EARTH SCIENCES

Kendrick Frazier reports from San Francisco at the fall meeting of the American Geophysical Union

Phenomena preceding two large quakes

At mid-day on Nov. 24, 1976, a magnitude 7.3 earthquake struck a populated area of eastern Turkey, destroying 80 percent of the dwellings in an 800-square-mile area. Four thousand persons were killed.

A geophysicist from the Massachusetts Institute of Technology says the earthquake could have been predicted in advance, saving many lives, if qualified personnel had been monitoring the area with scientific instruments.

M. Nafi Toksöz interviewed villagers during the first week after the quake and again several months later, and learned that a wide variety of physical precursors were observed from two weeks to a few minutes before the earthquake. They ranged from booming sounds to the unusual behavior of dogs.

Booming sounds resembling thunder (possibly due to very small foreshocks) were heard several times during the two weeks preceding the quake. Residents of one village on the lake told Toksöz of unusual sounds coming from the lake. Residents in another village reported an increase of water from a spring one day before the quake. Unlike some cases elsewhere, there were no confirmed reports of unusual behavior of farm animals prior to the earthquake, although Toksöz interviewed villagers and shepherds on the subject extensively. But barking or howling of dogs a few hours to a few minutes before the quake was widely observed.

Toksöz also interviewed villagers after a 6.7-magnitude quake in another part of eastern Turkey on Sept. 5, 1975. He says that survivors of this quake reported only one unusual phenomenon: a brightening of the sky the night before the event. Some geologists 250 kilometers away also noticed the brightening in the direction of the earthquake epicenter. Similar brightness in the sky has been reported before two earthquakes in Japan. Several hypotheses have been proposed to try to account for such glows.

Where a great earthquake may strike

An absence of major earthquakes during the last quarter century along a quake-prone margin of the Himalayas in the Assam Region of northeastern India seems to indicate that the area is due for a major quake. Seismologists K. N. Khattri and Max Wyss of the University of Colorado and the National Oceanographic and Atmospheric Administration have identified a pattern in the region's earthquake history: Every major earthquake in the area in the last 150 years has been preceded by a period of few or no earthquakes; and every period of seismic silence has been followed by a major quake. "Major" is an understatement. Quakes in 1897 and 1950 were among the most powerful earthquakes ever recorded (magnitude 8.7). The segment of plate boundary between those two quakes has been "suspiciously" quiet since 1950, Khattri and Wyss report. It may be due for a great earthquake. They can't make a prediction because they can't say when it might come, but they suggest an intensive search for other advance signals.

A 'recent' magnetic reversal?

Two scientists have discovered evidence from two lava flows in Iceland that the earth's magnetic field reversed polarity briefly sometime during the last glaciation, perhaps as recently as 20,000 to 30,000 years ago.

Two lava flows with reversed magnetic polarities were found in southwestern Iceland in June by John W. Peirce and Jeff Clark of Dalhousie University in Nova Scotia. There, pillow lavas clearly had erupted under a thick glacial cover. They apparently formed, according to the scientists, near the end of the Wisconsin ice age, about 20,000 to 30,000 years ago. Other recent evidence from the mid-Atlantic ridge had already renewed speculation that such a recent reversal may have occurred.

If such a reversal did occur as recently as 30,000 years ago, one would expect to find an error in carbon-14 dates, because magnetic field strengths affect the level of carbon-14 in the atmosphere. In fact, carbon-14 dates are too young when compared with tree-ring dates, and Peirce and Clark point out that the magnitude of the error is about that which would be produced by a brief magnetic reversal 20,000 to 30,000 years ago.

Ivory Coast tektite site

The region over which the Ivory Coast microtektites are strewn has been found to be nearly four times as large as previously thought. It also appears to be associated, like the Australasian tektites, with a magnetic-reversal event.

Billy P. Glass of the University of Delaware reports the discovery of microtektites in three additional sedimentary cores from the equatorial Atlantic Ocean off Africa. These now show the area of distribution to be equal to about half the area of the United States. He calculates that there may be as much as 10 billion kilograms of microtektites in the Ivory Coast site.

Microtektites and tektites are small glass beads found in restricted areas of the earth's surface. Many scientists believe they are formed from the impact of a meteorite on earth (although a second view is that tektites are from the moon). The largest tektite site, the Australasian, is closely associated with the last major reversal of the earth's magnetic field, 700,000 years ago. The Ivory Coast microtektites appear to be in a layer associated with the beginning of the Jaramillo magnetic event. This event is a time about 0.95 to 0.9 million years ago when the earth's magnetic field reversed polarity and then about 50,000 years later changed back. The latest discoveries lend support to Glass's long-held hypothesis that there may be a relationship between reversals of the earth's magnetic field and tektite falls.

Mapping lightning by satellite

A good record of worldwide lightning activity does not yet exist. The deficiency may soon be remedied, however, thanks to a lightning sensor aboard a dawn-to-dusk polar-orbiting satellite launched this summer.

Bruce C. Edgar of the Aerospace Corp. in Los Angeles and Bobby N. Turman of the Air Force Technical Applications Center describe the first results from the sensor aboard the Air Force DMSP meteorological satellite. Lightning flashes associated with weather-frontal activity across the southeastern United States, the Gulf of Mexico and the Caribbean Sea were detected and mapped. They show that at dawn much lightning is out over the ocean, but at dusk it tends to occur mainly over land. A very preliminary map of worldwide activity shows this pattern even more strikingly: at dawn, a fairly even distribution; at dusk, a clustering over the continents. Afternoon thunderstorms are generated by heat convected upward from the sun-warmed ground.

The flashes typically had peak powers of about 10 billion watts and lasted 1 millisecond, although a few at 100 billion watts, lasting 2 milliseconds, were observed. Edgar says they have as yet seen none of the "superlightning" bolts of 10 trillion watts reported by Turman earlier this year (SN: 7/2/77, p. 15) from analysis of data from the Vela defense satellites. But they hope to spot a few such massive discharges as more DMSP data are gathered.