reasonable assumptions Anderson and Kraft find that the mass loss is something between 10 and 1,000 solar masses per year, but how nature would provide such an apparently inexhaustible cornucopia of matter, they say, remains decidedly unclear. Conceivably the mass loss of NGC 4151 could pose the same sort of problem as the energetics of the Crab Nebula which should have run down long ago.

The starting point of the study is a coudé spectrogram of the nucleus of the Seyfert obtained in a 5 hour exposure. It shows an absorption feature buried between two emission lines which was first recognized, it seems, by N. U. Mayall in 1934. Anderson and Kraft maintain that the feature between 3869 and 3889 Å is composed of three shell lines of HeI with velocities of -280, -550 and -840 km s^{-1} relative to the corresponding emission line, although there is reason to believe that the -840 km s^{-1} component is distorted by the neighbouring NeIII, $H\zeta$ and HeI emission lines so that it ought to be -970 km s^{-1}.

By making assumptions based on other features of the spectrum about the conditions of the clouds or shells of gas which are responsible for the three absorption lines, Anderson and Kraft are able to make estimates of the masses involved. One question is whether the outward flowing mass is moving with the escape velocity. Observations of other Seyfert galaxies suggest that the mass of the nucleus is between 10^8 and 10^{10} solar masses, and if the true value is in the upper half of this interval, 10^9 solar masses or more, probably none of the gas escapes. Yet the spectral lines which would be expected from gas falling back into the nucleus are absent. Assuming then that the observed material is being lost, something between 10 and 1,000 solar masses per year (depending on whether a cloud model or shell model applies) has to be accounted for. Clearly there is a lot to be explained.

STRUCTURE

Conflict in Mercury

by our Solid State Physics Correspondent

The structure of the low temperature phase of solid mercury has been measured for the first time by X-ray diffraction and found to be different from the form predicted by non-local pseudopotential theory. J. S. Abell, A. G. Crocker and H. W. King (*Phil. Mag.*, **21**, 169; 1970) have produced a crystal sample of γ mercury by straining α mercury at 20 K, and have found four peaks in the diffraction pattern which could not have arisen from the face centred rhombohedral structure proposed by Weaire (*Phil. Mag.*, **18**, 213; 1968).

These results have both theoretical and experimental implications. Although only preliminary, they suggest that even the moderately sophisticated non-local pseudopotential used by Weaire is too inaccurate to distinguish between the two types of structure. The lattice spacings found by Abell *et al.* leave little room for doubt here, for even a generous variation of the axial angle cannot bring the theory into line. Experimentally, the chief difficulty was to strain the sample sufficiently to bring about the transformation to the γ phase and yet avoid fracture. A special jig was built for the purpose. The γ phase may well be thermodynamically stable at low temperatures, but the problem is to find some way of nucleating it which avoids generating too many common interfaces with the remaining α phase, thus producing severe strain in the lattice. The diffraction peaks showed the characteristic broadening of a strained lattice.

A detailed electron microscope study of the cubic form of solid nitrogen has thrown new light on the structure of this phase. J. A. Venables (*Phil. Mag.*, **21**, 147; 1970) has found that the grain boundaries move remarkably easily in α nitrogen, much more so than in oxygen or the rare gases, due partly, it is suggested, to the shape of the nitrogen molecules. Various imperfections were also observed, including dislocation loops and stacking faults. Venables points out that the free energy of stacking faults and twin boundaries may well be very dependent on temperature, implying that these defects might act as nucleation centres for the α–β phase transformation. Barrett suggested last year that small scale diffusion takes place across a large angle boundary in this transition, and Venables hints at the exciting possibility of actually observing this process in the electron microscope.

The *Philosophical Magazine* took on its new mantle as a Europhysics journal this month, but apart from an editorial hint of wider European participation on the board in the near future there was little sign of any new aspect to the journal. Indeed, of the thirty-six authors contributing to this issue, thirty are from Britain, five from North America and one from Africa. Perhaps the forthcoming meeting in Paris of the publications committee of the European Physical Society can inject some life into a policy which, although widely approved, is still felt by many to lack the credibility of a serious project (*Nature*, **224**, 1146; 1969).

MAGNETIC MONOPOLES

Sea Bed Search Sets New Limits

from our Cosmology Correspondent

New limits have been imposed on the possible abundance of free magnetic poles after a search for monopoles on the sea bed. In spite of the theoretical view, first proposed by P. A. M. Dirac (*Proc. Roy. Soc.*, A, **133**, 60; 1931), that the existence of free magnetic poles in nature is not only completely within the understanding of the laws of physics but also improves the symmetry of Maxwell's equations, no experimenter has been able to prepare or detect such free poles. The best limits on the existence of free monopoles have recently been reduced by a factor of several thousand by R. L. Fleischer *et al.* (*Phys. Rev.*, **184**, 1393; 1969), who have attempted to detect monopoles originating in cosmic rays using the Earth's oceans as a collecting tank for these energetic particles.

Having been thermalized in the atmosphere and oceans, suitably polarized poles would drift to the ocean bottom where they would be trapped in solid, magnetic material. The particular ferromanganese deposits used, taken from the mid-Atlantic, are particularly suitable because the slow rate at which this sediment was deposited means that a thickness of only 2·5 cm represents a continuous sample over at least 16 million years, while its magnetism will have prevented the escape of any poles. Removing any free poles present by means of a strong magnetic field, and detecting them by extending standard techniques for

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