crystals; symmetry relationships in physical properties and imperfections in real crystals. These chapters are followed by four appendixes; projections, calculations on stereograms, growth of crystals, and twinning.

The first section begins with a chapter on two-dimensional patterns, in which the elements of symmetry are described and used in a clear manner to derive two-dimensional lattice types, point groups, and space groups. The next four chapters (on stereographic projection, crystal classes and systems, axial systems and indexing, and morphological crystallography) lay the foundation for the chapter on three-dimensional lattice types and space groups. Detailed description is limited to space groups of the triclinic and monoclinic systems and brief comments are given for more symmetrical space groups. The second section begins with a chapter on the generation of X-rays, principles of diffraction, and the determination of space groups. Subsequent chapters describe diffraction by single crystals and powders. Laue, rotation, and oscillation photographs and the determination of cell dimensions are described, but structure analysis is deliberately omitted. The third section has an interesting chapter on symmetry relations in physical properties and one on imperfections in real crystals.

The style of prose often makes comprehension difficult, either through its complexity, or less often by undue compression. The treatment of the chapter on imperfections in real crystals and the appendixes on growth of crystals and on twinning do not seem to be entirely satisfactory; either the same subject matter should be treated in more detail or fewer topics should be covered in the space available. The standard of illustrations is generally good, but a number of crystal drawings are inaccurate and their crystallographic axes are grossly misorientated. There are also some elementary errors in the captions.

The author succeeds to a considerable extent in fulfilling the aims he set himself, of writing 'a modern introduction to the crystalline state' for students wishing to acquire 'an elementary knowledge of the fundamental language of the crystalline state' for studies in such diverse subjects as molecular biology, metallurgy, mineralogy, pharmacology, and petrology. However, many students would probably prefer a more comprehensive coverage of the crystalline state, including crystal chemistry, treated in a simpler manner.

A. F. SEAGER

BATTEY (M. H.). *Mineralogy for Students.* Edinburgh (Oliver and Boyd), 1972. xii+323 pp., 263 figs. Price £4·00.

It is difficult to say what is an ideal course in mineralogy for Honours Geology students. Not only does one have to decide on which minerals to include and the amount of detail for each, but also the amount of classical and X-ray crystallography, crystal optics, and crystal chemistry that is needed. Teachers are free to form their own preferred 'mix', using as texts appropriate parts of the various rather specialised books each of which deals with one of the subjects concerned. It is, of course, tempting, and various attempts have been made, to produce a suitable treatment of all under one cover. Not so long ago, there was undoubtedly wide variation in the importance

given to mineralogy and crystallography, relative to each other, and in relation to other parts of Earth science, in different universities. Probably there is more uniformity of outlook today, and it should now be possible to produce a fairly widely acceptable text.

The book under review sets out to cover mineralogy adequately for the whole of a geology student's degree course. It comes nearer to doing this than any single-cover treatment published hitherto (although one or two of these are extremely well written and serve excellently for a more elementary level). However, it does not in my opinion go quite far enough, particularly in lacking any discussion of use of phase equilibrium diagrams. It might be argued that these are the province of petrology, which is true for many of the complex systems, but I would have thought that treatment of at least the olivine series, and subsolidus behaviour of the alkali feldspars and the Ca,Fe,Mg pyroxenes would have benefited from some phase diagram illustrations.

Apart from this, the author has commendably tried to achieve compression, not by omitting whole topics, but by covering them all in abbreviated form. This brings its own difficulties, of course, most markedly in the section on crystal optics, which the student may find difficult to follow in places. There is no diagram, for example, to help explain the difference between wave normal and ray direction.

The relative weights given to different subjects in the book are indicated by its subdivision as follows: Principles of crystal structure—18 pp., crystal description—55 pp., physical properties—20 pp., optical properties—40 pp., X-rays and crystal structure—11 pp., mineral associations—21 pp., descriptions of minerals—113 pp.

