetition. The reports retain their critical quality, despite the conciseness of presentation [a doubtful *x*-coordinate is questioned (the Al_2 in 8*j* in Al_8Fe_4Np): a missing space-group is inserted (D_4GaNd); a Z value is corrected (TiF_3)]. An especially useful feature is the summary of previous references; for example, the entry on boulangerite with three references to earlier *Structure Reports* leads one to other references that summarize the varying previous literature reports. The new user should note carefully the arrangements of text and indices: thus $GaNaD_4$ is in the hydride section under Ga but in the index under D_4GaNa. Some minor defects were noticed: as a consequence of the reduction used, a few of the tables and the drawings are not easy to use; the indexing program used has some quirks, *e.g.*, $Al_{18}M_2Mg_3$, where M = Ta,Mo,W, is indexed under M, but the separate compounds are not indexed; Ln is used for any lanthanide, but the individual elements are not always specified, *e.g.*, Co_3LnP_2 (p. 58), where the elements are probably Ce, Nd, Pr and Sm, but are nowhere specified.

In summary, *Structure Reports* can be very strongly recommended as an essential reference for any worker who deals with metals or inorganic compounds and needs an authoritative, up-to-date and critical summary of the structural data on any given phase.

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Pearson's Handbook of Crystallographic Data for Intermetallic Phases (*Second Edition*). By Pierre Villars and Larry D. Calvert. ASM International, Materials Park, Ohio 44073-0002, USA, 1991, 5366 pages in four volumes. US $1709.00 (ISBN 0-8717-416-1).

The original edition printed in 1985 contained 3258 pages in three volumes. The first printing was sold out within a few months, and the second printing was sold out within a year. Rather than a further reprinting, the publishers wisely decided upon a new edition that would incorporate corrections and double the number of entries. Since the original edition was out of print, *The Canadian Mineralogist* decided not to try to obtain a review. The original edition has been used to find errors in the mineralogical literature of one structure type and 19 minerals (*Can. Mineral.* **28**, 751, 1990). Therefore, the appearance of the Second Edition has been eagerly awaited.

The table of compounds (4,885 pages), which contains nearly 50,000 entries taken from the literature between 1913 and 1989, is arranged alphabetically from Ac to Zr. Crystallographic data given include unit-cell dimensions, atomic positions with number of equivalent sites, point symmetry, and site occupancies, plus a statement to indicate if temperature factors are given in the original publication. Other information documented is as follows: miscellaneous, including mineral name; diffraction data; preparation; comments; T-, P- or

concentration dependence; phase diagram; and reference.

In order to find isostructural phases, there are a number of indices. The first three structure-type indices (each 31 pages) contain the same data of structure type, Pearson symbol, space-group symbol, and space-group number; however, each index is sorted differently. The first index is sorted alphabetically by structure type, the second index is sorted alphabetically by Pearson symbol (anorthic, monoclinic, orthorhombic, tetragonal, hexagonal and cubic), and the third index is sorted numerically by space-group number. The other two structure-type indices (each 177 pages) contain the same data of structure type with all the representatives listed, Pearson symbol, space-group symbol, and space-group number. The first index is sorted alphabetically by structure type, and the second index is sorted alphabetically by Pearson symbol.

The mineral name and common name index (5 pages) is ordered alphabetically and also contains a chemical formula, structure type, Pearson symbol, and space-group number. The three Strukturbericht-designation indices (7 pages) contain the Strukturbericht designation, prototype structure, Pearson symbol, and space-group symbol. The first index is arranged alphabetically by Strukturbericht designation; the second index is arranged alphabetically by Pearson symbol, and the third index is arranged alphabetically by prototype structure.

Since the volumes are now in the Second Edition, and all the data have been rechecked from the original publications, very few errors are found. The chemical formula for aramayoite, $Ag_5Bi_2Sb_4S_{12}$, is given correctly in contrast to the incorrect chemical formula in the 1991 editions of the *Glossary*, *Manual* and *Lapis* (all reviewed in *Can. Mineral.* **29**, 599, 1991). The reference adopts the use of the international unit of nm rather than the more conventional A used by most mineralogists. On the other hand, the reference contains such phase designation descriptions as β-, which the International Union of Pure and Applied Chemistry (IUPAC) states should be dropped, and recommends that the Pearson symbol should be used instead.

