CHAPTER XIV.

Imbedding of organic remains in alluvium and the ruins caused by landslips—Effects of sudden inundations—Of landslips—Terrestrial animals most abundantly preserved in alluvium and landslips, where earthquakes prevail—Erroneous theories which may arise from overlooking this circumstance—On the remains of works of art included in alluvial deposits—Imbedding of organic bodies and human remains in blown sand—Temple of Ipsambul on the Nile—Dried carcasses of animals buried in the sands of the African deserts—Towns overwhelmed by sand-floods in England and France—Imbedding of organic bodies and works of art in volcanic formations on the land—Cities and their inhabitants buried by showers of ejected matter—by lava—In tuffs or mud composed of volcanic sand and ashes.

In continuing our investigation of the manner in which the animal and vegetable creation leave permanent marks of their existence on the *emerged* lands, we have next to examine,

The imbedding of organic remains in alluvium, and the ruins caused by landslips.

We restrict the term *alluvium* to such transported matter as has been thrown down, whether by rivers, floods, or other causes, upon land not *permanently* submerged beneath the waters of lakes or seas.

The alluvium of the bed of a river does not often contain any animal or vegetable remains, for the whole mass is so continually shifting its place, and the attrition of the various parts is so great, that even the hardest rocks contained in it are, at length, ground down to powder. But when sand, mud, and rubbish, are suddenly swept by a flood, and then let fall upon the land, such an alluvium may envelop trees or the remains of animals, which may, in this manner, be permanently preserved.

The sudden descent of a body of water which had been discharged by a small artificial drain from a lake in Vermont, in the United States, in 1810, covered a wide valley with the spoils of the land washed down from the higher country.

Deep accumulations of mud and sand were spread far and wide, and, in some places, deposits of timber were heaped up, from twenty to eighty feet in height *.

Analogous results happen, from time to time, when the course of a river has been obstructed by landslips, volcanic ejections, masses of ice, or other impediments, and when the waters of temporary lakes so caused burst through the barrier. Besides these indirect effects, the landslip, by suddenly precipitating large masses of rock and soil into a valley, overwhelms a multitude of animals, and sometimes buries permanently whole villages, with their inhabitants and large herds of cattle. Thus three villages, with their entire population, were covered, when the mountain of Piz fell in 1772, in the district of Treviso, in the state of Venice †; and part of Mount Grenier, south of Chambery, in Savoy, which fell down in the year 1248, buried five parishes, including the town and church of St. André, the ruins occupying an extent of about nine square miles ‡.

The number of lives lost by the slide of the Rossberg, in Switzerland, in 1806, was estimated at more than eight hundred, a great number of the bodies being buried under mud and rock, at great depths, as well as several villages and scattered houses. In the same country, several hundred cottages, with eighteen of their inhabitants and a great number of cows, goats, and sheep, were victims to the sudden fall of a bed of stones, thirty yards deep, which descended from the summits of the Diablerets. In the year 1618, a portion of Mount Conto fell, in the county of Chiavenna in Switzerland, and buried the town of Pleurs with all its inhabitants, to the number of two thousand four hundred and thirty.

It is unnecessary to multiply examples of similar local catastrophes, which, however numerous they may have been in the mountainous parts of Europe, within the historical period, have been, nevertheless, of rare occurrence in comparison to

* Ed. New Phil. Journ., No. III.,146. † Malte-Brun's Geog., vol. i., 435.
‡ Bakewell, Travels in the Tarentaise, vol. i., p. 201.

the events of the same kind which take place in regions convulsed by earthquakes. It is then that all the causes whereby terrestrial animals may be buried in superficial alluvium are in full activity; in proof of which, we need only refer the reader to our description, in the former volume, of the effects of great subterranean movements in disturbing the drainage of a country and altering its levels. When the shocks are violent, enormous masses of rock and earth, even in comparatively low and level countries, are detached from the sides of valleys and cast down into the river-courses. The slides are so rapid and unexpected, that they often overwhelm, in the day-time, every living thing upon the plain; and when they happen in the night, escape is impossible. Although the streams are often only partially dammed up by the ruins thrown into their channel, the waters, nevertheless, collect in sufficient quantity to form torrents of mud, which, as we have seen in Calabria, sometimes bear along uprooted trees, and overwhelm animals until, wherever they cease to move, the mass shrinks on drying, and becomes hard and compact *.

Many geologists who seem desirous of ascribing as little power as possible to the aqueous causes now acting, are in the habit of overlooking the effects which the force of running water can produce, when combined with the movements of ordinary earthquakes. In a country like Great Britain, where the height of mountain-chains is not considerable, and where the shocks of earthquakes are rare and extremely feeble, scarcely any remains of terrestrial animals or plants are buried in alluvial deposits, in such a manner as to lead us to expect that they will be preserved for indefinite periods. Some skeletons, it is true, are occasionally imbedded, as, for example, in the mud and sand produced by the floods in Scotland, in 1829, in which the dead and mutilated bodies of hares, rabbits, moles, mice, partridges, and even the bodies of men, were found drifted and partially buried †. But if the levels

* Vol. i., pp. 427 and 428.

