time span over which the texture evolved from the original mush or Scropian 'Brei', and the likelihood that some granites might be intruded almost solid and 'ready-made', flowing by plastic deformation of the quartz. But these concepts are never developed in any depth.

In an aside on the relation of metallogenesis to granitization we are treated to some simple definitions and some elementary rules of geochemistry are restated. A model is then presented relating the concentration of metals in skarns and veins with the metasomatic processes forming granites.

Concerning the general conclusions it is very likely that the most common textural patterns of granites do develop during a long complex history of recrystallization but this reviewer considers that this holds equally for rocks originating by magmatic as well as metasomatic processes. Cooling of magmatic granites is rarely a single event, especially in syntectonic intrusions. Whilst the author has set out to compare 'textures of more than 500 different granites of world-wide distribution', in the event he has largely failed to relate in any detail the texture to environment and mode of intrusion. That 'the intrusive character of granites is not incompatible with a granitisation origin' is probably true, being a restatement of the hypothesis of Read that some granites, born as a result of anatectic processes in metamorphic environments, become unstuck and intrude upwards, as mushy magmas, into lower energy situations, losing heat as they do so. Nevertheless, only in association with the very earliest members of the Granite Series is the aureole more largely metasomatic than thermal, characterized by basic fronts and reaction skarns. And it is also clear that there are granites of other parentage judged from field, geophysical, and geochemical data. There are still 'granites and granites' despite a common texture and mineralogy.

W. S. PITCHER

RITTMANN (A.). *Stable mineral assemblages of igneous rocks: a method of calculation* (Minerals, Rocks and Inorganic Materials: Monograph Series of Theoretical and Experimental Studies, vol. 7). Berlin, Heidelberg, and New York (Springer-Verlag), 1973. xiv+262 pp., 85 figs. Price DM 76 ($31.20).

This handbook describes in detail a method for calculating modes from the chemical composition of igneous rocks. The calculation of the *Rittmann norm* is presented as an alternative to calculating the CIPW norm and the new method was developed because of the disagreement of the CIPW with the observed mode, particularly in melanocratic and highly sub-silicic rocks. The calculation of the Rittmann norm is based largely on empirical rules. Thus the average compositions of the main constituents in certain rock groups are estimated on the basis of available analytical data. Largely as a result of this empirical approach the key for the calculation of the new norm is lengthy, extending to over 40 pages of text, including some 25 graphical diagrams. Although, for any given rock, only a small part of the table needs to be referred to, nevertheless the key is dauntingly complex to the newcomer. An attempt has been made to overcome this problem by the provision of a computer program in a dialect of ALGOL. A listing of this program, which the reviewer has not seen, would have been a valuable

addition to the book, and a version of the program in FORTRAN even more useful. Charging the would-be user $7.00 for the program booklet would seem to unduly inhibit acceptance of the Rittmann norm as a viable petrological tool.

In addition to the key for the Calculation of the Rittmann norm, the book contains some introductory sections describing the principles on which the method is based, some comments on the composition of the major igneous rock-forming minerals, and a guide to the use of the key tables. Finally, there are two sections, one comparing the CIPW norm with the Rittmann norm and the other describing the various petrological applications of the Rittmann norm.

It is perhaps not surprising that the author and his associates are noted for their work on alkaline and sub-silicic igneous rocks. The Rittmann norms calculated for rocks of this general type appear to be particularly informative and the method may become quite widely adopted. Whether the Rittmann norm will be used by petrologists working on more 'normal' rocks seems less certain. The empirical and complex nature of the calculation will deter many, some of whom will continue to classify and subdivide their rocks on the more straightforward basis of the chemical analysis.

I. L. GIBSON

SUGIMURA (A.) and UYEDA (S.). *Island arcs: Japan and its environs.* Amsterdam–London–New York (Elsevier), 1973. viii+247 pp., 134 figs. Price £11·40.

This is the third volume in the series 'Developments in Geotectonics'. With a dominantly geophysical approach it is concerned mainly with the structural and dynamic aspects of island arcs as exemplified by the Japanese islands. The book is divided into three large chapters conveniently subdivided into more than fifty topics and supported by a list of some 600 references.

The first chapter deals mainly with the presentation of data on seismicity, gravity, heat flow, electrical conductivity, palaeomagnetism, etc., but there are also sections on geological structure, topography, volcanoes, basaltic magmas, and hot springs. It concludes with a unifying section on the zonal arrangement of geological and geophysical features in island arcs. The second chapter describes the post-Miocene geological history of Japan, underlining the relationship between igneous activity, sedimentation, and tectonics. The episodic nature of movements is stressed and in particular the contrast between Neogene and Quaternary events. The innovation of the east Japan arc system is considered in relation to the geometry of interacting plates.

In the final chapter, concerned with processes, the authors examine the island-arc model based on a descending mantle flow and lithospheric slab. Seismic properties and magma generation are discussed with respect to the pressure/temperature characteristics derived from the model. The Pacific or island-arc type of orogenic belt is said to be characterized by an asymmetric profile, paired metamorphic belts, and a spatial separation of geosynclinal and igneous activity. An integral part of the process is the development of marginal seas such as the Sea of Japan, which appear to result from expansion and spreading as magma rises above the deeper parts of the Benioff zone.

The book is generously, and in part well, illustrated but some of the figures are