NEWS AND VIEWS

How Useful is Earthquake Prediction ?

FOR many years seismologists have been measuring the velocity of compressional (P) and shear (S) waves in rocks and studying the relationship between these velocities and the elastic moduli and density. These parameters can change with changes in the applied stress; before an earthquake occurs the stress in the focal region increases, and if this increase can be monitored it may lead to a method for predicting the onset of the elastic failure responsible for earthquakes. Attempts to monitor P and S velocities in the past, using explosive charges over a measured line, never came to anything, and interest in this type of experiment waned. That was until 1969, when Semyenov published the results of an experiment in the seismic area of Garm in the Soviet Union (*Izv. Phys. Sol. Earth*, 4, 245; 1969). Semyenov showed that, before an earthquake with a value of m_b of the order 4 or more, there is a significant variation in the ratio of the P and S velocities. He reported observations of microearthquakes in the Garm region which showed that the ratio v_p/v_s remained fairly constant at about 1.77 ± 0.01 for considerable periods of time before v_p/v_s began to decrease to a minimum value of less than 1.70 followed by a sharp increase before a larger earthquake.

On page 101 of this issue of *Nature* a significant confirmation of these Soviet results is reported by Aggarwal and his colleagues of the Lamont-Doherty Geological Observatory. The significance of their work is that they have repeated the Soviet experiment in a completely different region of the Earth, namely the Blue Mountain Lake area of New York State, and have obtained very similar results. They, too, used microearthquakes as an energy source to monitor and establish the norm of the v_p/v_s ratio. In the Blue Mountain Lake area, they deployed a network of high gain seismograph stations, which were sufficiently close to obtain hypocentre information with adequate precision. Although no seismograms are illustrated in the article whereby the reader can judge how precisely the onsets of the P and S waves can be measured, the authors affirm that these arrivals are very clear and impulsive and can be read consistently to an accuracy of 0.01 s. Certainly the data show very little scatter, and as in Garm the ratio v_p/v_s decreases to a minimum and increases sharply before an earthquake.

Why should the ratio v_p/v_s vary in this way when an earthquake is about to occur? Nur has attempted to explain the Soviet observations by suggesting (*Bull. Seism. Soc. Amer.*, 62, 5; 1972) that the decrease in the ratio may be the result of dilatancy, that is to say decreased volumetric strain, of rocks in the focal region as a consequence of increased stress. The sharp increase in the ratio just before the earthquake may, he suggested, be caused by the flow of ground water into cracks formed by dilatancy. Increasing the pore pressure in this way weakens the rocks. A similar interpretation is presented by Aggarwal *et al.* in their article.

This hypothesis is also used to explain the increased seismic activity observed in Colorado when effluent fluids were pumped into deep boreholes. The increased seismicity around new dam and reservoir sites is similarly explained; further development of the idea should come from seismographs now commonly installed around new reservoir sites. At these sites the experiment can be carried out at all stages of construction before and after the reservoir is filled.

What does this technique contribute to the art of earthquake prediction? For the present it would seem very little, for it remains to be seen whether or not the observations are caused by shallow and superficial phenomena. The observed variation in the velocity ratio would seem to be very local and is a precursor to very small and particularly shallow earthquakes (about 3.5 km). The costs of the comprehensive network of stations which would be required for monitoring, their operation and the continuous processing of the data are far from trivial. Other observations of geophysical changes preceding an earthquake, such as small changes in the electrical conductivity of the rocks and variations in radon exhalation as the rock is stressed, are similarly localized and would suffer from similar logistic problems if they were to be applied in an operational sense.

It is also worth drawing attention in this context to the tendency for the more scientifically interesting problems associated with earthquake prediction and control to obscure the fact that the application of well-known civil engineering methods would mitigate the loss of property and life in cities, and for the more useful, if less glamorous, projects concerned with the problem of well-insulated, low-cost housing for villages in seismic areas to be starved of funds. There is little to be gained by predicting earthquakes, such as the one which recently hit Managua, if afterwards there is no city to which the temporarily evacuated inhabitants may return.—From a Correspondent.

Synthesizing Diamonds

PRECIOUS stones must satisfy two criteria—they have to sparkle and they have to be hard. Diamond, being the hardest material known and possessing a high refractive index and good dispersion, obviously qualifies; but in addition it has one property of even greater value for the world at large—it is not found in significant quantities in the United States.

For this reason the decision was taken in 1951 to "mount a major new assault on the old and bloody battlefield" of diamond synthesis; the US General Electric