

which may give rise to considerable subsequent changes of drainage. In some instances, the surfaces of solid rocks are shattered as if by gunpowder, as was particularly noticed to have taken place among the Primary rocks in the Concepcion earthquake of 1835.¹⁸⁰ It has often been observed also that the soil is rent by fissures which vary in size from mere cracks, like those due to desiccation, up to chasms a mile or more in length and 200 feet or more in depth. Permanent modifications of the landscape may thus be produced. Trees are thrown down, and buried, wholly or in part, in the rents. These superficial effects may, indeed, be soon effaced by the levelling power of the atmosphere. Where, however, the chasms are wide and deep enough to intercept rivulets, or to serve as channels for heavy rain-torrents, they are sometimes further excavated, so as to become gradually enlarged into ravines and valleys, as has happened in the case of rents caused by the earthquakes of 1811-12 in the Mississippi Valley. In the earthquake which shook the South Island of New Zealand in 1848, a fissure was formed, averaging 18 inches in width and traceable for a distance of 60 miles parallel to the axis of the adjacent mountain-chain. The subsequent earthquake of 1855, in the same region, gave rise to a fracture which could be traced along the base of a line of cliff for a distance of about 90 miles. Dr. Oldham has described a remarkable series of fissurings which ran parallel with the river of Calhar, Eastern British India, varying with it to every point of the compass and traceable for 100 miles.¹⁸¹ The great Japanese earthquake of

¹⁸⁰ Darwin, "Journal of Researches," 1845, p. 303.

¹⁸¹ Q. J. Geol. Soc. xxviii. p. 257. For a catalogue of Indian Earthquakes down to the end of 1869, see T. Oldham, Mem. Geol. Surv. India, xix. part 2.