† Sir T. D. Lauder, Bart., on the great floods in Morayshire, August, 1829, p. 177.

of a country remain unchanged, one flood usually effaces the memorials left by another, and there is rarely a sufficient depth of undisturbed transported matter in any one spot, to preserve the organic remains permanently from destruction.

The catastrophes, on the other hand, which arise from repeated earthquakes, cause not only the death of many animals, but their frequent inhumation in alluvium, so placed as to escape degradation for a succession of ages. When a valley has been half choked up with mud, sand, and gravel, or when numerous slides from the boundary hills have encumbered it with ruin, a river takes a new direction, finding, perhaps, its way through a new-formed fissure. From that moment the transported matter is no longer exposed to be undermined and removed by the action of running water.

Portions, also, of plains loaded with alluvial accumulations by transient floods, may be gradually upraised by earthquakes; and, if any organic remains have been imbedded in the transported materials, they will, after such elevation, remain undisturbed, and beyond the reach of the erosive power of streams. Every fissure, every hollow caused by the sinking in of land, becomes a receptacle of organic and inorganic substances, hurried along by transient floods, in districts where the drainage is repeatedly deranged by subterranean movements.

We have seen that the ravines which opened in Calabria, in 1783, were very numerous, varying in depth from fifty to two hundred feet*; and that animals were sometimes engulphed during the shocks. We may assume that many others fell in during the three years that the earthquakes continued, and that similar casualties happen in the intervals between convulsions. Every inundation, therefore, caused by heavy rains, every torrent that might chance to be in the line of any of these chasms, would pour in a quantity of mud, sand, and rolled pebbles, together with fragments of the adjacent rocks, and under these the animal remains might lie inhumed for ages.

Where houses with their inhabitants have been swallowed

* Vol. i., p. 421.

up in fissures, there appears to have been usually a sliding in of all the loose matter which lay upon the surface, so that, in such rents, we might look for rolled pebbles, mud, sand, angular fragments of rocks, ruins of buildings, and skeletons of men and animals, at the depth often of several hundreds of feet. It is obvious that a suite of subterranean caverns, communicating with such fissures, might become wholly, or partially, filled with these various materials confusedly mixed together.

During the great earthquake of 1693, in Sicily, several thousand people were at once entombed in the ruins of caverns in limestone, at Sortino Vecchio; and, at the same time, a large stream, which had issued for ages from one of the grottos below that town, changed suddenly its subterranean course, and came out from the mouth of a cave lower down the valley, where no water had previously flowed. To this new point the ancient mills were transferred.

When the courses of engulphed rivers are thus liable to change, from time to time, by alterations in the levels of a country, and by the rending and shattering of mountain masses, we must suppose that the dens of wild beasts will sometimes be inundated by subterranean floods, and their carcasses buried under heaps of alluvium. The bones, moreover, of individuals which have died in the recesses of caves, or of animals which have been carried in for prey, may be drifted along and mixed up with mud, sand, and fragments of rock, so as to form osseous breccias.

Nor should we omit to mention the havoc committed on low coasts, during earthquakes, by waves of the sea which roll in upon the land, bearing everything before them, for many miles into the interior throwing down upon the surface great heaps of sand and rock, by which the remains of drowned animals may be overwhelmed. Many of the storms, termed hurricanes, have evidently been connected with submarine earthquakes, as is shown by the atmospheric phenomena attendant on them, and by the sounds heard in the ground, and the odours emitted. Such were the circumstances which accom-

panied the swell of the sea in Jamaica, in 1780, when a great wave desolated the western coast, and bursting upon Savanna la Mar, swept away the whole town in an instant, so that not a vestige of man, beast, or habitation, was seen upon the surface *.

Now let us suppose that in a tract of land constantly inhabited by terrestrial quadrupeds, the species are thrice changed under the gradual influence of causes before considered in this volume, and that, during the first and last of these zoological epochs, the district remains entirely free from earthquakes, but is violently convulsed by them during the intermediate era,—we should expect, for reasons above considered, that the fossil remains of quadrupeds, buried in alluvium, would be confined to one period only, viz., that of the subterranean movements. If the series of shocks should happen not to have occupied the whole of the second epoch, but only a small portion of it, there might be no indication whatever, in the fossil relics, of a passage from one state of the organic world to another. The transition would appear abrupt; and they who, for the sake of economizing past time, do not hesitate to magnify the energies of natural agents in by-gone ages, might then imagine one paroxysmal earthquake to have caused all the fissures, caverns, and depressions, and one accompanying deluge to have filled the whole with alluvial matter, annihilating, at the same time, the race of quadrupeds of which the bones remain interred.