There are a few incorrect mineralogical names, such as zinc blend for sphalerite. The use of the standard mineralogical convention of bold-face type for acceptable mineral names and regular type for common names in the mineral and common name index would have been helpful. The paper on anisotropic pyrite of 1977 is quoted; however, the more probable orthorhombic model for anisotropic pyrite (*Am. Mineral.* **74**, 1171, 1989) has been missed.

The printing is clear on high-quality paper. Although the data are in tabular form to allow easy access, the amount of white space is minimal, owing to the use of a double-column format. The volumes do not have a table of contents, and the indices are not marked on the side of the pages as they are in the original edition with differently colored pages, so that the minerals name index is difficult to find.

The volumes represent good value for money. Although the price will eliminate most mineralogists from having a personal set, every scientific library with an interest in native elements, sulfides, sulfosalts, and binary oxides should have this reference set available for their readers.

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Public Domain Software for Earth Scientists – Handbook of Public Domain and Inexpensive Software (second edition). Compiled by Betty Gibbs & Stephen Krajewski. Gibbs Associates, Boulder, Colorado, USA, October, 1991, 189 pages, US $40, CAN $50 (ISBN 0-943909-05-8).

Over the last quarter of a century, portable software of interest to earth scientists has been developed at an ever-escalating rate. Anybody who brings together in one place the names and descriptions of presently available software certainly performs a most useful service. Particularly attractive, in some respects, is software that is available in the public domain and thus may be copied, modified, customized, *etc.*, for specific applications by individual users. This software is generally free or is supplied for a very modest administrative fee. However, it is commonly unsupported, comes with no guarantees, and sometimes with little or no documentation. Freeware, on the other hand, is generally considered to be software for which the author retains a copyright; it may be copied freely, but cannot be modified and sold except with specific permission. Finally, shareware is provided initially free of charge for evaluation purposes. However, users are expected to make a "donation" (the size of which is usually specified) if they find the software useful. Again, the copyright is generally retained by the author, and the software cannot be modified or resold. Commonly, the source code is not made available. In many cases, the fee covers registration and updates, bug notifications, *etc.*

Gibbs Associates have collected together in this catalogue a substantial number of descriptions of such software, which they will supply for a modest administrative fee. This catalogue is one of a series of their publications, the others being a "Directory

of Mining Programs", "EZSearch-Mining" and "Computers & Mining Newsletter". In the catalogue being reviewed here, they have listed the software under some thirty different headings. Those that are of possible interest to mineralogists, crystallographers, petrologists, geochemists, economic geologists and meteoriticists (who, collectively, are considered to be the principal audience of *The Canadian Mineralogist*), might reasonably be expected to be found mainly in the sections on Exploration, Geochemistry, Geology, Image Processing, Mine Design & Planning, Mineral Processing & Simulation, Mining Methods, Reserve Evaluation and Support Software. Within each such section, available software is listed under the original source. For example, within the section on Geology, there are headings for such sources as GEOLOGICAL SURVEY OF CANADA, PETMAR TRILOBITE RANCH and U.S. GEOLOGICAL SURVEY. Under the first of these, there are 23 entries. Unfortunately, to find out whether there are any of interest to the reader requires the systematic perusal of all entries. For these particular entries, there are few acronyms, no information on hardware requirements, and not even the cost – leaving the reader wondering if there are charges, who actually supplies the product and what is supplied – a program listing? a manual? or a reprint perhaps containing a listing? Similar problems exist with the entries under the U.S. GEOLOGICAL SURVEY. Although, in that case, prices are shown, it is not always clear exactly what is supplied for the price. If, for example, a reader wished to locate programs capable of mineral identification, he or she might search through the entire sections on Geology and Mineral Processing and come up with a blank, only to find later, perhaps fortuitously, four such programs buried within Area 19 of the COGSNET FILES ON LINE section. In fact, the catalogue is unindexed, and although it has a section toward the front on "HOW TO USE THIS HANDBOOK", after reading it, this reviewer felt little the wiser about the best way of locating listings of interest within the handbook.

After spending considerable time searching systematically for software likely to be of particular interest to mineralogists, the reviewer located between 20 and 30 items that were conceivably relevant. In many cases, the information provided was very scant indeed. In several instances, attempts were made to contact the original sources (using the listing of original source addresses conveniently included at the end of the Handbook). These requests for further information elicited very few responses, and enquiries to Gibbs Associates also went unanswered.

