

*ADDITIONS to the Article, Of the Effects of Rains, Marshes, Subterraneous Wood and Water, vol. i. p. 473.*

## I.

*Of the sinking and Derangement of certain Lands.*

THE rupture of caverns, and the action of subterraneous fires, are the chief causes of the great revolutions which happen in the earth; but they are often produced by smaller causes. The filtration of the water, by diluting the clay, upon which almost all calcareous mountains rest, has frequently made those mountains incline and tumble down. Of these remarkable events I shall subjoin some examples.

‘ In the year 1757,’ says M. Perronet, ‘ a part of the ground situated about half-way before we arrive at the Castle of Croix-fontaine, opened in many places, and successively tumbled down. The terrace wall, which inclosed this ground, was overturned, and the road, which was formerly at the foot of the wall, was obliged to be carried to a considerable dis-

tance.

‘ tance. . . . This ground rested upon a base of inclined earth.’ This learned and chief engineer of our highways and bridges mentions another accident of the same kind which happened, in the year 1733, at Pardines, near Issoire in Auvergne. The ground, for about 400 fathoms in length by 300 in breadth, descended upon a pretty distant meadow, with all its houses, trees, and herbage. He adds, that considerable portions of ground are sometimes transported either by the rupture of reservoirs of water, or by the sudden melting of snows. In 1757, at the village of Guet, about ten leagues from Grenoble, on the road to Briançon, the whole ground, which lies on a declivity, split and descended in an instant towards Drac, which is about a mile distant. The earth split in the village, and the part which moved off was six, eight, and nine feet lower than its former station. This ground was situated on a pretty solid rock, which was inclined to the horizon about forty degrees \*.

To these examples I shall add another fact, of which I have been a constant witness, and which has cost me a considerable expence. The detached rising ground, upon which the town and old castle of Montbard are situated, is elevated 140 feet above the level of the river, and its most rapid descent is to the north-east. This

\* Hist. de l’Acad. des Sciences, année 1769, p. 233.

rising ground is crowned with calcarious rocks, the strata of which, when taken together, are 54 feet thick. They every where rest upon a mass of clay, which, of course, before reaching the level of the river, is 86 feet thick. My garden, which is surrounded with several terraces, is situated on the top of this rising ground. From twenty-five to twenty-six fathoms of the last terrace-wall on the north-east side, where the declivity is greatest, gave way all at once, carrying along the inferior ground, which would have gradually descended to the level of the ground near the river, if its progressive motion had not been prevented by taking down the whole wall. This wall was seven feet thick and founded on clay. The movement of the earth was very slow: I perceived that it was evidently occasioned by the insinuation of water. All the water which falls upon the platform on the top of this rising ground, penetrates through the fissures of the rocks, and reaches the clay upon which they rest: Of this fact we are ascertained by two wells dug from the top of the rock to the clay. All the rain-water, therefore, which falls upon this platform and the adjacent terraces, collect upon the clay where the perpendicular fissures of the rock terminate. The water gives rise to small rills in different places, which are rendered still more apparent by several wells dug below the rocks. Wherever this mass of clay is cut

cut by ditches, we see the water filtrating from above. It is not, therefore, surprising that walls, however solid, should slip upon this first bed of moist clay, if they are not founded much lower, as I have done in rebuilding them. The same thing, however, has happened on the north-west side, where the declivity is gentler, and no rills of water appear. The clay had been removed at the distance of twelve or fifteen feet from a great wall, of eleven feet thick, thirty-five feet high, and twelve fathoms long. This wall is constructed of good materials, and has subsisted more than nine hundred years. The cut from which the clay was removed, though not above four or five feet deep, has produced a movement in this immense wall. It declines from the perpendicular about fifteen inches, and I could only prevent its downfall by abutments of seven or eight feet thick, and founded at the depth of fourteen feet.

From these facts I drew the following conclusion, which is not so interesting at present as it would have been in ages that are past, that there is not a castle or fortress situated upon heights, which might not be easily tumbled into the plain by a simple cut of ten or twelve feet deep and some fathoms wide. This cut should be made at a small distance from the last wall, and upon that side where the declivity is greatest. This method, of which the ancients never

dreamed, would have saved them the operation of battering-rams and other engines of war; and, even at present, might be employed, in many cases, with advantage. I am convinced by my eyes, that, when these walls slipt, if the cut made for rebuilding them had not been speedily filled with strong mason-work, the ancient walls, and the two towers that have subsisted in good condition nine hundred years, and one of which is 125 feet high, would have tumbled into the valley, along with the rocks upon which they are founded. As most of our hills composed of calcarious stones rest upon a clay base, the first strata of which are always more or less moistened with the waters that filtrate through the crevices of the rocks, it appears to be certain, that, by exposing these moistened beds to the air by a cut, the whole mass of rocks and earth resting upon the clay would slip, and in a few days tumble into the cut, especially during wet weather. This mode of dismantling a fortress is more simple than any hitherto invented; and experience has convinced me that its success is certain.

## II.

*Of Turf.*

TO what I have formerly remarked concerning turf, I shall subjoin the following facts:

In the jurisdiction of Bergues-Saint-Winock, Furnes, and Bourbourg, we find turf at three or four feet below the surface. These beds of turf are generally two feet thick, and are composed of corrupted wood, of entire trees with their branches and leaves, and particularly of filberds which are known by their nuts, and the whole is interlaced with reeds and the roots of plants.

What is the origin of these beds of turf, which extends from Bruges through the whole flat country of Flanders as far as the river Aa, between the downs and the high country in the environs of Bergues, &c.? In remote ages, when Flanders was only a vast forest, a sudden inundation of the sea must have deluged the whole country, and, in retiring, deposited all the trees, wood, and twigs, which it had eradicated and destroyed in this lowest territory of Flanders; and this event must have happened in the month of August or September; because we still find the leaves of trees, as well as nuts on the filberds. This inundation must have taken place long before that