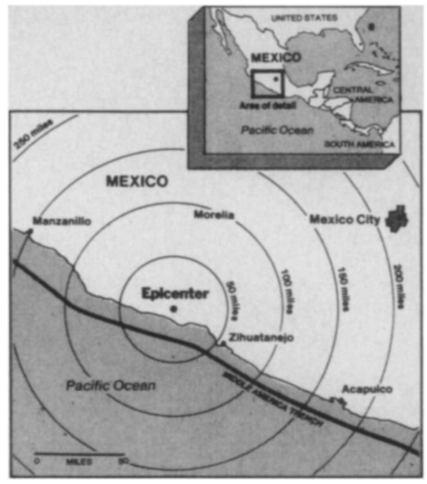
A Large and Late Quake

The magnitude 7.8 earthquake that jolted southwestern Mexico last week, devastating sections of Mexico City and three states on the coast and killing thousands of people, was unexpected only in the sense that it waited so long to happen, seismologists say.

Earthquakes along Mexico's western coast generally result from the movement of oceanic plates as they are subducted, or dragged down, under the North American plate upon which Mexico sits. In the region where the Cocos oceanic plate is being subducted, earthquakes typically recur every 30 to 60 years, says Christopher Scholz at the Lamont-Doherty Geological Observatory in Palisades, N.Y. But the last quake to shake this particular 140-kilometer-long segment of the plate boundary occurred 78 years ago. Since scientists are not certain that this 1907 earthquake was large enough to rupture the segment, it may well be that an even earlier earthquake, in 1811, was the last to rupture the fault.

Seismologists first pointed to the suspicious dearth of large earthquakes along this section of the plate margin in the late 1970s. In addition to its long recurrence time, the segment is unusual in that it is longer than the rupture lengths of other earthquakes in the region. Since longer lengths have been empirically correlated with larger earthquakes, this segment should create larger-magnitude quakes. Indeed, Scholz estimates that the energy released by last week's quake was three to four times greater than that released by the magnitude 7.5 to 7.6 earthquakes typical of the region.

The main theory explaining the unusual behavior of this segment is that sea-



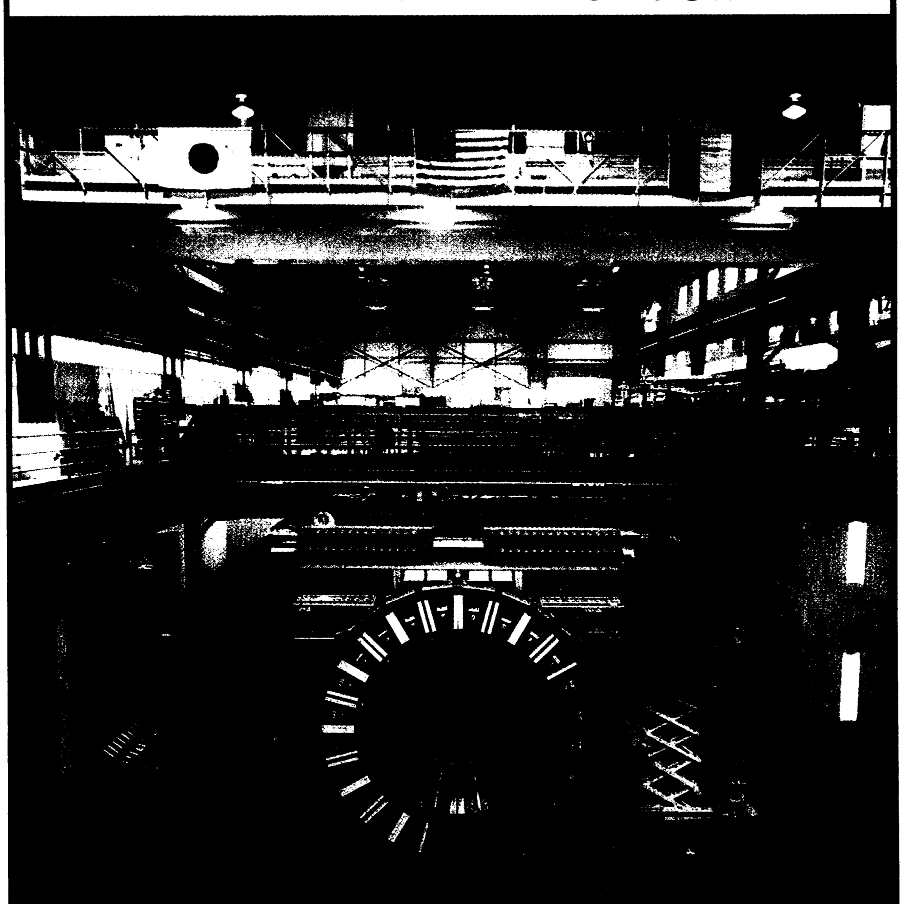
mounts, or undersea mountains, on the Cocos plate "jam up the works so that the stress builds up for a longer time, and then when an earthquake occurs it's bigger," says Scholz. One thing seismologists will be looking at when more data come in is how the earthquake's energy was distributed over the fault. Energy concentrated in a small part of the segment would support the idea that the fault had been locked in place by the seamounts.

