

## BOOK REVIEWS

*Crystal Data* (second edition). By Alexander R. Hölzel. Excerpt from *Systematics of Minerals*, A.R. Hölzel, Publisher, Ober-Olm, Ulmenring 11, D-55270, Germany, 1993, 185 pages. DM79 (paperback).

This book provides an up-to-date (to December 1992) listing of all mineral species with their crystallographic data. It is excerpted from *Systematics of Minerals* and the mineralogical database MDAT by A.R. Hölzel, which are briefly described in the appendix and which were reviewed in *The Canadian Mineralogist* (29, 177, 1991). The first edition of *Crystal Data* was reviewed in *The Canadian Mineralogist* (31, 248, 1993).

This book is intended to be an easy reference manual of crystallographic data of mineral species for use by mineralogists and crystallographers. Because its classification scheme is based on the mineral systematics of Hugo Strunz in his *Mineralogische Tabellen*, this book also might be useful for museum curators and collectors.

Chapter 1 briefly describes the derivation of the systematic number assigned to each mineral species, the specific data listed, and the easiest method to use the text. Chapters 2 and 3 translate mineral names where translation is necessary, from German to English and English to German, respectively. Chapter 4 is an alphabetical list of all mineral species with their assigned numbers. In order to find data on a species, it is necessary to first locate its assigned number in this list, and then refer to this number in chapter 5. Chapter 5, the "meat" of the book (115 pages), presents the data in columns beginning with the systematic numbers listed sequentially, followed by the name of the mineral species, the chemical formula, density, Z-value, crystal system, crystal class (symbol adapted to SHAPE, the crystal drawing program by E. Dowty), space group, crystal constants, and the volume of the unit cell. Most species are those accepted by IMA. However, a few problem "species" have been added, and new data for as yet unnamed species are included. Varietal names, included in the first edition, have been removed, although chalcidony is still given species status. The classification scheme has one main advantage over other quick reference texts: species of the same mineral group are placed together so that an easy comparison of data can be made between species of the same group; for example, all amphiboles can be scanned over three pages.

Other reference books, such as the *Glossary of Mineral Species* (Fleischer & Mandarino 1991) and

the *Mineral Reference Manual* (Nickel & Nichols 1991), which list species alphabetically, are well done and less expensive, but provide different data. For comparison, the *Glossary* lists chemical formula, crystal system, color, a significant reference, its relationship to other species, and lists the mineral groups as an appendix, whereas the *Manual* lists chemical formula, the status of the species with respect to the IMA, crystal system, brief description of its appearance, type locality, hardness, measured and calculated densities, a classification symbol based on the system by Strunz, author's name, date of publication, and at least one significant reference.

A few spelling errors and awkward use of a few English phrases were noted in the introductory chapters. Several references within the text to various chapters do not correspond to the list of contents. These minor problems do not detract from the usefulness of this book, however. The quality of paper and print is good, although the binding may deteriorate with heavy use.

For those requiring the type of information presented in this book and without the more useful but far more expensive computer programs, this book is worth acquiring.

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*Archeology of The Frobisher Voyages*. Edited by William W. Fitzhugh and Jacqueline S. Olin. Smithsonian Institution Press, 470 L'enfant Plaza, Suite 7100, Washington, D.C. 20560, 1993, 271 pages, Cloth, US\$45 (ISBN-1-56098-171-7).

*Archeology of The Frobisher Voyages* is a scholarly work presented in a very readable style. It is well illustrated by photographs, diagrams, and sketches of good quality. This is a book that will appeal to anyone interested in the history of Martin Frobisher's sixteenth century voyages and mining activities on Baffin Island, which was one of the first European contacts with the Inuit of the Canadian Eastern Arctic.

The Frobisher expeditions comprised three voyages. During the first, in 1576, in search of a Northwest Passage to the Orient, a sample of black rock was recovered from the shore of Frobisher Bay. Assays, later found to be in error, indicated this sample to be high-grade gold ore (in reality it was

hornblende-rich rock with low concentrations of precious metals). This supposedly rich discovery led to the mounting of two further expeditions to mine this material. The third voyage, in 1578, included 15 vessels and more than 400 men, and was the largest Arctic expedition of its type ever mounted. Though of very short duration, this was the first English habitation in North America.

*Archeology of The Frobisher Voyages* results from a melding of multidisciplinary, multi-institutional, and international efforts and interest. The book embodies a series of papers relating to: history and ethnography, results of archeological and geological studies, mainly between 1981 and 1991, metallurgical and other analyses, and the significance of these findings. Contributing authors are: R. Auger, R.C. Cresswell, R.M. Ehrenreich, W.W. Fitzhugh, Garman Harbottle, D.D. Hogarth, D. Laeyendecker, J.S. Olin, S. Rowley, R.W. Stoenner, H. Unglik, W. Washburn, and M.L. Wayman.

