Interpreting the rocks of deepest Africa

H.B.S. Cooke

Crustal Evolution of Southern Africa: 3.8 Billion Years of Earth History. By A.J. Tankard *et al.* Pp.524. ISBN 0-387-90608-8/3-540-90608-8. (Springer-Verlag: 1982.) DM118, $55.

THE systematic geological study of South Africa began before the middle of the nineteenth century and the first map of the Cape Colony by Andrew Geddes Bain appeared in 1852, by which time he had already worked out the essential Phanerozoic stratigraphy. Mineral exploitation subsequently showed the importance of the Precambrian and much attention has been devoted to unravelling the tangled skein of "basement" geology. It is only in the past decade or so that emphasis has shifted from a largely descriptive and stratigraphic attack to more detailed studies concerned with provenance and environmental interpretation. Tankard and his collaborators have produced a volume in keeping with this modern view, one that is radically different from the traditional text on regional geology; their approach is highly interpretative, strongly process-orientated and stresses the dynamic evolution of the crust. The work is dedicated to the great South African geologist and pioneer protagonist of continental drift, Alex L. du Toit, and he would certainly have enjoyed it.

The area covered is essentially the tip of the African continent south of about 16°S, embracing the Republic of South Africa and the adjoining territories of Namibia, Botswana, Lesotho, Swaziland and Zimbabwe. The introductory chapter outlines the basic tectonic framework and delimits the boundaries of major structural "provinces" that underlie the relatively undeformed cover sequences, some of the latter being as old as Late Archean. Each province is a geographical region that shares a number of geological parameters — notably the predominant radiometric age and metamorphic style — the sum of which differentiate the region from the adjoining ones. Thus the provinces are not "cratons" separated by "mobile belts", for the mobile belts of one age commonly become the cratons of a later stage. The Sand River Gneisses in the Limpopo Province south-east of Messina have been dated at 3.8 Ga and are some of the oldest rocks known on Earth; hence the subtitle of the volume. Thus the chronology of the region is a particularly long one.

For the subdivision of the Precambrian, the authors have chosen to use the standard international divisions, Archean and Proterozoic (with Early, Middle and Late subdivisions) rather than employ the regional units adopted by the South African Committee for Stratigraphy (SACS — see Handbook 8 of the Geological Survey of South Africa, 1980). Although this may be palatable to the international readership, it is a little unfortunate as the SACS units were selected because they are "natural" local divisions and, in point of fact, correspond well with the stages into which the authors divide the evolutionary history of the South African crust. Thus their Stage 1, "Archean Crustal Evolution", does not cover the Late Archean but does correspond to the Swazian, while Stage 2 is labelled "Early Proterozoic Crustal Development" but includes the Late Archean; it corresponds to Randian plus Vaalian. In some other respects, however, the authors use of supergroup where the SACS scheme employs "sequence" (e.g. for the Karoo) is decidedly an improvement.

The text is divided into sections, each of which is devoted to one of the five major stages. Within each section the treatment is generally similar with chapters that deal primarily with a characteristic terrain and a particular province. For example, Chapter 2 is entitled "Granite–Greenstone Terrane: Kaapvaal Province" and incorporates discussion of the now classic Swaziland supergroup, although it does also include some consideration of the Zimbabwe province.

Throughout the volume there is a tendency to provide more petrologic and geochemical data for igneous and metamorphic suites than there is descriptive material for sedimentary sequences, for which only a minimum of stratigraphic or lithostratigraphic data are provided and emphasis is strongly on depositional environments and basinal analysis. The text is thus unusual in its stress on processes and causes, employing the interrelationships between observed structures to unravel the succession of events responsible for the state of the rocks that we now see. On the whole a good balance has been maintained, although the Phanerozoic may be under-played, in marked contrast to the more conventional over-emphasis on this span of geological time.

The illustrations are clear and helpful, although the quality of photographic reproduction leaves something to be desired. Literature coverage is extensive and the authors are to be congratulated on the high quality and up-to-date nature of the synthesis. Not everyone will agree with all of the conclusions and alternative interpretations are not always considered, but this is inevitable with a work of this scope and one must admire the coherence of the whole presentation. It is not easy reading and it is inevitable that many stratigraphic units are mentioned without an accompanying description, so a companion stratigraphic text (such as the recent SACS volume) would be useful for reference.

The book was written, as the preface states, "for advanced undergraduates, graduate students, and professional geologists worldwide". For all of them it should provide a new perspective and an essential tool. □

H.B.S. Cooke was until recently Carnegie Professor of Geology at Dalhousie University, and is now a geological consultant in British Columbia. He was for many years on the staff of the University of Witwatersrand, Johannesburg.

The little bang

R.G. Evans

Inertial Confinement Fusion. By James J. Duderstadt and Gregory A. Moses. Pp.347. ISBN 0-471-09050-6. (Wiley: 1982.) £36, $64.50.

ALTHOUGH the intensive research effort now being devoted to controlled thermonuclear fusion may appear to be a consequence of the current emphasis on energy projects, the basic ideas date back to the early 1950s. The main approach to the problem of heating and confining a plasma at a temperature of one hundred million degrees has been to use a large and suitably shaped magnetic field. These magnetic confinement machines, for example the JET machine now being built at Culham, are relatively close to the conditions needed for net energy production. But there are still problems with the toroidal geometry for a reactor system, particularly regarding maintenance, and the breeding of tritium to replace that used up in the thermonuclear reactions.

An alternative approach to fusion is not to confine the plasma at all but to utilize the reactions that occur before the plasma pressure overcomes its inertia and it blows apart, hence the slight misnomer of inertial confinement fusion (ICF). At one extreme this technique has been proven with devastating efficiency in the thermonuclear or hydrogen bomb. To reduce the explosive yield of a hydrogen bomb to manageable proportions requires the rapid compression of a small pellet of deuterium/tritium fuel to densities of a few hundred grams per cubic centimetre. The technical means to do this were not available until the advent of high-power lasers in the late 1960s and the major declassification of inertial confinement fusion occurred in 1972. There was early optimism for "break even" experiments with fairly modest lasers and this spurred on laser development programmes in the United States, the Soviet Union and to a lesser extent Japan and Europe. The promise of the early theoretical predictions has been somewhat tempered in the light of experimental testing, however; the current