largely due to the oceanographic geophysicists, which has led to the wide acceptance that continents drift and that the sea floor spreads, and to the all-embracing theory of plate tectonics. Here continental drift (A. G. Smith), sea-floor spreading (F. J. Vine), polarity reversal and faunal extinction (D. I. Black), and plate tectonics (E. R. Oxburgh) are fully described and the application of this unified, revolutionary, and elegant hypothesis to explain ancient orogenies is expounded (J. Sutton) and taken on to suggest that the proportion of continental crust involved in mountain building has varied through geological time in long cycles some 800 Myr or more in length. Further chapters include those on volcanism and the Earth's crust (J. B. Wright), the regional location of mineral deposits (T. N. Clifford), earthquake prediction (R. L. Kovach), and the geopolitical fiasco of Mohole (D. S. Greenberg).

The book is profusely illustrated throughout: the diagrams are clear and aided by the frequent use of colour tinting but some of the black-and-white photographs are less successful in their reproduction. Despite its being conceived and produced in only nine months it has benefited from this short gestation period in being quite remarkably up to date without having suffered unduly from printing errors. The authors have certainly succeeded in presenting the modern view of the Earth and have at the same time authoritatively illustrated the scientific approach to problems involving several branches of science. Certainly this reviewer feels that the students of today are fortunate not only in starting to study geology at a time when a new and coherent picture is emerging of the Earth but also in having this book to stimulate their interest and to explain so clearly the methods and thinking that brought about this new understanding.

R. A. HOWIE

CLIFFORD (T. N.), and GASS (I. G.), editors. *African Magmatism and Tectonics. A Volume in honour of W. Q. Kennedy.* Edinburgh (Oliver and Boyd), 1970. xv+461 pp., 96 figs., 3 pls. Price £10.

Most of the contributors to this Festschrift to W. Q. Kennedy have at some time worked closely with him at the Research Institute of African Geology in Leeds. The composition of the volume, a monumental achievement in the development of African geology, naturally reflects his influence both in the topics and their treatment. Kennedy's main interests in geology have been in the sources and relationship of magma types to crustal structure, in regional structure and metamorphism especially in the Scottish Highlands, and subsequently in the evolution of the African continent. The latter interest, looking back to the first, has been aligned towards petrogenesis and mineralization. More than half the eighteen articles, each of the stature of a major paper, can be categorized as closely reflecting the title of the book. It may be thought that the magmatism is stronger than the tectonics, unless one agrees with the cynic's definition of tectonics as being 'structure which is too big to see'.

Let it be clearly said that the volume contains an enormous amount of factual information and solid scholarship from a body of researchers who have specialized in

African geology for many years and is an invaluable reference work and source for comparative study in itself. Two examples of hard fact compilation are von Knorring's account of the mineralogy and chemistry of pegmatites from equatorial and southern Africa, and Rooke's compilation of her analyses of granites. Here, however, some care should be taken in accepting the classification of 'orogenic' and 'non-orogenic' types. Considering another single topic—vulcanicity—there are at least four detailed accounts of volcanic occurrences and the processes involved, their ages, thicknesses, surface area, volume, composition and petrochemistry, structural setting and associated sedimentation, relationship to warping, and rifting where applicable. Thus Cox discusses the Karroo volcanics, Woolley and Garson the Malawi alkaline province and the Lebombo volcanics, Gass the Afro-Arabian dome, and Vincent the Tibesti volcanic province. In addition to the presentation of data each embarks on a synthesis relating petrogenesis to crustal development.

A notable attempt to assemble information on a regional scale is that of Vail in his review of dykes and related irruptive rocks in eastern Africa. One contribution that satisfies the requirements of large-scale geological conclusions being firmly connected, through boots and hammer, to the ground, is King's account of the Rift system, which depends on a unique, systematic research mapping programme in Kenya.

At the other end of the spectrum is Harris's valuable essay in which he puts into perspective theories regarding convection movement, rifts and swells, melting products and volcanic types, global tectonics and their relationship to African vulcanicity and structure. Another highly useful compilation is the Viljoens's account of the Barberton region where the Swaziland System forms the type 'Greenstone belt'. It is worth pointing out, however, that in Swaziland the pre-Onverwacht basement is not completely granitized and that perhaps a miogeosynclinal equivalent of the 'Greenstone belt' may yet be found to exist. Also that 'underplating' by the Archaean Granite 3 is open to question and that 'overplating' is more appropriate for the formation of a batholithic layer above the Ancient Gneiss Complex, as Hunter has demonstrated.

The interest in large scale tectonics is carried to its limits by one of the editors. Valuable as Dr. Clifford's historical outline may be, one cannot help wondering if his 'flow sheet' (fig. 7) of the structural development of Africa, starting with eight primitive nuclei, is not more semantic than geologic. Thus, did each of these nuclei emerge from the waves leaving the intervening passages to remain oceanic crust until the next orogeny? Or could there conceivably have been a vast, primitive super-Africa (why stop at Africa?), which was broken into its component parts by tectonic reworking of this crust? This is certainly the case in those orogenic belts whose basement/cover relations are well known and which Clifford rightly points out belie the concept of continental accretion.

One may also question the importance Clifford places on the 'Pan-African Orogeny' (or 'Damaran–Katangan Orogeny' or 'Mozambiquian orogeny') as the agent of final cratonization of the continent. W. Q. Kennedy put forward the notion of a 'Pan-African Thermo–Tectonic Episode' in 1964: since then the seed has grown and put out enough foliage to obscure half Africa (Clifford's fig. 5). For example, the inclusion of

the whole of Nigeria within the Pan-African domain as shown by Clifford, and by Black and Girod (p. 186) is certainly open to further interpretation.

The point is that the Pan-African episode was based on isotopic age determinations largely without its relation to structure being known. Geochronology has provided data over the last decade from which a highly interesting and significant pattern has emerged—but only on a vast mega-tectonic scale. What we would like to see now is Dr. Clifford applying his encyclopaedic knowledge of African geology to the actual locations of the Pan-African mobile (i.e. metamorphic and structural) belts where these can be identified. It will then be possible to ask, taking as an example from this volume Bloomfield's admirable account of 'Orogenic and post-orogenic plutonism in Malawi', 'Which orogeny?' with reasonable expectation that the reply will not only be 'Pan-African'.

The volume is meticulously edited and well up to date. One may ask whether so many folding plates were required and did they not contribute to an unnecessarily high cost. Clear and adequate illustration is, however, one of the work's strong points.

J. V. HEPWORTH

READ (H. H.) [1889–1970]. *Rutley's Elements of Mineralogy*. London (Murby: Allen & Unwin), xii+560 pp., 151 figs., 1970. Price £3·50.

The last thorough revision of this well-known text was in 1936: in this 26th edition the main changes are the integration of the section on the atomic structure of silicates into the part dealing with mineral descriptions and the insertion of an elementary introduction to stereographic projection and its use in the description of crystal symmetry. As before, the classification used is a combined economic and chemical one, so that with the exception of the rock-forming silicates the grouping is not a structural one: thus rhodonite is dealt with between dialogite (rhodochrosite) and alabandite rather than adjacent to wollastonite. There is a distinct tendency to continue with the old mining names, e.g. nickel vitriol, though the modern nomenclature is normally also given: piemontite is rendered as piedmontite. This work remains a good text for applied geologists and will also find a place in introductory mineralogy courses. At a price of just over ½p per page it is remarkably good value.

R. A. H.