The work draws upon extensive reports and documents relating to the Frobisher voyages, research studies of material remains from the mines, workshops, houses, shipways, and Inuit dwellings at the Frobisher sites on Baffin Island, analyses of iron blooms, charcoal, and other artifacts, and information from earlier investigations by Charles Francis Hall (1861), who recorded important Inuit oral history relating to the Frobisher expeditions.

The question as to whether or not this area of Baffin Island was previously visited by Norsemen receives considerable attention and discussion, particularly in the light of pre-sixteenth century age dates obtained from iron blooms found at the site. The origin of the blooms, and whether or not locally smelted, is assessed on the basis of metallurgical and dating analyses of the material, sixteenth century and earlier techniques of smelting, and analyses of charcoal and of driftwood. This aspect, which still remains a mystery, is a continuing thread throughout the volume. Reference is also made to the history of Inuit settlement in the southeastern Baffin region and the possible effect of this isolated sixteenth century European – Inuit contact.

The authors indicate that further archeological studies in the area are critical, in relation to both the Frobisher and Inuitian history, particularly as many of the old Inuit sites are being eroded by waves as relative sea level rises.

Publication and paper quality are high, photographs and diagrams are numerous, and the text contains appropriate reference citations, tables of contents and illustrations, glossary, index, bibliography, and appendices. This is a nicely presented, informative, and interesting book for the specialist and nonspecialist alike.

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*Holmes' Principles of Physical Geology* (Fourth Edition). By P.McL. Donald Duff. Chapman Hall, 29 West 35th Street, New York, New York 10001, U.S.A., 1993, 791 pages, \$US39.95 (soft cover) (ISBN 0-412-40320-X).

As a former student of Arthur Holmes and one whose interest in geology was nurtured by the first edition of his text on Physical Geology in the fifties, I am pleased to have the opportunity to review the fourth edition of his *magnum opus*.

Weighing in at 2.4 kg (softcover), this large-format, almost eight-hundred-page tome is a "must" for the library of anyone interested in geology. The work still fits in well with Holmes's hope "that the book would appeal not only to university students and the senior classes in schools and their teachers, but also to the wide range of general readers whose wonder and curiosity are excited by the behaviour of this mysterious world of ours".

The original book was published almost fifty years ago (1944), and the fantastic advances in the science of geology in the late fifties entailed Holmes in a seven-year full-time revision of his first edition. The second edition appeared in 1965, the year of his death. The third edition (1978) was revised by his widow, Doris Reynolds. The fourth edition is a thoroughly revised and updated version of the third edition, and many sections have been completely rewritten.

Donald Duff and his team of twenty-one "contributors" have not only tried to keep Holmes's style, but have attempted to emulate it in any new additional material. They have also gone back to the original structure of the book. After a survey of the subject, they go on to describe the external processes that affect the Earth's crust, and then deal with the internal processes. Many of the later chapters, dealing with Plate Tectonics and Continental Drift, are entirely new. Each chapter has been reviewed or rewritten by one or more internationally recognized authority.

The book seems to cover practically all aspects of physical geology relatively evenly. In this day and age, the contributions of twenty-two specialists no doubt help ensure a more equitable coverage than would be possible with a book written by only one author. For example, the expansion of the chapter on "Life as a fuel maker: coal and oil" reflects the area of expertise of coal geologist Donald Duff.

Although apparently originally intended as an undergraduate text in British universities, I doubt if it would be suitable for the North American one-semester "half course", as it contains such a fantastic amount of information. The book is practically an encyclopedia of geology, and I feel that, at our institution, we will continue to recommend it to *all* of our students who intend to pursue a career in Geoscience rather than tie it to a specific course.

The change to two-color figures enhances the visual appearance of the book, as does the inclusion of colored plates. However, the majority of the errors I noted in the work are connected with the figures or their captions. Some of these errors should surely have been spotted by the publishers and hopefully will be put right in any subsequent printing. For example, Figure 6.2, which shows a conglomerate overlying cross-bedded sandstone, is pretty obviously upside down, whereas Figure 31.41, purporting to be the Cordillera Darwin in the Andes of Tierra del Fuego, is the same photo used in Figure 18.52 to correctly depict the granite domes in the Yosemite Valley, California.

As with previous editions, the book is profusely illustrated with photographs taken all over the world. Many are new, but the majority are the excellent photographs that graced the pages of the first edition. Most of these have stood the test of time, but some, particularly those used to illustrate Chapter 31, appear to be particularly grainy, and more like newspaper photos than they ever did in the earlier editions. It was good to see that the photograph of Professor Holmes flanked by Professors Buxtorf and Reinhard in the Jura Mountains had been retained (Fig. 31.19). Just as Alfred Hitchcock made a brief appearance in all his movies, it is appropriate that we get a glimpse of Arthur Holmes at his prime in every edition of his book.

