BOOK REVIEWS

COPPER: ITS GEOLOGY AND ECONOMICS. By Robert Bowen and Ananda Gunatilaka. Halsted Press, Wiley, New York, 1977. 366 pages, 78 illustrations, 33 tables. $49.50.

This text is divided into 8 chapters. Chapter 1 (20 pages) deals with "The world of copper" and discusses briefly copper in history, copper in the crust and in natural waters, the copper cycle, copper biogeochemistry, copper distribution in some geochemical units, copper ore production, porphyry deposits, deep-sea nodules, the world's major copper areas, the self-sufficiency of the USA, world copper consumption, the market for copper, planetary reserves of copper, and the future of copper.

The second chapter (40 pages) treats "copper ores and plate tectonics" and involves classification of copper ores, distribution of porphyry deposits, interrelations between plate tectonics and porphyry copper ores, other sulfide ores, evolution of the crust and copper genesis and ore deposition in relation to time.

In the following chapter (3) we find a discussion of copper deposits of plutonic association. Most of the 60 pages devoted to this subject are reserved for porphyry coppers and very little space is given to copper deposits of mafic and ultramafic complexes, copper mineralization in carbonatite complexes, and copper in pyrometasomatic skarns. Copper ores of hydrothermal vein association are treated in the fourth chapter. This subject is covered in 20 pages and involves short discussions of vein types and associations, zoning characteristics, copper-containing hydrothermal breccia pipes, and hydrothermal copper deposits associated with undersaturated magmas. Considerably more emphasis (50 pages) is given to a treatment of copper deposits of volcanogenic–sedimentary association. Thus chapter 5 treats genetic relationships to host rocks and age of mineralization, crustal evolution of massive sulfide deposits, environments of formation of massive sulfide deposits, the hydrothermal system, metal transport, diagenesis and metamorphism, volcanic emanation reaching sea-floors, and genetic affinities between massive sulfides and porphyry copper.

Chapter 6 (60 pages) concerns itself with stratiform copper deposits and involves classification of such ores, the Central African Copperbelt as a model of stratiform ores, mineral zoning, copper deposits of non-marine origin, models of sedimentary sulfide ore genesis, detrital deposition of sulfides, paleogeographic considerations, and the origins of stratiform copper.

The last two chapters deal with the copper industry and its future. Mining and refining copper, dewatering and subsidence in mines, scrap copper, London Metal Exchange, world copper prices, state control in the copper industry, who uses copper and why, substitution for copper, and immediate future of copper are discussed in chapter 7 (30 pages). Development of deep-ocean and continental margin resources, deep-sea manganese nodules, exploitation of manganese nodules, economics, politico-legal aspects, developments in ocean resource development technology, and copper—towards and beyond the 21st century are considered in chapter 8 (28 pages).

This book contains a 12-page appendix composed of: (1) an alphabetical list of copper minerals, (2) data on world copper consumption in 1974, (3) USA main copper mine statistics for 1972 and some for 1976, and (4) data on indicators of potential ore bodies through biogeochemical techniques.

A rather useful general index (10 pages) is provided.

While this book focuses on the geology of copper deposits, it emphasises processes rather than descriptions. It reviews recent literature including that dealing with theoretical models. The book is well-written and therefore easy to read. It covers a large field and does not go into as much detail as the reader might find useful. Literature reviews are always appreciated and even more so when they are accompanied by critical evaluation. The authors have made great efforts to cover most areas of the literature, but the reader will find little in the way of critical evaluation. In some areas the literature review is incomplete. For instance, in the section (p. 189) discussing liquid immiscibility in sulfide systems, no reference is made to several published studies on such relations in the Cu–Fe–Ni–S system.

The book is of the quality one has become accustomed to expect from the Halsted Press. It is well bound, there are few printing errors, and the tables are generally clear and well organized. A number of the figures leave something to be desired, some of the photos are of questionable value, and some black and white photomicrographs are lacking in contrast.

I much enjoyed reading this book. It presents a very informative and useful review of the geology and economics of copper. I recommend it to economic geologists and geochemists. It should find a place in all geology libraries.

GUNNAR KULLERUD
Purdue University

MAGNETIC AND OTHER PROPERTIES OF OXIDES AND RELATED COMPOUNDS. By K. von Enke and others. Volume 12, Part a (garnets and perovskites) of Landolt-Börnstein: Numerical Data and Functional Relationships in Science and Technology. Edited by K.-H. Hellwege and A. M. Hellwege. Springer-Verlag, Berlin, 1978. x + 520 pages, 668 figures. $255.00

As pointed out in the Introduction to this book, the first synthesis of a rare-earth garnet was reported in 1951 by H. S. Yoder and M. L. Keith (*Am. Mineral., 36,* p. 519–533); this followed the suggestion by H. W. Jaffe that yttrium can occupy manganese positions in the garnet structure, with the concomitant replacement of silicon by aluminum (*Am. Mineral., 36,* p. 133–155). This discovery has had enormous technological consequences, with the development of uses for these synthetic garnets in microwave equipment, information storage, and laser materials, to name a few. The magnitude of the research effort on these compounds can be gauged by the fact that 367 pages of this book, closely packed with tables and figures, are devoted to them; the remaining 153 pages deal with perovskite-type compounds. Practically all the data reported have been obtained during the last 20 years, as can be seen from the references. The references for the garnets are very up-to-date, including 1977 publications and even one from 1978;

0003–004X/78/1112–1285$00.50

the references for the perovskite section extend through 1975. Although very few of the data in this book are from minerals, this compilation will be enormously useful to all researchers on garnet- and perovskite-type compounds.

