account of the determination of atom sizes in MnO_4^- based on energy band theory.

The final chapter is devoted to a discussion on the nature of the chemical bond in some classes and groups of minerals and contains a clear statement of the author's thesis that ultimately the only satisfactory description of bonding which can be made must be based on the molecular orbital and energy band theories. This concept, in as far as it is currently possible, is then applied to the silicates, beginning with the nature of the chemical bond in SiO_4^{4-}, and using data both from X-ray and ESCA spectra. The treatment proceeds in outline to other cation polyhedra in silicates. This is followed by a wide-ranging discussion of the nature of the bonding in sulphides in the context of their energy band structures. The chapter ends with a very brief account of the hydrogen bond.

While this book is superficially extremely well produced and will certainly be much used for the data which it contains it is somewhat surprising that the standard of writing and editing is so poor. With a good knowledge of English it is usually possible to guess what the author means and it is perhaps unfair to be too critical in this context. However, the book, in addition, is full of avoidable misprints and it has clearly been very inadequately proof-read. I find if difficult to understand how a publisher, in presenting a book on the international market, and at a very high price, should fail so miserably on the simple matter of spelling.

J. D. C. McCONNELL

Marfunin (A. S.). *Spectroscopy, Luminescence and Radiation Centers in Minerals* (transl. from the Russian by V. V. Schiffer). Berlin, Heidelberg, and New York (Springer-Verlag), 1979. xii + 352 pp., 170 figs. Price DM 108.00; $59.40.

This is the second book on mineral physics by the Russian author A. S. Marfunin to appear this year. The first (*Physics of Minerals and Inorganic Materials*) is reviewed above. As the title implies, the second volume deals with some of the less familiar spectroscopic methods, namely Mössbauer, nuclear magnetic resonance (NMR), nuclear quadrupole resonance (NQR), X-ray spectroscopy, luminescence and thermoluminescence, and the properties of electron-hole centres. The arrangement of each of the six main sections is similar, with a description of the theory and general principles of the method being followed by a discussion of its applications to minerals. There is a list of 1023 references, classified according to the spectroscopic method used, and an adequate index.

The section on the Mössbauer spectroscopy is typical. Three of the 37 pages describe the basic theory of the Mössbauer effect and 15 the experimental arrangement, the types of spectra, and the origin and meaning of the isomer shift, quadrupole splitting, and hyperfine splitting. The remaining 19 pages are devoted to the Mössbauer spectra of minerals, notably silicates, oxides and hydroxides, and sulphides. There are 235 references, all but a few pre-1977. The whole constitutes a good introduction to Mössbauer spectra for the non-specialist, and a useful summary for the mineralogist specializing in this field.

The remaining sections, of which that on luminescence and thermoluminescence (101 pp., 271 refs.) is the longest, and that on NMR and NQR (22 pp., 101 refs.) is the shortest, follow a similar pattern. Taken with the accounts of electron paramagnetic resonance (43 pp., 148 refs.) and X-ray spectroscopy (38 pp., 95 refs.), they provide an extremely useful introduction to these less-known spectroscopic methods, and particularly to their mineralogical applications, and deserve to be widely read and applied.

In view of the scientific merits of the book, it is a pity that the author has been let down by his publishers, who have devoted insufficient effort to editing the translation and to proof reading. It is usually possible for the reader to discover what the author must have meant, but the path to enlightenment is made harder by the peculiar Teutonic phrasing and word-order that is often adopted, and by the incorrect use of words, e.g. 'negligent' for 'negligible'. Foreign companies publishing in English would do well to have their translations edited by native speakers of that language, even if the translation is done by others. The proof-reading is poor, with 'sheelite' (scheelite) throughout §7.3.13, and an unreasonably high concentration of other errors.

Despite these defects, the book is to be welcomed. Perhaps the second edition will be better produced.

R. G. J. STRENS

Barrer (R. M.). *Zeolites and clay minerals as sorbents and molecular sieves*. London and New York (Academic Press), 1978. viii + 497 pp., 181 figs. Price £25·00.

It is unfortunate that this review of an important monograph was delayed by late receipt of the review copy: apologies to Professor R. M. Barrer!

One of the great commercial successes in recent years has been the development of zeolites and clay minerals as sorbents and molecular sieves, not to mention parallel applications of zeolites as ion-exchangers and catalysts. The crisis in petroleum

supply would have come 5 years earlier if zeolites had not replaced less-efficient amorphous catalysts. With the discovery of huge deposits of zeolites in sedimentary and altered volcanic rocks, there is a distinct possibility of development of huge-tonnage applications for water-treatment and agricultural purposes.

