news and views

Excuse me, your slip isn't showing

THE inexorable motion of plates relative to each other at the Earth's surface leaves behind a magnetic record at ocean ridges where new plate is formed. Much of the early work on plate tectonics was devoted to using this record together with a knowledge of geomagnetic field reversals to measure relative plate motions. By 1970 most geophysicists were agreed on the values for inter-plate velocities, typically a few centimetres per year. The motion was obviously manifested, in fits and starts, by earthquakes. But a most important question remained—did the rate determined as an average over several million years tally with the present rate determined from the cumulative displacement of successive earthquakes? For if not, either the movement had a cyclic character, or some of the strain build-up was relieved by non-violent processes such as creep on the fault plane. The relevance of all this to earthquake prediction efforts is obvious.

In 1971, Davies and Brune (*Nature phys. Sci.*, **229**, 101–7) made a major contribution to resolving this question. The only parameter of earthquakes which has been reliably measured over the last seventy years is magnitude. The logarithm of the amplitude of the radiated surface waves (corrected for distance), or surface wave magnitude, M_s, is a rough and ready measure of the slip on the fault plane once some assumptions have been made about the dimensions of the fault surface. These assumptions, it is widely admitted, are fairly major. Davies and Brune considered the magnitudes of very large earthquakes on all plate boundaries and concluded that the inferred displacements over the last seventy years agreed rather well with plate tectonics predictions. Thus it was possible to deduce from their results that for most plate boundaries the part that was played by, for example, creep was certainly not a dominant one. The Mediterranean region did not immediately fit into this scheme. For one thing the tectonics of the area is immensely complex so it is not easy to talk about a small number of plate boundaries. For another, the area is not highly seismic so the data are fewer (the frequent damaging earthquakes in the region result more from the proximity of people to faults than from very high magnitude events). The area clearly warranted a special study and this has now been done by North who reports in this week's *Nature* (page 560).

He comes up with a most interesting conclusion. When similar techniques to those of Davies and Brune are applied in the Mediterranean, the movement on most plate boundaries inferred from earthquake magnitude is very much less than plate tectonics would have it. Either strain is being built up throughout most of the region (and nowhere else in the world) on various types of fault—or strain is being relieved in the Mediterranean area by other processes than major earthquakes—and again this is not happening elsewhere in the world. It is a provocative and important result and should stimulate more research both in the field and in the laboratory.

DAVID DAVIES

Switching off symmetry breaking

THE elementary particles nearly obey a number of simple and elegant symmetry rules. Many useful approximate calculations can be made by assuming that the symmetries are perfect—for instance by assuming that the decays of K^0 mesons are well behaved when all the particles in the decay process are regarded as travelling backwards in time (time-reversal symmetry), or by assuming that the proton and neutron have the same interactions as the lambda, sigma and xi hyperons. Recently a great deal of progress has been made in building field theories of the elementary particles, such as the unified weak and electromagnetic theories which have been supported by the discovery of 'neutral weak currents' (see *Nature*, **245**, 119; 1973 and **250**, 186; 1974). These new theories incorporate symmetry breaking as a 'spontaneous' effect, drawing on successful theories of low-energy solid-state phenomena such as superconductivity which is also caused by 'spontaneous' symmetry breaking.

When a superconductor with zero resistance is placed in a high magnetic field, above some critical strength, it reverts to being a normal conductor. The theory of this transition has been taken as a model by Salam and Strathdee (this issue of *Nature*, page 569). They show that the same kind of behaviour could occur for a number of the symmetry-breaking effects in the weak interactions of elementary particles. For instance, there may be a critical magnetic field which would turn off the time-reversal asymmetry in K^0 decay. They estimate this field to be between 10^9 and 10^{14} gauss—10^4 or more times what can be achieved in a practical apparatus. Another example they give is that the β decay of the lambda hyperon may be turned off at 10^{16} gauss.

Although such field strengths may be difficult to achieve in the laboratory—partly because of the critical field effect itself in superconductivity which limits the strength of our magnets—they may already exist inside pulsars. If so, it may be possible to devise ways of detecting the effects of an absence of symmetry breaking. Another way of achieving high field densities may be through laser compression, using similar techniques to those being developed in research on thermonuclear fusion.

Even if we cannot achieve the predicted fields, they urge that experiments should be started to look for this kind of effect. Their current calculations are so model-dependent that they cannot rule out new effects at fields as low as 10^6 gauss.

D. J. MILLER