

ence to exist here, as in the intersecting waves of sound. The extent of the propagated waves of commotion will be increased on the upper surface of the earth, according to the general law of mechanics, by which, on the transmission of motion in elastic bodies, the stratum lying free on the one side endeavors to separate itself from the other strata.

Waves of commotion have been investigated by means of the pendulum and the seismometer* with tolerable accuracy in respect to their direction and total intensity, but by no means with reference to the internal nature of their alternations and their periodic intumescence. In the city of Quito, which lies at the foot of a still active volcano (the Rucu Pichincha), and at an elevation of 9540 feet above the level of the sea, which has beautiful cupolas, high vaulted churches, and massive edifices of several stories, I have often been astonished that the violence of the nocturnal earthquakes so seldom causes fissures in the walls, while in the Peruvian plains oscillations apparently much less intense injure low reed cottages. The natives, who have experienced many hundred earthquakes, believe that the difference depends less upon the length or shortness of the waves, and the slowness or rapidity of the horizontal vibrations,† than on the uniformity of the motion in opposite directions. The circling rotatory commotions are the most uncommon, but, at the same time, the most dangerous. Walls were observed to be twisted, but not thrown down; rows of trees turned from their previous parallel direc-

* [This instrument, in its simplest form, consists merely of a basin filled with some viscid liquid, which, on the occurrence of a shock of an earthquake of sufficient force to disturb the equilibrium of the building in which it is placed, is tilted on one side, and the liquid made to rise in the same direction, thus showing by its height the degree of the disturbance. Professor J. Forbes has invented an instrument of this nature, although on a greatly improved plan. It consists of a vertical metal rod, having a ball of lead movable upon it. It is supported upon a cylindrical steel wire, which may be compressed at pleasure by means of a screw. A lateral movement, such as that of an earthquake, which carries forward the base of the instrument, can only act upon the ball through the medium of the elasticity of the wire, and the direction of the displacement will be indicated by the plane of vibration of the pendulum. A self-registering apparatus is attached to the machine. See Professor J. Forbes's account of his invention in *Edinb. Phil. Trans.*, vol. xv., Part i.]—*Tr.*

† "Tutissimum est cum vibrat crispante ædificiorum crepitu; et cum intumescit assurgens alternoque motu residet, innoxium et cum concurrentia tecta contrario ictu arietant; quoniam alter motus alteri renititur. Undantis inclinatio et fluctus more quædam volutatio infesta est, aut cum in unam partem totus se motus impellit."—*Plin.*, ii., 82.