endless. I would appeal to all readers of this review to write to Professor Mitchell (or to myself) with any additional biographical information that they discover.

It has been a stimulating experience reading the book, which must be regarded as but an introduction to the subject. I very much hope that there will be a second, revised and expanded edition, that will include more data, more references, and many of the names omitted from this one; for by such is the history of our science enriched.

P. G. EMBREY

Cox (K. G.), Bell (J. D.), and Pankhurst (R. J.). *The Interpretation of Igneous Rocks.* London (George Allen & Unwin), 1979. xiv + 450 pp., 197 figs., 35 tables. Price £8·95.

In some branches of geology, new textbooks appear rather frequently but this is not true of igneous petrology when the publication of a new book is something of an occasion. This book represents a welcome addition to the literature on igneous petrology because it has a quite new and interesting approach to the subject.

To the reviewer's knowledge none of the authors has had first-hand experience of experimental petrology but they have nevertheless made the application of experimental studies a major part of the book, the treatment of this topic, amounting to 174 pages. In the introduction to the phase equilibria section it is clearly stated that the approach is chiefly empirical and is not based on thermodynamics. There is a modern tendency to belittle this empirical approach and to consider it to be out of date. When the Geophysical Laboratory was founded in 1907 the 'wise men' at that time had suggested that the new science of thermodynamics would permit the calculation of phase relation in all the silicate systems from thermodynamic data. When Dr. N. L. Bowen retired in 1952, he told this reviewer that, although forty-five years had elapsed since the founding of the laboratory, not one chemical system had been calculated or modelled with the precision which could be attained by experiment. The same observation is still true after seventy-three years. The two approaches are complementary as Cox, Bell, and Pankhurst make abundantly clear. On a similar theme there have always been critics of the experimental approach to petrology who have felt it their mission in life to point to the simplifying assumptions that the experimentalist or theoretician must make, and the most persistent of these criticisms is that few natural rocks represent equilibrium assemblages. However true this is, the assumption that equilibrium is attainable must be the starting-point of all studies of the failure to attain equilibrium.

The book begins with fractionation and goes on to discuss variations in the composition of magmas. An alkali–silica plot is used to show the range of variation of these oxides for different rock types and the nomenclature, of the more common volcanic rocks, is illustrated in this diagram. Although the authors state that their diagram is not intended to form a system of classification, it seems likely that others will use it for this purpose.

The phase equilibrium section is divided into two parts, the first is contained in three chapters which take the reader as far as ternary systems with ternary solid solution. The discussion of partial melting is particularly useful because, as the authors point out, the natural case will never be represented by perfect fractional melting or perfect equilibrium melting and so they discuss 'incremental batch melting'. The description of ternary equilibria in systems in which solid solutions are present considers both equilibrium crystallization and perfect fractional crystallization. This section has in the reviewer's opinion one slight failing—it does not stress that the tangent rule cannot be applied to a liquidus field boundary in the same way as it is applied in systems without solid solution. In short, it is not possible to specify under equilibrium crystallization conditions when a field boundary changes from co-precipitation of both solid phases to resorption of one phase and precipitation of the other, unless the bulk composition has been specified. The second part is concerned with quaternary systems and experimental work on natural rock systems, with and without the addition of water. Between these two sections there are chapters on the interpretation of variation diagrams and on petrography of volcanic rocks. The authors have divided the purely experimental part into two sections, presumably because they have found from their own teaching experience that a course in undiluted experimental petrology may be like drinking even the best of malt whiskeys, it should not be taken in excess in one sitting, but is best tasted over a period of time and may even be diluted with water, despite the popular notion that this is a heresy.

The next section of the book deals with the petrography of the plutonic rocks and the interpretation of evidence for their mode of intrusion and cooling. The final two chapters are on trace elements and the use of isotopes in the study of igneous processes. Even igneous petrologists are divided into two classes: those who are interested in the distribution of minor or trace elements and those who are not. This part of the book should

go a long way to bringing these two groups together so that they are on speaking terms at least.