In summary, I do not believe that this is a handbook which many readers of *The Canadian Mineralogist* will want on their private bookshelves, although it might be worthwile requesting a copy for the library. The price of $40 (US) or $50 (CAN) seems somewhat excessive for an inexpensively produced paperback catalogue in 8.5 × 11″ format and which might well be considered as little more than a brochure for a commercial service offered by the publisher. The reader may, in fact, wish to wait for the more specialized "IMA Mineralogical Software Catalogue", which is due to be published by the International Mineralogical Association in the Summer of 1992 and which, it is anticipated, will include upward of 800 software items of potential interest to the mineralogically inclined.

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Oxide Minerals: Petrologic and Magnetic Significance. Edited by Donald H. Lindsley. Reviews in Mineralogy, volume **25**, Mineralogical Society of America, Washington, D.C. 1991, 509 pages. US $24.00 (softbound) (ISBN 0-939950-30-8).

This volume is a must for all investigators choosing to do more than call the oxide minerals "opaques" and then turn their attention to other minerals. It is a vital next step from the Short Course on Oxide Minerals (published as Volume **3**, 1976, in the *Reviews in Mineralogy* series). The editor of Reviews in Mineralogy, Paul H. Ribbe, expresses this best in his introduction to Volume 25: ".. Much progress has been made in the interim. This is particularly evident in the coverage of the thermodynamics of oxide minerals: nothing in Volume 3, while in contrast, Volume 25 has three chapters (6, 7 and 8) presenting various aspects of the thermodynamics of oxide minerals; and other chapters (9, 11, 12) build extensively on thermodynamic models. The coverage of magnetic properties has also been considerably expanded (Chapters 4, 8 and 14). Finally, the interaction of oxides and silicates is emphasized in Chapters 9, 11, 12, 13 and 14..."

This volume includes the cutting edge in concepts, uses of thermochemical and magnetic data in interpretations of rock-forming processes, and provides guidelines for potential future research. Most geologists are familiar with the calculation of a "closing" temperature and oxygen fugacity from coexisting Fe-Ti oxides. With the recent incorporation of thermodynamics and the thermochemical data of silicate and oxide minerals, we are now offered the possiblity of inferring paths of crystallization, making use of oxygen barometry, monitoring metamorphic fluids, and studying magnetic petrology. For examples, see Chapters 6

through 14 and papers in press cited in the references.

The text of this volume is well organized, with clear explanations of recent advancements throughout. The amount of new material is not uniform from chapter to chapter, but all chapters offer valuable information in a concise format. The volume as a whole is a goldmine of data and references in almost any specific area of oxide petrology one might choose to pursue. The treatment of the subject matter is generally at the level expected for graduate students and research petrologists. Much of the material, however, would also be suitable for senior undergraduates. In short, this book is a bargain and an appropriate addition to any petrologist's "working" reference library.

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Early Precambrian Basic Magmatism. Edited by R.P. Hall and D.J. Hughes. Blackie and Son, Limited, Bishopriggs, Glasgow G64 2NZ, U.K. and Chapman and Hall Inc., 29 West 35th Street, New York, N.Y. 10001-2291, U.S.A., 1990, 504 pages. £85.00 (hardbound) (IBSN 0-674-64481-6).

The stated purpose of the book is to provide a comprehensive review of the basic rocks formed during the first half of the Precambrian. To the great majority of igneous petrologists, devoted to the study of more recent igneous rocks, the book is a timely reminder that basic igneous activity during this early period, while more difficult to study, has a critical role to play in deciphering both igneous processes in general and the derivation of the Earth's crust from its mantle in particular.

Following an introduction to some of the problems by the editors, the book is divided into two parts. Part I includes review papers of particular aspects of this early magmatism: the basaltic greenstones, noritic magmas, layered intrusions, and chapters on the mineralization associated with this magmatism, on mantle evolution, and an additional chapter on Lunar volcanism. These are useful and up-to-date reviews of significant and fascinating problems, and many could be required reading for graduate courses in igneous petrology. Inevitably, perhaps, there is a certain amount of overlap in subject matter. The origin of komatiites and related magmas is, indeed, well rehearsed.

