NEWS AND VIEWS

A Worldwide Marker for the Precambrian ?

HOWEVER many volcanic rocks come back from space, no astronaut is likely to bring back a piece of extra-terrestrial coal. The sedimentary rocks of the Earth reflect to such a remarkable degree the physical conditions at the planet's surface, and the nature of any biological activity which these have permitted, that these rocks are unlikely to be matched elsewhere.

On page 498 of this issue of *Nature*, Dunn, Thomson and Rankama discuss the rocks which formed during the great ice age which affected the Earth some 700–600 million years ago. They are particularly concerned with the possible use of these deposits as a worldwide marker with which to establish a subdivision of the late Precambrian. In putting forward this proposition they are elaborating a proposal made by Harland and other geologists from the northern hemisphere and are taking advantage of the particularly good conditions which Australia provides for the study of glacial deposits of this age. It has required 100 years to establish present knowledge of this worldwide event, for it was at the British Association meeting in 1871 that another Thomson suggested for the first time that certain boulder beds in Scotland now known to be Precambrian had been produced in a former ice age.

There are several remarkable things about these late Precambrian deposits. They are very widespread and reached the late Precambrian equator, which indeed ran close to the Scottish locality where the earlier Thomson made his discovery. They evidently date from a time when an exceptionally large area of continental crust lay below the sea, for they usually occur in marine successions overlying continental crust. A puzzling feature is the frequency with which dolomites occur in close proximity to the glacial beds which seem to have been deposited by drifting ice or possibly by grounded ice sheets.

If grounded ice sheets really reached the equator then the late Precambrian ice age must have been quite exceptional, as Spencer has emphasized (*Mem. Geol. Soc. Lond.*, **6**; 1971). It certainly covered a long period, though this may have been a time of successive glaciations separated by intervals when the climate was warmer. Dunn and his colleagues suggest an overall duration of 100 million years for the Australian examples. This is more than twice as long as the late Palaeozoic glaciation which reached a peak some 300 million years ago and about ten times as long as the most recent ice age.

Broadly speaking, three methods of measuring geological time are in use at present—the classical scheme making use of biological evolution ; the determination of age through measurement of the decay of unstable isotopes ; and schemes which are based on changes in the Earth's behaviour. Possibly the most promising of the third is the use of the periodic reversals of the Earth's magnetic field to establish a time scale which now covers the past 70 million years of geological time and which should in the future be extended further back in the history of the Earth. It remains to be seen whether climatic changes will provide a useful marker of time. Whether or not a worldwide event such as the accumulation of these late Precambrian glacial sediments can be used as Dunn and his colleagues suggest, there can be no doubt at all as to the value of investigations which treat sediments on a global scale.

Very soon after the study of sediments began, it was realized that they could provide information both about past climates and about the former relief of the Earth. At first such reconstructions had to be tentative. As experimental work such as that of Bagnold on the movement of wind-borne sand, and of McKee on water-borne deposits, gradually established the physical conditions which could produce the features characteristic of different types of deposits, so the nature of the environments in which they might have formed became clearer. Equally important have been the studies of Recent deposits such as those of Shearman and Evans in the Persian Gulf which led to a radical reappraisal of the conditions under which evaporites of arid zones formed. A great step forward occurred in the 1950s when for the first time palaeomagnetic measurements provided an independent check of past latitudes deduced from geological evidence. In general, the geological reconstructions based on interpretations of past climates came through these tests with flying colours, and it was this agreement which showed beyond doubt that both methods could produce reliable answers. Armed with these results and with the ability to identify periods of break-up and of unusually rapid movement of continental masses it is now possible to make renewed progress in understanding past climates.

The study of sedimentary rocks on a global scale has taken several forms. In two recent issues of *Nature*, Gregor (*Nature*, **228**, 273 ; 1970) and Garrels and Mackenzie (*Nature*, **231**, 382 ; 1971) discussed the quantity of sediments formed annually and the length of time these are likely to survive before they in turn are destroyed by erosion. Exercises such as these can bring out the global relationship between the varying tectonic behaviour of the Earth and sedimentary processes. Another relationship emerged when it was discovered that, broadly speaking, the abundance of different types of sedimentary rock varies with palaeolatitude. It also has slowly become apparent that certain lithologies became particularly widespread in certain geological systems. As Robinson has recently put it (*Palaeontology*, **14**, 131 ; 1971), one might almost lose faith in uniformitarianism. As she points out, however, what can be seen here is a complex situation in which the degree to which continents are emergent or submerged, their overall size and their position relative to the poles must all be borne in mind. Here one is at grips with the interrelationships of movements affecting the outer parts of the solid Earth and changes in the circulation of the oceans and the atmosphere. Solving such problems may take a long time ; what may be looked forward to now is a series of synoptic studies of climatic conditions over individual continents or the globe as a whole, on the lines of Robinson's review of the Trias or the work of Crowell and Frakes (*J. Geol. Soc. Austral.*, **17** (2), 115 ; 1971) on the Palaeozoic glaciation of Australia.