CHAPTER 3

SEISMICITY OF THE EARTH AND VOLCANOES

In the picture you can see an eruption of a volcano. These eruptions affect the land and the air for kilometers around. Earthquakes, like volcanoes, can cause a great deal of damage.

In this chapter you will read about earthquakes and volcanoes on Earth. This chapter also suggest some "signs" that scientists are using in an effort to predict earthquakes and volcanic eruptions.

CHAPTER OBJECTIVES

1. Explain the relationship between faults, earthquakes, and plate boundaries.
2. Explain how scientists use seismic waves to locate the epicenters of earthquakes.
3. Contrast the formation of intrusive and extrusive rocks.
4. Describe four types of volcanic cones.

3.1 EARTHQUAKES

An earthquake is a trembling or shaking of the earth. What causes an earthquake? Huge explosions can shake the earth, or magma moving up in a volcano may cause an earthquake. Most earthquakes, however, happen because rocks move along a fault. Think about these questions as you read about earthquakes:

a. How are earthquakes related to faults?

b. Where do most earthquakes occur?

c. What does the Richter scale tell you about an earthquake?

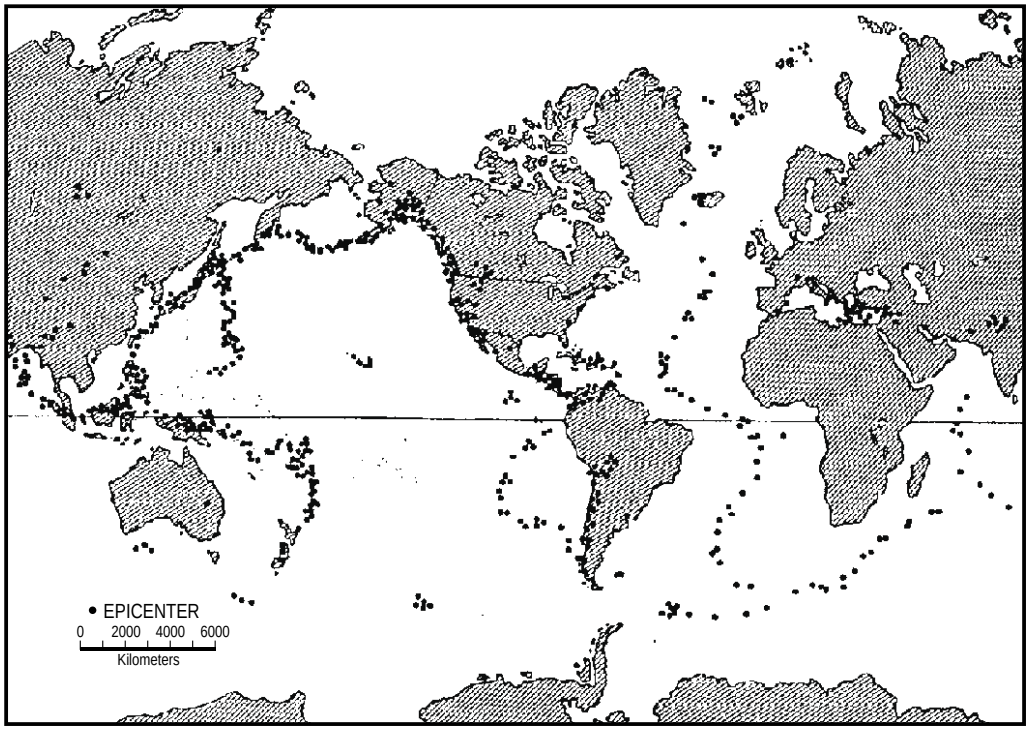
d. What are aftershocks?

• *Earthquakes and Faults*

Imagine what happens when you bend a plastic ruler. if you bend it far enough, the ruler breaks. Both pieces snap back to a straight position. Rocks in the earth's crust that are under pressure also bend, break, and snap back. A fault is a break in rocks along which rocks have moved.

When the break occurs, energy is released as seismic waves. This energy makes the earth shake, and we feel an earthquake.

With the installation of highly sensitive seismographs in many locations around the world, it is relatively easy to record the seismic disturbances, even if they are not felt by man. Once seismic waves have been detected and recorded at several seismic stations, it is possible to determine where they were produced. There are several institutions which are dedicated to determining earthquake parameters for all the seismic activity of the world. With this information it is possible to determine the pattern of places of high and low seismicity.



World distribution of earthquakes.

