taken kindly to a revolution which owed nothing to scientific insights.

The problem is essentially one of understanding how a homogeneous, amorphous blob of material can be reversibly modified by the passage of a current, when no p–n junctions, Brillouin zones or minority carriers crowd the scene. Because the glasses in question have positive temperature coefficients of conductivity, the idea of some kind of thermal runaway triggered by Joule heat has been very popular, but has never succeeded in explaining the entire behaviour of the switches. More recently, however, a related hypothesis has gained favour—the idea of hot but stable conducting filaments, reversible when small currents flow, but irreversible if currents are large enough because then the Joule heat in the filament devitrifies (that is, crystallizes) the glass. When that has happened, only a current pulse large enough to remelt the crystallites and thus turn them back into glass (when the remelted filament is quenched) can wipe out the imprinted memory. This basic model owes much to two scientists at the Central Electricity Research Laboratories in Leatherhead, J. Male and A. Warren, and was outlined by them in the *New Scientist* (**47**, 128; 1970).

The model has now been put on a scrupulously quantitative basis by K. W. Böer, working with support from both Ovshinsky's own firm and the US Office of Naval Research. His review article (*Phys. Status Solidi*, (a) **4**, 571; 1971) is mandatory reading for anybody interested in the field. He starts from the known conductivity/temperature relationship of a typical chalcogenide glass, and works out the stable temperature distributions in conducting filaments of various aspect ratios, under different assumptions as to cooling efficiency at the electrodes. The problem is complex because the temperature, current and field distributions all influence each other. Experimental observations of local infrared emissions from hot filaments in Ovonic devices offer a direct check on the calculated quantities. The calculations, firmly tied to realities based on numerous experimental measurements, prove, probably for the first time, that the filament model of Ovonic action forms a self-consistent theory for the mode of action of both threshold and memory switches.

EARTH'S MANTLE

Why Gravity Anomalies?

from our Geomagnetism Correspondent

ONE of the most important of the unsolved problems in global geophysics is undoubtedly the source of the large-scale gravity anomalies which, thanks to data from artificial satellites, are now quite well defined up to harmonic degree $n=8$. These anomalies do not, for example, correlate uniquely with topography and thus presumably cannot be entirely attributable to variations in lateral density in the lithosphere. More specifically they show no obvious relationship to the present pattern of continents and oceans. To some extent this is only to be expected. If there is good isostatic equilibrium between elements of the surface topography and the compensating density distribution below, gravity anomalies from this source should not exist. In fact, the lithosphere does give rise to low degree gravity harmonics; but they are weak and in any case bear no relationship to the anomalies observed. Moreover, there is some apparent correlation between some of the gravity anomalies and tectonic activity. For example, over areas of current post-glacial uplift the anomalies tend to be weak, over the circum-Pacific belt they are positive and over regions of Quaternary volcanism they also tend to be positive. On the other hand, some of the largest anomalies are apparently unrelated to surface topography, tectonic activity or even what is known about the subsurface structure of the Earth. A source in the lithosphere thus seems most unlikely.

At the opposite extreme the obvious contender in the deeper parts of the Earth is the core-mantle interface, though there is some doubt about whether irregularities upon this boundary could be large enough to produce the observed anomalies. Nor, according to Cook (*The Earth's Mantle*, Academic Press, p. 63; 1967), it is likely that the lower mantle contains density variations large enough to produce the higher gravity harmonics. The asthenosphere seems more hopeful especially as lateral variations in its structure and physical properties are known to exist. But the large-scale variations in the as-

Doubt about Stellar Fields

SOME contradictions arising from recent measurements of the magnetic fields of white dwarf stars are highlighted in an article in next Monday's *Nature Physical Science* by Virginia Trimble, writing from the Institute of Theoretical Astronomy at Cambridge. It is important to have some idea of the strength of white dwarf fields, if only to verify that the large fields of around 10^6 Gauss that are to be expected from the contraction of a main sequence star to white dwarf size indeed occur. If so, astronomers will be confident that the fields of 10^{12} Gauss which seem to be necessary to explain the radio emission from the even smaller pulsars are feasible. But white dwarf fields are hard to measure from their almost featureless spectra, and there has been much excitement in astronomical circles recently over the discovery that measurements of circular polarization can be used to detect high magnetic fields in sources which emit a continuum.

Virginia Trimble's latest contribution arises from an article by George Preston (Hale Observatories) in *Astrophysical Journal Letters* last year suggesting that fields greater than 10^6 Gauss would also result in a quadratic Zeeman effect that would shift spectral lines toward short wavelengths (**160**, L143; 1970). This effect ought to be detectable, if the fields are high enough, in the so-called DA white dwarfs, which show hydrogen lines of the Balmer series and are the most numerous classification of the white dwarfs. But Preston points out that measurements of white dwarf spectra published by Greenstein and Trimble do not show this effect, and hence that the fields of these stars, at least, must be less than about 5×10^5 Gauss.

Next Monday's article is a reassessment of Preston's work, in which Virginia Trimble points out that the upper limit of 5×10^5 Gauss is more stringent than justified because any discordant Balmer lines (presumably such as might originate from the quadratic Zeeman effect) were omitted from the Greenstein and Trimble work on white dwarf spectra. Their analysis was directed at the measurement of the radial velocities of white dwarfs from the Doppler shift of the Balmer lines, and any out-of-the ordinary lines would have been ignored.

So the original data were re-examined to look again for the expected effect, and this time signs corresponding to a median field for the stars of 5×10^5 Gauss were detected in the systematics of the Balmer lines. The contradiction occurs because circular polarization measurements have also been made on some of the stars in the list with no positive result, implying fields less than about 5×10^4 Gauss, whereas the Balmer lines for these stars suggest the presence of fields a factor of ten, or more, larger. Virginia Trimble points out that there may be ways of overcoming this inconsistency, by considering precisely what aspect of the stellar field is being observed by the two methods, although it seems that instrumental effects can still not be ruled out in her measurements based on the shift of the Balmer lines.