than ever as diamonds play an ever-increasing role in industry, in basic science, and in world economics. This concise book by Schmidt and Malzahn spans most of the aspects of diamonds. There are chapters on the science of diamond, the geology of its growth, world production, mining techniques, diamond synthesis, grading diamond, its use in industrial abrasives, and a description of gem-diamonds. Inevitably any book covering such a wide-ranging field will have omissions. There is no mention of the early synthesis of diamond in Sweden. Sections of the scientific literature have been overlooked so that, for instance, in the discussion of electrical conductivity there is no reference to the definitive work of Collins and Lightowlers. However, the main drawback of the book is that it is already slightly dated. Although published in 1980 the text describes the state of the diamond world as it was a few years earlier. The authors have not incorporated the most recent advances, for example of determining the growth conditions of natural diamonds. Nor, apparently, have they been able to take advantage of the recent substantial reviews of diamond such as '*The properties of diamond*' edited by J. E. Field (Academic Press, 1979). But despite these drawbacks, Drs Schmidt and Malzahn have presented a well-balanced introduction to the properties and uses of this unique mineral.

G. DAVIES

Luger, P. *Modern X-ray analysis on single crystals.* Berlin (Walter de Gruyter) (1980). 312 pp., 151 figs. Price DM 96.00.

There have been many books published on crystallography and X-ray structural analysis and hence, in reviewing this new book, one must ask whether it is really necessary, and also decide how it compares with others in the context of clarity, and the needs of the modern crystallographer. Currently the art of structure analysis is wrapped up in extremely sophisticated computer programs and is practised by many research scientists who have not necessarily undergone a rigorous training in formal crystallography. In such circumstances there is a real danger that the casual user of the 'black box' technique of structure analysis may be quite unaware of some of the fundamental pitfalls in analysis. This new textbook is designed specifically with such research workers in mind. In this context I believe that it is extremely valuable. It is well written and provides exactly the right sort of overview of the whole technique. The text throughout is extremely well illustrated and, at each stage in the programme of analysis reference is made to the results obtained for three quite complex organic test structures.

The book assumes very little and begins with a clear account of the necessary mathematical background. This includes an elementary treatment of matrices, determinants, and vector algebra. The first chapter ends with Fourier transform theory and the relevant convolution operations. The second chapter is devoted to the description of essential preliminary experiments in selecting and examining suitable single crystals for structure analysis. Photographic techniques and all the important types of single-crystal camera are described in detail. In effect this chapter warns the would-be analyst about the dangers of proceeding directly to single-crystal diffractometer techniques where an imperfect crystal can be detected only with difficulty and the loss of time.

In chapter three the author deals with all aspects of crystal symmetry. The simple point-group symmetry operations are carefully illustrated and at the same time their matrix representations are written out in full. In dealing with the translational symmetry of the lattice and non-primitive lattices the author stumbled somewhat in using an inequivalent motif at $[\frac{11}{22}0]$ in a centred square lattice, fig. 3.13, p. 130. Tabulation of the Bravais lattices is followed by the definition and illustration of the space-group symmetry elements. Full space-group formalism follows and is illustrated with reference to space-group determination for the three chosen organic test structures. This chapter ends with an account of the atomic scattering function, the electron-density function, and the structure factor.

Chapter four deals with the use of a modern single-crystal diffractometer and an account of the usual programs and routines available for refining lattice constants and data collection. The criteria used in the selection of slit widths and incident radiation are defined. Chapter five continues with the editing of the intensity data and details the theory and practice of statistical analysis of the data for centrosymmetric and non-centrosymmetric structures. Statistical data for the three test structures are figured and used in this context. Having discussed the theory of the Patterson function and Harker sections, the author turns to direct methods of phase determination next. The theory is given and direct methods are used to derive preliminary structural data on the three test structures.

The last chapter is devoted to the final stages in structure analysis using least-squares methods, and methods of graphical display are both discussed and illustrated.

