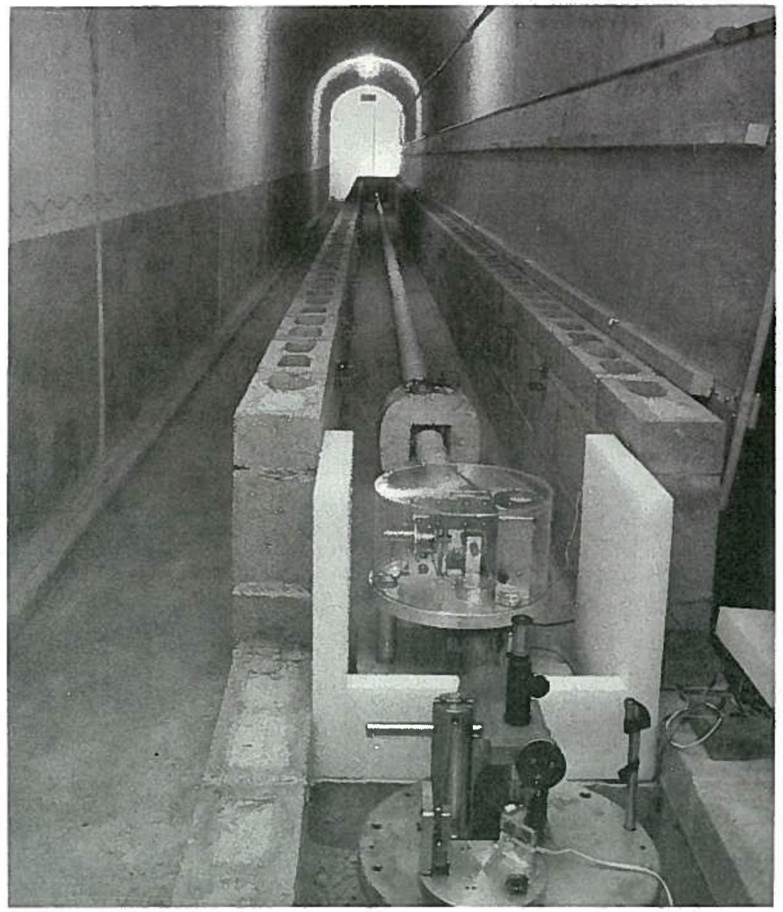

Figure 17-6
Example of an actual strain seismograph installation in an underground tunnel. This system is so sensitive that it could detect a change of 1 mm in the distance between New York and California.

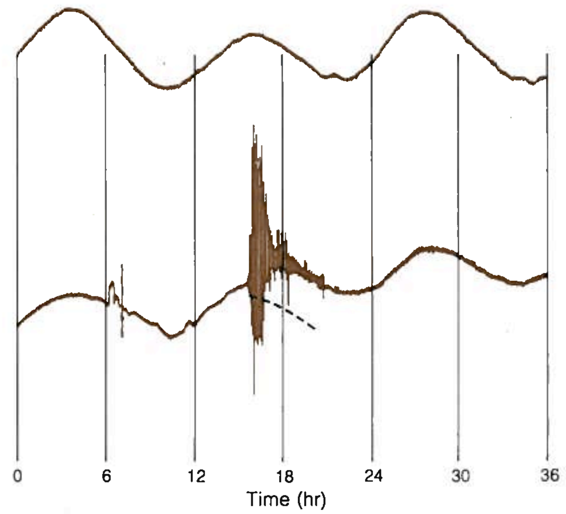

Figure 17-7
Record made by a strain seismograph. The slow periodic movements are the Earth tides; the more rapid vibrations are the seismic waves from an earthquake. [From "Resonant Vibrations of the Earth" by Frank Press. Copyright © 1965 by Scientific American, Inc. All rights reserved.]