Part II provides a useful review and catalogue of specific shield areas: North and South America, Greenland and Scotland, the Baltic Shield, China, Australia, and Africa (nothing from the Soviet Union). This part contains excellent chemical data from around the world, which are thus made readily available under one cover. As such, the book will be a most useful reference for those of us who may not be as familiar as we should be with individual contributions in this area.

I find the format a little depressing: small print on rather small pages. I think the publishers could have made their product look more attractive to the more casual reader. A color photomicrograph of a komatiite as a frontispiece would not have been amiss.

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Geology of the Mineral Deposits of Australia and Papua New Guinea. Edited by F. E. Hughes. Monograph No. 14 (in two volumes), The Australasian Institute of Mining and Metallurgy, Clunies Ross House, 191 Royal Parade, Parkville, Victoria 3052, Australia, 1990, 1828 + xxii + 45 (indices) pages + 2 co]ored maps (one in the pocket of each volume). AUS $ 100 for Aus.I.M.M. student members; AUS $ 200 for Aus.I.M.M. members; and AUS $ 250 for non-members (ISBN 0-949106-53-4).

The long-awaited new edition (the fourth) of the Australasian Institute of Mining and Metallurgy monograph on ore deposits of Australia and Papua New Guinea is a monumental piece of geological documentation. Its overall appearance is striking: two hardbound volumes totalling almost two thousand pages with colorful, glossy, plastic covers and printed on heavy, high-quality paper (its total weight in its mailing carton is 6.3 kg). Each volume carries, in its pocket, a colorful geological map showing the overall geology of Australia and Papua New Guinea and the location of the ore deposits described in the text.

The format of the Aus.I.M.M. Monograph 14 is essentially similar to that of the previous edition (Monograph 5), *i.e.*, the ore deposits are grouped into chapters according to tectonic domains, but has been expanded from one to two volumes. As in the previous edition, each chapter begins with an introductory section, in which the overall geology of that specific tectonic domain is described. In his Editorial, the Chief Editor points out that Monograph 5 had an emphasis different from its successor: the former was dominated by descriptions of base-metal deposits (*i.e.*, nickel in Western Australia and copper in Papua New Guinea), whereas the latter documents a large number of gold deposits, mainly from the Archean (63 papers), the Paleozoic Fold Belts of eastern Australia (28 papers) and Papua New Guinea (15 papers). Monograph 14 also contains papers on other types of ore deposits, which have been either

discovered or extensively explored since Monograph 5 was published in 1975. The editors issued strict guidelines to the authors on how to write their contributions, so that a consistent format could be maintained throughout the entire monograph. Even if they achieved their goal, the quality of the different papers spans the full range of possible standards. This publication presents mainly field descriptions of ore deposits and the tectonic domains in which they occur; apart from assays for a few deposits, only a handful of papers contain new analytical data, such as fluid-inclusion measurements, stable and radiogenic isotope analyses, *etc.*

Rather than reviewing Monograph 14 chapter by chapter, I prefer to assess it according to arbitrarily chosen headings, because it is impossible to compare papers dealing with different topics (*e.g.*, review articles *versus* descriptions of ore deposits) and relying on variable amounts of data (*e.g.*, world-class ore deposits, which have been mined for over half a century and extensively researched, *versus* prospects that have only been explored for few years and never been studied before). The headings are Chapter 1, regional geology and mineralization, large mines, small mines and prospects.

Chapter 1 is the overall introduction to the entire monograph and is subdivided into three sections: (1) The Framework – Industry, Stratigraphy, Tectonics, (2) Commodity Reviews, and (3) Processes in Ore Genesis. Rather than having a strictly mineral economics content, these commodity reviews summarize the geological occurrence of gold, diamond, opal and platinum-group mineralization in Australia, in a very informative way. In particular, the paper on opal represents the first contribution on such a commodity in any recent book on economic geology. In the section on ore genesis, Stanton and Elliston summarize some of their earlier work, respectively, on the volcanic affiliation of some deposits and on the capacity of fluids to extract metals from sediments. A thorough explanation of geochemical processes causing gold enrichment in the supergene environment is provided by Mann and Webster.

