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 α–β 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 as a teaching set. The system is dependent mainly on the quantitative measurements of reflectance at four standard wavelengths although other distinguishing characteristics (colour, anisotropic rotation tints, pleochroism, microindentation hardness) are also referred to. The charts are single-sided and printed in colours corresponding with the wavelengths to which they refer. The descriptive notes on each mineral in combination with the notes on the use of the system make this a useful student text at a sensible price.

R. A. Howie