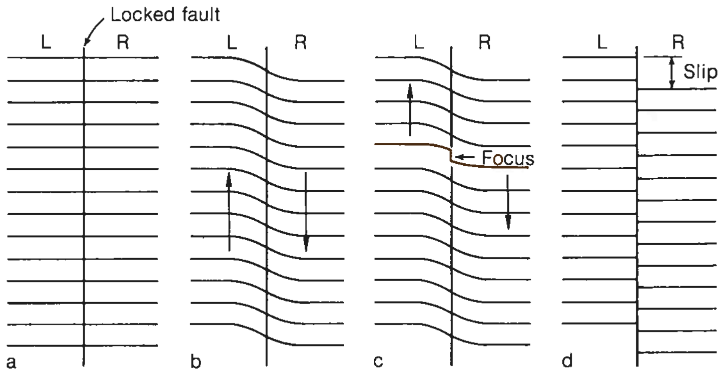

Figure 17-8
Sketch illustrating the elastic rebound theory of an earthquake. The two simulated crustal blocks *L* and *R* are being forced to slide past one another (a). Friction along the fault prevents slip (b), but the deformation builds up until the "frictional lock" is broken (c) and an earthquake slip occurs (d).

Figure 17-9
The earthquake of 1906 was caused by slip along the San Andreas fault. The offset fence shown here shows a slip of nearly 3 m. Scene is near Bolinas, California. [Photo by G. K. Gilbert; courtesy of R. E. Wallace, U.S. Geological Survey.]

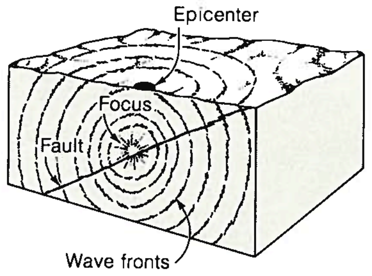

Figure 17-10
Diagram showing the focus and epicenter of an earthquake. The focus is the site of initial slip on the fault. The epicenter is the point on the surface above the focus. Also shown are seismic waves radiating from the focus.

crustal blocks in Figure 17-8. Suppose that surveyors had located lines running perpendicular to the fault from block *L* to block *R*, as shown in part *a* of the diagram. Blocks *L* and *R* are moving in opposite directions, but because they are pressed together by the weight of the overlying rock, friction locks them together, just as a brake can lock the wheel of a car if enough force is applied. Instead of slipping taking place along the fault, the blocks are deformed in the vicinity of the fault, and the surveyors' lines are bent as shown in Figure 17-8*b*. As the rock is strained, elastic energy is stored in it in the same way that it is stored in a wound-up watch spring. The movement continues, the strain builds up until the frictional bond that locks the fault can no longer hold at some point on the fault, and it breaks, as in Figure 17-8*c*. The blocks suddenly slip at this point, which is the **focus,** or **hypocenter,** of the earthquake. Once the rupture is initiated it will travel at a speed of about 3.5 kilometers per second (2 miles/second), continuing for as much as 1000 kilometers (600 miles). In great earthquakes, the **slip,** or offset, of the two blocks can be as large as 15 meters (50 feet). Figure 17-8*d* shows the two blocks after the earthquake, displaced by the amount of slip. Once the frictional bond is broken, the elastic strain energy, which had been slowly stored over tens or hundreds of years, is suddenly released in the form of intense seismic vibrations—which constitute the earthquake. The vibrational waves are propagated large distances in all directions away from the fault. Near the focus the waves can have large, destructive amplitudes. The process may be likened to storing elastic energy by slowly drawing out the rubber band of a sling shot, and then releasing it suddenly to propel a pebble.

7200 mi/hr.

Strictly speaking, the elastic rebound theory is an incomplete one. The reason for this is that the pressure holding the blocks together is so great that the frictional bond is actually stronger than the rock itself. In other words, the block would prefer to fracture elsewhere rather than slip along the fault. Yet faults do exist, and movement occurs along them periodically. To complete the theory, we need a means of "lubricating" the fault or reducing the locking pressure. Geologists working in the field of rock