Each of the eight descriptive chapters deals with a specific tectonic domain: (1) Archean gneiss and granite–greenstone domains of Western Australia, (2) Proterozoic orogenic domains and Precambrian cover sequence of Western Australia, (3) Precambrian orogenic domains and cover sequences of northern Australia, (4) Precambrian cratons domains and cover sequences of southern Australia, (5) Late Proterozoic and Phanerozoic epicratonic basins, (6) Eastern Australian epicratonic basins, (7) Post-Paleozoic platform cover in Australia, and (8) Papua New Guinea – geology and mineral deposits. The chapter on the Archean of Western Australia differs from the others, because it contains also an overall summary on gold deposits of this tectonic domain; it is a very useful synthesis, as it represents the essence of twenty years of research carried out by David Groves and coworkers on the Archean gold deposits of Western Australia.

The papers on the regional geology and the mineralization of the different tectonic domains vary in length according to the economic importance of the region with respect to the occurrence of ore deposits. All papers present good and up-to-date overviews; in one of them, Ahmad and Wygralak present a classification of U deposits, which appears to be rather questionable, as the main characteristics of each type of mineralization are poorly documented.

Australia and Papua New Guinea have some world-class mines, most of which were described elsewhere. Overall, most of the papers dealing with major ore deposits are interesting and present valuable field data. However, a few descriptions are exceptionally good, as they document, in great detail, either recently discovered deposit (*e.g.*, Olympic Dam, Argyle, Mt. Leyshon, *etc.*), or provide new information on mines that have been exploited for several decades (*e.g.*, the Golden Mile at Kalgoorlie, Kambalda, *etc.*). Smaller ore deposits are given less space; thus their descriptions are rather general, with the exception of the paper on Hill 50 gold deposits (Western Australia).

Owing to the limited amount of available data and, probably, to confidentiality, the papers on prospects are very sketchy. However, the authors describing the Benambra massive sulfide deposit (Victoria), the Matilda gold deposits (Western Australia) and the Bendigo gold field (Victoria) present remarkable details of information in their work.

In summary, Monograph 14 of the Aus.I.M.M. represents a high-quality publication documenting the main geological features of ore deposits from Australia and Papua New Guinea. The editorial team must be commended for their enormous effort, mainly considering that they had to deal with about 438 authors (two papers are listed as the joint effort of two groups), most of them with busy schedules and unaccustomed to write publishable scientific papers. A summary of the strong points of this publication can be stated as follows: (1) it is a very comprehensive and updated field-based general documentation of Australian and Papua New Guinean gold and other types of ore deposits and of the regional setting in which they occur; (2) it contains some excellent descriptions of world-class ore deposits (*e.g.*, the Golden Mile in Western Australia and Olympic Dam in

South Australia); (3) it has a high typographical standard, with very few printing mistakes, and is very well presented. There also are some weak points in Monograph 14: (1) some papers provide too little information about the deposit or prospect they describe; (2) most papers, although descriptive in nature, fail to carry their work down to the microscopic scale; and (3) an abstract at the beginning of the longer papers would have been helpful. In spite of these shortcomings, I believe that the explorationist will soon become a keen reader of this Monograph, as it can provide him with lots of data on the most recent ore findings in Australia and Papua New Guinea. The scholar of ore deposits should not dismiss Monograph 14 as scientifically substandard because it lacks sophisticated analytical data, but treat it with the respect it really deserves (after all, the best papers could easily have been published in any international journal in economic geology!) and use it as a source of inspiration when deciding which ore deposit to study next in this part of world.

Although the price of AUS $ 250 appears a little bit expensive, it represents very good value if compared to the cost of other books in geology, which contain by far fewer than the about 1900 A4-size pages (some with beautiful color photographs too!) of Monograph 14. This book is an obvious must for any geology library at universities, mining companies and govemment organizations; geologists who are interested in ore deposits of Australia and Papua New Guinea should get their own copy. Undergraduate and graduate students in economic geology should consider that for about AUS $22 they can join the Aus.I.M.M. and take advantage of the heavily discounted price of only $100 to buy their own copy of Monograph 14.

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Exploration for Metalliferous and Related Minerals in Britain: a Guide. T.C. Coleman, British Geological Survey, 1990, 52 pages, £15.

This 52-page information guide is designed as an aid for those undertaking mineral exploration in the United Kingdom. Most of the contents will not be new to individuals and companies already involved in such exploration, but the volume is a useful compendium of information for newcomers to exploration in Britain.