From this diagram it can be concluded that the distribution of seismic events is not homogeneous. There are very well defined seismic areas. In the middle of the oceans seismic events are concentrated along very narrow strips which coincide with the location of the mid-oceanic ridges. Away from these areas, most of the oceanic floor is aseismic.

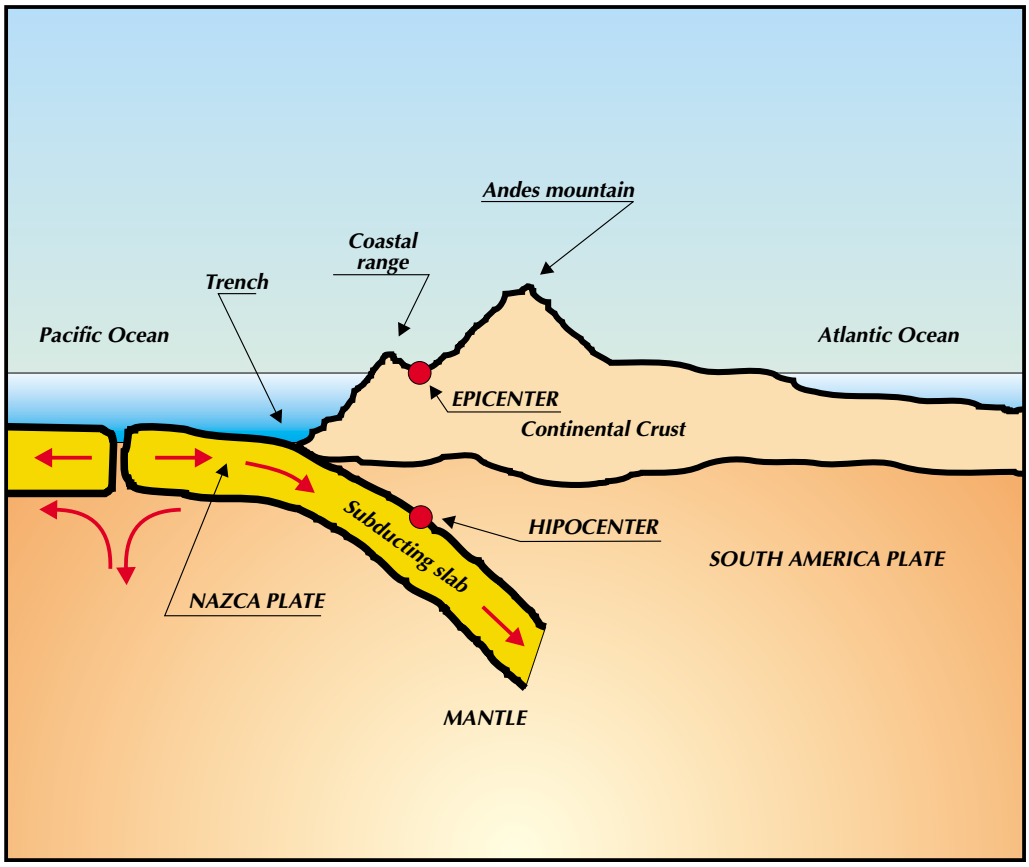
The most important mid-oceanic ridges are: the Mid-Atlantic ridge, the Mid-Indian ridge which divides in two branches to the south, and the East Pacific Rise. The East Pacific Rise starts in the Gulf of California and divides in two at Easter Island (Chile), one going south-west, and one going up to Taitao Peninsula, in continental Chile. Normally all the seismic activity in these areas is shallow and of small magnitude.

Equally concentrated and most numerous are the seismic events located in structures called island arcs. The most important island arcs are located in strips around the Pacific Ocean. The main island arcs are: Alaska-Kodiak Islands, Kamchatka Peninsula, Kuril Islands, Japan, Mariana Islands, Solomon Islands, New Hebrides Islands, Fiji Islands, Phillipines-Sunda-Adaman islands. in the Atlantic Ocean we find the Lesser Antilles and the South Sandwich Islands. Similar seismic strips are found along the coast of Central and South America. The deepest and largest magnitude earthquakes are all located in these regions. The wider seismic belt along the southern part of Europe, the Himalayas and

South East Asia, is a more complicated area, where earthquakes are more sparse.

Minor seismicity (or almost null) areas are the continental shields, like the Canadian shield in the eastern part of North America, the Brazilian shield in South America, the eastern part of Australia, Central Europe, South Africa and the oceanic floors far from the mid-oceanic ridges.

The point inside the earth where the rock breaks or moves is the focus of the earthquake. The focus of most earthquakes is inside the earth where plates rub; the place on the surface of the earth immediately above the focus is the epicenter of the earthquake. if the focus is at the surface of the earth, the focus and epicenter coincide.



