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BOOK REVIEWS

PRINCIPLES OF ENGINEERING GEOLOGY. By P. B. Attewell and I. W. Farmer, John Wiley and Sons, New York, 1976. xxx + 1045 pages. $62.50.

This book is designed as a textbook to cover engineering geology as presented in either civil engineering or geological curricula. It covers most of the aspects of the subject in great depth from qualitative and quantitative viewpoints. One subject, however, is given practically no attention and that is engineering geology as applied to karstic rocks. The chapters on soils mechanics and rock mechanics are disguised under titles such as "Rock as a material" and "Preferred orientation, symmetry concepts---" but they are detailed and to the point. Other chapters cover slope stability, improvement of the ground, groundwater, site selection, reservoirs and dams.

The references are numerous and cover 55 pages at the end of the volume. Almost all of them are English, American, or South African citations. Apparently scant attention was given to Czech or Russian sources. The index is comprehensive and well-keyed to the text. A table of symbols used in the text with each symbol keyed to the chapter in which it is used is a useful addition to the book.

From the mineralogist's viewpoint this text presents data on clay minerals and crystallographic plane symmetry concepts not usually found in texts on engineering geology. However, the field of mineral decay and alteration, the deleterious effects of specific minerals and their cause and corrections, as well as solution chemistry affecting various minerals are given little or no attention. Maybe this reflects the fact that mineralogists have so far not developed a specialty of engineering mineralogy, a field of investigation that could prove extremely useful.

The size of the book and its extremely high price are unfortunate and probably will greatly limit its use as a text.

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APPLICATION OF THERMODYNAMICS TO PETROLOGY AND ORE DEPOSITS. Edited by H. J. Greenwood. *MAC Short Course Handbook,* Vol. 2, 1977. Mineralogical Association of Canada, c/o Dept. of Mineralogy, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario, Canada, M5S 2C6. xiii + 231 pages. Photo-offset reproduction of typescript. Separate errata sheet.

The publication of *Application of Thermodynamics to Petrology and Ore Deposits* is a timely effort by its editor and contributors to provide for the geological public a guidebook to modern research articles in which thermodynamic theory forms the logical basis for analysis of data. A list of chapter topics shows that a broad range of current research topics are represented, including: calculation of phase equilibria and phase diagrams using tables of thermodynamic properties; examples of calculations involving pure solid phases, solid and fluid solutions, dehydration, decarbonation, oxidation, and sulfidation; sulfide mineral solubilities; mass transfer between rocks and fluids; derivation of numeric thermodynamic data from experimentally-determined phase diagrams; and the analysis of experimental data using Schreinemakers' method. Introductory chapters cover such necessary basic subjects as: fundamental equations; fugacity, activity, and equilibrium constant; statistical mechanical interpretation of entropy in solutions; ideal and non-ideal solutions; and numerical evaluation of uncertainties in thermodynamic calculations. The contributors to the short course are active research workers in the application of thermodynamics to petrologic problems and include G. M. Anderson, T. H. Brown, D. M. Carmichael, E. Froese, E. D. Ghent, T. M. Gordon, H. J. Greenwood, R. S. James, J. Nicholls, and G. B. Skippen.

The stated goal of this book is "to be instructional rather than impressive," thus its success is to be judged on pedagogic rather than on research grounds. The introductory chapters by Anderson, Brown, and Greenwood are succinctly and clearly written. The remaining chapters on applications of thermodynamics to petrologic problems lapse occasionally into "research-ese" such as citation of unpublished matter, but do convey a sense of the excitement of current research work. The contributors to the handbook have included many worked-out numerical examples of commonly encountered thermodynamic calculations that will aid the efforts of those absorbed in the task of self-education. No original exercises are provided, however, so that the reader desiring to learn by doing calculations on his own will have to turn elsewhere.

Typographical errors are scattered throughout the text, but most of them have been corrected on the errata sheet that accompanies the volume. One of the figures, Fig. 6.4, p. 96, is not in agreement with what is known of the system FeO–Fe_2O_3–TiO_2 from experimental studies. The figure shows the stability field of ilmenite extending to higher values of fO_2 than the hematite–magnetite equilibrium.

The handbook Applications of *Thermodynamics to Petrology and Ore Deposits* will serve well the needs of readers desiring an introduction to the thermodynamic theory of current research articles in igneous, metamorphic, and ore petrology.

DOUGLAS RUMBLE, III
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THE MINERALOGY OF THE HATURIM FORMATION, ISRAEL. By Shulamit Gross. Geological Survey of Israel Bulletin 70, 1977. 80 pages, 18 figures, 25 plates. Price not given.

