

ADDITIONS to the Article, Of Caverns,
vol. i. p. 442.

Of Caverns formed by the primitive Fire.

IN my Theory of the Earth, I mentioned only two kinds of caverns, the one produced by the fire of volcano's, and the other by the motion of subterraneous waters. Those two species of caverns are not situated at great depths. They are even new, when compared with those vast cavities, which were formed at the time the globe first assumed a solid form; for, at this period, all the superficial eminences and hollows, and all the cavities in the interior parts of the earth, especially near the surface, were produced. Several of those caverns produced by the primitive fire, after being supported for some time, have afterwards split by cooling, which diminishes the volume of every kind of matter; these would soon fall in, and, by their sinking, form basins or reservoirs for the sea, into which the waters, formerly much elevated above this level, ran, and abandoned the lands which they origi-

nally covered. It is more than probable, that a certain number of these ancient caverns still subsist in the interior parts of the globe, and by their sinking may produce similar effects, and give rise to new receptacles to the waters. In this case, they will partly abandon the basin which they now occupy, and run, by their natural propensity, into these lower places. For example, we find beds of sea-shells in the Pyrennees 1500 fathoms above the present level of the ocean. Hence it is certain, that the waters when these shells were formed, rose 1500 fathoms higher than they do at present. But, when the caverns, which supported the lands that are now the bed of the Atlantic ocean, sunk, the waters which covered the Pyrennees, and the whole of Europe, would run with rapidity into these reservoirs, and, of course, leave uncovered all the lands in this part of the world. The same revolution would extend to every other country. The waters appear to have never reached the summits of the highest mountains; because they exhibit no reliicks of marine productions, and no sufficient marks of a long abode of the waters. However, as some of the matters of which they are composed, though all of the vitrescent kind, seem to have derived their solidity and consistence from the intervention and cement of water, and as they appear to have been formed, as already remarked, in the

the masses of sand, or glass dust, which formerly lay on the peaks of mountains, but which, in the progress of time, have been carried down to their bottoms by the rains, we cannot pronounce positively, that the waters of the sea never stood higher than the places where shells are now found: The waters have perhaps stood much higher, even before their temperature permitted the existence of shells. The greatest height reached by the universal ocean is to us unknown. But we know that the waters were elevated from 1500 or 2000 fathoms above their present level; since shells are found in the Pyrennees at 1500 fathoms, and in the Cordelières at 2000.

If all the peaks of mountains were formed of solid glass, or of other matters immediately produced by fire, it would be unnecessary to have recourse to the abode of the waters, or to any other cause, in order to conceive how they assumed their consistence. But most peaks of mountains seem to be composed of matters, which, though vitrifiable, have acquired their solidity by the intervention of water. We cannot, therefore, determine whether their consistence is solely owing to the primitive fire, or whether the intervention and cement of water were not requisite to complete the operation of fire, and to bestow on these vitrifiable masses the qualities which they possess. Besides, this supposition prevents

prevents not the primitive fire, which at first produced the greatest inequalities on the globe, from being the chief cause of those chains of mountains that traverse its surface, and particularly of their cores or nuclei; but the contours of these same mountains have perhaps been disposed and fashioned by the waters at a subsequent period; for it is upon these contours, and at certain heights, that shells and other productions of the sea are found.

To acquire a clear notion of the ancient caverns formed by the primitive fire, we must suppose the globe to be deprived of all its waters, and of all the matters which cover its surface, to the depth of ten or twelve hundred feet. By removing in idea this external bed of earth and water, the globe will present to us the form it possessed about the time of its first consolidation. The whole mass was composed of vitreous rock, or, if you will, of melted glass; and this matter, in cooling and acquiring consistence, produced, like all other melted bodies, eminences, depressions, and cavities, upon the whole surface of the globe. These internal cavities formed by fire, are the primitive caverns, and they are more numerous in the southern than in the northern regions; because the rotatory motion, which elevated the equatorial regions before consolidation, likewise produced the greatest derangement of the matter, and, by

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retarding the consolidation, would concur with the action of the fire in giving rise to a greater number of inequalities in this than in any other part of the globe. The waters coming from the Poles could not approach those burning regions before they cooled. The vaults which supported these regions having successively fallen in, the surface sunk and broke in a thousand places. For this reason, the greatest inequalities of the globe are found in the equatorial regions: There the primitive caverns are more numerous than in any other part of the earth. They are likewise more profound, *i. e.* perhaps five or six leagues deep; because the matter of the globe, while in a liquid state, was agitated to that depth by the motion of rotation. But all the caverns in high mountains derive not their origin from the operation of primitive fire. Those alone which are deeply situated below the mountains can be ascribed to this cause. The more exterior and more elevated have been formed, as already remarked, by the operation of secondary causes. Hence the globe, deprived of its waters and the matters transported by them, would present to us a surface much more irregular than it appears with the aid of this covering. The great chains of mountains and their peaks and ridges, have not now the appearance of half of their real height. The whole are attached by their bases to a vitrifiable

rock, and are of the same nature. Thus we should reckon three species of caverns produced by Nature: The first by the force of the primitive fire; the second by the action of water; and the third by that of subterraneous fires: Each of these caverns, though different in their origin, may be distinguished by examining the matters they contain, or by which they are surrounded.