

crust, waves are also propagated through the air, and, where the site of the impulse is not too remote, through the ocean. Earthquakes originating under the sea are numerous and specially destructive in their effects. They illustrate well the three kinds of waves associated with the progress of an earthquake. These are, 1st, The true earth-wave through the earth's crust; 2d, A wave propagated through the air, to which the characteristic sounds of rolling wagons, distant thunder, bellowing oxen, etc., are due; 3d, Two sea-waves, one of which travels on the back of the earth-wave and reaches the land with it, producing no sensible effect on shore; the other an enormous low swell, caused by the first sudden blow of the earth-wave, but travelling at a much slower rate, and reaching land often several hours after the earthquake has arrived.

Amplitude of earth-movements.—The popular conception of the extent to which the ground moves to and fro or up and down during an earthquake is a great exaggeration of the truth. As the result of very careful measurement with delicate instruments, there appears to be reason to believe that the horizontal motion at the time of a small earthquake is usually only the fraction of a millimetre, and seldom exceeds three or four millimetres. When the motion rises to five or six millimetres brick and stone chimneys are shattered. Yet even with such an intensity of shock a person walking in an open place might be quite unconscious of any perceptible movement of the ground. The vertical motion also appears to be exceedingly small.¹⁷¹

Velocity.—Experiments have been made to determine the

¹⁷¹ Milne "Earthquakes," pp. 75, 76. An ingenious model in wire has been made by Prof. Sekiya to illustrate the highly complex path pursued by a particle on the surface of the ground during an earthquake at Tokio, Japan, on 15th January, 1887.