

Stalking the Mid-Continent Quake

The most awesome earthquakes in U.S. history have occurred not in ever-trembling California, but in the Missouri "boothel," a small piece of the state that nicks into Tennessee, Arkansas and Kentucky. Between December 1811 and February 1812, three massive shocks, centered near the town of New Madrid, Mo., devastated forests for hundreds of miles, changed the course of the Mississippi River, created new lakes and wiped out old ones.

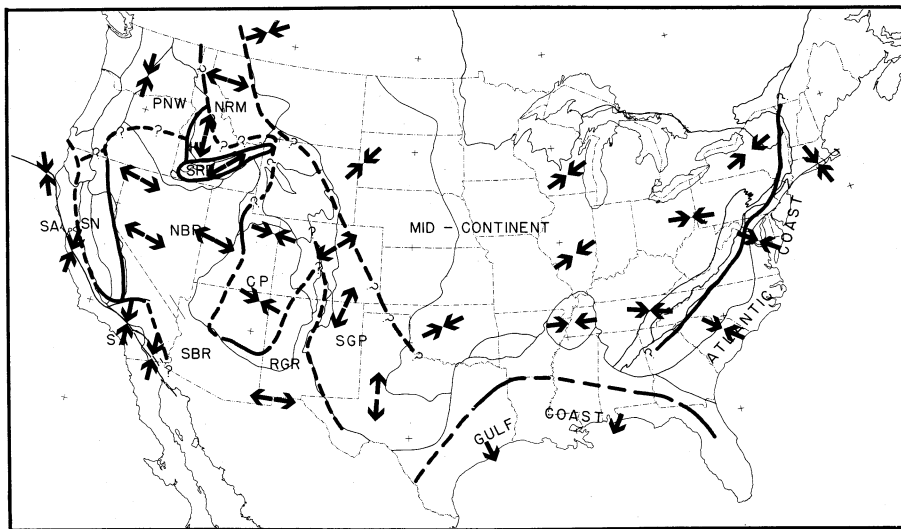
Geologically, these quakes are particularly distressing: Most major earthquakes, such as those in California, occur at well-defined faults where two tectonic plates grind past one another. New Madrid-style quakes, however, occur within a tectonic plate and cannot be neatly explained by obvious faults and plate motions.

But a cohesive explanation is beginning to emerge for "intraplate" quakes such as those in the Midwest and on the East Coast. In particular, recent measurements by Mary Lou Zoback and Mark D. Zoback of the U.S. Geological Survey have uncovered the direction and types of stress that may be responsible for eastern and mid-western quakes — an important step toward determining where and when such quakes may occur.

As Mark Zoback told a recent symposium on earthquake prediction in New Paltz, N.Y., the nascent theory is the fruit of a variety of recent research concentrated primarily in the New Madrid region. A seismic network operated by St. Louis University shows two distinct regions of quake activity in Missouri — one running northwest-southeast from New Madrid into Tennessee and one crossing northeast-southwest from Arkansas into the boothel. Seismic soundings recently revealed a shallow fault (SN: 11/3/79, p. 310) that coincides with the northeast-southwest zone of activity. Beneath the fault zone, magnetic and gravity surveys uncovered a 50-mile-wide, 200-mile-long rift valley — a region that at one time stretched and collapsed in a process similar to that now splitting Asia and Africa (SN: 1/5/80, p. 9). A deep trench dug across the fault zone showed researchers that in the past 2,000 years, three devastating quakes have occurred in the region.

More recently, the Zobacks have examined the stresses within the crustal rock of the New Madrid region, as well as of the eastern seaboard. The researchers use a technique called hydrofracture, in which a hole is drilled into the ground and water is pumped in under sufficient pressure to cause cracks in the walls of the hole. According to theory, the cracks will form along the direction of maximum stress.

In the interior of the continent, the



Stress direction measurements may lead to cause of Midwest and eastern U.S. quakes.

Zobacks found that the maximum stress is east-west, approximately parallel to the westward drift of the North American plate. The stress, they suggest, is caused by drag on the bottom of the plate as it moves; earthquakes occur in the New Madrid area as drag-stress builds up and the already rifting-weakened crust gives way.

