conductor electronics, materials science, biology and medicine are expanding at a great pace, but little of the work involved makes any general contribution to the method. How many more such specialist conferences will be justified before the method is regarded as established?

As usual, the efforts of Professor Albert Crewe (University of Chicago) aroused a great deal of interest. He demonstrated a 10 Å resolution last year and claims something like 5 Å this year, in a transmission scanning electron microscope with a field emission source (described earlier in *Nature*, **226**, 213; 1970). This method has the advantage over conventional transmission electron microscopy that energy loss analysis can be conducted on the transmitted beam and that it is sensitive to differences in atomic number. It is possible to examine much thicker specimens than are used in a transmission electron microscope run at the same accelerating voltage, and a much higher contrast can be obtained with the Crewe method.

In the biological sphere, it was interesting to find that the value of using as low an accelerating voltage as will give the required resolution is becoming widely recognized. Mr A. N. Broers (IBM) showed that it is possible to achieve high resolution, certainly better than 100 Å, from a biological sample—in this case of bone crystals. A lively discussion followed the description by Mr W. C. Lane (Battelle Memorial Institute) of his environmental control stage which allegedly makes it possible to examine water drops in the scanning electron microscope. Even this was doubted and it was suggested that the surface of the drop might be a thin skin of ice. The usefulness of a freezing stage in the examination of frozen botanical specimens was demonstrated by Dr P. Echlin and others from the University of Cambridge.

It is surprising that, in a meeting devoted to the results of a method of microscopy with a great depth of focus, so little attention was paid to measurements made in these images. Simple magnification markers in images of rough surfaces serve practically no useful purpose and it is to be hoped that some alternative method of conveying approximate information about sizes, such as signifying the nominal width of the field, will soon be adopted.

EARTH'S MANTLE

Viscosity and Drift

from our Geomagnetism Correspondent

It is implicit in the theories of continental drift and sea floor spreading that at least the upper mantle of the Earth, though ostensibly solid, behaves in certain circumstances as a viscous fluid. The first application of viscous flow theory to the asthenosphere, in fact, owed nothing to continental drift but arose in calculations of the viscosity required to enable Fenno-Scandia to return to isostatic equilibrium after the removal of the most recent glaciation. Working along these lines, Haskell (*Physics*, **6**, 265; 1935) estimated the anelastic response of the upper mantle to applied stress in terms of a Newtonian fluid viscosity of the order of 10^{22} poises. Later, Crittenden (*J. Geophys. Res.*, **68**, 5517; 1963) derived a value of the order of 10^{21} poises from a similar study of the Lake Bonneville uplift.

These estimates were derived from application of

viscous theory over comparatively localized areas of the Earth, and may or may not be valid over regions of continental or oceanic extent. The question thus arises as to whether the more modern concepts of global tectonic mobility can be used to calculate the viscosity on which they themselves depend. Cramer (*Science*, **167**, 1123; 1970), using a very simple model, has shown that they can and that, furthermore, the result turns out to be almost identical with the earlier results of Haskell and Crittenden.

The basis of Cramer's analysis is to assume that the decrease in amplitude of ocean bottom relief from the mid-Atlantic Ridge towards the continents arises from viscous creeping of the bottom features under gravitational stress. Examining an east-west profile across the mid-Atlantic Ridge at 25° N, and assuming a sea floor spreading rate of 2 cm yr⁻¹, Cramer obtained a mantle viscosity of between 1.5 and 3.9×10^{22} poises with a most probable value of 2.1×10^{22} poises. A similar analysis of a second profile at some time in the past. Up to a point 160 km to the west of the Ridge the calculated viscosity was 4.6×10^{22} poises whereas beyond 160 km it turned out to be 8.2×10^{22} poises.

Whether this discontinuity in viscosity is real is a moot point. Clearly much depends on the accuracy of the assumed spreading rate; and an apparent change in viscosity could equally well be due to a change in spreading rate at the 160 km point. Indeed, there is already evidence that the spreading rate has decreased along some portions of the mid-Atlantic Ridge. The actual spreading rates deduced by Heirtzler *et al.* (*J. Geophys. Res.*, **73**, 2119; 1968) are 1.3 to 1.4 cm yr⁻¹ at 25° N and 2.0 cm yr⁻¹ at 28° 40' S. The use of these values would tend to make the viscosity values converge, bringing them within the error of least squares analysis.

The essential result, however, is that in spite of the large difference in the horizontal dimensions of Fenno-Scandia and Lake Bonneville, on the one hand, and the Atlantic Ocean, on the other, a very simple model for the ocean floor produces values for mantle viscosity remarkably consistent with the earlier results of Haskell and Crittenden.

MAGNESIUM ISOTOPES

Arcturus Like Solar System

from our Cosmology Correspondent

By studying the magnesium hydride bands in solar and stellar spectra the relative abundances of the magnesium isotopes can be determined fairly accurately. The terrestrial and meteoritic abundance ratios for ²⁴Mg : ²⁵Mg : ²⁶Mg are known to be 80 : 10 : 10, and the solar abundance ratios were thought to be roughly comparable, until in a study of sunspot spectra D. Branch found ratios of 60 : 20 : 20 (*Astrophys. J.*, **159**, 39; 1970). Branch has joined forces recently with R. A. Bell to measure these isotope ratios for the star Arcturus, a K giant.

This analysis has been carried out using a computed model in which the abundance ratios, Doppler velocity, atmospheric temperature and other physical parameters of the atmosphere can be varied to produce theoretical line spectra, a boundary temperature of 3,360 K producing the best fit with the observed colours for