news and views

Prediction of volcanic activity and climate

from P. M. Kelly and H. H. Lamb

CURRENT interest in climatic change has stemmed from the growing awareness that man's activities are everywhere circumscribed by his environment, and in particular, by the vagaries of climate. The fluctuations of weather and climate in most parts of the world have been increasingly troublesome in the past 20–25 yr. This has happened partly because of an apparently real increase in the variability from year to year, or from one group of about 5 yr to the next, which has affected the Indian monsoons and temperatures and rainfalls in middle latitudes of both hemispheres, and partly because the growth of population and the rationalisation of agriculture towards specialisation in one-crop economies in various regions has increased vulnerability to weather. Climatic change has provided a control on human affairs in certain regions in the past and now, with the ever increasing economic interdependence of nations, its effects must be considered in future planning in all spheres—industrial, social and economic. Unfortunately this need for climatic forecasts cannot yet be adequately catered for by meteorologists or climatologists, who are still trying to determine the causes of climatic change by study of the limited climatic record.

In recent years much evidence, both theoretical and observational, has been put forward suggesting that the amount of volcanic dust in the upper atmosphere may be the major control of climatic change during the postglacial. Stratospheric dust effectively reduces the amount of solar energy reaching the Earth's surface where this energy is made available to the atmospheric circulation and variations in the amount of this pollutant, caused by the varying frequency and magnitude of explosive volcanic eruptions, may produce corresponding fluctuations in the

nature of the atmospheric circulation and climate. If this hypothesis is correct, prediction of climate will first necessitate prediction of volcanic activity. Although great steps are being taken in the forecasting of volcanic activity on time scales of days, prediction of volcanic activity on time scales of years and decades has been considered a remote possibility (and perhaps considered by many a distinct impossibility).

In last week's issue of *Nature*, Roosen *et al.* (261, 680; 1976) attempted to determine one cause of fluctuations in volcanic activity on time scales of centuries and provided a possible tool for the forecasting of tectonic activity and climate. They postulate that changes in the degree of tectonic activity may arise from variations in the rate of change of lunar tidal stress effects on the Earth's core and crust. Calculation of the long term variation of the tidal stress reveals a cycle of about 179 yr due to resonance effects arising from shorter period variations in the lunar orbit. There are many references to a cycle of about this length in the literature concerning climatic change, although in most cases the length of record analysed has been too short to evaluate the statistical significance and precise period of this fluctuation; its existence is not well-established. Spectral analysis of the Camp Century, Greenland ice core δO^{18} record reveals a cycle of about 180 yr and Roosen *et al.* claim that 13% of the variance of the δO^{18} record can be explained by the derivative of the tidal stress curve during the period AD1200 to AD1700. The correlation breaks down during the periods AD1420 to AD1530 and AD1650 to AD1700, an effect which the authors tentatively attribute to dominance of the effect of the exceptionally low degree of solar disturbance during those spans of

years.

Roosen *et al.* note that a cycle of about 180 yr has been observed in variations in solar activity, thereby providing an alternative explanation for this variation in climate. Therefore, before the climatic cycle of 180 yr can be used for forecasting purposes, it is essential that its existence be confirmed by analysis of other long climatic records and that its cause, solar and/or tectonic, be defined.

Research related to the past record of climate and the apparent causes, and rapidity, of climatic fluctuations and changes is being undertaken by scientists in many fields other than climatology. This is providing a great stimulus with many opportunities of increasing knowledge and verifying diagnoses as new data and new techniques of measurement and analysis are put forward. It is important that collaboration between workers in all the fields involved in the study of climatic change be initiated and fostered. A multidisciplinary approach is needed, both to compile the evidence of the facts of the past climatic record and to solve the problems of the causes of climatic change, which seem to extend from the Earth's core to the Sun (and, on the longest time scales, to the Galaxy beyond). Only from the work of organisations, ranging from the powerfully equipped mathematical laboratories of the atmospheric, oceanographic and Earth sciences to academic institutes and meetings where diverse specialists can be brought together, will the knowledge and understanding needed to develop sound advice on probable future climatic development be attained. The specialists will include agriculturists and forestry research workers, palaeobotanists, geologists and, in some cases, archaeologists and interpreters of ancient texts and inscriptions. □