Profile across South America.

If the focus is located at depths between 0 and 60 kilometers, the earthquake is shallow. If the focus is located at depths between 60 and 300 kilometers, the earthquake is of intermediate depth. If the focus is between depths of 300 and 700 kilometers, the earthquake is of deep focus.

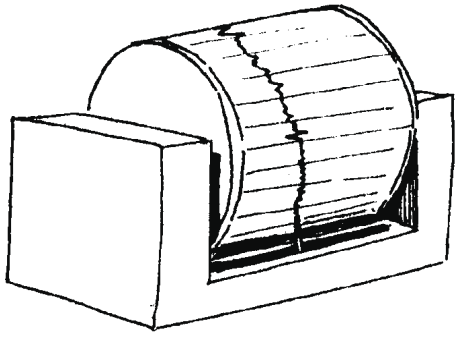
• SIZE OF AN EARTHQUAKE

To measure an earthquake two scales are used to determine intensity and magnitude.

The intensity of an earthquake is the violence with which the earthquake is felt at different locations in the affected area. Its value is determined by assessing the damage produced, the effect on objects, buildings and grounds, and the impact on people. The intensity value of an earthquake is determined according to a previously established intensity scale, which is different for different countries.

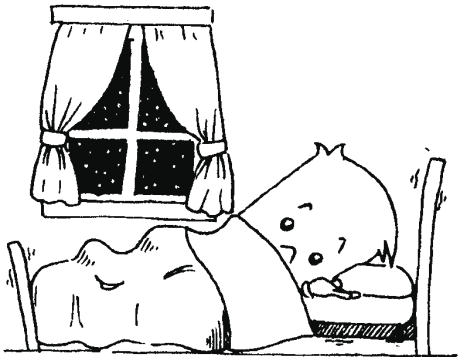
In most countries of America, the scale in use is the Modified Mercalli Intensity Scale which has 12 intensity levels. Following diagrams show the different intensity levels.

INTENSITY I



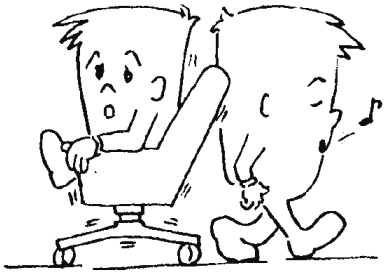
Not felt except by a very few persons under especially favorable circumstances.

INTENSITY II



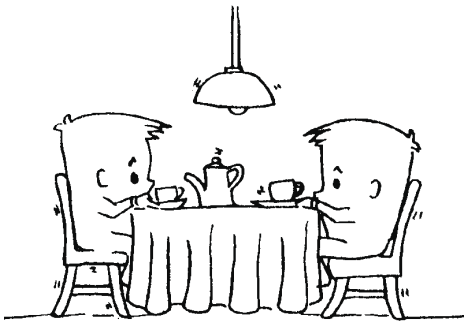
Felt only by a few persons at rest, especially on upper floors of buildings.

INTENSITY III



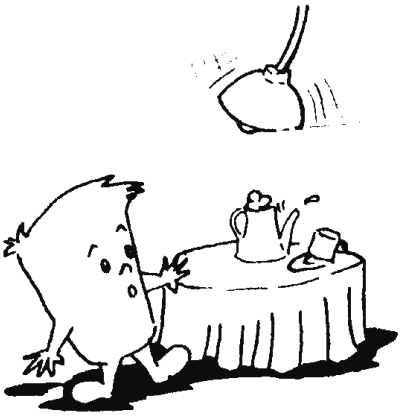
Felt quite noticeable indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake.

INTENSITY IV



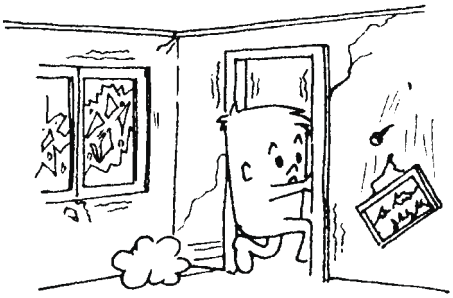
During the day, felt indoors by many people. Dishes, windows and doors, disturbed; walls make cracking sound; liquids in open vessels disturbed.

INTENSITY V



Felt by nearly everyone. Some dishes, windows, etc., broken. Unstable objects overturned.

INTENSITY VI



Felt by everyone. Some heavy furniture moved. A few instances of fallen plaster or damaged chimneys.