Stein of the U.S. Geological Survey in Menlo Park, Calif. He and his colleagues calculated that 9 out of 10 large recorded earthquakes on the North Anatolian occurred in areas where previous shocks had increased stress. Their analysis also pinpointed the two most worrisome parts of the fault, one of which caused last week's quake.

Stein notes that this work did not predict the shock. The researchers gave only a 12 percent probability that the Izmit section would go by 2026. "In a sense, we said there was a 88 percent probability it would not occur," admits Stein.

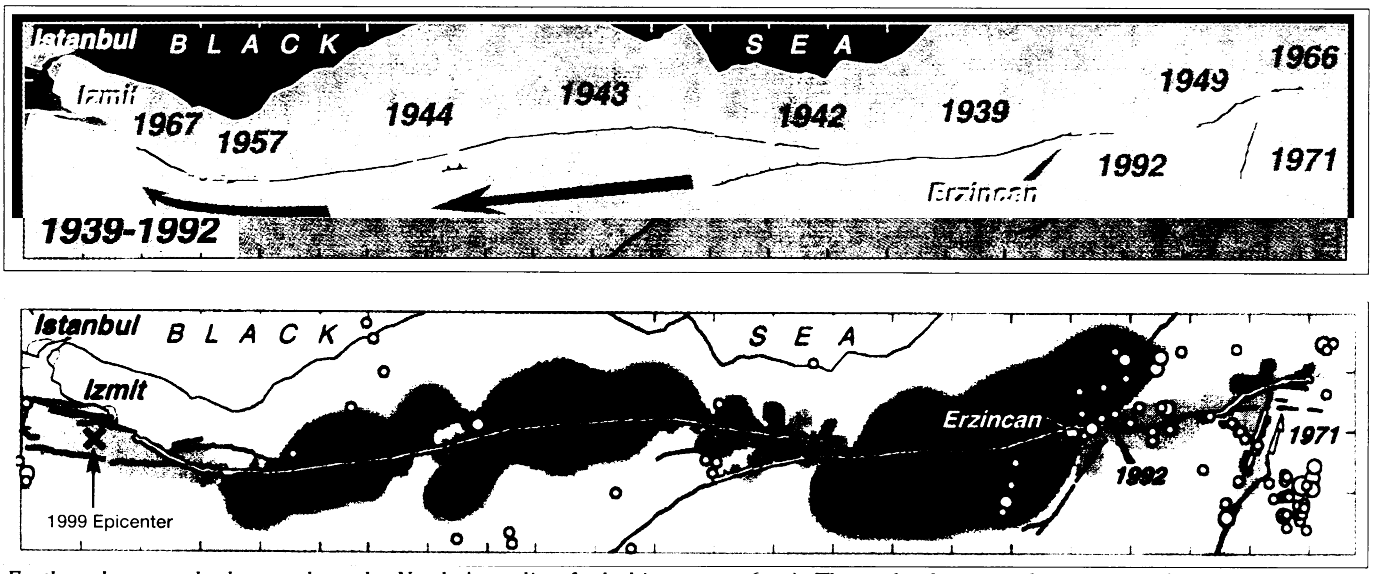
Nonetheless, the earthquake supports the hypothesis of stress triggering, says Gregory C. Beroza of Stanford University. Researchers are currently using this theory to determine how past earthquakes have raised and lowered seismic risk in different parts of California.

U.S. seismologists see parallels between the Turkish and the San Andreas faults. In both, land moves horizontally during quakes. The faults are the same length, and each splits into branches. The earthquake beneath Izmit happened on the north fork of the fault. "That behavior of the fault splitting up is much like what happens in the San Francisco Bay area of the San Andreas," says Sykes.

The quake also offers sobering lessons about how ineffective scientists are in influencing building practices, says Nick N. Ambraseys of Imperial College in London. "From the point of view of reducing damage and cutting down the death toll, science alone can do absolutely nothing."

Turkish building codes accounted for the seismic risk, but the government did not enforce such codes, says Ambraseys. "The important thing is complacency. It doesn't apply only to Turkey or Japan. It also applies to California." —*R. Monastersky*

Stein/from Geophysical J. Int'l.



Earthquakes marched west along the North Anatolian fault this century (top). These shocks created stress, in red, in the region of last week's quake (bottom).

Pokey pulsar mystifies astronomers

Whirling stars called pulsars are like celestial lighthouses, sending a narrow beam of energy into the galactic darkness. Astronomers have now discovered a slowly rotating pulsar that defies their basic understanding of how the stars work.

When a massive star collapses, it forms a terrifically dense, magnetized core, known as a neutron star. A neutron star whose magnetic axis tilts away from its rotational axis emits a beam of radio energy that, from Earth, appears as a pulse at each rotation, and so the body is called a pulsar.

The electromagnetic field, or magnetosphere, that envelops a young, swiftly rotating pulsar generates duos of charged particles called electron-positron pairs. These, in turn, spawn the beam of radio emissions. The faster a pulsar spins, the more particle pairs it produces, and the more powerful are its radio emissions. As the stars age, they slow down and stop producing particle pairs. Scientists have theorized that as this energy supply is exhausted, pulsars' radio emissions cease.

Australian scientists, however, report that a radio pulsar they discovered in 1994, called PSR J2144-3933, rotates only once every 8.51 seconds. This rotation takes more than 3 seconds longer than that of any known pulsar—and is one-third as fast as the researchers had earlier believed.

Spinning this slowly, PSR J2144-3933 should have already stopped producing particle pairs, making it silent to radio telescopes. Instead, the star's radio pulse beats loud and clear, the researchers report in the Aug. 26 Nature. "It was quite surprising and a very exciting discovery," says study coauthor Matthew D. Young of the University of Western Australia in Nedlands.

The finding challenges long-standing assumptions about pulsars. "I think [the finding] is going to have a fairly large impact," remarks David J. Nice of Princeton University. "Whatever is going on in the magnetosphere of the pulsar is very complicated in ways that we don't entirely understand—we don't know how to figure it out from our current observations."

"It may be that the radio emission derives its energy from some other source [than the particle pairs]," Young speculates. "Or maybe that process can continue for longer than we thought, or maybe we just don't understand the underlying physics of the neutron star itself."

"I'm baffled at this point," admits Alice K. Harding of NASA's Goddard Space Flight Center in Greenbelt, Md. "I think theorists are just going to have to go back to the drawing board for a while."

"It doesn't necessarily mean that you have to throw out all the old theories, but it does mean that you have to rethink the details of them," says coauthor Richard N. Manchester of the Australia Telescope National Facility in Epping.

In an editorial accompanying the study, Alex Wolszczan of Pennsylvania State University in State College argues that "a really meaningful discussion of these and other alternatives will depend on new detection of very slow pulsars like J2144-3933."

That could be tricky. Although the researchers estimate that the Milky Way could contain about 100,000 similar pulsars, Young notes, "the beam from such a slow radio pulsar is very narrow, and it was purely by chance that this one happened to sweep over the Earth." —*S. Carpenter*