travelling, in one direction, towards Asia to its ultimate destruction under the ocean trenches of the Aleutians, Kuriles, Japan, Marianas and Tonga. It would be naive to think that the pattern of development has remained constant for 140 million years, but data that JOIDES are producing now should help to show just how long the Pacific conveyor belt has been running at a rate of about five centimetres a year. This is great credit to those who took the risk of putting money into the venture.

SEA FLOOR SPREADING

Age of Anomaly 10

from our Geomagnetism Correspondent

BECAUSE hydrostatic pressure and rapid cooling impede the release of excess radiogenic argon-40 from rocks, the dating of oceanic basalts by the potassium–argon method is usually impossible. The only dating method which can be applied directly is the fission track counting technique, although this is only possible when the rock contains minerals or mineral states (glass, for example) able to record tracks. In view of these problems, even a single accurate date on an oceanic basalt is important as a test for the validity of sea floor spreading.

One such date has been obtained by Luyendyk and Fisher (*Science*, **164**, 1516; 1969) on a glassy tholeiitic basalt from an abyssal hill in the North-east Pacific (32° N, 126° W). Because the hill was a product of post-depositional faulting of the oceanic crust, it was not immediately clear whether the basalt sample collected was part of the original crust or a product of volcanic eruptions accompanying the faulting. But the hill's importance is its position within the younger positive event of magnetic anomaly 10 as defined by Pitman *et al.* (*J. Geophys. Res.*, **73**, 2069; 1969). This anomaly lies outside the region which can be compared directly with the continental polarity time scale, and thus in the absence of an experimentally determined age may only be dated assuming a constant rate of ocean floor spreading.

The new age turns out to be 35 ± 5 million years. This compares well with the age of 31·50 to 31·84 million years obtained assuming a constant spreading rate. Had the new age been less than about 30 million years the sample could have been attributed to eruption associated with the faulting. On the other hand, an age greater than about 32 million years would have indicated a non-linear spreading rate out to anomaly 10. As it is, the sample probably represents the age of the original oceanic crust in the area. Taking the true age as 35 million years, the spreading rate in the North-east Pacific over this period must have remained linear within about ten per cent.

ELEMENTARY PARTICLES

Lepton Number Test

AFTER the discovery of separate neutrinos associated with muons and electrons, the concept of a lepton number assigned to all leptons (muons, electrons and neutrinos) was modified to include independent contributions from muons and electrons (with their associated neutrinos and antineutrinos). The muon lepton number, L_μ, is defined as $+1$ for μ^- and ν_μ; -1 for μ^+ and $\bar{\nu}_\mu$, and 0 for all other particles. The electron lepton number, L_e, is defined in an analogous way.

It is theoretically attractive to postulate the conservation of ΣL_e and ΣL_μ, in an interaction, and several experiments have been carried out to determine the degree of non-conservation, if any. Bardin *et al.* (*Phys. Lett.*, **26**B, 112; 1967), working at Columbia University, looked for neutrinoless double β-decay of ^{48}Ca. The appearance of two electrons and no neutrino would have been an example of the non-conservation of L_e because its value would be 0 for ^{48}Ca and $+2$ for the products of the decay. Their work provided no evidence for a violation of the conservation law.

More recently, a test of the conservation of L_μ has been carried out at CERN, Geneva, by Borer *et al.* (*Phys. Lett.*, **29**B, 614; 1969), using the neutrino facility of the proton synchrotron. The test requires observation of a double process as follows

$$\pi^+ \rightarrow \mu^+ + \nu_\mu$$
$$\nu_\mu + \mathbf{A} \rightarrow \mathbf{A}' + \mu^-$$

where **A** and **A**′ are nuclei. If two positive muons are emitted in the process, L_μ has not been conserved because, either a $\bar{\nu}_\mu$ has been produced in the first interaction and thus μ^+ in the second, or a ν_μ has produced a μ^+ in the second interaction. In both cases the change in ΣL_μ would be -2 for one interaction or the other.

The interactions were observed in a combination of spark chambers and a bubble chamber, but, as with most experiments of this type, there is a possibility of spurious events caused by the simultaneous passage of unrelated particles. This can, however, be allowed for when quoting an upper limit for a possible violation. A total of nine out of 3,300 double events contained two μ^+, but, if the relevant corrections are made, the upper limit on the 90 per cent confidence level of a violation is 1 in 260. Further work will be needed to produce a conclusive result.

CRITICAL POINT PHENOMENA

Ultrasound in Nickel

THERE has been a tendency in recent years to regard all critical point phenomena in solids as coming from the same stable. This theme is underlined in an article by B. Golding and M. Barmatz (*Phys. Rev. Lett.*, **23**, 223; 1969) who have shown that ultrasonic propagation near the magnetic critical point of nickel bears a striking resemblance to the behaviour of sound near the lambda point of liquid helium. They have investigated the propagation of sound in the megahertz region in nickel near the critical temperature, about 630 K, and have found that the attenuation maxima and velocity minima occur below T_c and are frequency dependent. These observations are novel for a magnetic system.

Impurity atoms seem to have a marked effect on the ability to observe intrinsic critical behaviour. R. J. Pollina and B. Luthi (*Phys. Rev.*, **177**, 841; 1969) have found that impurities obscure the separation of the ultrasonic attenuation in rare earth metals from the critical scattering of sound, and account for the finite attenuation near the Néel temperature. In liquid helium near the lambda point the effect of impurities is minimal, which makes the common behaviour of helium and nickel quite plausible.