The author uses his considerable teaching experience to anticipate difficulties which students have with particular topics. Many such problems are dealt with in footnotes and elsewhere in an undoubtedly helpful manner. The desire to make things easier has also led to the use of a rather breezy colloquial and sometimes humorous style of writing ('. . . there is a chlorite for every low temperature occasion . . .' and 'for garnet structures . . . imagine two kinds of totem poles . . .'). Also there is the rather delightful straightfaced . . . 'Talc is the first mineral with which the student comes into contact.'

The plain language, simplifying approach is laudable, but occasionally it is overdone and misleading. For example, the statement that 'high temperature forms are more nearly random or isotropic in structure, and this means more nearly the same in all directions'. In similar vein, the reason given for cubic substances being optically isotropic is not satisfying, and probably there is no simple way of explaining this. In the X-ray section, there is the completely misleading statement that the 022 planes 'disappear' for a primitive lattice.

In treatments of interference colours seen between crossed polars, it is common for textbooks to state mistakenly that two beams vibrating at right angles do not interfere. In the present text, although the combination of two perpendicular vibrations is treated correctly for reflected light on p. 136, the mis-statement is made for transmitted light on p. 121.

In some places, overdone attempts at simplicity lead not to errors but to unnecessarily clumsy treatments. For example, the expression of *d*-spacing in terms of orthogonal cell parameters is derived by the geometry of right-angled triangles rather than

by trigonometry, and elsewhere the avoidance of explicitly stating the Weiss Zone Law leads to an unnecessarily lengthy proof that three stated faces lie in one zone.

There is one example of unnecessary complication, namely, where a ruler construction is employed to find the opposite of a stereographic pole when a pair of compasses could step off the required point along a diameter. The more lengthy ruler construction would make sense if it were used for its proper purpose, that is, finding the opposite pole *outside* the primitive, and using it together with a third pole to define a great circle. But this important construction is not mentioned.

Unfortunately, there are a fair number of other errors, among them: the body-centred cubic arrangement is treated under the heading of close packing; inversion axes cannot all be described as stated in terms of other symmetry elements; c/b is not given by tan (001):(011) for the monoclinic system (the diagram is incorrect); amosite is not an anthophyllite; the conventional brackets around Miller indices have been omitted throughout. A number of misprints are present, but are usually sufficiently obvious not to be misleading.

Two noticeable omissions are, one in the optics section where there is little mention of the relation between extinction angle and symmetry, and another in the description of the feldspars where there is no mention of the schiller effects in moonstone, peristerite, and labradorites, although the schiller phenomenon is mentioned generally elsewhere in the book.

The author has employed S.I. units throughout, including nanometres for cell dimensions (with one lapse) and meganewtons/m^2 for pressures. In the latter respects, he is ahead of the specialist literature, in which Å units and bars are still prevalent.

In summary, though in my opinion not quite up to B.Sc. degree standard, this book comes considerably nearer to being so than others which could claim similar breadth. Since it is the first British book of its kind it also gains topicality for British use by including more of the prominent British mineral localities. Unfortunately, it is somewhat marred by certain omissions and by a fair number of non-trivial and trivial errors. Some of these errors are by way of a penalty paid for an otherwise commendable attempt at simplification.

J. ZUSSMAN

MASON (BRIAN), editor. *Handbook of Elemental Abundances in Meteorites.* New York, Paris, and London (Gordon and Breach Science Publishers), 1971. vi+555 pp., 62 figs. Price, cloth £14·60, paper £5·80.

An authoritative review of the abundances of the elements in meteorites has long been a desideratum for cosmologists, meteoriticists, geophysicists, and geologists: the present volume goes a long way to meet this need, and will be an essential tool in those studies and a mine of useful information. It is, however, disappointingly uneven, and, in the future edition that will certainly be called for, a number of changes and additions could advantageously be made.

Each element (the lanthanons counting as one) is accorded a separate chapter, resulting in a certain amount of repetition, but making it easier to extract the information on any one element. The twenty authors or teams among whom the elements were