The text begins with a concise outline of the geological framework of the UK and quickly progresses to a historical review of mineral production and exploration, with interesting details of the more important discoveries since the mid 1960s. Recent finds include the Aberfeldy sedex deposit (Zn-Pb-Ba), the Coed y Brenin Cu porphyry deposit, the Cononish and Curraghinalt Au-quartz veins, the Gairloch Besshi-type Cu-Zn deposit, and numerous others.

A substantial section is devoted to a description of prospective exploration areas in the context of styles of mineralization and geological environment; topics include carbonate-hosted mineralization (Irish style and Pennine style), calc-alkaline porphyry-style deposits, sedex deposits, volcanogenic mineralization, ophiolite mineralization, and a variety of other settings that appear to have more limited potential. The tone is optimistic, perhaps to be expected in such a guide, but seemingly warranted by the wide range of types of deposit that have been discovered in recent years.

A review of some exploration techniques is presented in the context of pertinent efforts undertaken by government groups. Topics include stream sediment, soil, hydrogeochemical and biogeochemical surveys, regional and local geophysical surveys, remote sensing and aerial surveys.

By far the most useful part of the guide begins on page 19 with a section on mineral legislation in various jurisdictions, and continues with several appendices of particular importance including (1) a general summary of UK mineral occurrences arranged by commodities, and (2) a detailed documentation of sources of information pertaining to exploration in the UK. This latter appendix provides useful details of the British Geological Survey, including the geological mapping programs, the Mineral Reconnaissance Programme (all reports are tabulated), the Geochemical Survey Programme, the Mineral Intelligence Programme, and the National Geosciences Data Centre. Addresses are provided for various government departments and professional organizations concerning trade and industry, environmental matters, financial assistance, pertinent publications (including university research) and mineral rights. A third appendix provides information on setting up or expanding business in Britain.

The guide is directed to a very specific readership, which will find it useful in the efficiency it brings to organizing exploration programs in Britain. It might also serve to motivate other states in developing source books for the mineral industry worldwide.

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Regional Metamorphism of Ore Deposits and Genetic Implications. Edited by Paul G. Spry and L. Taras Bryndzia. VSP International Science

Publishers, Utrecht, Holland, 1990, 243 p. US $86 (ISBN 90-6764-126-X). Ordering information: for USA–Canada: Books International Inc., P.O. Box 163, Mitcham, Virginia 22106, USA. Other countries: VSP, P.O. Box 346, 3700 AH Zeist, The Netherlands.

This book consists of a series of eleven papers presented at a special symposium held on the occasion of the 28th International Geological Congress (1989) in Washington, D.C. Geologists having some background in metamorphic petrology and economic geology, and readers who would like to get acquainted with this subject, will find the book interesting. Six papers deal with volcanogenic and sediment-hosted stratabound massive sulfide deposits (Zn ± Cu ± Pb ± Ag) in regionally metamorphosed (and deformed) terranes. The topics involved are: 1) the metamorphism of the Kipushi carbonate-hosted Zn–Pb–Cu deposit, Zaire (Chaba), 2) the regional setting of the Aggeneys/Gamsberg Zn–Pb ± Cu deposits in Namaqualand, South Africa (Moore *et al.*), 3) the metamorphism and geochronology (tectonic cycle) of the "60 million ton" (sic) Zn–Cu Prieska copper mines, Namaqua Province, South Africa (Cornell *et al.*), 4) the regional metamorphism of the Zn–Pb ± Cu deposits in the Aravalli–Delhi orogenic belt, India (Deb), 5) the petrology and geochemistry of the 60 million tonnes Zn–Pb Rampura–Agucha deposit, India (Ranawat and Sharma), and 6) metamorphic features of the Pb-rich ores in the 5.36 million tonnes Sargipali deposit, India (Rai and Kar). Note that both ton and tonnes (metric tons) are used in the book, but it is not made clear whether ton refers to metric, long or short ton. A pre-metamorphic origin for these massive sulfide deposits is favored by the authors. One paper deals with gold mineralization associated with the Calumet Zn–Pb–Ag–Au massive sulfide deposit, Grenville Province, Québec, and with the problem of metamorphic *versus* metamorphosed origin (Williams). The geochemistry and origin of coticules (sperssatine–quartz rocks) associated with metamorphosed massive sulfide deposits are assessed (Spry), and the problems of host-rock protolithology of metamorphosed ore deposits and genetic modeling are discussed (Scheepers and Cornell). A disparate but interesting paper is on the zoning of hydrothermal alteration within the upper part of the Troodos ophiolite in relation with the formation of Cyprus-type Fe–Cu deposits (Yang and Hall).

