helped those of us with bad memories to sort out (page 75) which of La, Y, Ce, Tb, Yb and Lu are rare earths and we could have been helped by not seeing La_2C_3 (page 79) when it is more rationally written $La_4(C_2)_3$. (The word oxygen has been substituted for carbon on this page.)

In a short book such as this perhaps one has a right to expect few errors; it is gratifying nevertheless to find so few. Anyone (such as this reviewer) who has failed to keep abreast of advances in neutron diffraction will have his eyes opened to a fascinating field of research. The ideas of 'invisible' atoms will appeal to all X-ray crystallographers and there are few fields of scientific endeavour where one can so easily forgive a pun: crystals with invisible atoms are called 'null matrices'.

Whether or not one is contemplating the daunting prospect of seeing all the hundred volumes on one's shelf, this particular volume, which stands independently of the others, will be a valuable addition to every crystallographer's library. It augurs well for the next two volumes we can expect under topic 11: lattice theory and the theory of metals.

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Atomic structure and chemical bonding. By F. SEEL. 112 pp. (Translation and revision of 4th German edition by N. N. GREENWOOD and H. P. STADLER). London and New York: Methuen and John Wiley, 1963. Price 15*s*.

If one were required to compress an elementary non-mathematical account of atomic structure and chemical reactivity into a crown octavo booklet of 112 pages one would be hard put to it to better this book which is a translation of the 4th German edition.

The book will not be of special concern to crystallographers *qua* crystallographers and indeed, although the author gives good coverage to important structural types, he does not stress that crystal-structure analysis has been the basis of our revolution in thought concerning valency. His approach to this is often curious. He claims (p. 54) that it is erroneous ever to regard nitrogen as five-covalent, not as one might expect on crystal-structural grounds, but as 'is evident from Fig. 41 ...'. This figure, needless to say, begs the question. There are several curious quirks of this kind. Examine the logic of the argument on pp. 66–69: (*a*) Li can use unhybridized *s* orbitals to form a metal; (*b*) atoms in general can involve hybridized orbitals to form metals; (*c*) one reason why hydrogen does not form a metal is because its electrons cannot hybridize.

Naturally the subject matter of the book is condensed and a student could hardly make much of it on his own. It would, however, be excellent collateral reading for a lecture course. The text is aided by a generous supply of ingenious diagrams. (Occasionally a bit too ingenious; examine Fig. 14 as an illustration of variable valency in the transition elements.) Here and there one felt the need for more illustrative information. Thus coordinate axes would have helped with *d* orbitals (Fig. 9), as they would when comparing COClF with SOClF (pp. 63–64). The author makes very sensible use of energy data to explain chemical reactions and, although it is all chemically orthodox, it is well set out. Here again an energy-level diagram or two would have helped the discussion.

The sensible layout and good coverage have made this a popular book in Germany. This excellent translation should be equally popular in the English-speaking world.

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Silicate science. Volume 1. By W. EITEL. Pp. xii+666, with 375 figs. New York and London: Academic Press, 1964. Price 171*s*. 6*d*. Subscription price 150*s*. to those who have placed orders for the complete set prior to publication of the last volume.

The Physical Chemistry of the Silicates by W. Eitel, published in 1954 was recognized as a *tour de force* summarizing the vast body of knowledge about silicates which had accumulated up to 1952. It is a measure of the enormous growth of this subject that the present large volume is the first of five being prepared, all by W. Eitel, which are now needed to cope with the progress made in the period 1952–62. It its important to realize that the five new volumes (1. *Silicate Structures;* 2. *Glasses, Enamels, Slags;* 3. *Dry Silicate Systems;* 4. *Hydrothermal Silicate Systems;* 5. *Ceramics and Hydraulic Binders*) are not a revision of the earlier work but are entirely supplementary to it. Volume 1 *Silicate Structures* is divided into three sections: *A*. Silicate crystal structures, 218 pages; *B*. Clay mineral structures, 67 pages; *C*. Silicate dispersoids, 327 pages. The arrangement within each section is by means of numbered paragraphs each dealing with a separate topic: the paragraphs are in effect extended abstracts (with illustrations) of one or more papers on a given theme, and related themes are usually found in neighbouring paragraphs.

The largest part of section *A* describes the important silicate structures determined in the ten year period, but this is preceded by chapters on general crystal chemical topics, infrared spectrometry and complex anions in alumino-, beryllo- and boro-silicates. For the arrangement of material in the description of structures the Zoltai method of classification is used. The hitherto commonly adopted Bragg classification of silicate structures is ruled by the type of linkage of SiO_4 tetrahedra (chains, sheets, *etc.*), but inconsistencies arise through the treatment given to aluminum and other atoms when they occur within oxygen tetrahedra. For example, in cordierite AlO_4 groups are not regarded as in the 'silicate' arrangement, but in anorthite they are. The classification by Zoltai takes into account all tetrahedrally coordinated cations in describing tetrahedral arrangement. Thus beryl and cordierite, for example, are described as having framework rather than ring structures, and oakermanite containing linked Si_2O_7 and MgO_4 groups is treated under sheet structures. One result of the new classification is that it causes sillimanite (Si_2O_5 chains) to be separated from its polymorphs, because aluminum is in fourfold coordination in sillimanite whereas in kyanite and andalusite it is in 5-fold and 6-fold positions respectively.

