

degree, succeeded. Most of the sulphide structures are interpreted in terms of a blend of molecular-orbital and band theories of chemical bonding.

A chapter on sulphide thermochemistry begins with a basic introduction to thermodynamics, and then moves on to discuss the measurement of sulphur activity and the construction of phase diagrams. Techniques of sulphide synthesis are briefly summarized, and numerous examples of phase equilibria given. A separate chapter is devoted to sulphide equilibria in aqueous systems.

A number of minor topics relevant to sulphide mineralogy are covered, including reflectivity and hardness measurements, electrical and magnetic properties, sulphur isotope fractionation, and various kinds of spectroscopy, including X-ray emission, X-ray photoelectron, and Mössbauer. Wherever possible the results are interpreted within a theoretical framework which again leans heavily on molecular-orbital and band theories, although consideration is also given to valence-bond, crystal-field, ligand-field, and Brillouin zone theories.

In general the book is a happy blend of fact and theory. If the book has a drawback, it is that the important category of sulphosalt minerals has not been included; however, there are practical limits to the size of a volume, and it is difficult to suggest topics that should have been eliminated or curtailed in favour of sulphosalt coverage.

The book is copiously illustrated with line drawings, which, for the most part, are clear and legible, the text is well referenced, the quality of the paper is good, and the type comfortably legible. The book deserves a prominent place on the reference shelves of mineralogists and other technologists whose interests include sulphides, and it is easy to see it as a textbook for courses in sulphide mineralogy. For specialists in sulphide research, the book provides a very useful and up-to-date review of sulphide properties, and the principles and techniques involved in their study.

E. H. NICKEL

Pies (W.) and Weiss (A.). *Crystal Structure Data of Inorganic Compounds. Part f. Key Elements: d⁴... d⁸ Elements*. (Landolt-Börnstein: Numerical Data and Functional Relationships in Science and Technology, New Series. Group III. *Crystal and Solid State Physics. Vol. 7*). Berlin, Heidelberg, and New York (Springer-Verlag), 1977. xxvi + 778 pp., 14 figs. Price DM 780 (\$343.20).

This large and very expensive volume is one of a series of eight (six of tabulation plus reference and index volumes) in the Volume III/7 series, of which III/7a and III/7e have already been published. The key elements referred to in the title are Cr, Mo, W,

Mn, Tc, Re, Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, and Pt, crystal structure data being tabulated for those multiple oxides which contain these elements in an anionic (or 'pseudo-anionic') grouping (e.g. chromates, molybdates, tungstates, etc.). Within these key element groups the compounds are arranged in order of increasing atomic number of the associated elements.

The information compiled includes the chemical formula and mineral name (where appropriate), space group, lattice constants, number of formula units in the unit cell, density, structure type, scope of the structure determination, and method used. Finally, where available, additional data, such as optical properties, morphology, phase relations, and magnetic properties, are listed. References are given by referring to the relevant volume of Structure Reports.

Despite the lack of an index with this volume, the tables are fairly easy to use, once the chemical classification scheme is understood, but the lack of direct reference to the source material could prove a disadvantage. Obviously the vast majority of the inorganic compounds listed have no naturally occurring counterparts, but the series should provide a compact source of structural data in the wider field of inorganic crystal-structure studies.

A. M. CLARK

Klemm (D. D.) and Schneider (H. J.), editors. *Time- and Strata-bound Ore Deposits*. Berlin, Heidelberg, and New York (Springer-Verlag), 1977. xviii + 444 pp., 160 figs. Price DM 86.00.

This *Festschrift* in honour of Professor Albert Maucher's seventieth birthday, organized in 1975-6 has been produced in good time, and forms a fitting tribute to 'that unflagging advocate of the idea of time- and strata-bound ores' (I quote the dedication). Maucher has indeed been in the van of synsedimentary interpretation and is to be regarded as one of the architects of contemporary notions on layered or layer-controlled ore deposits. The articles nevertheless range widely both in geography and philosophy.

