news and views

Geomagnetism and climatic change

THERE is a remarkable similarity between the pattern of the Earth's magnetic field over the northern hemisphere, as displayed by the isopleths of magnetic intensity, and the mean height contours of the surfaces of constant atmospheric pressure which define the shape of the circumpolar vortex of (broadly) westerly upper winds which prevail through most of the depth of the troposphere and lower stratosphere. Both patterns have an elongated, dumb-bell-like or bipolar form, at least when averages over a number of years are considered. In both cases, one end of the long axis is in the general region of the Canadian Arctic Archipelago, where the magnetic pole lies, and the other end is over northeast Siberia. In spite of its striking nature, this near-parallelism has received no more than passing notice in the literature of science. In an article on page 131 of this issue of *Nature*, King, of the Appleton Laboratory, Slough directs attention to the matter and adduces a number of other associations between the Earth's magnetic field and the atmospheric circulation and climate. These associations call for serious discussion and investigation, as they may indicate that the parallelism has a physical explanation, possibly of predictive value, in connection with long-term trends in climate.

Among the additional associations claimed by King perhaps the most impressive is just that the distinctive form of the isopleths of constant magnetic intensity over the southern hemisphere, much more nearly circular than in the north but eccentric in relation to the geographical pole with the pattern centred in the Indian Ocean sector, again broadly parallels the prevailing flow of the atmosphere (which has only been established by observation in recent years, roughly since the International Geophysical Year).

Meteorologists have been shy—perhaps understandably shy—about suggestions of a linkage, let alone control (as mentioned by King) of the flow of the atmosphere by the magnetic field, that is, ultimately by the flow in the Earth's molten core. But both phenomena could be registering parallel responses to some other aspect of the physical environment. The reluctance of meteorologists to consider these things doubtless has something to do with the fact that the atmosphere's dynamics and thermodynamics have long been explained adequately for most purposes (but perhaps not for the understanding of all long-term changes affecting climate) in terms of the major items of the energy budget at the Earth's surface and within the atmosphere, together with the effects of friction and distortion of the atmospheric flow by the greatest mountain barriers. Recent years have seen an impressive development of skill in forward calculation of the state of the atmosphere, based on these premises, using the capacity of the giant computers in the service of numerical methods of weather forecasting over one to five days ahead. It is natural that those who have been most closely involved in that particular advance of science should be a little reluctant to admit the need for other considerations in connection with long-term climatic development and changes—for example, the slow cumulative effects of extraneous influences, terrestrial and extra-terrestrial, and their possible trigger effects—and, perhaps, the appropriateness of quite other methods. It is far from clear, however, that the models used in numerical daily weather forecasting or any climatic models so far in sight will bring any advance at all in the capacity of scientists to forecast the weather a month or more ahead or to meet the demand for prediction of the climatic trend over years and decades ahead; though models can throw light on probable side effects of human activity (for example, increasing the carbon dioxide content of the atmosphere) which may modify the climate of the Earth.

King presents some further riddles in his article, in which a parallelism appears between the long-term displacement of the non-dipole element of the Earth's magnetic field and the behaviour of the atmospheric circulation over the northern hemisphere and its climatic effects suggest parallel histories over recent decades and centuries. Several of these apparent associations may turn out to be of only passing duration, and hence illusory, or they may be no better than loose and qualitative; but the facts will never be known unless they are investigated with the fullest assembly of long-term data that can be marshalled to the task. There is a clear, and urgent, need to identify and understand the physical processes that are involved in climatic changes—a need stressed, even before the current energy crisis, by the upsets to the international economy during the past 5 to 15 years by the long-continued, and increasing, drought in parts of Africa and several individual years of harvest failure over wide areas in India, China and the Soviet grainlands in central Asia.

Among the variables that have to be brought into the consideration of how climate varies, solar disturbance and minute, but directed, inputs of energy in high geomagnetic latitudes are often suggested. The ionosphere is well known to be affected by solar activity. Any responses in the lower atmosphere or, through the agency of geomagnetic disturbances, in the Earth's molten core are likely to differ with the time-scale of the external trigger operation; but they may show some common features and they are perhaps both likely to be more important in the case of long-lasting changes, however small in origin. One noticeable difference may already have been observed, which should warn meteorologists against expecting too close, or too complete, a paralellism: there is no suggestion so far that the geomagnetic field has registered a three-pole field over the northern hemisphere like that which has often appeared in the northern hemisphere atmosphere during the past 13 years (the third pole being near Novaya Zemlya.) Surely, however, no such strong hints of association as King points to should be left uninvestigated, especially when better knowledge of the processes of climate and climatic change is urgently needed. Another possibility is that such investigations may throw some light on the probable evolution of the flow in the Earth's molten core.

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