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## Bigger Quake in Area Called Possible

By WALTER SULLIVAN

The earthquakes recorded in recent days near Ardsley, N.Y., may be foreshocks for a more severe one yet to come, according to Columbia University seismologists.

They said such a quake could occur at any time within months. They stressed, however, that this was a possibility, rather than a probability, and other specialists expressed doubts regarding the prognosis.

The Columbia seismologists said they could not estimate how much more severe a new quake might be than the one that occurred Saturday. Its magnitude was measured at 4.0 on the Richter scale of ground motion, a relatively small earthquake that caused little damage.

Dr. Leonardo Seeber and other earthquake specialists at Columbia's Lamont-Doherty Geological Observatory in Palisades, N.Y., said in a series of interviews that their recent analyses of past earthquakes in the New York area showed that those roughly centered on the city and sufficiently strong to topple chimneys, measuring 5.0 or greater on the Richter scale, occurred in 1737, 1783 and 1884.

### Last Big Quake

Because a century has elapsed since the last big quake, the specialists said, the possibility of a recurrence must be considered. They said they could not entirely rule out an earthquake comparable to one estimated at magnitude 7.5 that hit Charleston, S.C., in 1886, destroying many homes and taking at least 60 lives.

On the other hand, Dr. Alan Kafka of Boston College, who published a paper on New York earthquakes in the Oct. 1

issue of The Bulletin of the Seismological Society of America, described the cause of these earlier quakes as "an enigma." He termed any predictions for a recurrence premature.

According to Dr. Seeber, the dozen or so small aftershocks recorded since the main earthquake last Saturday are not as numerous as would be expected if the quake on Saturday was the main event. Normally, he said, there are about 10 times as many aftershocks in the extremely weak class of magnitude 1.0 than of magnitude 2.0, which is 10 times stronger, but such a pattern has not been observed.

Dr. Kafka said yesterday that he did not consider this a strong argument for further quakes. Dr. Seeber could not be reached for further comment.

A more typical swarm of aftershocks, Dr. Seeber said earlier, followed the Goodnow earthquake of Oct. 7, 1983, in the heart of the Adirondacks four miles east of Newcomb, N.Y. Rated at magnitude 5.2, it was the strongest in the state since a 1944 earthquake that toppled 90 percent of the chimneys in Massena.

Dr. Seeber said he suspected that the Goodnow earthquake and others in this part of the continent, including the one Saturday, were controlled by a combination of geological factors and faults.

### Faults in New York City Area

Those faults cutting across the New York City area lie in two directions: from southeast to northwest, parallel to a fault under 125th Street, and from southwest to northeast, parallel to the Hudson Highlands and a geological feature known as Cameron's Line.

A preliminary analysis of fault movement in the Ardsley quake by Co-

lumbia seismologists has indicated movement in one of those two directions, but as yet has not shown which.

The region of the Goodnow earthquake in the southeastern Adirondacks, whose cause Dr. Seeber likens to that of the Ardsley temblor, is cut by a multitude of faults trending from west of south to east of north. Some of them can be traced for 60 miles or more and contain long, narrow lakes such as Indian Lake and Long Lake. Last summer Dr. Seeber and his colleagues searched the region, however, and found little evidence of recent motion along those faults.

Furthermore, analysis of the Goodnow earthquake and its aftershocks showed that the deep crust had ruptured for only a mile, compared with slippages along many miles of fault typical of California earthquakes. To assess those in the East, Dr. Seeber said, one must avoid a "California mentality."

The geological factor involved in both the Adirondack and Ardsley quakes, Dr. Seeber suspects, was the existence of a deep-lying marble formation. In the high temperature at a depth of four miles, where the Ardsley quake occurred, marble becomes plastic and can readily respond to stress, whereas surrounding formations of more rigid rock remain unaltered until the stress reaches a high enough level to cause rupture and an earthquake.

According to Dr. Leo M. Hall of the University of Massachusetts in Amherst, the Inwood marble of Westchester County underlies Central Park Avenue very close to the epicenter of the Ardsley quake. It forms a valley flanked on both sides by much more rigid rocks: Fordham gneiss on the

east and Manhattan schist on the west.

The digging of two new tunnels under New York City has helped trace the paths of Cameron's Line and the 125th Street Fault. Excavation of a water tunnel under the east side of Manhattan has enabled Dr. Seeber to photograph a band of crushed rock where the 125th Street fault cuts across it.

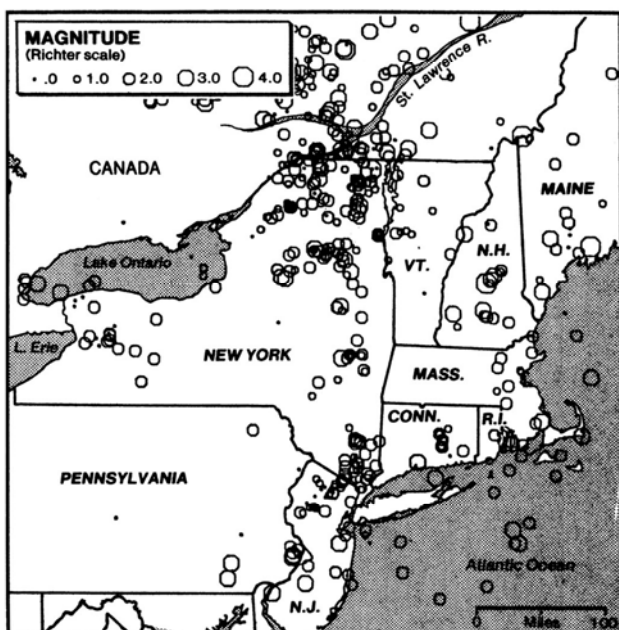
Dr. Charles Mergerian of Hofstra University has found where the new subway tunnel from 63d Street to Long Island City crosses Cameron's Line. The latter, he discovered, lies under the channel between Roosevelt Island and Queens.

Cameron's Line is a so-called suture zone where converging land areas became joined as the European-African land mass collided with North America 400 million years ago. Although the Ardsley quake took place only two miles from the line, Dr. Hall doubts that the quake originated on it. Unlike the San Andreas Fault of California, it has not been a source of many quakes.

Parallel to it and more active, however, is the Ramapo Fault along the southeast margin of the Hudson Highlands. It passes within a few miles of the Consolidated Edison Company's nuclear reactors at Indian Point.

According to the Consolidated Edison Company, the reactors there are designed to shut down at the start of any quake of magnitude 7.0 on the modified Mercalli scale, an index of local destructiveness. That would be 10 times as violent as any quake recorded within a 200-mile radius of the plant since the 1800's.

Dr. Kafka argued that the significance of the Ramapo Fault has been exaggerated. He said he believed the quake-prone area surrounded the entire basin between the Hudson Highlands of northern New Jersey and the Bear Mountain area and the east bank of the Hudson River. He also questioned efforts to relate the earthquakes to motion of North America over the earth's deep interior, or mantle, as the continent drifts away from the Mid-Atlantic Ridge. The picture, he said, "is much more complicated."



Location and intensity of earthquakes over the period 1972-1983.

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