The quality, presentation and format of the papers are variable. Many figures (*e.g.*, on pages, 4, 36, 38–39, 127, 137, 164, 166, 221) are misaligned in relation to their respective captions, and some have been reduced too much. The most serious shortfall concerns the numerous typographical errors encountered such as: the lack of spacing between a dot and the starting sentence (*e.g.*, pp 37, 162–163), no space between two words (*e.g.*, pp 3, 4), repetition of a word (*e.g.*, gold gold, p. 22), and misspelling ("trnsformation" p. 118, "yeilds" p. 128, "specultion, subsequntly" p. 133, "phyllitioid, guartzite" p. 161, "earlies" p. 163, "meatllogenetic" p. 169, "ideomorphic" p. 203, *etc.*). Numerous freehand corrections were directly made on manuscripts and appear to have been reproduced as is by the publisher. Furthermore, the sequence of presentation of papers could have been improved to be thematic. For example, the paper by Scheepers and Cornell on protolithology refers to the Prieska area and was placed after the paper by Deb on the Aravalli–Delhi belt, India, whereas it should come after the paper by Cornell *et al.* on the tectonometamorphic evolution of the Prieska Copper Mines area. The final two papers are on Indian occurrences and should have followed that of Deb. Perhaps the disposition reflects the flow of oral presentation of the papers during the symposium; if so, there is no mention of it in the book. A transcription of the question period relevant of each paper presented could have been very informative. Quite frustrating is the lack of hard data, in some papers, on how temperature and pressure estimates were obtained (methods used, activity models, mineral compositions, table of prograde metamorphic assemblages, *etc.*). Basic information on some of the ore deposits discussed, such as tonnage and ore grades, is not always provided. As an example, Williams should have reported, for the benefit of the readers, that 3.66 million tonnes at 5.95% Zn, 1.66% Pb, 0.12% Cu, 43 g/t Ag and 0.8 g/t Au were mined out at Calumet. A troubling statement by Williams concern the assumption "that if Al was fairly immobile then the Ca:Al ratio can be used as an index of alteration. Empirical judgements can be made about the chemical changes..., p. 11–12". Various methods should have been used to test this assertion!

Among the facts gleaned from reading this book is that large massive sulfide deposits can be found in high-grade metamorphic terranes, and this, regardless of the genetic model being promoted. This book can be helpful to the exploration geologist who has to work with high-grade metamorphic rocks. It provides him with valuable information on what to look for, the types of host-rock lithologies associated with these deposits, and what kind of assemblages of alteration minerals ought to be expected. The obvious unresolved question is: How do they form? Are they synmetamorphic or premetamorphic? The global approach of Cornell *et al.* on geochronology

of tectonometamorphic cycles is a promising one. They have proposed that Besshi- and Kuroko-type deposits, which generally form in arc-related tectonic settings, might have been preserved and incorporated into continents during collision events. It is also clear that some metamorphosed deposits have undergone a complex sequence of polydeformation and metamorphism that renders the interpretation of primary origins difficult. As the editors concluded in their preface, there is still a great deal of research to be done on how sulfides interact with their host rocks during metamorphism, on host-rock protolithology, textural interpretations, *etc.*, and this book can be used to catalyze discussion on the various problems outlined. Finally, the format is handy (23.5 × 15.5 × 2 cm); however, the price (US $86) is steep and may prevent numerous potential readers from adding this book to their personal library.

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Traces on the Appalachians: a Natural History of Serpentine in Eastern North America. By Kevin T. Dann. Rutgers University Press, 1988, 159 pages, US $11.95 (paper), $25 (cloth) (ISBN 0-8135-1324-3, 0-8135-1323-5).

If you have any interest whatsoever in serpentinites and their associated rocks, or are intrigued by the idea of an artistic, interdisciplinary treatment of a subject that has its basis in the geological realm, this book is for you. The way that Dann presents the subject can't but cause those who work with these interesting rocks to have piqued curiosities in regard to the "rest of the story". I can't imagine a geologist visiting a serpentinite or soapstone outcrop after reading this book and *not* wondering about the associated plant life and human (pre)history.

