No easy way to quake prediction

Dilatancy is "in" this year. As with other theories of what makes earthquakes happen, the basic idea has been around for decades, but only in the past few years has the possibility of earthquake prediction gained widespread scientific credibility. And with it, dilatancy.

The dilatancy theory got its biggest boost last summer. A group of researchers at Columbia University's Lamont-Doherty Geological Obeservatory wrapped the concept up in a neat package suggesting that a wide range of prequake phenomena follow predictable fluctuation patterns that could be used to spot tremors before they hit (SN: 9/29/73, p. 200). One of the team, Yash P. Aggarwal, underscored the point by successfully predicting the time, place and size of a small quake near New York's Blue Mountain Lake two days in advance.

At the annual meeting of the American Geophysical Union in Washington last week, dilatancy was all the rage. Dozens of papers on every aspect of the subject dominated the field as seismologists searched old records to see if past quakes could have been foreseen and sought reinterpretations of the theory to shed more light on the future. A not-too-surprising consensus seems to be that not even the tempting compactness of dilatancy theory has the solution yet.

The theory simply says that accumulating pressure on subterranean rocks causes cracks to open (dilate) to relieve the stress. Water from surrounding rocks flows into the new fissures, and when they become saturated, restoring the pressure, the quake is triggered. The drop and rise of the pressure, many seismologists feel, seem to follow a pattern that can be related to the time, size and location of the ensuing quake. The Lamont researchers last year reported that this pattern is coupled to changes in seismic-wave velocities, vertical earth movements, electrical resistivity, emission of radon (a radioactive isotope found in underground water flows) and numbers of small, advance tremors, all of which seemed to follow such well-ordered cycles that they could be used as indicators in the elusive goals of earthquake prediction.

Neat. Almost too neat, in fact. The theory still has a lot going for it, but the AGU meeting served to point out that the answer is just not going to be that simple.

At the California Institute of Technology, for example, James Whitcomb predicted a magnitude 5.5 quake, about two months in advance, near the city of Riverside. On Jan. 30, right on time, the quake struck, but only as a far weaker tremor of magnitude 4. "We haven't ruled out the possibility of a larger event yet to come," Whitcomb says, "but this becomes less likely with the passing of time."

A more likely factor, he suggests, may be that dilatancy applies in different ways to different kinds of earthquakes. The Riverside quake was predicted using data from past tremors of the thrust type, in which land on one side of a fault thrusts itself under or over land on the other side. At Riverside, either the movement was lateral, called strike-slip faulting, or one side of the fault dropped relative to the other, known as gravity faulting. The type of fault seems to be critical.

Other researchers believe that dilatancy theory may have shown the right thing to look for—changes in the velocity ratio between pressure and shear waves caused by clusters of "microearthquakes" before the big one—but the wrong reason to look for it. Dilatancy blames the velocity-ratio changes on water entering the dilatant rocks. The alternative, according to Raymon Brown and George Zandt of Massachusetts Institute of Technology, may be that the little advance quakes begin at a given depth, then migrate systematically upward to where the reduced pressure that is normal at shallower levels causes the change. This rising of the microquakes may not occur before every large tremor, the seismologists point out, which could be a setback for this line of prediction. But there are other signs, and never before have earth-watchers probed so hard to dig them out.

Indra Gupta of the University of Nevada, for example, has had poor results with pressure-shear ratios, but finds a clear clue in shear-wave splitting: the dividing of a shear wave into vertically and horizontally polarized components that move along compressive stresses with different speeds, a difference that grows just before a quake.

Tides in the earth are another avenue of research. In studying swarm earthquakes, groups of localized quakes in a short time with no single quake being dominant, Fred Klein of Lamont-Doherty reports that of 39 swarms between 1934 and 1970, 90 percent occurred when the solid-earth tide was rising. John Bagby of Bell and Howell maintains, in fact, that a detailed analysis of tidal forces caused by the moon, Venus, Mercury and other bodies can provide "a method of tying down the date, hour and minute, once a prediction to the nearest 10 days or so has been achieved by more conventional means.

An earthquake predicted to strike Hollister, Calif., last summer failed to occur, possibly because the two sides of the fault relieved their stress by gradual creeping rather than a huge snap. Robert Nason of the U.S. Geological Survey in Menlo Park has predicted a quake in a nearby region using creep itself as his only indicator. Lack of adequate instrumentation is a bane of the predictors, but Nason's measure is a crack in the concrete floor of the Cienega winery. The lateral displacement between the sides of the crack has been growing ever since the winery was built in 1948. In 1959, the creep rate jumped from about 12.5 millimeters per year to 20, followed in 1961 by the largest quake in the area in 50 years, magnitude 5.6. That slowed down the creep again, but it jumped back up in 1972. The coming quake, Nason says, could come sometime this year or next. □

A substance that triggers sleep

Peptides that purportedly contain memory have been isolated, chemically unraveled and synthesized (SN: 4/28/73, p. 268). Now a peptide that triggers sleep has been isolated and chemically sequenced by Marcel Monnier and G. A. Schoenenberger of the University of Basel in Switzerland.

Some years ago Monnier discovered that filtered venous blood taken from sleeping rabbits and injected into awake rabbits made the latter fall asleep. Electroencephalographs showed that the recipients were indeed enjoying middle-deep sleep, which is characterized by delta brain waves. Monnier named the substance "sleep peptide delta." Working with Schoenenberger, Monnier has now isolated and identified the sleep-inducing substance. It is a polypeptide containing nine amino acids. □