PLATE TECTONICS

On the Move

from a Correspondent

A MEETING held on February 25 at the Royal Society to discuss plate tectonics and the evolution of the Earth's crust turned out to be both lively and controversial. Dr D. P. McKenzie (University of Cambridge) began by explaining that the original plan of the organizers had been to hold a meeting about the geodynamics project, but had changed their minds in favour of a discussion of the scientific problems with which the project is concerned. He then went on to talk about the present day deformation of the Mediterranean, which is dominated by two small, rapidly moving fragments of continental plate, and warned that similar continental plates might have existed in other older mountain belts.

Dr N. Ambraseys (Imperial College, London) then discussed the historical records of the seismicity of the eastern Mediterranean, which clearly showed that the same belts were active in the past as are now active. But some regions such as south-eastern Turkey have had few large recent earthquakes compared with the number expected from the old records, and therefore recent activity does not give a good indication of the long term seismic risk, although it is generally sufficient to define the active plate boundaries. Dr A. G. Smith (Sedgwick Museum, Cambridge) and Professor K. Hsü (Ecole Polytechnique Fédérale, Zurich) both talked about their attempts to reconstruct the arrangement of the continental fragments within and around the Mediterranean basin in the lower Jurassic. Both speakers were impressed by the absence of deep oceanic sediments in the rocks around the western Mediterranean, and argued that the western Mediterranean is not a relic of Tethys but has been formed by sea floor spreading since the lower Jurassic. Although Smith and Hsü agreed on the general outline, the details of the reconstructions they presented were different and neither believed that there was yet enough information to produce an accurate map.

The two major questions which were not discussed in the early contributions on plate tectonics were the nature of the driving mechanism and the extent to which ancient continental tectonics can be discussed using the concept of rigid caps in relative motion. Professor J. Sutton (Imperial College, London) began the afternoon by arguing that the Precambrian tectonics of the greenstone belts seems to be quite different from that of present day tectonics, and illustrated this point with some remarkable slides of these old belts. He and later speakers agreed that the change from the greenstone belt type of tectonics, with its linear belts of basic volcanics separated by large circular granite and gneiss domes, occurred about 2.7×10^9 years ago, and remarked that active and inactive regions could be clearly recognized in rocks 1.8×10^9 years old. Drs C. J. Talbot (University of Dundee) and B. F. Windley (University of Leicester) discussed various mechanisms by which the greenstone belts could have been formed, but both emphasized how incomplete is our present understanding of their origin.

The other major problem concerns the driving mechanism. Dr L. Lliboutry (University of Grenoble) and Professor S. K. Runcorn (University of Newcastle upon Tyne) both put forward possible mechanisms which were radically different, and the discussion after their contributions showed that there was still no general agreement on the nature of the convection which moves the plates. This seems to be the field in which least progress has occurred in the past few years. Dr X. T. Le Pichon (Centre Océanographique de Bretagne, Brest) put forward the view that a detailed study of the history of the relative motion between major plates may help our understanding of this problem.

Few related disciplines have so far made any use of the concepts of plate tectonics. In particular, the distribution of animals, plants, palaeoclimatology and palaeoecology must be closely connected with the evolution of continents and ocean basins. Dr P. L. Robinson (University College, London) suggested various simple rules by which the climate of a region could be obtained from a continental reconstruction, but pointed out that our present understanding of oceanic and atmospheric circulation was not yet sufficient to make detailed predictions.

The meeting showed that plate tectonics has suggested many new lines of research in related subjects, but also demonstrated that the new theory still has several major difficulties to be overcome before it is the theory of global tectonics.

Are Gravity-Geomagnetism Correlations Valid?

THE hypothesis that the interface of the Earth's core-mantle is not perfectly smooth but undulates has been neither confirmed nor refuted directly. For example, there is no evidence of topography from the travel times of compressional waves reflected at the interface; but this only means that if undulations are present their height must be less than a few tens of kilometres, the present lower limit of resolution of seismological methods. It is quite possible that the resolution may be improved by the use of seismometer arrays and better methods of data analysis; and so the search for evidence of topography from PcP waves is still going on. In the meantime, however, evidence must be sought by indirect methods—by predicting the consequences of interface topography of the core-mantle and then showing that such consequences obtain.

The correlations between global features of the Earth's magnetic field and gravitational field recently found by Hide and Malin (*Nature*, **225**, 605; 1970) could be taken as just such evidence, though other explanations are possible. If undulations are present at the core-mantle interface there will be density variations which may produce large-scale gravitational anomalies at the Earth's surface. At the same time such a topography might interact with the magnetohydrodynamic motions which produce the magnetic field in the Earth's core, especially the non-dipole field which is thought to originate in the vicinity of the core-mantle boundary. What Hide and Malin showed was that there is indeed a significant correlation between the Earth's gravitational field and the non-dipole part of the geomagnetic field as long as the latter is displaced eastwards by about 160° longitude. The correlation coefficient for this is about 0·84 which, according to Hide and Malin, is so high that the odds against its occurring by chance are more than one hundred to one.

But in next Monday's *Nature Physical Science*, Lowes and Khan independently take issue with Hide and Malin on the supposed significance of the correlations. Lowes's essential point is that the odds against the correlations is not one per cent, as Hide and Malin suggest, but rather between 5 and 10 per cent. Thus he does not seem to doubt the existence of the basic correlations but suggests that such a high probability of the correlations occurring by chance must throw doubt upon their physical significance. He also completely rejects the significance of the correlations between undisplaced gravitational and magnetic fields recently found by Khan and Woollard (*Nature*, **226**, 340; 1970). Khan, on the other hand, has devised a modified test which purports to show that all gravitational-magnetic correlations are insignificant.

In their reply, which follows the original criticisms, Hide and Malin reject Khan's point completely on the grounds that an analytical error in his test invalidates it. By devising other significance tests they also beg to differ from Lowes. In other words, Hide and Malin are quite prepared to stick to their conviction that their original correlations are valid.