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CAN WE PREDICT EARTHQUAKES?

(This is an unsensational statement on the earthquake problem by one of America's leading seismologists. Is there danger of earthquake in California, New England, and elsewhere in the United States? Dr. Willis states the facts and the reader can draw his own conclusions.)

By Dr. Bailey Willis

Professor Emeritus of Geology, Stanford University.

"All I know is what I read in newspapers", as Will Rogers says. At least that is true as regards "predicting" earthquakes. Prediction connotes precision and precision spices news. Hence news predicts precisely. There will be a destructive earthquake shock in Wall Street in two years, two months, and a day. That, telegraphed by an irresponsible reporter is news, though not true. There have been severe earthquake shocks in New England. They are sure to occur again sooner or later. Common sense demands that we take precautions against disaster. That is not news, though true.

Earthquake news, served up as a kind of side dish, is overspiced. It is time for seismologists to give the public plain food. Certain facts we know; others we think we know; still others we infer confidently; others doubtfully; then we guess. The prediction of an earthquake is a guess, which I prefer to call a forecast.

We know that earthquakes are natural phenomena, which have occurred from time to time, at longer or shorter intervals, with greater or less violence, but unequally as regards time-intervals and intensities in different countries.

If earthquakes were like comets they would return at definite intervals, But they do not resemble comets in any respect whatever. Rather are they like storms, an effect of concentrated energy; gathered in the one case in the air and reaching a crisis at frequent intervals; in the other case gathered in the earth's crust and rising to a critical state at longer intervals. That much we know regarding their periodicity and we can say with confidence that the farther we are from the last great shock, the nearer we are to the next one.

We know that sometimes, but not always, earthquakes group themselves in a district in a brief sequence of years. We recognize in those cases what we call fore-shocks, a relieving shock, and after-shocks. When we have a full series there

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is no difficulty in distinguishing the several parts of the sequence. The fore-shocks are moderately severe and limited in their effects to a small area. The relieving shock is one of great intensity and large area. The after-shocks gradually diminish in intensity and frequency. In case of a moderately severe earthquake, however, such as the Santa Barbara incident, we cannot know definitely to what extent it may have served as a relieving shock for that locality or in what manner it may have relieved adjacent districts of strain, or have increased the strain upon them. Here we begin to guess.

We may be guided in guessing by related facts and may feel more or less justified accordingly. Thus the historical record shows that southern California is a province which has been shaken from time to time by earthquakes of a general character. In 1857 the disturbance was strong over an area of some 250,000 square miles. That is, it compared in extent with the earthquake of February 28, 1925 in the eastern States, but it was much more violent. The Santa Barbara shock, by contrast, shook an area that did not exceed 3000 square miles and points of high intensity were curiously limited and sporadic. The energy released in the latter case was not more than one percent., very likely not one tenth of one percent. of that set free in 1857. The 1857 shock was a relieving shock. It was followed by a long interval of quiet. I would not feel safe in guessing that the Santa Barbara incident would have a like effect.

During the last seven years there have been four incidents of the Santa Barbara kind in southern California. We do not know that they are fore-shocks. We cannot know until the relieving shock shall have shown that they are. But we are on the safe side in guessing that they will prove to have been fore-shocks.

We think we know that earthquakes are produced by pressure which distorts the elastic rocks, so that when they slip they vibrate. It has been found by the Coast Survey that the mountains in California are on the move, so to speak; that is, they are pushed out of place, and we connect their movements with the pressure to which we attribute earthquakes. In southern California certain mountain peaks not far from Santa Barbara have moved northward, in the direction in which the earthquake pressure should push them, as we understand it. In northern California other mountain peaks moved northward until after the earthquake of 1906, but they then began to slide back southward. The shock of 1906 was a relieving shock for the north and we guess that it took off the pressure. The mountains in the south have not begun to slide back, so we think that the pressure has not been relieved, and this confirms our guess that the relieving shock is ahead of us.

Until recently we have had to depend upon our senses for evidence of nearby earthquake activity and we have been aware that their capacity to detect vibrations is limited to the greater ones. Thousands of minor shocks or micro-tremors occur daily and they would give us an index of the elastic strain in the rocks not unlike the significance of a barometer in weather observations, if we could but register them constantly. We have had instruments, it is true, that would record the occurrence of a great shock a thousand miles away, but they are not tuned to the more rapid waves of a local tremor. Through the researches of the Carnegie Institution of Washington, we now have available the Wood-Anderson seismometer, a simple, but very sensitive little instrument, which can be tuned to record elastic waves of any length, and we are thus in a position to know what the actual condition of the earthquake strain is in any district where the seismometers may be installed. We shall then guess more certainly, but we have to wait

until the value of that information is appreciated in San Francisco, New York, Boston, and elsewhere, at least to the degree that business interests Will provide the instruments as a measure of self-protection.

In the mean time the seismometers have been made and tested at Pasadena, where they have proved their efficiency by registering as many as two hundred micro-tremors a year. This state of activity is not what we would expect during a period of quiet. It might occur before a relieving shock or soon after one, but in the latter case the great shock must have occurred recently, and that is not the fact.

To sum up for southern California: Sixty-eight years have passed since the last general earthquake; severe strain is indicated by local shocks, displacements of mountains, and seismometric records; in 1852 a disturbance similar to that of 1925 preceded the relieving earthquake of 1857. Will history repeat?

For northern California the facts are: It is only 16 years since the greatest relieving shock recorded in that province; slight, though sensible tremors occur from time to time; they are not as strong as we would expect fore-shocks to be; the pressure which moved mountains has been relaxed. The best guess seems to be that the strain has begun to re-accumulate, but is not likely to reach a critical condition for two or three decades.

As regards New England we know that the conditions are very different from those in California. Intervals between relieving shocks are much longer; distinct fore-shocks have not been recognized; movements of mountain peaks may have occurred, but are unknown; seismometric records of micro-tremors are lacking. The St. Lawrence earthquake of February 28, 1925, no doubt relieved the strain within a considerable area. Does that area include New England? I do not know. Does it include New York? I cannot guess! The poverty of information is lementable. We fact two possibilities, as far apart as the poles: (1) the strain is relieved, we need not expect another severe shock in a century or two. Or (2) the strain is not relieved; it has been increased by the failure of one part of the continental structure, which brings the pressure to bear on another; if so, we may expect renewed activity soon. No light leads in either direction.

New York, Philadelphia, Washington are in a seismic belt where shocks have been so rare and so slight that we hardly expect them. It may be a safe guess that no earthquake of any severity will ever affeet those cities. And yet - there was the Charleston earthquake of 1886! A great shock, its intrusion upon our fancied security gives one pause. I wish seismometers had been longer in use, that they were more generally installed today.

TETRAETHYL LEAD GAS FOUND NOT DANGEROUS

Tetraethyl lead "knockless" gasoline is safe to handle and use as fuel, though the anti-knock compound itself is still recognized as dangerous in its concentrated form. This is the gist of the findings of the special committee of the U. S. Public Health Service that has been investigating the problem brought up by the alleged "lead-gas" poisonings some months ago.

The committee examined 252 men, most of them car owners and users, employees