General topics include a contemplative discussion of time in ore genesis by V. I. Smirnov, who is prepared to accept sedimentary origin of the Pb/Zn ores of Karatau (Kazakhstan) in the Devonian followed by activity of migrant solutions in the Carboniferous. His comments on the general absence of clasts of ore from the roof-rocks of supposedly sedimentary ores are interesting. L. J. Lawrence also sees the possibility of a transition from syngensis to epigenesis at Mount Morgan (Australia). E. T. Degens and P. Stoffers contribute

an interesting discussion of the possibility that the seas of the past 600 Ma were stratified and thus not amenable to the Principle of Uniformity. J. Pereira, though hindered by the limitations of the literature, attempts an assessment of the ore resources of China in relation to plate tectonics. A new potash evaporite field, at Sergipe (Brazil) makes its first impact at the capable hands of H. Borchert, while G. K. Strauss, J. Madel, and F. Fdez Alonzo, describing the latest position in the Spanish-Portuguese pyrite belt, produce the interesting fact that of 500 m tonnes of new ore reserves, 50 m can be credited to geological reasoning, 130 m to geophysics, and the rest to systematic driving and boring.

The catholic outlook of the *Festschrift* is even clearer in the particular description of ore problems, grouped under Pre-Cambrian, Palaeozoic, and Mesozoic for discussions of fields, with concluding sections on strata-bound intrusive deposits (an elaborate way of describing chromite layers!) and on geochemical problems, especially those of S, C, and O-isotopes. A remarkable discovery in the past few years in which Professor Maucher played an important part has been that of stratified scheelite deposits in metamorphic contexts in such widely separated areas as the Eastern Alps, Tasmania, and South Korea. This volume adds another case, this time in Argentina, described by M. K. and A. de Brodtkorb. R. Höll contributes on the Alpine Sb-W-Hg deposits and U. Burchard on King Island. G. C. Amstutz who always attempts to find the origin of ores in the enclosing strata runs true to form and deals with the Michigan copper deposits, invoking statistical procedures, which, to me, fail to give objective conviction. The strata-bound magnesite deposits of the Spanish Pyrenees appear to W. Petrascheck and his collaborators as showing many metasomatic features, yet the unravelling of the structure convinces them of a sedimentary origin; while O. Schultz and F. Vartar find sedimentary fabrics in the well-known Alpine magnesites.

Finally the notion of time in ore-genesis could hardly be better illustrated than in H. J. Schneider and B. Lehmann's new conception of the Bolivian tin province, where they identify Pre-Cambrian stanniferous granites, Silurian metasedimentary tin mantos, and two cycles of magmatic regeneration respectively in Early Mesozoic and Cainozoic times.

Except for one excellent article by Paul Ramdohr in German (on titanomagnetite) the papers are all in English. Proof reading has not been perfect, but the volume is well-produced and illustrated.

KINGSLEY DUNHAM

Waters (K. H.). *Reflection seismology*. New York and Chichester (Wiley-Interscience: John Wiley & Sons), 1978. xvi + 377 pp., 211 figs., 2 colour pls. Price \$35.60 (£19.75).

The sub-title of this book is *A Tool for Energy Resource Exploration* and it deals almost wholly with the exploration for petroleum with only passing reference to the investigation of the structure of coal seams. Possible uses of reflection seismology to map bedded ores or in hydrogeology are not specifically dealt with although both the general principles and specific techniques described have applications in these fields.

After dealing with general principles there are chapters on sources and receivers, data gathering, and data processing. In the second half of the book the author deals with more detailed investigations, and includes separate chapters on migration, near surface corrections, and interpretation. He concludes with an account of new techniques now in development. Appendices deal more fully with special subjects following the general accounts in some chapters.

The book is well illustrated throughout and includes many illustrations from unpublished industrial sources. Although the author disclaims the level of the mathematical background he provides it should prove more than adequate for honours students in geology and geophysics and to most practising exploration personnel. However geologists can use this work advantageously without following all the mathematical arguments.

H. C. POTTER

Tsuboi (S.), Mizutani (S.), Suwa (K.), and Tsuzuki (Y.). *Charts of Plagioclase Optics*. Tokyo (Iwanami Shoten), 1977. ix + 137 charts. Price 7200 Yen.

Before the electron probe became widely available the Universal Stage was regarded as the most satisfactory instrument for investigating plagioclases in thin section. On good material it will give a reliable estimate of the composition ($\pm 2\%$), determine the twin laws present, and produce an assessment of the structural state if the mineral is less calcic than An₇₀. Unfortunately optical methods, though rapid, do not reveal the potassium content and are of restricted use on finely twinned or unfavourably oriented material. Until the appearance of *Die Orientierung der Plagioclase* by Burri *et al.* (1968), optical methods suffered from an inadequate number of reliably determined chemical compositions. Paradoxically the arrival of the electron probe coincided with a decline in optical studies: there is still an absence of good chemically