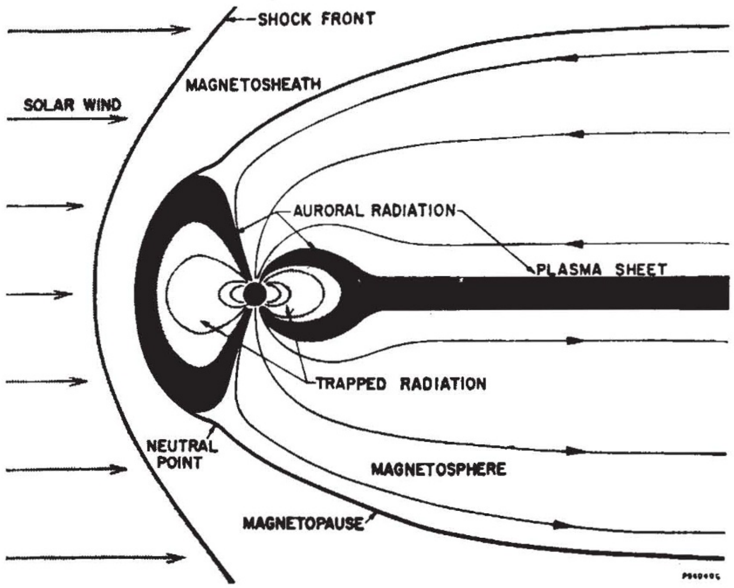
MAGNETOSPHERE

Convecting Field Lines

from a Correspondent



A model magnetosphere (meridional plane), according to B. J. O'Brien, showing the termination of the Earth's field at about ten Earth's radii towards the Sun.

A RECENT discussion meeting on the polar ionosphere and the magnetosphere, organized by the Royal Society on December 15 and 16, 1970, provided a forum for reviewing contemporary developments, both as regards magnetospheric models and dynamic processes, particularly those associated with substorms and their manifestations in the polar ionosphere. These latter seem to be caused by magnetic field lines convecting from the day to the midnight hemisphere where they re-connect and cause precipitation of energetic particles into the midnight auroral ionosphere. Although great magnetic storms are known to be initiated by increases in the solar wind flux and velocity, substorms occur in the auroral zone at other times. Thus of particular interest was the report by Dr P. J. Coleman (University of California, Los Angeles) of observations made on the satellite OGO 5 when, during a period of little or no change in the solar wind, the magnetopause boundary was observed to move in by two Earth radii. This accompanied a change in direction of the interplanetary field from northward to southward which was interpreted as causing connexion between the terrestrial and interplanetary field with subsequent convection of the field lines and erosion of the magnetopause boundary. Such a condition would facilitate entry of solar electrons and protons into the magnetosphere. Dr J. J. Quenby (Imperial College, London), on the other hand, reported calculations of particle trajectories which favour a sharp discontinuity between the magnetospheric tail and the interplanetary magnetic field.

The problem of the nature and role of electric fields recurred throughout the meeting, particularly the question of whether there could be a significant component parallel to the magnetic field lines. Dr Pamela Rothwell (University of Southampton) pointed out also that abrupt changes in fluxes and pitch angle distributions of gyrating energetic particles support the idea of longitudinal electric fields. Professor J. W. Dungey (Imperial College, London) felt that the conductivity along field lines was too high to support such fields, but he suggested that electromagnetic wave turbulence might provide a sufficient scattering mechanism to inhibit conduction.

Dr J. O. Thomas (Radio and Space Research Station, Slough) described the complex nature of the polar ionosphere and drew attention to the trough at about 60° magnetic latitude which seems to correspond with the plasmapause (the outer boundary of the relatively dense co-rotating magnetospheric plasma). Polewards of this, the Earth rotates under an ionospheric pattern including a relatively dense belt of ionization embracing the auroral oval and which is likely to be associated with enhanced fluxes of energetic electrons. A novel mechanism for the transfer of matter from the polar ionosphere into the tail of the magnetosphere was proposed by Dr T. E. Holzer (Imperial College, London). Neutral hydrogen escapes from the Earth's gravitational field at altitudes above about 500 km but the ionized constituents can escape only along the field lines. Holzer suggests that the space-charge electric field resulting from the separation of electrons and oxygen ions can accelerate hydrogen ions outwards to supersonic velocities.

A Million Years in Space

THE fall of a meteorite is still an important event for astronomers, as it always will be for laymen, but it is often months or years after a fall before all the information is gleaned from the fragments that reach the Earth's surface without having being burnt up in the atmosphere. An account of an analysis of a fragment of the Bovedy meteoroid which broke up in the atmosphere and scattered pieces over Northern Ireland (and possibly into the surrounding Atlantic Ocean) in the evening of April 25, 1969, is included in next Monday's *Nature Physical Science*. The report describes how the low level of gamma ray activity from a handful of isotopes in the fragment was measured at the Centre des Faibles Radioactivités of CNRS. The unexpected result reported by the group, J. Tobailem, D. Nordemann and T. Grjebine, is that the activity of ^{26}Al is surprisingly low, and the question is what this implies about the history of the meteoroid.

In meteoroids such as Bovedy this isotope of aluminium is produced chiefly by the action of cosmic rays on aluminium and silicon, so it ought to be possible to estimate the length of time for which the meteoroid was exposed to cosmic rays in space after its formation and before it struck the Earth, assuming, of course, that the low level of activity does not mean simply that the fragment examined at CNRS came from within the meteoroid and was therefore shielded to some extent from cosmic rays. There are ways of allowing for the effects of shielding, however, and, using these, Tobailem *et al.* put forward an exposure age of 0.9 ± 0.3 million years. Presumably this corresponds to the time which elapsed since the Bovedy meteoroid broke away from the parent body. This value of exposure age given by the CNRS group does not seriously contradict an earlier measurement of the length of time during which the Bovedy meteoroid was exposed to cosmic rays, based on an examination of the rare gas content, but the earlier measurement also allowed an exposure age as long as 20 million years. The shorter ages allowed by the rare gas measurements were then thought to be spurious. It now seems that there is more to be said for the shorter ages, but these are considerably less than the ten to fifty million years which are the exposure ages of most stony meteorites. As Tobailem *et al.* say, this suggests a rather complicated history for the Bovedy meteoroid.