But although we conceive that, in a country entirely free from subterranean movements, a long succession of ages might pass away without any permanent monuments being left in *alluvium* of the terrestrial animals which have lived upon the surface, yet it appears scarcely possible that man, if he has made considerable progress in civilization, should fail to leave some lasting signs of the works of his hands, to testify his former existence. We are informed by M. Boblaye, that in the Morea, the formation termed céramique, consisting of pottery, tiles, and bricks, intermixed with various works of art,

* Edwards, Hist. of West Indies, vol. i., p. 235, Ed. 1801.

enters so largely into the alluvium and vegetable soil upon the plains of Greece, and into hard and crystalline breccias which have been formed at the foot of declivities, that it constitutes a real stratum which might, in the absence of zoological characters, serve to mark our epoch in a most indestructible manner *.

Imbedding of Organic Bodies and Human Remains in Blown Sand.

The drifting of sand is the next cause which we may consider among those capable of preserving the remains of the inhabitants of the land during its period of emersion. We have already alluded to the African deserts, as the most remarkable example of desolation produced by this cause. Innumerable towns and cities have been buried to the westward of the Nile, between the temple of Jupiter Ammon and Nubia; and it is scarcely possible to conceive a mode whereby interment could take place under circumstances more favourable to the conservation of monuments for indefinite periods. The sand which surrounded and filled the great temple of Ipsambul, first discovered by Burckhardt, and afterwards partially uncovered by Belzoni and Beechey, was so fine as to resemble a fluid when put in motion. Neither the features of the colossal figures, nor the colour of the stucco with which some were covered, nor the paintings on the walls, had received any injury from being enveloped for ages in this dry impalpable dust †.

At some future period, perhaps, when the pyramids shall have perished, the action of the sea, or an earthquake, may lay open to the day some of these buried temples. Or we may suppose the desert to remain undisturbed, and changes in the surrounding sea and land to modify the climate and the direction of the prevailing winds, so that these may then waft away the Lybian sands as gradually as they once brought them to those regions. Thus many a town and temple of higher antiquity than Thebes or Memphis might reappear in their

* Ann. des Sci. Nat., tome xxii., p. 117. Feb. 1831.

† Stratton, Ed. Phil. Journ. No. V., p. 62.

original integrity, and a part of the gloom which overhangs the history of earlier nations might be dispelled.

Whole caravans are said to have been overwhelmed by the Lybian sands; and Burckhardt informs us that "after passing the Akaba, near the head of the Red Sea, the bones of dead camels are the only guides of the pilgrim through the wastes of sand." "We did not see," says Captain Lyon, speaking of a plain near the Soudah mountains, in Northern Africa, "the least appearance of vegetation; but observed many skeletons of animals, which had died of fatigue on the desert, and occasionally the grave of some human being. All these bodies were so dried by the heat of the sun, that putrefaction appears not to have taken place after death. In recently-expired animals I could not perceive the slightest offensive smell; and in those long dead the skin with the hair on it remained unbroken and perfect, although so brittle as to break with a slight blow. The sand-winds never cause these carcasses to change their places, for in a short time a slight mound is formed round them, and they become stationary *."

The burying of several towns and villages in England and France by blown sand is on record; thus for example in Suffolk, in the year 1688, part of Downham was overwhelmed by sands which had broken loose about one hundred years before, from a warren five miles to the south-west. This sand had, in the course of a century, travelled five miles, and covered more than a thousand acres of land †.

The ruins of buildings have been found entire in the drift-sand of Cornwall, as we before mentioned, as also land-shells. One of the latter is said to belong to a species which is unknown at present in this country ‡. Near St. Pol de Leon, in Brittany, a whole village was completely buried beneath drift-sand, so that nothing was seen but the spire of the church §.

* Travels in Northern Africa in the years 1818, 1819, and 1820, p. 83.

† Phil. Trans. vol. ii., p. 722.

‡ Vol. i., p. 301.

§ Mém. de l'Acad. des Sci. de Paris, 1772.—Malte-Brun's Geog. vol. i., p. 425.

Imbedding of Organic Bodies and Works of Art in Volcanic Formations on the Land.

We have in some degree anticipated the subject of this section in a former volume, when speaking of the buried cities around Naples, and those on the flanks of Etna *. From the facts referred to by us, it appears that the preservation of human remains and works of art has been frequently due to the descent of floods caused by the copious rains which usually accompany eruptions. These aqueous lavas, as they are called in Campania, flow with great rapidity, and in 1822 surprised and suffocated, as we have stated, seven persons in the villages of St. Sebastian and Massa, on the flanks of Vesuvius.