At the price quoted to me by our university bookstore, *Holmes' Principles of Physical Geology* is excellent value for money and should be in every geologist's library.

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*The Preparation of Thin Sections of Rocks, Minerals, and Ceramics.* By D.W. Humphries. Oxford University Press, 70 Wynford Drive, Don Mills, Ontario M3C 1J9, 1992, 83 pages, CDN\$32.50 (paper) (ISBN 0-19-856431-7). (Royal Microscopical Society, Microscopy Handbook 24).

This is a useful, informative, and unusually well-written geological cook-book that many mineralogists and geologists will profit from reading or at least thumbing. Most of us who in our work use thin sections, grain mounts, or peels, take these mundane objects for granted. We may be upset by thin sections that are dirty, have incorrect thicknesses, are improperly stained, or use a mounting medium of unknown index of refraction. Few of us, however, have an appreciation of the intricacies of producing a thin section and the care required. D.W. Humphries's book

is at one time both an instruction manual and a sort of veneration of a technique that, although now nearly 150 years old, remains largely unchanged.

Following a preface and a statement on safety, the text is divided into a dozen concise chapters that begin with sample collection in the field, and go on to cover all aspects of preparing thin sections, polished sections, ultrathin sections, staining, peels, and, frankly, a lot more. That so much information has been so clearly conveyed in less than 70 pages reflects the skill and experience of the author.

Three appendices follow the text. The first, on the petrological microscope, will be of little interest to the readers of this review. The second deals with a quantitative method to determine the index of refraction of mounting media. With so many different cements now in use, this technique is particularly relevant to petrographers. The final appendix lists 15 suppliers of machinery, mounting media, abrasives, and so on. Thirteen of the suppliers are in the UK (the other two are in the States). Perhaps the publishers should have considered a list of Canadian and American suppliers for the important North American market. The book concludes with a trenchant glossary of terms, and a bibliography of 38 references, dating from 1834 to 1989.

An aspect of the text that I found particularly engaging is that it carries a common thread from the opening paragraph to the concluding lines: Henry Clifton Sorby (1826–1908). It was Sorby who invented the technique, and made his first thin section at the age of 23, in 1849. Several of his thin sections (he produced around 1000 during his lifetime) are illustrated, and all are preserved in the Department of Geology, University of Sheffield. Sorby used Canada balsam (the sap of *Abies balsamea*) for mounting and affixing cover slips, and I was astonished to learn that in normal use (*i.e.*, not overcooked), this medium is permanent. Sorby's slides show no sign of deterioration even after 140 years! In a finale, Humphries writes: "... mention has been made of some of the 'black boxes' that are creeping, or indeed galloping, into the fields of professional microscopy. But this should not lead to the belief that the basic methods of slide making, initiated by Henry Clifton Sorby 150 years ago, are no longer relevant to the modern world. Whatever electronic device is developed to analyse rocks, minerals, and ceramics, the first requirement is a thin section and the second is an eye (attached to a human brain!) applied to the eyepiece of a polarizing microscope. All the electronic technology in the world will not replace the truly observant eye."

Yes, I recommend this book. Buy it, read it, and then give it to your thin-section technician for Christmas. You'll both be the better off for it.

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*The Acadian Orogeny: Related Studies in New England, Maritime Canada, and the Autochthonous Foreland.* Edited by David C. Roy and James W. Skehan. Geological Society of America, Special Paper 275. The Geological Society of America, 3300 Penrose Place, P.O. Box 9140, Boulder, Colorado, U.S.A., 80301, 1993, 171 pages. US\$42.50 paper-bound (ISBN 0-8137-2275-6).

The papers in Special Paper 275 were presented at a symposium held at the 1989 annual meeting of the Northeastern Section of the Geological Society of America in New Brunswick, New Jersey. The symposium was organized to present recent ideas on the driving forces of the Acadian orogeny. As noted by the editors in the Preface, it is generally accepted that the early Paleozoic Taconian orogeny resulted from an ocean-closing event that juxtaposed a volcanic arc against the North American craton. The cause of the mid-Paleozoic Acadian orogeny is, however, equivocal since ophiolites of that age have not been recognized in the Appalachians.