According to the National Earthquake Information Center in Golden, Colo., preliminary data place the quake about 360 kilometers southwest of Mexico City. Although Acapulco is even closer to the epicenter, the resort city, which is built on relatively solid ground, is reported to have suffered little damage. The central part of Mexico City, on the other hand, sits atop a drained lake bed consisting of 46 meters of soft clay, which vibrates "like a bowl of jelly when seismic waves come through the ground beneath it," says earthquake engineer George Housner of Caltech in Pasadena.

During a 1960 earthquake, the natural period of this vibration was found to be 2.5 seconds, according to Housner. Because 10- to 20-story buildings have natural periods much closer to this value than do one- and two-story buildings, Housner believes that tall (as well as weak) buildings were the most likely to succumb to the shaking of the earthquake and collapse. Of the approximately 1 million buildings in Mexico City, fewer than 1 percent have been reported damaged. The main quake is thought to have completely destroyed 250 buildings. A magnitude 7.3 aftershock the day after the main quake crumbled more structures that had been damaged by the initial jolt.

Scientists will have to wait until data from many more seismic stations arrive before they can pin down the precise epicenter, depth, magnitude and rupture mechanism. According to one geophysicist at the National Earthquake Information Center, initial estimates had been made using only three stations in Alaska, Colorado and Canada; because they were

Collisions in the Fermilab Tevatron



Fermilab

Protons and antiprotons can now collide in the Fermilab Tevatron accelerator in Batavia, Ill., at total energies of up to 2 trillion volts (see p. 202). The Collider Detector Facility (CDF), shown here, will record the outcome of such collisions. In the center of the blue circle appears the pipe through which protons and antiprotons will run. Assembled in a hall at the edge of the accelerator, the CDF was recently moved with rollers and hydraulic pushers through the opening at right to the accelerator itself.

closer to the epicenter, many seismographs to the south were overloaded by the quake and unable to provide accurate magnitude measurements.

At press time, U.S. researchers had yet to receive seismographic data from Mexico. When the detailed data sets do become available, seismologists plan to scrutinize them for possible precursory signs — such as a period of quiescence, which has been observed before a number of other earthquakes on that plate boundary — to help make predictions for the future. —*S. Weisburd*

ASAT target was working research satellite

It is not just that the Air Force satellite deliberately destroyed by an Air Force missile on Sept. 13 was still transmitting at the time. That much was a requirement in the test of the U.S. antisatellite (ASAT) system, says a Pentagon spokesperson, "so that we could verify impact." What has outraged some scientists is that the chosen satellite was instrumented for studies of the sun, and had been operating until the instant of its destruction as what one solar physicist calls "the backbone of coronal research through the last seven years."

Known as P78-1, the satellite had been launched on Feb. 24, 1979, carrying seven scientific instruments. Only two were in use at the time of the ASAT test, due, the Pentagon says, to "continuing battery degradation." But one of them was a "white-light coronagraph" that had been photographing the sun's outer atmosphere on the way to what scientists hoped would be the first record, made from outside earth's own atmosphere, of the corona's behavior over a full, 11-year cycle of solar activity. (A coronagraph aboard NASA's Solar Maximum Mission satellite had become useless when "Solar Max" blew three fuses 10 months after its 1980 launching, and was not restored to duty until space shuttle astronauts repaired the satellite last year [SN: 4/14/84, p. 228].)

"I can't believe that they couldn't find a piece of space junk, really, instead of a working laboratory," says David Rust of the Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, Md. "This was a working observatory, so I'm just a little taken aback [by] the SDI [Strategic Defense Initiative, sometimes dubbed 'Star Wars'] people. ... They particularly made a pitch to the university community, to the scientists, in saying this is a 'Manhattan Project' sort of thing, and it's good science and so forth — and then they turn around and blow up a laboratory."

