

1783, the Lisbon earthquake of 1755, the Chilian earthquakes of 1822 and 1835. In 1822, according to Mrs. Graham, the Chilian coast was agitated by a movement which extended in length 900, 1000, or perhaps 1200 miles (including Copiapo and Valdivia), and raised the whole line of coast for a distance of 100 miles; at Valparaiso 3 feet; at Quintero 4 feet; the greatest movement being about 15 miles N. E. of Valparaiso: the beds of oysters and other shells were raised clear to the surface. The whole region between the Andes and a line far out in the sea is supposed to have been permanently raised, 2, 3, or more feet (in the interior the elevation is said to have reached even 7 feet). The area under which, ashore, the earthquake extended, is estimated at 100,000 square miles.* If, as Mr. Lyell supposes, the whole of this vast area was raised, and the elevation be taken at 1 foot on the average, the whole augmentation of the earth's diameter caused by it will be $\frac{1}{40000}$ th part of that which we attribute to the whole mass of visible volcanic accumulations on the surface. It is unnecessary to re-open the discussion of the accuracy of the data above assumed, because in 1835 similar phenomena happened on another part of the same coast.

This second great disaster on the Chilian coast has been described by Mr. Caldcleugh, from his own and other observations, with much care. It was heralded by the landward flight of immense flocks of sea-birds (the same thing occurred previous to the shocks of 1822), and by the remarkable activity of the volcanos of the Andes. An enormous wave, rising 28 feet in height, destroyed Talcahuano, and was followed by a greater. Columns of smoke rose in the sea, followed by whirlpools. In the Bay of Concepcion the strata of clay slate were elevated about 3 or 4 feet. At San Vicente,

* Journal of Science, vol. xvii. p. 46. It is not here asserted that 100,000 square miles were "permanently altered in level." It is stated that the "principal force was exerted in a circle of 50 miles diameter, having its centre N. E. of Valparaiso," and again the force diminished in proportion to the distance from Valparaiso.