known but potentially important ingredient. Electromagnetic coupling is the linkage between the electrical currents flowing in the core and the finitely conducting lower mantle. S. K. Runcorn (Newcastle) discussed in more detail the possibility of exciting the short time-scale fluctuations in the length of day and the Chandler wobble by impulsive rather than step-like torques. P. H. Roberts (Newcastle), after reviewing various models, also saw some hope that short time-scale fluctuations could be accounted for by electromagnetic coupling. He pointed out, however, that topographic coupling could introduce stresses greater than those from electromagnetic coupling.

M. A. Khan (University of Hawaii) looked critically upon the hypothesis that the gravitational anomalous field was likely to originate at the core–mantle boundary. He showed the small magnitude of density variations in the upper mantle necessary to produce the same anomalies, and considered this a more reasonable location for heterogeneities. He was also sceptical of the statistics of the correlation between magnetic and gravity field. A vigorous discussion ensued on this topic between Khan, Hide and S. R. C. Malin (Herstmonceux).

The geomagnetic dynamo, and its proclivity to reverse, were the final subjects of discussion. J. A. Jacobs (University of Alberta) discussed energy generation and dissipation within the core. Driving force is likely to come from only two sources—precessional coupling and thermal convection (maybe strongly influenced by the presence of potassium-40). There must remain doubts about the operation of the core dynamo until more is known about electrical conductivity. The functional dependence of ohmic dissipation on conductivity is strongly author-dependent—from inverse cubic to square laws have been proposed.

E. N. Parker (University of Chicago) reviewed the magnetohydrodynamics of the dynamo. The field generated by the Earth's core probably originates in a combination of nonuniform rotation of the fluid and cyclonic turbulence controlled by the rotation. The kinematics of various dynamos have been extensively studied; he saw the dynamics as being the challenging problem at present. There are some strong constraints on the core motions placed by the two major perturbations that are seen in the geomagnetic field—its apparent westward drift and its rather frequent reversal. The westward drift was described in detail by F. J. Lowes (Newcastle) and T. Yukutake (Tokyo). The phenomenon is by no means a simple rotation. Some elements seem to move westward at up to 40 kilometres per year, whilst other features such as the "Canadian anomaly" appear static. It is difficult at present to ascribe the source of the westward drift to one particular feature. The two chief candidates are physical motions within the core and magnetohydrodynamic waves on a planetary scale.

Reversals of the field as recorded palaeomagnetically were described by A. Cox (Stanford). There is little evidence that reversals have been other than random in occurrence in the Tertiary. A mean spacing is 200,000 years. Earlier in the history of the Earth, particularly during the Permian, reversals were much less frequent—as rare as once every 10 million years or more. The Hawaiian palaeomagnetic record shows anomalous behaviour in that non-dipole field activity in the past few million years has been suppressed. Cox suggested that this could be associated with the deeper structure of this region including perhaps the core–mantle boundary. M. W. McElhinny (Australian National University, Canberra) described efforts to put together a frequency of reversals curve for the Palaeozoic. He expanded on his televised discovery of an anomalous pole position in an aboriginal fireplace. The behaviour of the field during the reversal process (which appears to take less than 10,000 years) was the subject of contributions by C. E. Helsley (Dallas), M. Fuller (Pittsburgh), K. M. Creer (Newcastle) and P. Steinhauser (St Louis). The most striking aspect seems to be the similarity of the pole path during each reversal, which has led to the suggestion of equatorial dipole terms which are only well revealed when the main dipole is weak.

There were many other contributions to the conference, which served as a valuable meeting ground for different disciplines. If nothing was resolved on the core–mantle bump hypothesis, at least the quality of evidence in different fields should now be better understood. Particularly useful was the clear indication that there are strong divergences of opinion within each discipline.

LASERS

Edward Phillips

Shortest Wavelength Yet

R. T. Hodgson and R. W. Dreyfus of IBM report the successful operation of a new laser at wavelengths of 1161 Å to 1240 Å, an appreciable improvement on the previous shortest wavelength laser, also reported by Hodgson, which operates near 1600 Å.

The previous laser, described in *Physical Review Letters* a year and a half ago (**25**, 494 ; 1970), used hydrogen gas between 20 and 150 torr as the active medium. A discharge through the gas led to stimulated emission at several wavelengths around 1600 Å in the Lyman bands of hydrogen. Pulses of duration about 2 ns and maximum power of 1.5 kW were achieved.

Because the power necessary to induce laser action increases towards the ultraviolet, the new laser is pumped by an electron beam rather than by a gas discharge (*Phys. Rev. Lett.*, **28**, 536 ; 1972). Again hydrogen gas, at 20–100 torr, is the active medium, and laser action is seen at several wavelengths in the Werner bands between 1161 Å and 1240 Å.

In this system, illustrated in the figure, the electron source is a field-emission diode which delivers 5×10^{9} W in a pulse of 3 ns, and the beam is contained by a pulsed magnetic field of 6 kG to follow the axis of a 2.3 m long tube containing the gas. The current in the electron beam in the tube is of the order of 4,000 A cm^{-2}, and collisions between electrons and hydrogen molecules lead to laser action, which was demonstrated by spectral analysis of the emitted light. The densities of the lines recorded on film in an ultraviolet spectrograph indicated that power densities of up to 500 W cm^{-2} were being achieved in nanosecond pulses.

One problem with the system as it stands is that when the pressure of the hydrogen gas is raised so as to increase the number of collisions, the beam seems to become unstable and the power in the stimulated emission drops. Hodgson and Dreyfus say that if this problem can be overcome, gas lasers pumped by electron beams could become relatively convenient and useful.

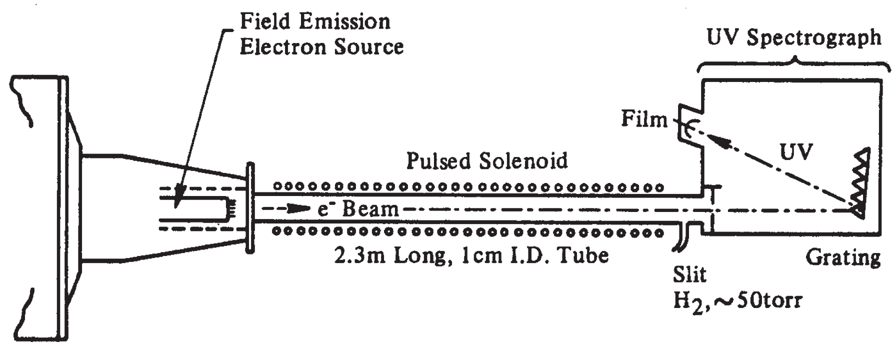

Diagram of the new laser.