Rust, a supervisor of the APL solar physics program, was also coordinator of satellite observations during the 1980-81 Solar Maximum Year. P78-1 "played a major role in that," he says, and its researchers "have made major strides in explaining how coronal changes affect interplanetary space. They found the first evidence of a comet falling into the sun [SN: 10/17/81, p. 244], and you could expect that they'd continue to show some good results, particularly with the solar cycle changing the characteristics of the corona...." As for APL, he says, "our chief reaction here, among several of us who have used the data, was really one of shock."

The ASAT test was originally to have been aimed at an instrumented, balloon-like vehicle launched into space just for that purpose. But according to the Sept. 2 Aviation Week & Space Technology, problems with the target caused delays until "the decision was finally made to use an older, no longer functional satellite already in space...." P78-1 had a "planned, on-orbit lifetime" of only one year when it was launched, and a "maximum design lifetime" of three. And, said one Pentagon spokesperson after the test, it had "outlived its useful life and fit the requirements of the test."

But "useful life" and "design lifetime" are not always synonymous. Design lifetime is a technical specification, used for such purposes as determining the reliability requirements for microcircuits and other components (those tested to higher reliability standards cost more), or scheduling subsequent satellites. Researchers working with scientific satellites and interplanetary spacecraft, however, often plan for the possibility of longer periods of operation.

The Voyager 2 spacecraft, for example, exceeded its official design lifetime when it passed Saturn in August 1981, yet even before its 1977 launching scientists had been planning for the possibility of encounters with Uranus in 1986 (Voyager 2 will get there in January) and Neptune in 1989. Similarly, the Viking 1 landing craft, which reached the surface of Mars on July 20, 1976, collected data about the planet for more than six years, yet its formal "spec" had called for only 90 days. "Design lifetime," says an engineer who has worked on some of NASA's interplanetary missions, "is not what I'd fall back on if I were trying to rationalize turning off a working spacecraft."

Even so, the Pentagon spokesperson says that, "based on cost and return-on-investment, P78-1 would have been turned off in early 1987, when ground systems are scheduled to be upgraded." For the ASAT test, he says, "the Air Force made a conscious decision ... [which] considered the loss of the continuing useful scientific data being provided by the two operating experiments."

"If you want to say that I called it 'a travesty,'" Rust told Science News, "why you can say that. I think that's a perfectly correct characterization." —*J. Eberhart*

A hot vent find in the Atlantic

This summer, a team of oceanographers on its way to track down the exact sites of the low-temperature hydrothermal vents, or undersea geysers, it had found on the Mid-Atlantic Ridge last year (SN: 10/20/84, p. 246) made an even steamier discovery. While retrieving some current meters at another hydrothermal field along the ridge, the scientific party aboard the National Oceanic and Atmospheric Administration (NOAA) ship *Researcher* found the telltale signs of enhanced hydrothermal activity in water samples. They decided to abandon their original plan to cruise farther south, and three weeks later zeroed in on a cluster of at least 11 high-temperature vents — "black smokers" that were vigorously spewing out blackened, mineral-laden water just like their counterparts along the East Pacific Rise.

The find is remarkable not only because it adds to the number of vents found in the Atlantic but also because it is the first example of high-temperature venting along a slow-spreading ridge. Traditionally scientists have hunted for undersea geysers along ridges where seafloor is being created rapidly; the East Pacific Rise, for example, churns out new ocean floor about 10 times faster than the Mid-Atlantic Ridge. But since 1972, when the first evidence of low-temperature venting was found along the Mid-Atlantic Ridge, oceanographers have come to understand that fast-spreading ridges don't have a monopoly on venting.

Finding high-temperature vents fortifies the view that slow-spreading ridges — which account for half of the world's ridge network — may contribute much more to the oceans' chemical and thermal budgets than previously thought. In addition, the recent find demonstrates that there is enough heat available under slow-spreading ridges to drive black smokers — an idea that was in question before the cruise, says *Researcher* chief scientist Peter Rona at NOAA in Miami. Rona also reports that the group dredged polymetallic sulfides from the floor, a find suggesting that the Atlantic may house more economically important resources than had been assumed.

Rona's group, which includes researchers from the University of Cambridge in England and the Florida Institute of Technology in Melbourne, has yet to analyze in detail the water and sediment samples collected during the July 9 to Aug. 7 cruise. Preliminary results will be presented at the December meeting in San Francisco of the American Geophysical Union. The researchers would like to return to the vents with a submersible to examine them in detail and to collect samples of the hot, bubbly fluids from the mouths of the vents. —*S. Weisburd*