In the eastern United States, however, the picture is less clear. The stress field apparently lies perpendicular to the coast

and is not consistent with the plate motion. Moreover, only two structures that might be interpreted as faults have been found, one in South Carolina and one in New York, and the relation between them and the stress field is not clear, the Zobacks say.

Particularly in the eastern United States, "We need to look for more structures and somehow get enough stress data," says Mark Zoback. "But it's all very consistent; the picture is coming together well." □

Gene-spliced hormone, interferon do job

Rapid has been the success of biologists in engineering bacteria to make animal materials. But slower has been the task of demonstrating that the new bacterial products can function effectively in animals. Now Nowell Stebbing of the research firm Genentech (SN: 3/29/80, p. 203) reports that two bacterially produced materials — human growth hormone and human interferon — are as active in animals as are their mammal-made counterparts. He was speaking at a recent meeting held by the Food and Drug Administration.

Stebbing's report includes the first announcement that Genentech, in a collaboration with Hoffman-LaRoche Inc., has produced two types of human interferon — fibroblast and leukocyte — through recombinant DNA technology. Earlier this year a Geneva-based company, Biogen, S.A., reported the first bacterial production of the leukocyte form (SN: 1/26/80, p. 52). The yields reported by Biogen were only a few molecules of interferon per bacterial cell. The Genentech procedure, however, yields as many as 100,000 molecules per cell. That amount corresponds to 50 patient doses, Genentech es-

timates. Interferon is currently being studied both as an anticancer and antiviral agent (SN: 6/7/80, p. 358).

The high yield is due to two factors, according to Genentech vice-president Robert F. Byrnes. The gene, which was copied from human RNA, is attached to a natural bacterial control system. In addition, the connection is a "direct hook-up," so no precursor regions need to be trimmed from the product.

The interferon produced by bacteria at both Genentech and Biogen differs from mammalian interferon in at least one respect. The bacterial material does not contain sugar groups. Stebbing reports preliminary data indicating that despite its sugar deficiency bacterium-produced interferon is active.

Groups of three squirrel monkeys received either bacterial or human cell leukocyte interferon before and after infection with the deadly encephalomyocarditis virus. All animals in both groups survived, but not monkeys that received only natural bacterial proteins.

At the most recent meeting of the federal Recombinant DNA Advisory Commit-

tee, Genentech requested permission to "scale-up" production of both interferons to batches of 600 liters.

Like interferon, human growth hormone bacterially produced (SN: 7/14/79, p. 22) is fully as effective as natural material, Stebbing reports. In experiments measuring weight gains and bone length in rats, bacterially made hormone stimulated growth to the same extent as hormone obtained from human pituitaries. □

Two more visits to Salyut 6

The Soviet Salyut 6 space station, in orbit since September 1977 and occupied since April 9 by cosmonauts Leonid Popov and Valery Ryumin, has served as home for two more cosmonaut crews in recent weeks, making a total of 10 crews who have visited the facility. On May 26, Valery Kubasov and Bertalan Farkas, the first Hungarian cosmonaut, were launched toward the station aboard Soyuz 36. They returned to earth eight days later aboard Soyuz 35, leaving the fresher craft still docked with the Salyut. (Besides Russia, cosmonauts have also been provided from Czechoslovakia, Poland, East Germany and Bulgaria. Others are in training from Cuba, Mongolia and Vietnam, with plans to include candidates from India and France.)

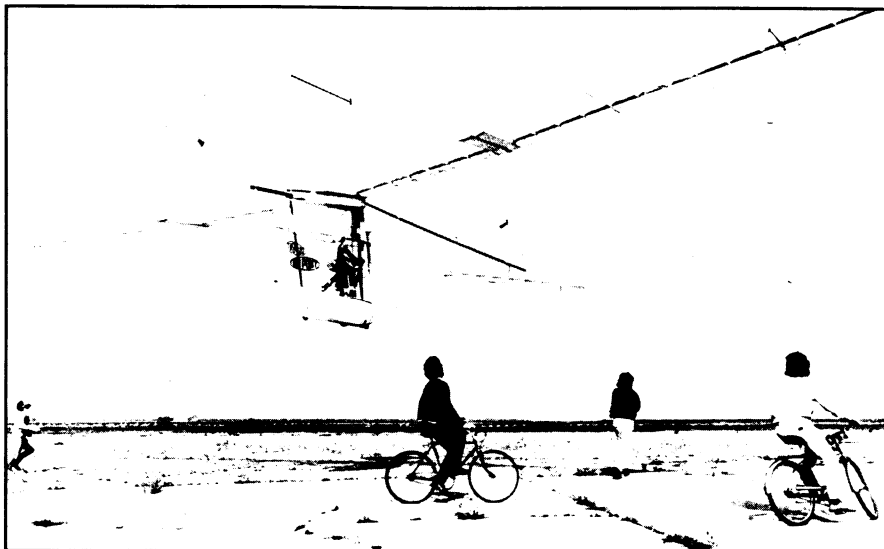
Only two days later, on June 5, Yuri Malyshev and Vladimir Aksenov took off for Salyut 6 aboard Soyuz T2, an improved version of the spacecraft including revised propulsion equipment and a computer designed to reduce the crew's dependence on data and navigational support from the ground. After spending some time aboard the station, they descended to earth aboard the T2.

