widely believed that magnetic changes so deep in the core would not be felt quickly enough at the Earth's surface to account for the observed secular change. Nevertheless, the purely dipole model describes the secular change field remarkably well. For the 1965 IGRF it leads to a westward drift of 0·2 degrees longitude a year, almost identical with the observed westward drift velocity.

The real field sources in the Earth's core are certainly very complex; and a complete understanding awaits a tractable hydrodynamic model. Meanwhile, Alldredge and Stearns hope that their kind of model will lead to a better understanding of the nature of the geomagnetic field and its secular variation without enquiring too deeply into the basic physics of the core motions.

UNUSUAL STARS

Infrared Object which Varies

by our Astronomy Correspondent

THERE seems to be no easy explanation for the odd behaviour of the infrared object which E. E. Becklin *et al.* of California Institute of Technology have found to be fluctuating in brightness by two magnitudes, equivalent to a factor of more than six (*Astrophys. J. Lett.*, **158**, L133; 1969). The favoured model for several infrared objects in the galaxy—that they are surrounded by a dust cloud which absorbs the energy from the central star and re-radiates it at infrared wavelengths—gives no hint as to why there should be such striking variability. But the magnitude and period of the fluctuation are like that of the Mira variables, and one possibility is that the central star is a Mira variable. The dust cloud would then have to be opaque enough to obscure certain strong absorption bands which are prominent features in the infrared spectra of long period variables but which are absent in the object IRC+10216 under study.

At 5 microns the object is the brightest thing outside the solar system, and clearly it is going to be an embarrassment to infrared astronomy if its nature cannot be cleared up fairly speedily, at least in outline. At visual wavelengths the object is insignificant—fainter than eighteenth magnitude—but on a plate taken by Arp at the 200-inch it has an elliptical non-stellar appearance. It has been observed at 2·2 microns since 1965 using a 62-inch infrared telescope, and these are data reported by Becklin *et al.* The time scale of the brightness variations seems to be 600 days or so.

The location of IRC+10216 is still a mystery. Absence of proper motion and of parallax sets a lower limit on distance of 100 parsec and this is, of course, still within the galaxy. Assuming a distance of 200 parsec—a typical distance for a nearby member of the galaxy—the luminosity comes out to be similar to that of the infrared source in the Orion Nebula and to long-period Mira variables. But Becklin *et al.* cannot rule out that the object is extragalactic, in which case its size as inferred from the 600 day fluctuation places it at 200 kiloparsec with a luminosity comparable with that of the galaxy.

Clearly Becklin *et al.* favour the view that IRC+10216 is in the galaxy, even though it refuses to fit any particular classification. Its similarity to the infrared point source in the Orion Nebula suggests that it may be a protostar, yet it is in an unlikely area where there is no gas or dust and no other young stars, and the brightness variations are awkward. One interesting speculation is that IRC+10216 may be a Mira variable evolving into a planetary nebula, and the clue here is the elliptical nebulosity which surrounds the object.

ELECTRON BEAMS

Electrons for Carrying Light

Two members of the Signals Research and Development Establishment at Christchurch have suggested an explanation for an apparently mystifying effect discovered in an electron diffraction experiment (Schwarz and Hora, *Appl. Phys. Lett.*, **15**, 11; 1969, reported in *Nature*, **225**, 15; 1970). The effect is that if a beam of electrons is diffracted by a thin crystal film of silicon or aluminium oxide through which a laser beam is shone at right angles to the electron beam, the diffraction pattern seen on a non-fluorescent screen of alumina contains spots of the same colour as the light in the laser beam. Drs R. L. Harris and R. F. Smith write:

It appeared to us, at first sight, not particularly surprising that the effect should have been observed. Indeed, analogous interactions between electromagnetic waves and electron beams have been used for some time in devices such as klystrons. Energy at the electromagnetic wave frequency is carried by the electron beam as velocity modulation, resulting in bunching which varies in intensity with distance along the beam.

But, on closer inspection, bunching as it is normally understood cannot directly cause the observed effect. This conclusion was reached by consideration of the electron density in the beam. Using the figures given by Hora and Schwarz, we calculated a value of 500 electrons per centimetre of the beam. A typical figure for the klystron would be between 10^4 and 10^6 times this value, and the modulating wavelength would be, say, 1 cm. In the case of light, the wavelength is only about 4×10^{-5} cm, and so the electrons are, on average, separated by many wavelengths. In spite of this, the effect may still be explained by velocity modulation if bunches of electrons occur separated in time by integral numbers of periods of the original optical wave. This requires the recovery process in the screen to be non-linear, thus producing harmonics of the electron bunching frequency.

If the effect is due to velocity modulation, then movement of the screen along the axis of the electron should result in a periodic variation in intensity of the optical emission from the screen. Because the distances between these peaks of intensity are dependent on the velocity of the electron beam, the reported reduction in intensity of the optical images with a decrease in electron velocity is possible for a particular position of the screen.

The reported disappearance of the effect on rotation of the plane of polarization of the incident light is to be expected if the velocity modulation explanation is true.

Fairly simple experiments can be devised to disprove the velocity modulation explanation, and this should be done before more erudite explanations involving "modulation" of individual electrons are proposed.