Analyses of the top few centimetres of the foil and the foil wrapped around the reel turn out to be consistent with measurements of the solar wind by space probes. By heating parts of the foil and determining the amount of helium released, the incident energy of the ions was determined as about 3 keV, corresponding to an ion velocity of about 400 km $s^{-1}$. The Moon also seems to have a solar wind albedo. Some parts of the foil which pointed towards the lunar surface and which were shielded from the directional flow of the solar wind nevertheless trapped some $^4He$. The inference is that the solar wind is being reflected from the surface.

TEKTITES

## Fifth Fall

from our Geomagnetism Correspondent

TEKTITES have a curious distribution in both space and time. They are known to occur in four well defined geographical areas, the specimens from each falling into a single discrete age group—0·7 million years in the Far East, about 1·0 million years in the Ivory Coast, 15 million years in Czechoslovakia and 34 million years in the United States. Their origin is still a matter of some dispute, but they are widely believed to be extraterrestrial, each set representing the result of some type of impact event. It has even been suggested that the most recent tektite fall at 0·7 million years bears a causal relationship to the well known geomagnetic field reversal at the Brunhes–Matuyama boundary.

To these four sets must now be added a fifth, according to Fleischer *et al.* (*Earth Planet. Sci. Lett.*, **7**, 51; 1969). Evidence comes from fission track dating of some of the Australian tektites. Until recently, all the Australian tektites were thought to be part of the Far Eastern fall 0·7 million years ago. But nine specimens of a chemical subgroup with a high content of sodium have now been identified. Fleischer and his colleagues have dated three of these in the range three to four million years. These new dates are unlikely to be spuriously high. There are several ways in which particles resulting from cosmic radiation could, in principle, produce extra fission tracks in extraterrestrial materials and thus give an apparent age which is too high. But such tracks are easily recognizable, and were not seen in the three tektites investigated.

It is strange that a second fall has only just been recognized in an area where a previously known fall occurred. Presumably the discovery reflects the renewed interest in tektites in recent years and more determined searches for additional specimens. It also suggests that there may be other tektite falls in other areas so far unrecognized.

CREEP

## Magnesium in Oxygen

from our Materials Science Correspondent

THE concept of diffusion-creep, proposed by Nabarro and Herring some twenty years ago, is still a source of controversy, which, however, recent work may help to settle. Herring–Nabarro creep, as the concept is also called, involves the biased migration of point defects, usually vacancies, across the grains of a stressed polycrystalline solid. If vacancies are involved, the model requires them to diffuse from grain boundaries roughly normal to an applied tensile stress to other boundaries disposed parallel to the stress vector; the effective flow of matter is then in the opposite sense. The process requires small grains and high temperature, and its rate must be proportional to the applied stress at a given temperature. Dislocation motion is not involved.

Interest in Herring–Nabarro creep revived some years ago with the discovery that the magnesium alloys used to enclose nuclear fuel in gas-cooled power reactors were subject to this form of creep, and that usual methods of increasing creep-resistance might not be effective. The danger of this form of creep is that it can be dangerous even at very low stress and thus could endanger the integrity of fuel elements. Zones were observed at grain boundaries transverse to the tensile stress which showed clear metallographic indications of Herring and Nabarro's mechanisms, but the stress-dependence of rates of creep was quite inconsistent with their theory. A detailed review of the available information led Vickers and Greenfield to the conclusion that Herring–Nabarro creep could not be the dominant mechanism in magnesium alloys (*J. Nucl. Materials*, **24**, 249; 1967).

Recent work (Hales, Dobson and Smallman, *Acta Met.*, **17**, 1323; 1969) has thrown fresh light on this controversy. A study was made of the influence of concurrent oxidation on the rate of creep-strain of unalloyed magnesium. When the atmosphere in the creep apparatus was changed from oxygen to a mixture of hydrogen and nitrogen, there was a sharp and reproducible increase in the rate of creep at 450° C. In air, the rate of creep varied linearly with stress, though at zero stress there was an actual slow contraction of the sample.

These results can be rationalized on the basis of Herring and Nabarro's model. The metal sheet was thin and so the predicted vacancy flow was from the transverse grain boundaries, which pass right through the specimen, to the free surfaces. These surfaces, however, were provided with a steady stream of excess vacancies from the growing oxide film, as a counterbalance to the magnesium atoms diffusing out through the oxide film to its outer surface. The excess vacancies counteracted the driving force, pushing vacancies from the transverse boundaries towards the surface under the action of stress, and thus the rate of creep was reduced.

The experiment does not settle conclusively the argument about the nature of creep in magnesium alloys, first because alloys containing precipitates do not necessarily behave like metal free from precipitate, and, second, because the vacancies injected on account of the concurrent oxidation could accelerate creep merely by enhancing self-diffusion, thereby accelerating the climb of migrating dislocations; this could also cause increased rates of creep. Nevertheless, these new observations, combined with the fact that the rate of creep was found to be proportional to the stress, on balance support the hypothesis that high temperature creep in magnesium takes place by the Herring–Nabarro mechanism. Oddly enough, no attempt seems to have been made to settle the matter by careful creep measurements on a series of samples with grains of different sizes.