BRIAN MASON
Smithsonian Institution

THE MOON BOOK. By Bevan M. French. Penguin Books, New York, 1977. 287 pages, 10 figures, 36 photographs. $4.95.

In this book Dr. French, a geologist who has been closely associated with the space program since he joined the NASA Goddard Space Flight Center in 1964, has set out to provide a coherent account of the aims, execution, and results of the Apollo Program. As he notes in an introductory section: "Published scientific results include over 5000 technical articles and cover many yards of bookshelf space." The task of reducing this mass of material into the format of a Penguin book was undoubtedly formidable, and the author is to be congratulated on his success. The account is pitched at the level of the intelligent and interested layman, but the book can be read with pleasure and profit by all geology students (and their teachers). A short bibliography includes both popular and advanced accounts of lunar science and exploration. At the price of $4.95 this book is certainly a "best buy," and deserves the widest circulation.

BRIAN MASON
Smithsonian Institution

OXIDE MINERALS. Mineralogical Society of America Short Course Notes, Volume 3. Edited by Douglas Rumble III. Mineralogical Society of America, 1909 K Street N.W., Washington, D.C. 20006, 1976. 594 pages. $6.50.

These eight chapters devoted to opaque oxide mineralogy span the gamut from crystal chemistry to experimental technique to phase equilibria to a really superb set of tables (100 pages) that summarizes the literature available on opaque oxides in igneous rocks. Perhaps not since Ramdohr's classic text has there been, between two covers, such an extended collection of excellent reflected-light photomicrographs of oxide opaque minerals. The 120-some photographs and their captions make clear not only the textures, but also the range of redox reaction sequences that can take place in opaque oxides. Three chapters deal with oxide opaques in metamorphic, lunar, and meteoritic suites, while other specific chapters are individually devoted to the oxides of iron, titanium, and manganese. Furthermore, data of fO_2–T relationships are presented in an extended discussion as a sub-topic within the chapter devoted to igneous opaque oxides.

After a page-by-page reading, and a year's constant use of this very important volume, this reviewer can only make two minor criticisms. First, the bibliography will "unlock" the opaque oxide literature available in the American and British Ceramic Society publications, but only if the reader already knows which are the "key" references in the bibliography. Since the ceramists have, of necessity, also a great backlog of data and experience with opaque oxide minerals, it may have been worthwhile to have devoted a few pages and a few more references to this important aspect of the topic. As another example there is a four-part work edited by A. Alper, entitled *High Temperature Oxides,* Academic Press, 1970 *et sequitur,* in which there are over a dozen pertinent chapters that have not been directly referenced in this short-course volume. Secondly, the drafted position of the fayalite–magnetite–quartz buffer (FMQ) wanders from diagram to diagram throughout the many fO_2–T diagrams. While this is not very critical, it could lead to future confusion if the user were to utilize these figures without returning to the original cited references for his actual data.

Nevertheless, the overall thorough encyclopedic nature of this work and its low price should nominate it for a place on the bookshelf of every professional petrologist.

GENE C. ULMER
Temple University

NOTICES

IMPHOS (World Phosphate Rock Institute) is organizing the Second International Congress on Phosphorus Compounds in April/May 1980, in the United States. This scientific and technical congress will deal with the multiple aspects of the separation of impurity elements from phosphate rock and from industrial phosphoric acid as a route to the development of phosphorus compound uses. Further information can be obtained from IMPHOS, 8, rue de Penthièvre, 75008, Paris, France; telephone (331) 266.05.62.

ICOMOS (International Council of Monuments and Sites), recognizing the importance of reliable, objective data relating the nature, quality, and properties of the stone encountered in historic and artistic structures, as well as of materials offered for the repair, consolidation, and conservation of such structures, has called attention to the need for a standardization and validation of the procedures employed for the testing of stone and stone conservation materials by workers throughout the world.

Several task forces for the development of such standard methods have been established. This announcement relates to the initial planning of a "Stone Chemistry Task Force—ICOMOS," and invites the participation of interested parties in the next phase of the work of this group.

All qualified persons (whether members of ICOMOS or not) who are interested in contributing their experience, time, and insights to this project are invited to contact: Professor S. Z. Lewin, New York University, 4 Washington Place, Room 514, New York, NY 10003, USA.

April 10–15, 1980: The 8th International Geochemical Exploration Symposium (The Association of Exploration Geochemists, Section Economic Geology Research in the Society of German Mining and Metallurgical Engineers, Geochemical Section of the German Mineralogical Society). Scientific and technical sessions, poster presentation, exhibition of laboratory equipment, pre- and post-symposium excursions. For further information, contact Dr. H. Gundlach, Organizing Committee, 8th International Geochemical Exploration Symposium, P.O. Box 51 01 51, D-3000 Hannover 51, West Germany.

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