Popov and Ryumin, meanwhile, are expected to remain aboard Salyut 6 for an extended period, in view of Soviet reports that the cosmonauts exercise 90 minutes a day, "as they have to be in a perfect state of fitness for a long time to come." □

NOAA-B aloft but useless

The National Oceanic and Atmospheric Administration's NOAA-B weather satellite, launched on May 29, is useless, according to agency officials, because it was launched into the wrong orbit. The mishap apparently resulted from a sequence of events that began when one of the two booster engines on the rocket carrying the satellite developed only 75 percent of its planned thrust, leaving NOAA-B in a 150-by-900-nautical-mile orbit instead of the 470-n.m. circular orbit for which its instruments were designed. To ensure data continuity from the satellite series, NOAA-C, formerly scheduled for 1981, is being retargeted for a November launch. □

Condor's grandchild: This penguin can fly



What's left for the team that engineered successful human-powered flight? The world's first human-piloted solar-powered aircraft. Brainchildren of Paul MacCready — whose Gossamer Condor (SN: 9/3/77, p. 149) and Gossamer Albatross (SN: 6/16/79, p. 390) set records and won awards for human-powered aircraft — the Gossamer Penguin and the Solar Challenger are expected to demonstrate later this year the potential of sunlight-powered flight. Having already completed test hops, MacCready's Penguin (above) — a 68-pound, three-quarter scale version of his Albatross — is expected to make its maiden voyage later this month under the control of Janice Brown, a 31-year-old Bakersfield, Calif., elementary school teacher and certified pilot. Soaring at about 15 miles per hour all of five to 10 feet off the ground, Brown hopes to prove that the craft can take off and be controlled over a several mile flight path. A panel of photovoltaic solar cells powers a five-inch-long motor, which in turn drives the rear-mounted propeller. There are no batteries for energy storage, so clouds could mar its success. Sometime this fall Brown will pilot the Challenger, a more conventional-looking extremely lightweight plane that carries 30,000 solar cells. The two-horsepower craft is expected to cruise 100 miles or more at 40 mph and altitudes of 200 to 5,000 feet, even under turbulent conditions.

New pieces to the Mayan puzzle



What, at first glance, may look like a computerized cave painting is actually a radar image taken from 28,000 feet above the dense rain forest of Guatemala's central lowlands. The grid patterns (enhanced by computer processing) represent part of a complex network of drainage canals dug by the Mayan civilization between 250 B.C. and A.D. 900, according to archaeologist Richard E. W. Adams of Cambridge University in England. After a month-long trip by car and canoe through the rain forest, Adams and archaeologist T. Patrick Culbert of the University of Arizona confirmed the existence of the elaborate canal network. The finding, they say, appears to answer the long-time question of how the Mayan population — estimated to have been at between 2 million and 3 million persons at one time — fed itself in an area that would seem to have been only marginally suited for agriculture. The one-half-meter-deep by one-to-three-meter-wide canals would have increased agricultural productivity, say the archaeologists. The discovery occurred during initial tests of the radar imaging system over an 80,000-square-kilometer region of Guatemala and Belize in 1977 and 1978. A form of the system, called synthetic aperture radar, was later used in the now-defunct NASA Seasat ocean monitoring satellite. It was developed for NASA by the Jet Propulsion Laboratory in Pasadena, Calif.