reason, he says, is that "osteoporosis is a serious disease and the nutritional value in dairy products goes beyond calcium. It is safe and inexpensive [to get calcium this way]. It is quite something else to say that the entire population should take calcium supplements."

Mazess says he is on record as opposing the consensus panel's calcium recommendations. "There is no evidence of efficacy and the safety has never been evaluated." He points out that a high calcium intake can lead to kidney stones in susceptible people and that calcium supplements cut off vitamin D, which is necessary for the cellular activation of bone cells.

A number of researchers are telling their patients that calcium supplements should be used only as a last resort.

Riggs points out that his study applies only to adults. There is a body of evidence indicating that calcium intake in childhood and adolescence determines peak bone mass in adulthood. Those with greater peak bone mass are less likely to develop osteoporosis. Mazess notes that his remarks about calcium also apply only to adults.

The real danger of the calcium bandwagon, say Riggs and Mazess, is that women will believe that calcium is a substitute for estrogen in preventing osteoporosis. Estrogen supplements for postmenopausal women, the researchers agree, are the best way to slow bone loss.

Riggs also notes that a number of studies have shown that weight-bearing exercise can slow bone loss. And there are risk factors for osteoporosis that can be reduced. Smoking doubles a person's risk, as does drinking as few as two alcoholic drinks a day.

Yet the calcium debate is likely to continue as researchers, provoked by Riggs' and Christiansen's results, try to decide whether dietary calcium is really as crucial as it has been said to be. At this point, Riggs notes, "it is important to try and settle the issue." ■ GINA KOLATA

ADDITIONAL READING

"Osteoporosis," *National Institutes of Health Consensus Development Conference Statement* **5** (no. 3) (1984).

B. L. Riggs and L. J. Melton, "Involutional osteoporosis," *N. Engl. J. Med.* **314**, 1676 (1986).

Briefing:

Quake Prediction Under Way in Earnest

In June the 25-kilometer section of the San Andreas fault that passes by the tiny town of Parkfield in central California showed signs that it might rupture and produce the moderate earthquake officially predicted to occur by 1993. The fault's unusual behavior gave the U.S. Geological Survey's most sophisticated earthquake prediction network its best test to date.

The threatening fault activity, which became obvious on 6 June and prompted a mid-level earthquake alert, eventually subsided. Nevertheless, the experience has reassured researchers that the direction that prediction research has taken since a major reassessment in the 1970's is a sound one. "It gives us confidence," says one USGS scientist, "that all these instruments we've installed do measure something."

In hindsight, the activity along the Parkfield section of the fault started in late May, but the fault's behavior was not unusual enough by the standards of the USGS's response plan to warrant any kind of alert until the seismometer system picked up a flurry of tiny, imperceptible earthquakes between 6 and 8 June beneath Middle Mountain. That is where the fault broke first during the Parkfield earthquakes of 1966, 1934, and presumably those of 1922, 1901, 1881, and 1857.

On the USGS's scale of e up to a, the June microearthquakes created a d-level alert. According to the best estimates of the response plan, the probability of a repeat of the 1966 quake within the next 3 days jumped from the background level of 0.01% to between 1 and 3%. But no more quakes of significance appeared and the d-level alert lapsed according to schedule on 11 June.

On 13 June Parkfield chief scientist William Bakun of the USGS in Menlo Park passed the word that the other mainstay of the network, the creepmeter system, had triggered another d-level alert. Accelerated creep of the sides of the fault past each other had begun on 6 June, when the flurry of microearthquakes began, at an instrument in the central area of the typical Parkfield rupture. One and a quarter millimeters of creep in a week rated a d-level alert.

By 15 June each of two water wells straddling the creepmeter independently exceeded the d alert criterion, presumably after shifting stresses in the surrounding rock squeezed water levels upward several centimeters. Two d's at water wells make a c alert under the response plan. Both a strainmeter at the southern end of the rupture zone and laser distance measurements around the anomalous creepmeter, while not rating an alert on their own, showed "seriously anomalous" readings. The net result under the plan was still an overall c alert, so the probability of an imminent repeat of 1966 rose to between 3 and 11%.

By the next afternoon the USGS's Parkfield working group hypothesized that all or most of the observations could be explained if a 3-kilometer-square patch on the fault 1 to 4 kilometers below the creepmeter had slipped perhaps 10 millimeters. Although the slipping patch was well above the deep fault patch thought to be tightly locked and awaiting the next rupture, it was the same area in which ground cracks that may have been the result of accelerated slip were seen weeks before the 1966 earthquake.

By 17 June, the alert began to wind down. No ground cracks appeared, and the anomalously high rates of change on the network began to slow. On 18 June the alert was dropped back to the d level. That was the same day that the response plan that directed the whole procedure became official with the USGS director's signature. On 27 June the status returned to normal.

"When it [the alert] was going on," says Bakun, "there wasn't anyone who didn't think it might be the start of a repeat of the '66 earthquake." There will likely be a lot more such excitement. If the anticipated magnitude 6 earthquake does not strike until 1993, there could be another 5 to 15 c-level alerts and one to two a-level alerts, when the probability reaches better than 37% and the USGS sends a warning to the California Office of Emergency Services. The working group is generally pleased with this first experience. The event appeared on several types of instruments, researchers could tell what was happening at the time, and the response procedures went reasonably smoothly.

The June alert also points up a problem. "We saw the slip event where we had the sensors to see it," says Allan Lindh of the working group, "We don't have much of an idea what happened beneath Middle Mountain," where the magnitude 6 rupture will likely begin. Whether the flurry of microearthquakes had anything to do with the slip event 10 kilometers to the south thus remains unknown. The problem is that the rugged Middle Mountain area remains relatively lightly instrumented with strainmeters of any kind. Money to beef up that part of the network is now available and installation of several new instruments should be complete by fall, less than 2 years before the predicted most likely date of the next Parkfield quake. ■ RICHARD A. KERR