Professor Barrer was a distinguished pioneer in discovery of new types of zeolites and in study of physical properties, and until his recent retirement directed a host of co-workers at Imperial College. To his great disappointment, the commercial opportunities were exploited more vigorously in the USA than in Great Britain. The present monograph capitalizes on his comprehensive research programme.

The introductory chapter 'The Zeolites: Their Nature and Some Uses', 31 pp., has a distinctly historical and personal flavour. 'Zeolite Frameworks, Cations and Water Molecules', 71 pp., is adequate, but weak in topology and subtleties of crystallographic aspects. Four-connected 3D nets are the key to zeolite frameworks, and several topological features described by A. F. Wells and others deserved mention rather than Fig. 2 (p. 35). Unfortunately the incorrect concept of zero-coordinated cations (pp. 76–7, 87) has been accepted even though it was quite implausible from the viewpoint of crystal-chemical theory: fortunately, new experimental data (Pluth and Smith (1979), *J. Phys. Chem.* **83,** 741) have shown that the original proposal of zero-coordination was based merely on computer refinement of experimental error! No account is taken of the systematic displacement of interatomic distances for atoms in sites of low fractional occupancy. Some distances in Table 21 (p. 94) must suffer badly from this effect. Recent interpretation of interatomic angles in terms of molecular-orbital theory (Gibbs *et al.*) came too late to be used on p. 97. Readers should also note that recent structure determinations of high-silica zeolites ZSM-5 and ZSM-8 and their pure silica analogues (Flanigen *et al.*, 1978, *Nature*, **271,** 512; Kokotailo *et al.*, 1978, *Nature*, **272,** 437) came too late for inclusion. Mineralogists will miss the d in felspar and felspathoid. Errors are few: *e.g.* Perrotta on p. 98.

Professor Barrer is at home with the next six chapters: 'Equilibrium', 59 pp., 'Energetics of Sorption', 62 pp., 'Entropy and Heat Capacity', 32 pp., 'Diffusion in Zeolites', 83 pp., and 'Chemisorption and Sorption Complexes', 68 pp. They contain extensive compilations of experimental data and theoretical interpretations. Most measurements were made under conditions not found in nature, but nevertheless these chapters are of considerable value to mineralogists and geochemists. In nature, water is the prime sorbent, but the possibility of traces of other sorbents in natural zeolites has not yet been explored thoroughly. Furthermore the extent of diffusion in beds of natural zeolites is deserving of quantitative research.

The final chapter of 80 pages covers 'Sorption and Molecule Sieving by Layer Silicates'.

This monograph is highly recommended to all libraries catering to mineralogists, geochemists, and soil scientists. It complements and extends the existing monographs by D. W. Breck, 'Zeolite Molecular Sieves', Wiley-Interscience, 1974, and J. A. Rabo (ed.), 'Zeolite Chemistry and Catalysis', *Am. Chem. Soc.* In such a dynamic subject, readers of Professor Barrer's monograph will have their appetite whetted for the next meeting of the International Zeolite Association in Naples, 2–6 June 1980.

J. V. SMITH

Reedman (J. H.). *Techniques in mineral exploration.* London (Applied Science Publishers Ltd.), 1979. xii + 534 pp., 213 figs., 56 tables. Price £36·00.

This book is a well-organized and illustrated introduction to the procedures of prospecting and mineral resource evaluation. Unfortunately, because of the scope of the subject matter, a book of this size can only be an introduction to principles, but the author has used examples from his own experience and other case histories to demonstrate the application of many of the techniques described. The author is a professional exploration geologist with experience in many parts of the world and this is reflected in the practical suggestions and comments which complement the theoretical concepts discussed.

There are ten chapters, the first of which is a brief review of mineral resources as a concept, and the economic factors which influence the mineral industries. This is followed by descriptions of the main techniques of geochemical and geophysical exploration, and discussion of the applications of satellite image, aerial photograph, and remote-sensing techniques as aids to propecting, together with brief comments on the geological mapping as an exploration 'tool'. There are good introductory chapters on surveying, 'soil' sampling (pitting, trenching, and shallow augering/drilling), and deep drilling methods. The text ends with two chapters devoted to ore-reserve calculation and prospect evaluation.

The volume contains as much factual information as possible and pleasantly little generalization. The scope of the work is perhaps a little too broad to allow as full a treatment of any of the subject