LETTERS AND QUESTIONS.

IN accordance with the request of Mr. Retlaw we furnish some information concerning earthquakes in this issue, but as the letter editor has never had a personal interview with one (and has no particular desire to do so), the reader will please bear in mind that a number of the facts and theories here presented are not original, but culled and arranged from various sources.

EARTHQUAKES.

The cause of earthquakes has long been the subject of careful study, and still remains an unsolved problem among scientists, yet their frequency, force, effects, and mystery combine to urge their consideration upon the attention.

They appear to be the result of subterranean forces; but what these forces are, and how set in motion, are matters of pure conjecture. The irregularity of their occurrence, both as regards time and place, together with their dangerous nature, preclude any possibility of organized effort to be on the spot and observe their origin.

It has been estimated that about a dozen earthquakes, more or less destructive to life and property, occur every year; and in addition to these, on some part or other of the earth's surface, tremors or slight shakings, are constantly taking place.

The force of earthquakes varies in intensity. Sometimes there is a mere trembling of the ground without producing any damage; at others they are of so serious a nature that whole cities have been destroyed, fertile districts laid waste, and thousands of lives lost. In severe cases the first indication almost invariably is a gentle tremor followed by a heavy shock, or succession of shocks, which, having expended their energy, gradually subside in a series of tremblings, each succeeding one being less distinct until all is quiet again.

The shock of earthquakes is usually accompanied by peculiar subterranean noises. In some cases they resemble chains drawn about increasing to thunder, in others they are like the rumbling of carriages, gradually becoming louder until they equal the loudest artillery; again the sound is like that of heavy wagons running away upon the road; or like the hissing produced by quenching red hot iron in water; or like the rush of wind underground. As earthquakes have occurred without these noises, however, so there are frequently underground sounds not accompanied by earthquake.

The violent shocks are instantaneous, very few in number, usually only one, but occasionally three or four. When there is more than one violent shock, smaller shocks or tremblings are felt in the intervals between the larger ones.

The direction of the shock at the point or line of greatest disturbance is from below directly upwards, but gradually becomes more horizontal, and the force diminished as distance from the point increases.

This progressive movement is produced by an earthwave or true undulation of the solid crust of the earth. The whole area affected by the shock is not moved at once; only the wave crest. When the earthquake is near the shore or on the bed of ocean, the influence of the earthwave is communicated to the water. the sea swells, retires slightly from the beach, and then a huge wave rolls in upon the shore, carrying with it sea spoil and scattering it over the surface of the earth far beyond the ordinary reach of the sea.

The velocity of this earthwave is very great, but lasts only an instant in any one spot. In the case of the great earthquake at Lisbon. in A.D. 1755, the area affected was very large. On one side the shock was felt in the northern part of Russia. and on the other it was noticed in Canada and the West Indies, an area of fully 7,500,000 square miles. It must have required a tremendous force to move this, for if the thickness of the earth's crust moved be no more than twenty miles then 150,000,000 cubic miles of solid matter must have been stirred. The ocean swell reached the height of sixty feet and 60,000 lives were lost in the destruction of the city.

In addition to the effects already noticed, earthquakes have produced changes upon the earth's surface to an extent that can scarcely be imagined. New lakes and river courses have been formed, and old ones obliterated; new valleys and fissures of various sizes have been hollowed out, while immense landslips bear testimony to the forces that have been at work beneath them.

Egypt has probably been less visited by earthquakes than any other country, but there is no portion of the earth's surface that is free from their influence. Not even the bed of ocean is exempt, for records of subaqueous earthquakes exists taken by vessels at sea, some of which were passing over the point of greatest disturbance at the moment of the shock.

They occur most frequently around the centres of volcanic action. and their frequency and violence seems to bear some relation to the activity and intensity of the associated volcanoes. It is, however, an important fact that while regions of active volcanic action are most frequently affected by earthquake movements, yet the most violent earthquakes do not appear to have occurred in those regions, but in districts lying at considerable distance from active volcanoes. Districts in which extinct volcanoes are found are not more liable to such visitations than non-volcanic regions.

The mysterious nature of the producing cause of earthquakes is a strong incentive to study, but from the impossibility of direct observation, every attempt at explaining their origin is purely theoretical. All theorists appear to agree that volcanoes and earthquakes are produced by the same subterranean agency, and the existence of molten matter in the interior of the earth is the starting point of all, except the chemical theory advanced by Davy which he afterwards abandoned. Mr. Mallet proposed the following theory to the British Association. He assumes that volcanoes and the centres of earthquake disturbances are near the sea or other large supplies of water, and says that when an irruption of igneous matter takes place beneath the sea bottom, the first action must be to open up large fissures in its rocky material or to remove its incoherent portions such as sand, mud and gravel. The water on meeting the heated surfaces assumes the spheroidal state; while in this condition the intestine motion may be great, yet little steam is