

Earthquakes: Causes, Mapping, and Predicting

Throughout history, man has made many advancements. These advancements have been made to make life easier. The one thing man can't do is to control Mother Nature. Mother Nature can cause many things such as earthquakes.

The causes of earthquakes have been theorized in many ways. According to the book *Predicting Earthquakes* by Gregory Vogt, the Greeks, "blamed the earthquakes on Poseidon, god of the sea"(25). The Hindu believed that "the earth was a platform that rested on the back of eight great elephants. When one of the elephants grew weary, it lowered and shook its head causing the ground above to tremble"(Vogt 25). Margaret Poynter writes "many primitive people thought that the earth rested upon the back of some sort of animal. When that animal became restless, great cracks appeared in the ground, and tall trees swayed and fell. In South America, the animal was a whale. In Japan, it was a great black spider or giant catfish. One ancient tribe thought that four bulls supported the earth on their horns. To amuse themselves, they sometimes tossed it from one to another"(6). In the same book, Poynter says "The Chinese believed that monsters lived in the caves inside the earth. When the creatures fought, the surface of the earth trembled (6)." "In Greece, it was not an animal, but a titan named Atlas who was condemned to support the world upon his shoulders. Later, about the third century B.C., a Greek philosopher, Aristotle, had a more scientific explanation. He thought that earthquakes occurred only when hot air masses tried to escape from the center of the earth. Two centuries later, Lucretius, a Roman, wrote that underground landslides caused the earth's surface to move"(Poynter 7).²

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Today, scientists have found a more logical reason to earthquakes. Scientists say almost 600 million years ago, all the continents were connected to form a huge super continent called Pangaea. At about 220 million years ago, Pangaea began to break up into sub-blocks. According to the book *Volcanoes, Earthquakes, and the Formation of Continents*, these sub-blocks were

called "Gondwana (which corresponds approximately to the continents of the present southern hemisphere) and Laurasia (the northern hemisphere)" (Kohler 15). According to Pierre Kohler, "The earth's surface is divided into 13 plates: seven large ones (the largest corresponding to the Pacific) and six small ones" (18–19). The book *Earthquakes* by Margaret Poynter states that a person named Robert Mallet studied earthquakes. He made tests, drew a world map, and recreated earthquakes only to find that rocks are being overstressed at the faults. "A fault is the place where two plates meet and are rubbed against each other" (Grolier Electronic Publishing, Inc.). The book, *Predicting Earthquakes*, the author points out "There are generally three kinds of faults: normal, reverse, and strike-slip. By careful observation and measurement, geologists, acting like detectives, can tell how much a fault moved, which part went up, which part went down, and which way the fault moved" (Vogt 26). "When one of the plates slip under the great amount of stress at the fault, an earthquake occurs. The shaking we feel are the passing of long waves" (Putnam 443). "The L-waves (long waves) travel at slower velocities than the primary and secondary waves. These waves make the largest squiggles on a seismograph but their effect diminishes rapidly with distance. The L-waves are limited to the crust" (Putnam 443).

One of the two kinds of waves are "Primary waves are a kin to sound waves, and thus produce alternate compression and rarefaction in the medium through which they travel much like the waves that spread out through the air in all directions from a tuning fork" (Putnam 444).

The second of the two kinds of waves are "Secondary waves, the particles in the rock through which the wave is traveling vibrate at right angles, or transversely, to the direction of

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propagation. The velocity of P-waves are almost twice as fast as S-waves" (Putnam 444).

"A seismologist cannot locate the epicenter (where the earthquake took place) of an earthquake that has shown up on his seismometer from the seismogram, or written record, alone.

All the seismogram tells him are the times when the P and S waves reach his station, and how

violent they are" (Marcus 62).

Rebecca Marcus, in her work *The First Book of Volcanoes & Earthquakes*, explain how scientists locate an earthquake's epicenter. "To locate a quake, the seismologist first finds the difference between the time of arrival of the P wave and that of the S wave. Let us suppose that an S wave reaches a station in New York on a certain date at 10:30 P.M., 4 minutes and 42 seconds after a P wave. the seismologist then refers to a table, which tells him that the epicenter is 2,000 miles away. Although he has found its distance, he does not know its direction from his station.

