rational planes other than [100]. The anisotropy of surface tension can then (following a calculation due to Kuznetsov) be related to the specific energy and orientation of these facets. Asselmeyer and Mecke adduce several independent lines of evidence for the existence of the microfacets, including their own studies of the adsorption isotherms of water on cleaved sodium chloride. They might have added the extensive body of experimental results on the decoration of cleavage planes of sodium chloride by means of evaporated gold; these studies (at CSIRO in Australia) have shown the vital importance of the microfacet structure for the occurrence of epitaxial deposition of metals on salt substrates. The loss of anisotropy following annealing or in the presence of excessive humidity is attributable to the smoothing-out of the microfacets. It would be interesting to establish a direct correlation between epitaxial efficiency and anisotropy of cleavage surfaces treated in various ways.

Asselmeyer and Mecke's study was prompted by their own recent work (*Naturwissenschaften*, **55**, 129; 1968) on the velocity of propagation of cleavage cracks in sodium chloride, in which they found this velocity to be markedly anisotropic. Because the spread of cleavage cracks is dominated by the surface energy of the newly created crack surface, their recent findings serve to interpret these earlier results, which should indeed be of wider interest to those interested in fracture mechanics. Their results raise a rather intriguing problem: Griffiths's equation for the stability of a cleavage crack includes the surface energy, a quantity which cannot be anisotropic within a plane. The surface tension, which can be and is anisotropic within a plane, has the wrong dimensions for Griffiths's equation, yet plainly it is the right quantity to use if the anisotropy of cleavage velocities is to be explained.

GEOCHEMISTRY

# Diffusion and Dating

from a Correspondent

"CRYSTAL imperfections can greatly modify the diffusion behaviour of a crystal, and lie at the core of the problem of argon retentivity of minerals." This is the conclusion of A. E. Mussett, who has evaluated the physical processes involved in the potassium–argon method of dating (*Geophys. J. Roy. Astron. Soc.*, **18**, 257; 1969).

This method of age determination depends on the complete retention of argon by the mineral or rock being dated, but it is known that among apparently similar rocks, some have retained all their argon and others have a part of it. Many experiments have been carried out to investigate the loss of argon from minerals and to define a test for argon retention. The apparent inconsistencies in the resulting data can be explained by examining critically the physical assumptions that underlie the experimental methods and the mathematical models used in their interpretation. The popular view that loss of argon can be explained using a volume diffusion model is fallacious. In this model, the diffusing atoms are confined to definite sites in a lattice, such as interstitial positions or lattice vacancies. Even at temperatures sufficient to destroy completely the mineral lattice, the mechanism is energetically unfavourable. Crystal imperfections such as single atom defects, dislocations, cracks and inclusions can all, however, contribute significantly at lower temperatures, but at near room temperature only diffusion through the macroscopic defects is appreciable. Alternative mechanisms such as chemical changes and lattice rearrangement can also be important.

Mussett's work is a timely review by a physicist of the premises underlying a subject of concern to various non-physical disciplines. As Mussett is at pains to point out, it is partly a general lack of comprehension of the physical principles involved that has led to the present confusion about argon loss. His case is well exemplified by a worker who describes his experimentally determined value for an activation energy of 35 kcalories mole$^{-1}$ as being in "substantial agreement" with a previously determined value of 67 kcalories mole$^{-1}$. Assuming the usual simple diffusion model, these two values result in room temperature values for the diffusion coefficient which differ by twenty-seven magnitudes. The work also constitutes an excellent up to date bibliography of the subject, containing a critical appraisal of the contents and significance (and mistakes) of each article reported.

Though reaching no very firm conclusion, Mussett points the way in which further studies might be directed. The large structural defects, which he shows permit significant loss of argon at room temperature, may include grain boundaries, impurity inclusions, exsolution and alteration. Each of these will release argon only from the region affected. It is therefore possible that correct ages can still be obtained if the potassium and argon in the retentive parts can be separated. Some experiments in this direction have already been carried out, with promising results.

ELECTRON MICROSCOPE

# New Zoom Lens

A HIGH-RESOLUTION 125 kV electron microscope developed by Marubeni-Iida of Tokyo contains what is claimed to be the first electron zoom lens. The manufacturers seem to have found how to stabilize the image when the magnification of the microscope is changed. They claim that, with the new system, both the focus and the intensity of the image remain stable and there is also no rotation when magnification is increased. The Marubeni-Iida microscope also includes a visual aid system to help the inexperienced operator align the electron beam. Another innovation is a fully automatic pneumatic valve system for controlling the vacuum, chosen in preference to manual or motor controlled valves for increased efficiency. There are also two visual display units for monitoring positions and operating modes of the pneumatic valves. The vacuum is claimed to be slightly better than normal at $5 \times 10^{-6}$ torr.

The resolution of the microscope is guaranteed at 3 Å for adjacent points and 2 Å for the easier task of resolving the planes of a crystal lattice. This is similar to the resolution of other 100 kV microscopes, but the manufacturers believe that the extra 25 kV accelerating voltage gives the new model extra penetration. Specimens up to a thickness of about 1500 Å should be capable of analysis in the microscope, which costs £25,000, roughly the same as other microscopes of the range.