Although the book has three authors they were together in the same department at the time of conception, if not at the actual birth of the book. Each has undoubtedly contributed mainly to his own special interest but the result is a very well integrated and clearly written text. One gets a feeling that the authors are enthusiastic about their subject and some of this enthusiasm will almost certainly be transmitted to their readers.

Although the authors state in their preface that the book is not built round any specific course, it seems likely that some teachers of igneous petrology may wish to build a course, somewhere between second- and third-year level, round this book. The fact that exercises accompany each chapter with answers at the end of the book, is another feature which makes it an attractive book on which to base a course.

Both the authors and publishers are to be congratulated in setting the price at a level which allows lecturers to recommend this text to geology students as an essential purchase. Of course one can find faults but most of these are misprints or small omissions. This reviewer is slightly disappointed in the reproduction of the photomicrographs which are much too black and in some cases this has obscured the features which the authors wish to illustrate.

W. S. MACKENZIE

Gupta (A. K.) and Yagi (K.). *Petrology and Genesis of Leucite-bearing Rocks* (Minerals and Rocks, vol. 14). Berlin, Heidelberg, and New York (Springer-Verlag), 1980. xv+252 pp., 99 figs. Price DM 69.50 (£19·60).

Leucite-bearing rocks have aroused a disproportionately high level of interest compared to their volume. This is probably due to two main factors viz. (*a*) their unusual chemistry (both major and minor element) which is reflected by such minerals as wadeite, priderite, magnophorite, kaliophilite, and leucite itself, (*b*) their geographically widespread occurrence in many tectonic settings. One unfortunate result of this unusual chemistry is the evolution of a large, overlapping sometimes confusing nomenclature. Such names as jumillite, orendite, wolgidite, shonkinite, etc., abound and these names must seem unpalatable to many students of petrology.

The number of hypotheses to explain both the origin of the parent magma and the relationships of the many rock types have also built up over the many years of investigation. Thus there is a need for a single publication to gather and explain (*a*) nomenclature, (*b*) petrography, (*c*) chemistry, (*d*) experimental work, (*e*) hypotheses on petrogenesis of the leucite-bearing rocks and it is the expressed intention of the authors to fill this need.

The book consists of 18 chapters and can be divided into 3 parts, (*a*) chapters 1 to 6 deal with the nomenclature, mineralogy, chemistry, and occurrence, (*b*) chapters 7 to 15 present experimental data, (*c*) chapters 16 to 18 cover tectonic setting and theories of origin. The reviewer's opinion on the length of these three sections is that the first is about right, the second far too long, and the third much too short.

The first section should prove very welcome to students and research workers alike since most of the rock types are described (although tephrite is unfortunately omitted) and a clear picture of the interrelationships is built up. The essential and also accessory minerals are described in turn. The description of leucite is marred by a failure to state that leucite is only cubic at elevated temperature and is always tetragonal when examined at ambient temperature, instead the misconception suggested by Carmichael that the high-temperature cubic form could be quenched is perpetuated here.

The middle section is largely devoted to descriptions of synthetic and natural systems and seems too long and tedious. The excessive length is chiefly caused by the inclusion of material which is only marginally relevant to the main theme, for instance two longish chapters are devoted to melilite-bearing systems, a mineral totally absent from many leucite rocks. A third chapter is devoted to the incompatibility of leucite and albite which is not a very positive approach. These three chapters are largely based on the authors' own work, and while it is usual to emphasize one's own experiences to some extent, I think this approach has been overdone in this book. My other criticism of this middle section is that, although it contains much data, the application of this data to elucidating the problems of genesis is not too profound.

The third section is devoted to wider problems on the petrogenesis of K_2O-rich magmas and the interrelationship of the many rock types. The more important hypotheses for the origin of the leucite rocks are all presented and discussed. The authors come down almost exclusively in favour of a process of partial melting of a mica-bearing mantle for the production of a suitable primary magma. Their dismissal of several of the other hypotheses are all based on too little argument. For instance, the idea of Gorai, which depends on the selective absorption of alkali-feldspar from a granite by a basic magma, is ruled out because of results obtained on equilibrium, heating experiments involving the mixing of granite and basalt powder.