The Haturim Formation (formerly known as the Mottled Zone Complex) outcrops at a number of locations west of the Dead Sea; in its fully-developed occurrence in the Haturim syncline it has a preserved thickness of more than 220m and covers an area of 50 km². It was apparently deposited as a chalky-marly marine sequence of Campanion to Neogene age, and has been largely converted into high-temperature metamorphic minerals corresponding to the sanidinite and pyroxene–hornfels facies. Metamorphism probably took place during the Miocene, and is believed to have been caused by the combustion of bituminous matter in the formation. The high-temperature metamorphism has been followed by

younger, still active weathering processes, with extensive hydration and recarbonation. This monograph describes 114 minerals in the Haturim Formation, of which eight were previously known only as synthetic products and five others reported from only one locality. Particularly noteworthy are the many calcium silicates, calcium aluminates, and calcium aluminosilicates. The descriptions include optical and X-ray diffraction data, thermal analyses, chemical analyses, and excellent photomicrographs. This is a comprehensive monograph describing a unique mineral deposit of great paragenetic interest.

BRIAN MASON
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THE ARCHEAN: SEARCH FOR THE BEGINNING. Edited by G. J. H. McCall. Dowden, Hutchinson and Ross, Inc., Stoudsburg, Pennsylvania, 1977 (distributed by Halstead Press, a division of John Wiley and Sons, New York). 505 pages. $32.00.

The Preface states "The papers selected are designed to cover the gap in time between the first thermal event that is known to have closely followed accretion, about 4600 million years ago, and the appearance of the earliest well-preserved, Proterozoic-type platform sequences in the geological record, about 2550 million years ago." This effectively limits the papers to those published in the last twenty years; as a historical benchmark it might have been appropriate to include the article by L. H. Ahrens, *Oldest Rocks Exposed* [in Poldervaart, A. (ed.), *Geol. Soc. Am. Spec. Paper 62,* 1955], in which the oldest well-established date was 2700 million years, for rocks from Rhodesia and Manitoba.

The enormous expansion in our knowledge and understanding of Archean rocks in recent years is excellently documented in Dr. McCall's selection of 38 papers (some of them in summary or excerpted form), which are accompanied by his commentaries. Except for the first paper (J. T. Wilson, The Origin of Continents and Precambrian History, 1949), all date between 1964 and 1973. The papers are grouped as follows: general papers concerning the beginnings of the geological record (4 papers); the greenstone associations (12 papers); sedimentology of Archean rocks (1 paper); the high-grade terrains (9 papers); general papers on the Archean (12 papers); Dr. McCall has also provided brief accounts entitled: evidence of life in the Archean; plate tectonics and the Archean; the nature of the primordial crust.

The papers have been skillfully selected to include both general review-type articles and those dealing with the geology of specific regions. The latter include classic areas in southern Africa, Canada, Western Australia, northwest Scotland, and Greenland. Many of the papers are from journals and publications not readily available, such as the symposium volumes of the Geological Society of South Africa and the Geological Society of Australia. The volume has comprehensive author citation and subject indexes.

While not explicitly so stated, this book appears to belong in style and format to the *Benchmark Papers in Geology* series of this publisher. I would judge it among the best of these; I agree with the statement in the dust jacket "*The Archean* will be a welcome addition to the library of every geologist, and will be important as well in the adjacent fields of geophysics and astronomy." It will be particularly useful to graduate students and teachers who need a comprehensive and reasonably concise account of the first billion years plus of geological time.

BRIAN MASON
Smithsonian Institution

THREE-DIMENSIONAL NETS AND POLYHEDRA. By A. F. Wells. Wiley-Interscience, New York, 1976. 268 pages. $29.95.

Let us construct a network of points joined by links in two or three dimensions. Each point has p links, and we may follow links from point to point to trace out a loop (returning to the starting point) that has n links forming an n-gon (possibly nonplanar). The problem of classifying and delimiting the topologically distinct systems of this type has been attacked and explored extensively in many short publications by Wells. All of his specialized study is now brought together in a coordinated and systematic manner in this interesting book.

One of the problems of this kind of study is to set up a group of criteria that define a closed group of systems. The first and most obvious set given in this book requires that both n and p be invariant, that the n-gons be plane and regular, and that the systems be finite in extent. This leads at once to the Platonic solids, of which there are only five $[(n,p) = (3,3), (3,4), (3,5), (4,3), (5,3)]$. Beyond this first set, unlike the symmetry groups, there seem to be no further closed sets. When other less restricted combinations of n and p are explored, one finds himself in the limitless world of three-dimensional networks. Wells is naturally interested in the relationship of the network systems he finds to crystal structures, so the requirement of three-dimensional periodicity is imposed almost entirely. Wells then explores the class of nets in which n is constant (uniform nets), of which there are two kinds: Platonic, with p constant; and Catalan, with p variable. The Archimedean class, in which p is constant and n is variable, is also considered. Every attempt is made to systematize the exploration for and classification of particular nets, but the process soon develops a mushrooming quality that has one wondering where it will all lead. One whole chapter is devoted to the study of uniform 3-connected ($p=3$) nets. A single (12,3) net is described, but no less than seven topologically distinct (10,3) lattices are outlined and illustrated. It is apparent that there may be many different nets corresponding to a given (n,p) type, but there seems to be no general way to determine how many there are, or indeed, whether or not the number is finite. The process of discovery is largely empirical and abstract. Several crystal structures are cited that are found to be analogous to an identified net, but there seems to have been little attempt to use crystal structures to find new unidentified nets to add to the catalog.