In the tuffs, moreover, or solidified mud, deposited by these aqueous lavas, impressions of leaves and of trees have been observed. Some of those formed after the eruption of Vesuvius in 1822, are now preserved in the museum at Naples.

Lava itself may become indirectly the means of preserving terrestrial remains, by overflowing beds of ashes, pumice, and ejected matter, which may have been showered down upon animals and plants, or upon human remains. Few substances are better non-conductors of heat than volcanic dust and scoriæ, so that a bed of such materials is rarely melted by a superimposed lava-current. After consolidation, the lava affords secure protection to the lighter and more removeable mass below, wherein the organic relics may be enveloped. The Herculanean tuffs containing the rolls of papyrus, of which the characters are still legible, have, as we before remarked, been for ages covered by lava.

Another mode whereby lava may tend to the conservation of imbedded remains, at least of works of human art, is by overflowing them when not intensely heated, in which case they often suffer little or no injury.

Thus when the Etnean lava-current of 1669 covered fourteen towns and villages, and part of the city of Catania, it did not

* Vol. i., pp. 349 and 365.

melt down a great number of statues and other articles in the vaults of Catania; and at the depth of thirty-five feet in the same current, on the site of Mompiliere, one of the buried towns, the bell of a church and some statues were found uninjured *.

We remarked in a former volume, that in many countries which have been peopled from remote ages by civilized nations, and have been at the same time the theatres of volcanic action, there must be innumerable monuments of the highest value to the historian, which continue unobserved "because they have not been searched for." But we omitted to describe in detail a splendid example of several buried cities in Central India, which might probably be made to yield a richer harvest to the antiquary than Pompeii and Herculaneum †. The city of Oujein (or Oojain) was, about fifty years before the Christian æra, the seat of empire, of art, and of learning; but in the time of the Rajah Vicramaditya, it was overwhelmed, together, as tradition reports, with more than eighty other large towns in the provinces of Malwa and Bagur, "by a shower of earth." The city which now bears the name is situated a mile to the southward of the ancient town. On digging on the spot where the latter is supposed to have stood, to the depth of fifteen or eighteen feet, there are frequently discovered, says Mr. Hunter, entire brick walls, pillars of stone, and pieces of wood of an extraordinary hardness, besides utensils of various kinds, and ancient coins. Many coins are also found in the channels cut by the periodical rains, or in the beds of torrents into which they have been washed. "During our stay at Oujein, a large quantity of wheat was found by a man digging for bricks. It was, as might have been expected, almost entirely consumed, and in a state resembling charcoal. In a ravine cut by the rains, from which several stone pillars had been dug, I saw a space from twelve to fifteen feet long and seven or eight high, composed of earthen vessels, broken and closely compacted together. It was conjectured, with great appearance of probability, to have been a potter's kiln. Between this place and

* Vol. i., p. 366. † Ibid., p. 407.

the new town is a hollow, in which, tradition says, the river Sipparah formerly ran. It changed its course at the time the city was buried, and now runs to the westward *." The soil which covers Oujein is described as " being of an ash-grey colour, with minute specks of black sand †."

That the " shower of earth " which is reported to have " fallen from heaven," was produced by a volcanic eruption, we cannot doubt, although no information has been obtained respecting the site of the vent; and the nearest volcano of which we read, is that which was in eruption during the Cutch earthquake in 1819, at the distance of about thirty miles from Bhooi, the capital of Cutch, and at least three hundred geographical miles from Oujein.

Captain F. Dangerfield, who accompanied Sir John Malcolm in his late expedition into Central India, states that the river Nerbuddah, in Malwa, has its channel excavated through *columnar basalt*, on which rest beds of marl impregnated with salt. The upper of these beds is of a light colour, and from thirty to forty feet thick, and rests horizontally on the lower bed, which is of a reddish colour. Both appear from the description to be tuffs composed of the materials of volcanic ejections, and forming a covering from sixty to seventy feet deep overlying the basalt, which seems to resemble some of the currents of prismatic lava in Auvergne and the Vivarais. Near the middle of this tufaceous mass, and therefore at the depth of thirty feet or more from the surface, just where the two beds of tuff meet, Captain Dangerfield was shown, near the city of Mhysir, buried bricks and large earthen vessels, said to have belonged to the ancient city of Mhysir, destroyed by the catastrophe of Oujein ‡.

* Narrative of a Journey from Agra to Oujein, Asiatic Researches, vol. vi. p. 36.

† Asiatic Journal, vol. ix. p. 35.

‡ Sir J. Malcolm's Cent. Ind.—Geol. of Malwa, by Captain F. Dangerfield, App. No. ii. pp. 324, 325.