The author has prepared a wonderful, readable text, based upon his personal "probings" into the mysteries of serpentinite, soapstone, and steatite. Neither a shallow nor a stiflingly academic book, it keeps the reader's attention *via* its nearly poetic if not romantic style of dealing with its theme. It is obvious that the author has more than a passing interest in serpentinite, probably something more akin to a lingering love affair.

The short preface reveals how the affair began in the Diablo Range of California and was nurtured in other parts of California and in New Zealand. Later, Dann's adventures led him to Rhode Island and Vermont, where the allure of the Appalachians embraced him. After a brief introduction, the author weaves a wonderful tapestry of Appalachian ultramafic rocks, leading us to outcrops in Newfoundland and Quebec, then following the "trace" to Vermont, on to Pennsylvania, Maryland and Washington, D.C., and making stops as far south as Georgia. He comes at the topic from every angle, considering economic (for example, chromite, asbestos, magnesite and talc deposits), mineralogical, petrological, geochemical, and tectonic aspects of his quarry, examining the unique characteristics of soapstone that made it the perfect medium for the handiwork of early native Americans (and commended it to myriads of other, later uses), and offering rich insights into the peculiar flora that are spawned by serpentine soils. Indeed, the study of serpentine-endemic plants is a vast subject in itself, and the reader will have to wade through a fair amount of botany, including plant nomenclature, but it will be well worth the effort.

Dann's book provides us with a holistic view of these fascinating and complex green rocks; the references cited are 38% botanical, 32% geological, 23% anthropological-archaeological, and 7% other. This breakdown might be disconcerting to some, but I found it the real appeal of this attractive little volume. The author is to be congratulated for the skillful and captivating way that he has drawn together information from several disciplines.

The book is thorough but not exhaustive (or exhausting!). In the conclusions, the author admitted that "this natural history is quite incomplete", providing "an entry point for new observations and interpretations." It does cite "classic" references, as well as research from the 1980s (as late as 1987). This volume has an introduction and a conclusion and 17 engaging chapters sandwiched between, a helpful glossary of 102 terms, a bibliography, and a useful index (an excellent idea for a book of this sort). The illustrations, which include nine figures and nine maps, are all clear and useful, contributing to the whole serpentine picture that Dann has painted. The paperback book is handsome, sturdy and well worth its US $11.95 price tag.

Because the *Traces on the Appalachians* is a wonderful model of interdisciplinary study, it could be used to great advantage in undergraduate seminars or colloquia, or in general natural history courses, particularly within a liberal-arts setting. But its main benefit for geoscientists is to expose them to the biological and anthropological aspects of serpentinite and its talc-rich relatives.

I found relatively few problems with this book. It is unfortunate that lizardite, since it is probably the most important serpentine mineral worldwide, was omitted from lists of serpentine-group minerals on pages 3 and 140, but I was glad to see it included on page 22. Also on page 3, kimberlites and carbonatites both were described as ultramafic

"volcanic intrusions". There also was some apparent confusion about the difference between talc (a mineral) and soapstone and steatite (rock types) on pages 7 and 140. The well-known Appalachian physiographic province, the Valley and Ridge, was termed the "Ridge and Valley province" (pages 37 and 140). Only a few typographical errors were discovered: "ensiatic" (ensialic) on page 70; "mantel" (mantle) on page 85, "notice" (noticed) on page 91; "raspbery" (raspberry) on page 96. In one place, the area of ultramafic pods and lenses was given as "a few hundred yards in area", rather than in *square* yards. One of the more common geological "verbing-of-a-noun" offenses, "outcropped" (page 115), was used rather than *cropped out*. On page 130, an occurrence of soapstone blocks in black shale at L'Anse aux Meadows, Newfoundland, was described by the author as "a melange of fragmented and mixed rock types", a glaring redundancy. Finally, as nice as the glossary is, there are a number of entries (gneiss, graywacke, klippen, obduction, Piedmont, schist, serpentine, soapstone, steati(ti)zation) that are either incorrect, imprecise or incomplete.

However, the potential reader should not be deterred by these rather basic errors and inaccuracies, as the book was written masterfully. Notwithstanding these relatively minor quibbles, I heartily recommend this wonderful natural history of serpentinite. In the preface, Dann described the man who introduced him to the subject as having been "bitten by the serpentine bug". If you haven't already been, get this book and let yourself be exposed to it.

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