Although the coverage of recent structure determinations is fairly comprehensive, a number of important spheres of

structural progress appear to have unduly little treatment, but it is expected that they will feature in another volume. (The subject of polymorphism, for example, including much about the feldspars is to appear in Volume 3). In the section on amphiboles the 'curvature' of the chains is mentioned but the paper (1949) which first demonstrated this is not mentioned in the 1954 volume or here; a group of several more recent papers on the structures of amphiboles in the German literature, and an important one on their crystal chemistry in *Acta Crystallographica*, are also not mentioned in the present volume.

After dealing with crystal structures section *A* ends with chapters on crystallo-chemical aspects of isomorphism and on epitaxy. In section *B*, structural work on clay minerals is well represented. There are chapters on the principal clay mineral groups: kandites, smectites, mica-like clay minerals, and vermiculite; there is also a chapter on mixed-layer clay minerals.

The title of section *C* 'Silicate dispersoids', and the way in which this term is interpreted, allows a very wide range of topics to be dealt with in this part of the book. Among these are: colloidal solutions and sols; flocculation; optical properties of colloidal suspensions; X-ray and other investigations of colloids; hydrogels; various aspects of adsorption on silica and silicate gels. Also included are discussions of solid dispersed phases in solid dispersion media. Thus under 'optical properties of colloidal suspensions' there is discussion of structure defects and their role in coloured and luminescent materials. Also in section *C* is a chapter entitled 'Electron microscopy of dispersed systems', but this in fact deals partly with general techniques of electron microscopy and electron diffraction (*e.g.* the carbon replica method); in this and in some of the detailed studies mentioned, the chapter seems to be only marginally concerned with 'dispersoids'. There is a large section of over a hundred pages dealing with clay-water systems.

Silicate Science is not an easy book to read. This is partly because of the advanced nature of the subject matter and partly, unfortunately, due to unskilled use of the English language. Many phrases are clumsily constructed and sometimes quite wrong words are chosen. The meaning is often obscured because of this, and the difficulties which result will be greatest for foreign readers with imperfect understanding of English, who will not be able to guess so readily what the author is trying to say.

There is no doubt, however, that this book will be widely used by all concerned with silicates, and it will be appreciated as one which brings together results on natural and synthetic materials which are otherwise largely treated separately in mineralogical, ceramic and chemical publications. The detail with which structural information is given is considerably greater than that contained in the typical abstract journal. The coverage of literature from all countries is very good and that from the U.S.S.R. is particularly well represented. References are well documented, and at the end of the book there are four kinds of index: author, subject, compound, and mineral.

Such an enormous compilation could not have been produced without errors; there are indeed, in marked contrast with the 1954 book, a large number of minor errors. The figures are of very varying quality; they are mostly photographic reproductions of figures published in journals, and their quality is often somewhat poorer than that of the originals which themselves were sometimes not too good. If a work such as this were to be produced with perfect attention to all details its publication would be so delayed as to make it very much out-of-date on appearance, if indeed it appeared at all. The enormous value of this work, in collecting, arranging and summarizing related topics from such a wide field, is marred but not substantially reduced by the irritating rather than damaging blemishes.

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Advances in X-ray analysis. Volume 7. Edited by W. M. MUELLER, G. R. MALLETT and M. J. FAY. Pp. x+662. New York: Plenum Press, 1964. Price $22.50.

The annual conferences on applications of X-ray analysis held in Denver are now well established, and the volume under review contains the proceedings of the twelfth, held on 7–9 August 1963. Volume 6 was reviewed in *Acta Cryst.* **17**, 791 (1964).

Volume 6 contained 44 papers and 480 pages. Volume 7 contains 53 papers and, in spite of the recent increase in the size of the page, 662 pages. The emphasis on X-ray fluorescence analysis is maintained, though there is still no mention of it under any likely heading in the subject index. There is also an impressive group of papers on electron-probe analysis, which does appear in the index.

Conference proceedings are notoriously difficult to review. Papers that particularly attracted the reviewer's attention dealt with the use of peaks and mid-points of chords at half height for lattice-parameter determination (Parrish, Taylor and Mack), a graphical method of indexing powder photographs (Schieltz), and a double-crystal X-ray spectrometer based on the Philips diffractometer (Wittels, Sherrill and Kimbrough). Other reviewers could reasonably choose quite a different selection.

This volume needs no recommendation to those already familiar with the series. Those unfamiliar with it may like to know that the book is well reproduced by photolithography, and that it contains numerous figures, a few in colour.

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Fundamentals of transmission electron microscopy. By R. D. HEIDENREICH. Pp. xiv+414. New York: Interscience, 1964. Price 109*s*.

This is a book which will be welcomed by all those — and especially metal physicists — who want to get the most out of the application of the electron microscope in their various researches. When the author uses the word 'fundamentals' in his title, he very much means what he says. The treatment commences from the elementary interactions of electrons with atoms and proceeds *via* an exposition of wave mechanics and electron diffraction to a detailed discussion of diffraction contrast in crystals. Anyone looking for a description of the design, construction and operation