Wells has obviously spent many happy hours building models, which presumably play an essential role in the exploratory process. These are profusely illustrated in stereoscopic photographic pairs. This commendable technique greatly increases the involvement of the interested reader with Wells' treatise, especially if the former can acquire the simple technique of fusing the images without optical aid. (I found only one figure—Fig. 7.3—that is flat, consisting of either two left or two right views.) The line figures are of the high illustrative quality to which we are accustomed from Wells' *magnum opus, Structural Inorganic Chemistry.*

Clearly, the driving force behind all this painstaking study of lattices and polyhedra is Wells' fascination with their expression in the great body of known crystal structures, so richly described in

his *SIC*, and his deep curiosity as to how they go together. It is interesting that he has attacked this last question from a direction opposite to the structures themselves, that is, in terms of abstract lattices. The result, because of its exasperating open-endedness, does not seem to provide the unifying insight into structure formation one might have expected. I have the feeling that Nature does not rely on the laborious catalog-building based purely on sticks and connectors to make her structures, but uses some other surer procedure. Nevertheless, the results which Wells presents to us so clearly and extensively in this book are eminently worthwhile, and give us an additional and useful viewpoint on the nature of crystal structure.

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NOTICES

Professor Emeritus of the University of Tokyo, Dr. Eiiti Minami, died in Tokyo on September 16, 1977, in his 78th year. He had a distinguished research record in mineralogy and geochemistry. His pioneer work on the abundances of the rare-earth elements in shales, carried out in V. M. Goldschmidt's laboratory at the University of Gottingen in 1933–35 and published in the latter year, remained for many years almost the only source of information on the terrestrial abundances of these elements.

Announcement

The Smithsonian Institution makes annual awards of predoctoral and postdoctoral fellowships in a variety of fields, including mineral sciences. Applications close on January 15 each year, and awards are announced on or about April 1. Further information and application forms can be obtained by writing Office of Academic Programs, Smithsonian Institution, Washington, D. C. 20560.

JCPDS Publications

The Joint Committee on Powder Diffraction Standards announces the availability of three new publications:
Selected Powder Diffraction Data for Minerals Data Book, 833 pages and Search Manual containing an alphabetical section and a numerical search section containing 262 pages
Crystal Data, Determinative Tables, Third Edition, Donnay and Ondik, Inorganic and Organic Volumes
Diffraction Data from the JCPDS Associateship at the National Bureau of Standards Data Book, 440 pages and Search Manual containing an alphabetical section and a numerical search section containing 152 pages.

These publications are available from the JCPDS, International Centre for Diffraction Data, 1601 Park Lane, Swarthmore, Pennsylvania 19081.

INTER/MICRO

INTER/MICRO-78, the annual international conference on microscopy, will be held at the McCormick Inn at 23rd Street and the Lake, Chicago, Illinois 60616, on July 23–27, 1978. It is expected to be attended by about 250 microscopists and other scientists who will hear and see approximately 60 technical papers describing the most recent advances in light, electron and X-ray microscopy applied in biology, metallography, mineralogy, chemistry, and medicine. An exhibition including all major manufacturers of microscopes and accessories will feature the newest microscopes and accessories.

For further information write:

Robert I. Johnson
McCrone Research Institute
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Chicago, Illinois 60616

ERRATA

Orientation of exsolved pentlandite in natural and synthetic nickel-ferous pyrrhotite by Carl A. Francis, Michael E. Fleet, Kula Misra, and James R. Craig (Vol. 61, 913–920).

Fig. 4A on page 915 is misorientated. It should be rotated 90° clockwise to conform with the orientation of Fig. 4B and the description in the text.

The crystal structure of eakerite, a calcium–tin silicate by A. A. Kossiakoff and P. B. Leavens (Vol. 61, 956–962).

The following numerical mistakes are present in the article as published:
a = 15.829(7), not 15.892(7) [page 956]
β = 101.32°(3), not 101.34°(3) [page 956]
Si(2), Z = 0.3091(2), not 0.0391(2) [Table 1]

In Table 4, Bond angles, there are two mistakes:
O(3)–Ca–O(5) = 148.0°, not 108.0°
O(8)–Ca–O(8)′ = 138.3°, not 148.3°

The identification of Fe^{2+} in the M(4) site of calcic amphiboles by Don S. Goldman and George R. Rossman (Vol. 62, 205–216).

Page 211, the last sentence should read "If the 1030 nm band is due to Fe^{2+} in $M(4)$, the presence of 1.95 formula units of calcium in this site implies an ϵ_{1030} of at least 80, assuming that $Fe_2{}^+$occupies the remainder of the site."

Crystal synthesis of a new olivine, $LiScSiO_4$ by Jun Ito (Vol. 62, 356–361).