Having read this book with considerable enjoyment it was clear that both in the mode of presentation and in its clarity it succeeds in its main objective. I feel that it could be given to an

intelligent research student with little or no formal training in X-ray crystallography prior to his attempting some structural analysis. Of course he is likely to come back and ask some questions about difference Patterson functions, and exactly what he should do about refining the structure of an incommensurate phase.

J. D. C. McCONNELL

McLellan, A. G. *The classical thermodynamics of deformable materials.* Cambridge Monographs on Physics, Cambridge (Cambridge University Press) (1980). xviii + 338 pp., 22 figs. Price £27·50.

One of the leading problems in the Earth Sciences, and particularly in metamorphic mineralogy and petrology, is the application of thermodynamics to systems subjected to non-hydrostatic stress. Such problems relate not only to one-component phase transformations but also to reaction between mineral phases under stress conditions. The necessary extensions to classical thermodynamics in such circumstances are dealt with in rigorous mathematical terms in this new book. The result can hardly be described as light bedtime reading for petrologists! It is interesting to note that the author became interested in this topic through contact and discussion with Professor W. S. Fyfe, FRS.

The book is divided into two main parts which deal respectively with the mathematical foundations of finite strain theory, and with the development of non-hydrostatic thermodynamics. Although this development is simple in principle, it is difficult in practice since it involves, necessarily, the full tensor treatment of classical crystal physics. Each chapter in this book is prefaced by a short summary of contents, and ends with a list of all the important definitions and equations introduced, and a set of practical examples to be worked by diligent students. Difficult mathematical concepts are clearly explained and presented in logical sequence.

The text begins with an Introduction, Chapter 1, in which the author states clearly the case for studying the thermodynamics of crystalline systems under non-hydrostatic conditions, and quotes, as examples of relevant problems, some of the more important phase transformations in minerals. Unfortunately for the mineralogist most of these interesting examples do not reappear in the text, and practical examples of the application of the theory are restricted to a detailed and elegant account of the non-hydrostatic behaviour of quartz in the $\alpha$–$\beta$ transition, and the ferroelectric transition in barium titanate, in the concluding chapters of the book. While it is abundantly clear that the author is extremely competent in crystal physics, it is not nearly so obvious that he is equally well acquainted with the vast literature which exists on the mechanisms of solid-state transformations. This is particularly evident in Chapter 4 where the author uses a very over-simplified treatment of all such transformations in terms, simply, of coherent and incoherent transformation processes. Indeed throughout the book it is clear that incoherent phase transformations do not fit at all easily into the mathematical formalism. Thus on p. 254, where the author sets up a model for solid-state transformations under stress, and at equilibrium, he is forced to postulate an interfacial zone which 'would link and accommodate' different structural forms, i.e. two polymorphs. There is certainly no good experimental evidence for such a transition zone, nor is such a zone normally possible during the equilibrium interconversion of two polymorphs.

From a purely practical mineralogical viewpoint the theory developed in this book is directly applicable to the case of coherent phase transformations and in particular martensitic transformations. It is unlikely, as it stands, to be of direct use in many of the more complex situations existing in nature where first-order incoherent transformation and reaction processes are involved. The solution of such problems, apart from requiring many more experimental and physical data, must await a treatment which combines the formal equilibrium approach with considerable insights on the real mechanisms of solid-state transformations. Unfortunately such treatment, in order to be at all successful, must also deal with the real world, i.e. irreversibility, and the kinetics of such natural processes. Thus, in the final analysis, this treatment of thermodynamics under stress is likely to form only a part of the total body of theory necessary for the solution of stress transformation, and reaction, problems in nature. This volume may be regarded as an important initial step in the right general direction.

J. D. C. McCONNELL

Bowie, S. H. U., and Simpson, P. R. *The Bowie–Simpson system for the microscopic determination of ore minerals.* First students issue. London McCrone Research Associates) and Oxford (Blackwells Sci. Publ.) (1980). 18 pp., 3 figs., 4 charts. Price £2·50.

This booklet is designed to introduce students to the theory and practice of ore mineral identification by microscopic methods. The characteristics of thirty-seven common ore minerals are summarized