may occur: if one part of the cell membrane transports ions at a different rate from the rest, a steady electric current may be driven through the cell, carrying towards the specialised patch of membrane just those charged molecules which support its specialisation. This speculation has some experimental backing.

In the first place, Jaffe (*Proc. natn. Acad. Sci. U.S.A.*, **56**, 1102; 1966) aligned about 200 eggs, similarly polarised, in seawater in a loose-fitting capillary tube. He found a potential difference of about 40 μ V between its ends, and argued persuasively that this must arise from a flow of current, with an estimated density of 6 μ A cm⁻² at each rhizoid tip. This might plausibly be driven by a cellular e.m.f. of the order of millivolts.

More recently, Nuccitelli and Jaffe have described in detail (*J. Cell Biol.*, **63**, 614; 1974) a probe small and sensitive enough to measure the electric fields and hence the current densities within 50 μ m of a single egg (*Proc. natn. Acad. Sci. U.S.A.*, **71**, 4855; 1974). The tip of the probe vibrates (at about 200 Hz), and picks up the minute change of potential (10⁻⁷ to 10⁻⁸V) between the extreme points of its path, typically 30 μ m apart. The findings roughly match the results of the earlier work. A striking phenomenon is the occurrence of large irregular spikes, lasting about a minute, during which the signal from the probe increases by a factor of ten or a hundred. These spikes may well mark the insertion of fresh vesicles of membrane at the growing rhizoid tip; though sceptics might say they could be artefacts—transient diffusion potentials, perhaps, due to polyelectrolytes released from the egg and turbulently stirred about by the vibrating probe.

Before the rhizoid axis becomes irreversibly determined at germination, there is an impressionable phase when environmental cues, such as light, can impose on the eggs a tentative and still reversible polarity. Robinson and Jaffe (*Science*, **187**, 70; 1974) took a sieve with small round holes, plugged each hole with a *Pelvetia* egg at the impressionable stage, shone a light from one side, and measured the rates of entry and exit of radioactive calcium ions through the dark (prospective rhizoid) and light (prospective thallus) ends of the eggs. The rate of entry on the dark side was at first about three times greater than on the light side, and the rate of exit about three times less. The eggs, therefore, must pump calcium through themselves. This pumping of calcium peters out towards the time of germinating, just as the flow of electricity begins.

One still does not know how strongly the ionic currents affect the cytoplasm,

or whether the cells are in fact polarised by self-electrophoresis. But the evidence for persistent currents through furoid eggs is important, if only in drawing attention to a factor in cell organisation which tends to be neglected, more because it is hard to measure than because it is insignificant, rare, or peculiar to seaweeds. One might here perceive a distant echo of the finding, for instance, that the localisation of acetylcholine sensitivity in muscle cell membranes depends on electrical activity (Lomo and Rosenthal, *J. Physiol., Lond.*, **221**, 493; 1972).

Between Earth and Sun

from L. J. C. Woolliscroft

A MIST (Magnetosphere, Ionosphere and Solar-Terrestrial Relations) Meeting, arranged by the Royal Astronomical Society, was held at the University of Exeter on March 25 and 26.

THE significant role of atomic oxygen was stressed in a session on the lower ionosphere. M. R. Bowman and L. Thomas (Appleton Laboratory, Slough) gave two reasons for studying the density of oxygen: first, it breaks the chain of reactions which starts with electrons and ends with negative ions, and thus it tends to prevent the loss of free electrons. Second, it also breaks another chain by which positive ions such as N₂⁺ react to form the series of water cluster ions, H⁺(H₂O)_n where *n* can be at least as high as seven. These cluster ions dominate the ion spectrum below about 85 km and it was encouraging to see that the model of Bowman and Thomas predicts an increase in atomic oxygen above this height with a diurnal variation below it. P. H. G. Dickinson (also Appleton Laboratory) presented new rocket measurements of atomic oxygen using the resonant fluorescence and absorption techniques. These methods give better results than measuring the resistivity of thin silver films (oxidised by the atomic oxygen) because the response is faster. His results seem broadly to agree with the Bowman and Thomas model but as yet the whole diurnal variation has not been studied.

F. N. Byrne (Queen's University, Belfast) showed some preliminary data on the ionised and neutral concentrations of magnesium, aluminum and iron. The ionised form of the metals has been shown to be important at altitudes above those characteristic of the cluster ions (typically 90–110 km) but the ratios of the ionised to neutral concentration is uncertain. The reaction

of neutral metal atoms with nitric oxide ions to give metal ions should be very efficient and so some reverse mechanism is needed to explain Byrne's finding that significant densities of neutral atoms remain. He suggested this was another role for atomic oxygen.

The solar magnetic field and its effects are now felt to be more complicated. W. M. Glencross (University College, London) challenged the conventional theory for the heating of the solar corona by shock waves. He suggested that magnetic fields also play a part and showed Skylab and X-ray photographs to illustrate that the intersecting loop field configurations he proposes can in fact exist. G. M. Simnett (Birmingham University) invokes the magnetic field at a few solar radii to account for the delays (at least 20 minutes) in the propagation of energetic protons and electrons from solar flares. This process also accounts for modification of the energy spectrum of the particles during their passage through the corona which can be inferred from measurements near the Earth.

The yields of turnips and other crops were discussed, together with the whole relationship between solar phenomena and the weather on Earth, by J. W. King (Appleton Laboratory). The correlation between various climatic and related phenomena, such as rainfall, surface pressure and temperature, with the 11-year sunspot cycle is interesting enough, but what is much harder to envisage is why some properties correlate with the 22-year solar cycle of field reversals. Perhaps the most striking of these are the periods of drought in the United States which at least in part led to the depression of the 1930s, and the mini-depression of the 1950s. On a much shorter time scale the weather is altered by magnetic storms and after reversals of the magnetic field of the solar wind at the magnetosphere.

These results were greeted with scepticism by a meteorologist in the audience who wanted details of a mechanism rather than King's qualitative suggestions of various possibilities including variations in the solar constant (the power emitted by the Sun), solar protons leading to water molecules in the atmosphere, and perturbations of the atmosphere at, say, 100 km causing a resonance in the lower atmosphere.

D. M. Willis (Appleton Laboratory) presented results of how the magnetosphere might be involved in some form of coupling between the solar wind and the weather. On the basis of the energy available it does not seem that the magnetosphere can provide the mechanism unless it is by some triggering or resonance phenomenon.