The volume begins with a comparison of Acadian orogenic events in North America and Europe by Rast and Skehan that sets the tectonic framework for other papers covering specific regions of the Appalachian orogen. Next, van der Pluijm, Johnson and Van der Voo discuss paleomagnetic constraints on the paleogeography of central Newfoundland; perhaps more logically this paper could have been grouped with the two others on Newfoundland. Boucot applies biogeographic data to plate tectonic reconstruction of the Northern Appalachians – a series of maps to accompany the text of this paper would have been useful. Eusden and Lyons provide a new interpretation of the nappe structures in the high-grade metamorphic belt of central New Hampshire. Ludman, Hopeck and Brock present a plate tectonic model for southeastern Maine based on stratigraphic, structural and isotopic evidence. Cousineau and Tremblay, and Malo and Bourque, respectively, document the tectonic history of the Appalachian forelands in the Eastern Townships and Gaspé Peninsula of Quebec. Williams provides an overview of Acadian orogenesis in Newfoundland, and Cawood describes the effect of Acadian deformation on the Taconian allochthons of western Newfoundland. Finally, Hamilton-Smith relates sedimentological events in the autochthonous foreland basin of the Central Appalachians to tectonic loading of the continental margin.

In summary, results of the recent studies suggest that the definition of the Acadian orogeny should be broadened to include a series of mid-Paleozoic tectonic pulses that most likely arose from the accretion of distinct terranes to the North American continental margin prior to widespread continental collision. The relative influence of oceanic subduction, transcurrent displacement, and crustal delamination in

the accretionary process, however, remains a matter of controversy. Nonetheless, the marked variations in structural style and timing of deformational events would seem to indicate that different processes were at work along the length of the orogen. On a global scale, these differences can be attributed to the spatial distribution of tectonic plates and to temporal changes in plate motion. On a more regional scale, the interaction of continental promontories and microplate indentors control the local tectonic environment and make worldwide correlation of orogenic events unwise.

Articles are presented with clarity, typographical errors are few, and illustrations are generally of good quality. Although much of the information presented in Special Paper 275 has been published previously in various journals, this concise summary of Appalachian geology provides a synopsis of the Acadian orogeny that should provide a useful reference for the research specialist and for teaching at the undergraduate and graduate level.

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*Geology of Titanium-Mineral Deposits.* By Eric R. Force. The Geological Society of America, Special Paper 259, 1991, 112 pp. The Geological Society of America, P.O. Box 9140, Boulder, Colorado 80301. US\$28.75 (ISBN 0-8137-2259-4).

This Special Paper is a useful condensation of those aspects of the large body of published data on titanium-mineral deposits that are relevant to the economic geology of titanium. Eric Force is a recognized expert in this field, and he has been able to supplement the review with informed comments and evaluation based on his own research.

The first chapter gives an excellent introduction to the uses of titanium minerals, the types of titanium-mineral deposits, and the world distribution of resources and processes. The description of deposit types is evenly divided between those formed by igneous and metamorphic processes (chapters 2 to 5), and those formed by sedimentary processes (chapters 7 to 10). The two sections are linked by chapter 6, which describes the weathering of titanium oxide minerals in all types of deposits. The role of climate is given particular attention, particularly for shoreline deposits.

In most chapters, the same pattern of presentation is used; a general discussion of mineralogical, genetic and geological factors relevant to the deposit type is followed by descriptions of specific major deposits, then an economic prognosis and a summary of exploration methods. This mode of presentation results in

some duplication and repetition, both within and between chapters.

The amount of discussion devoted to each type of deposit is proportional to its economic importance. Thus Quaternary placer deposits, metamorphic sources and titanium oxides in anorthosite-ferrodiorite massifs receive most attention. However, Force points out that the economic geology of titanium minerals will change dramatically early in the next century as these major sources are depleted. In this context, he considers types of deposit that may become economic in the near future. These include eclogites, contact-metasomatic zones of alkaline anorthosites and porphyry metal deposits as sources of rutile, alkaline pyroxenites as sources for perovskite and anatase, and detrital deposits on continental shelves and in glacio-lacustrine deltas.

The different topics are very well referenced. However, presumably in the interest of keeping to a compact format, some topics have been given a rather perfunctory treatment, and the reader is referred to major reviews for further details, *e.g.*, titanium oxide

minerals in kimberlites. Perhaps also because of space limitations, the links between mineralogy, provenance and genesis have not been dealt with in any detail. For example, a subject that could usefully have been explored further concerns the different types of primary and secondary minor-element substitutions in titanium oxide minerals and their implications in relation to conditions of crystallization and modifications due to metamorphic and weathering processes.

The book is attractively presented in an inexpensive (US\$29) soft-cover A4 format, with a balanced selection of photographs and diagrams. Detailed information in tabular form is limited, but an extensive bibliography is provided for the reader to pursue further details. The book generally meets the aim expressed by Force in the preface, to provide a reference book for economic geologists and other geologists oriented toward earth processes and having a particular interest in exploration.

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