

recent changes in NIH procedure would now prevent funding of recombinant DNA research without an approved memorandum, should such a situation arise again. Thomas has recently moved from Harvard to Scripps Clinic and Research Foundation in La Jolla, Calif. □

Anxious animals as quake precursors

Can animals sense an impending earthquake before humans or even seismic equipment detect physical clues? A team of scientists at the University of California at Davis thinks so on the basis of data collected last year following the November 22 earthquake near Willits, Calif. The researchers reported their findings at the American Geophysical Union meeting in Miami Beach last week.

Thousands of references to animal precursors of coming quakes — in legends and, more recently, in scientific literature — piqued sufficient curiosity in this country that a conference was held in September 1976 to explore whether and how scientists might investigate the alleged phenomenon. Animal behaviorist Dale F. Lott took part in the conference but came away very skeptical. When the United States Geological Survey said it would consider funding such research, however, Lott and several of his UC-Davis colleagues were among the first to apply. Their current research team consists of Lott together with another animal behaviorist, Ben L. Hart, geologist Kenneth L. Verosub and anthropologist Mary Howell.

One week after their contract took effect, a magnitude 5.0 earthquake rumbled through the Little Lake Valley area, about 200 kilometers north-northwest of San Francisco. They were ready; within three days they were interviewing some of the area's 3,000 residents about whether they had noticed any unusual behavior in pets or farm animals. About 17 of the 50 households interviewed during the next six

weeks reported unusual behavior in some, but not all, of their animals. "The behavior reported was unusual because there was no immediate explanation for it, but it was not bizarre," Lott reported. "It had often been observed other times under circumstances that one would expect to make animals anxious or nervous."

For example, a "normally very calm" Arabian horse was found kicking the sides of its box stall about four hours before the quake. The owner tried to quiet it and finally released it into a paddock "where it continued to move about nervously," Lott said. "Horses in neighboring stalls were calm the whole time." Pets often sought the company of their owners while pacing nervously. "A Doberman pinscher, which normally ran about outdoors or slept during the morning, remained in her owner's presence almost continually, vocalizing and acting nervous," Lott reported. "The woman wondered aloud to her husband if she should give the dog a Valium," he said.

"In nearly every case the behavior of the subjects and the internal consistency of their reports convinced us that they were faithfully reporting their recollection," Lott said. "Most of the positive reports came in response to a general question about observed changes prior to the earthquake" and preceded the specific question about animal behavior in the interview, he said. Furthermore, "almost all owners who gave negative reports on all their animals had heard that animals behave abnormally prior to earthquakes and thought that in general it was true," he said. One even seemed disappointed that his goose hadn't shown signs; he had been watching her.

One of the most "convincing" aspects of the data is the nonrandom distribution of positive and negative reports, Lott says. Positive findings were confined primarily to a small region, strengthening the possibility that unusual behavior "was indeed an earthquake precursor and that the physical stimulus which caused that behavior had a limited, definable range," Lott says.

Interviews were designed to establish rapport with individuals and to "convince the interviewee that the interviewer does not have a preferred answer." Most of all, there was an attempt to "get an objective description of the animal's actions." Since animals cannot talk, the scientists must try and read their behavior for clues about what, if anything, the animals are sensing. For this reason, one animal behaviorist participated in each interview.

The value in looking for animal precursors is not to gain a few hours lead time in evacuating potential earthquake zones but to learn where to look for warning clues, Lott says. If the animals are really sensing something, there must be ways to measure it; he says that's the ultimate objective. The UC-Davis team plans to conduct similar studies at as many as four additional earthquake sites, Lott says. □

Tumors not typed to a T

The immune system resembles a Russian novel: So many characters and subplots keep appearing that it's hard to keep them all straight. For example, take the protagonists known as the T-cells, lymphocytes so named because they are programmed in the thymus gland. Among other things, these cells are in charge of zapping tumors, rejecting organ transplants and giving bacteria the boot. In recent years, it has become apparent that there is not just one type of T-cell, but rather a menage à trois: helper Ts, killer Ts, and suppressor Ts.

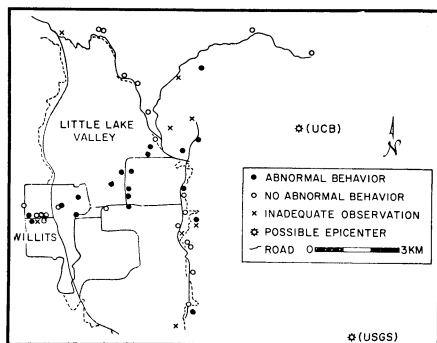
Killer T-cells are credited with detecting and destroying tumors. But, obviously, sometimes a tumor slips by the surveillance of the killer T-cells. Karl E. Hellström and Ingegard Hellström of the Fred Hutchinson Cancer Research Center in Seattle, Wash., are coming closer to understanding one of the ways it escapes detection. They reported at the recent annual meeting of the Federation of American Society for Experimental Biology in Atlantic City that antigens (substances foreign to the body that can elicit an immune response) shed by the growing tumors apparently activate suppressor T-cells to, well, suppress killer T-cells.

Injecting mice with various combinations of tumor, a form of tumor antigen, killer T-cells and suppressor T-cells, they discovered that tumor growth was enhanced if the tumor antigen was injected along with the tumor. They traced this protective effect of the antigen to a population of suppressor T-cells in the spleen. If these cells are knocked out by irradiation, the tumor antigen can no longer protect the tumor.

Now in the great war waged by the immune system against foreign invaders, the suppressor T-cell is no fifth column. If the killer T-cells were left unrestrained, they might start knocking off innocent body bystanders. The suppressor T-cells are thought to keep in check the incidence of autoimmune disease by hindering the killer T-cells.

Many body components are potentially antigenic and could be attacked by the immune system. Suppressor T-cells are thought to recognize these natural body components and their circulating potential antigens because they are present from birth. Researchers speculate that the circulating levels of the tumor antigen trick the suppressor T-cells into believing that the tumor is part of the body and their suppressive actions become misdirected.

The Hellströms are trying to discover just what the suppressor T-cells do to thwart the killer T-cells. They suspect that the cells may secrete a suppressing substance and are now searching for it. Then perhaps they can suppress it. □



Region studied following the Nov. 22, 1977 quake. Possible sites for the quake's epicenter — one proposed by UC-Berkeley, one by the U.S. Geological Survey — vary due to placement of seismic monitors.