"Now he needs the cooperation of at least two other stations. Messages are sent, let us say, to a station in San Francisco and to another in Rio de Janeiro, asking for their distance from an earthquake that occurred on that date at eighteen seconds past 10:25 P.M., New York time. When the seismologist receives his answers, he learns that the epicenter was 3,800 miles from San Francisco and 3,500 miles away from Rio de Janeiro. Using a radius representing 2,000 miles, he draws a circle around New York. Next , using the same scale, he draws a circle with a radius representing 3,800 miles around Riode Janeiro. The three circles cross at a point near the Dominican Republic. And here is the epicenter of the earthquake" (63).

To measure and identify these waves, an invention called the seismometer was used.

Rebecca Marcus tells about the first seismograph. "The very first attempt to detect a distant earthquake was make about A.D. 136 in China by an inventor whose name was Chang Heng.

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Chang Heng's invention consisted of a large hollow ball standing on its base which was set on level ground. A heavy weight was suspended inside the shell. Around the large ball, at equal distances, were eight open-mouthed bronze dragon heads, and on the tongue of each was a small copper ball. A bronze open-mouthed toad stood beneath each dragon head. The whole instrument

was so arranged that, at the slightest jarring by an earthquake wave, the suspending weight would cause one of the balls to shoot out of the dragon's mouth into the toad's mouth. Which ball shot out depended on the nearest path of the wave" (Marcus 57).

In today's modern world, technology would make Chang Heng's seismometer look crude and untrust worthy. Today's modern seismometer looks similar but more complicated because it involves photographic paper, a beam of light, a mirror, and many other things.

In 1935, Charles Richter created a scale that measured earthquakes. In February 1977, Richter's scale was slightly revised because of the fact that there are now more sophisticated ways of measurement and the scale didn't cover the higher magnitude rating. In the book Geological Disasters, by Thomas G. Aylesworth, the author states:

"There is another method of measuring earthquakes, the modified Mercali scale.

This is a twelve-point scale of intensity that grades the quake by describing the kinds of damage and other effects caused by it. You might say that the Richter scale measures the actual power of the earthquake, while the modified Mercali scale measures the earthquake's effect on humans. In any case, the two scales do not give us quite the same information. Here are the twelve points that make up the modified Mercali scale:

I Just detectable by experienced observers when prone. Microseisms (tiny vibrations).

II Felt by few. Delicately poised objects may sway.

III Vibration, but still unrecognized by many. Feeble.

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IV Felt by many indoors but by few outdoors. Moderate

V Felt by almost all. Many awakened. Unstable objects moved.

VI Felt by all. Heavy objects moved. Alarm. Strong.

VII General alarm. Weak buildings considerably damaged. Very strong.

VIII Damage general except in proofed buildings. Heavy objects overturned.

IX Buildings shifted from foundations, collapse, ground cracks. Highly destructive.

X Masonry buildings destroyed, rails bent, serious ground fissures. Devastating.

XI Few if any structures left standing. Bridges down. Rails twisted. Catastrophic.

XII Damage total. Vibrations distort vision. Objects thrown in air. Major catastrophe" (14–15).

In the book Earthquake by Bryce Walker there is an article that explains how to predict earthquakes. Most of the theories involve the other planets lining up and putting great stress on the earth which causes earthquakes. "I think that all of the oil and soft medals that we are taking is creating friction and causing the earthquakes in California" (Last Name).

In, When Nature Runs Wild, the author states that "At the present time, man cannot predict earthquakes. Several nations, however, have research programs that are investigating these problems. Leaders in this field are the United States, Japan, and the Soviet Union" (Johnson 12).

The World Book Encyclopedia, writes that "Scientists can make fairly accurate long-term predictions of where earthquakes will occur. They know, for example, that about 80 percent of the world's major earthquakes happen along a belt encircling the Pacific Ocean. This belt is sometimes called the Ring of Fire because it has many volcanoes, earthquakes, and other geologic activity" (Earthquakes; Karen C. McNally 38).

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