the spinal cord, and pain will result. When these neurones are excited, they exert presynaptic inhibition on afferent fibres, and the input to the spinal cord will be moderate; pain will not occur. Excitation of the large afferent fibres thus reduces the input to the spinal cord and is said to close the gate.

Wall and Gutnick now suggest an alternative way in which electric stimulation might act. It could do so preventing nerve impulses being fired off spontaneously, and, as it is this firing that causes both the pain and the phantom sensation, both would be stopped by electric stimulation. The mechanism by which antidromic stimulation stops impulse generation after stimulation has stopped its unknown. Wall and Gutnick suggest that the excitability of small nerve fibres within the neuroma is altered by electric stimulation because these endings are abnormal and are not behaving in the same way as do normal nerve fibres; and they bring forward some evidence to show that this is so.

This is probably the first physiological investigation to have been carried out on a traumatic neuroma induced in an animal. It seems as if it has already thrown light on how certain forms of therapy may work; and it suggests that a similar investigation could be carried out in man, now that it is possible to record from human nerves by means of electrodes introduced into the peripheral nerves. P.W.N.

Unpredictability of comets

from a Correspondent

COMET Kohoutek disappointed many people over Christmas by being considerably fainter than predicted. Most of the blame for this disappointment can be laid at the feet of the mediamen who seem to hanker after superlatives such as brightest, longest, most spectacular and are not interested in run of the mill comets and the qualified predictions of astronomers. Comets themselves, however, must also carry some of the blame as they are notoriously unpredictable. This cometary fickleness has been stressed in an article by Jacchia, who works at the Center for Astrophysics, Harvard Observatory and Smithsonian Astrophysical Observatory (*Sky Telesc.*, **47**, 216; 1974).

The brightness J of a comet can be represented by the formula $J=J_0\Delta^{-2}r^{-n}$ where J_0 is a constant, Δ is the distance between the comet and the Earth, r is the distance between the comet and the Sun, and n, the power of r, is a quantity that varies from comet to comet and in certain cases as a function of r.

In an extensive study by Bobrovnikoff the mean value of n was found to be 3.3. This indicates that cometary luminosity is produced by two mechanisms; first, the reflection of sunlight from the small dust particles in the coma (if this was the only source n would be 2) and, second, by direct emission from gas molecules, thus producing band spectra. The luminosity increases as the comet approaches the Sun because of the increase in the incident radiation, coma size, gas and dust production and molecular excitation. Increases in luminosity and therefore brightness, however, do not always occur and n has been known to take values that range from -1.77 to $+11.40$. This variability in the power of r is indicative of the chance one takes when predicting cometary brightness. Jacchia gives as one telling example the case of comet Westphal which was observed as an 8th magnitude object on September 26, 1913. Perihelion passage was due on November 26 but instead of brightening the comet gradually faded being 13 mag at the end of October and 17 mag on November 22, 4 days short of perihelion, when it had been expected to be at its brightest.

Jacchia compares Kohoutek with comet Halley's apparition in 1910. Halley performed excellently having an n of 5 and also brightening in the post-perihelion phase. Kohoutek started well with an n of 4.0 shortly after discovery (justifying the early optimistic predictions) but n dropped to 3.0 in early November 1973 and 2.2 around December 20. At perihelion the comet shed more matter than expected and was easily photographed by the Skylab astronauts, but after perihelion the comet followed a trend one magnitude fainter than it did at the corresponding distance on the way to the Sun—exactly opposite to the behaviour of Halley's comet.

So comets seem to have two records in astronomy. Not only do they have the greatest range of brightness of all celestial objects, the great comet of 1882 being seen in full daylight 4 degrees away from the Sun and comet Wolf 1 being observed in 1942 when it had a magnitude of 19.3, but they also seem to be the most unpredictable: comet Kohoutek unfortunately lived up to this latter reputation.

Man misled by man—on ice

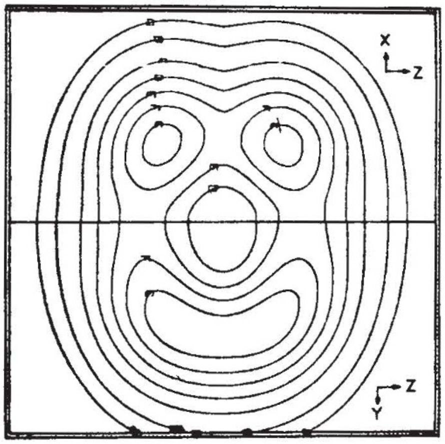
from our Geomagnetism Correspondent

THERE is a standing joke among palaeomagnetists about the man who spent several weeks collecting beautiful samples of baked red laterite. When he returned to the laboratory one of his more experienced colleagues coolly informed him that he had drilled the brick foundations of a long-demolished farmhouse. Each branch of the earth sciences has its own variant of this story, but for glaciologists the joke seems to have come uncomfortably to life. As the recent experience of two North American scientists demonstrates, it is easy to be misled by one's ancestors even in the most unlikely of places.

Last year, Berkland and Raymond (*Science*, **181**, 651; 1973) reported that they had found glacial polish, grooves and striations at a height of 1,370 m on Grandfather Mountain in North Carolina. The longest of the grooves were about 1 m long, 15 cm wide and 5 cm deep, and the 60 or so recognised examples gradually changed their trend from S80°E to S40°E from the southern to the northern ends of the exposure. This variation, Berkland and Raymond argued, indicated "two lobes of ice which formerly coalesced at the site of the outcrop and preserved it as a bastion". They then went on to calculate that the ice had maximum and minimum thicknesses of 300 m and 100 m, respectively, in the cirque containing the outcrops investigated. It is true that no moraines were observed at the cirque outlet, but this was considered neither unusual nor significant.

What was considered significant was that Grandfather Mountain lies at a latitude of about 36°N, whereas alpine glaciation in the eastern United States had not previously been reported south of the Catskill Mountains in New York state (about 42°N) and the Laurentide ice sheet ended in New Jersey and Pennsylvania between 40° and 41° N. In other words the new result suggested that Pleistocene glaciation had extended some 890 km further south in the

Happy nuclei



Hartree–Fock calculations of nuclear matter have now advanced to the stage where they can reveal quite detailed and unexpected features of nuclear structure. This illustration shows the contour plot of the density of sulphur-32 obtained by Curry and Sprung (*Nucl. Phys.*, **A216**, 125; 1973).

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