nite number of marine productions. The ſecond, on the contrary, are leſs regular in their ſtructure, and include no marks of ſea-bodies. Theſe mountains of the firſt and ſecond formation have nothing in common but the perpendicular fiſſures; but theſe fiſſures are effected by two different cauſes. The vitreſcent matters, in cooling, diminiſhed in ſize, and, of courſe, they ſplit, and receded to different diſtances. But thoſe compoſed of calcarious matters tranſported by the waters, ſplit into fiſſures ſolely by drying.

I have often remarked, that, in detached hills, the firſt effect of the rains is gradually to carry down from the ſummit the earth and other bodies, which form at the foot a pretty thick ſtratum of good ſoil, while the top is left entirely bare. This effect is, and neceſſarily muſt be, produced by the rains. But a previous cauſe diſpoſed theſe and ſimilar matters round all hills, not excepting thoſe which are detached; for, on one ſide, the earth is uniformly better than on the other: The hills are always ſteep and precipitant on one ſide, and have a gentle declivity on the other; which proves clearly, that the action, as well as the direction of the motion of the waters, were greater on one ſide than on the other.

IV.

Of the Denſity which certain Matters acquire by Fire, as well as by Water.

IN p. 246, I ſaid, *that the hard points found in free-ſtone conſiſted of metallic matter, which appeared to have been melted by a ſtrong fire.* This aſſertion ſeems to inſinuate that the great maſſes of free-ſtone have originated from the action of the primitive fire. I at firſt imagined that this matter owed its denſity and the adheſion of its particles ſolely to the intervention of water. But I have ſince learned that the action of fire produces the ſame effect; and I ſhall relate ſome experiments which at firſt ſurpriſed me, but which I have repeated ſo often as to remove every doubt upon this ſubject.

EXPERIMENTS.

I pounded free-ſtones of different degrees of hardneſs, till they were reduced to a powder more or leſs fine. Theſe powders I employed to cover the cements I uſed in converting iron into ſteel. This powder of free-ſtone was ſtrewed over the cement, and heaped up, in the

form of a dome of three or four inches in thickneſs, on an earthen veſſel of three feet long by two broad. After undergoing the action of the fire in my blaſt furnaces, during ſeveral days and nights without interruption, it was no longer the powder of free-ſtone, but a maſs ſo ſolid that we were obliged to break it in order to uncover the veſſel which contained the iron, now converted into ſteel. The action of fire upon this powder of free-ſtone produced maſſes equally ſolid as free-ſtone of a middling quality, which does not ring under the hammer. This fact ſhewed that fire, as well as water, could prove a cement to vitrifiable ſand, and, conſequently, might have formed thoſe immenſe maſſes of free-ſtone which compoſe the nucleus of ſome of our mountains.

I am, therefore, fully perſuaded, that all the vitreſcent matters, of which the interior rock of the globe, as well as the nuclei of great mountains, are compoſed, have been produced by the action of the primitive fire; and that the waters have only formed thoſe acceſſory ſtrata which ſurround theſe nuclei, which are all parallel and horizontal, or equally inclined, and in which we find the relicks of ſhells and other productions of the ocean.

In the formation of free-ſtone and other vitreſcent matters, I pretend not to exclude the intervention of water. On the contrary, I am inclined

inclined to believe, that vitrifiable ſand may acquire conſiſtence, and unite into maſſes more or leſs hard, perhaps more eaſily by means of water than by the action of fire. I have related the above facts ſolely with the view of preventing objections which would not fail to be made, if it had been thought that I attributed the ſolidity of free-ſtones, and other bodies compoſed of vitrifiable ſand, to the intervention of water alone. It is certain, that all the free-ſtone found on the ſurface, or at inconſiderable depths, have been formed by water; for, on the ſurface of theſe maſſes of free-ſtone, we perceive marks of undulations and rollings, and ſometimes the impreſſions of plants and ſhells. But the free-ſtones formed by the ſediments of water are eaſily diſtinguiſhed from thoſe which have been produced by fire. The latter have a coarſer grain, and crumble down more eaſily than free-ſtone cemented by the intervention of water, which is more compact, and harder than that whoſe particles have been united by the action of fire.

Ferruginous matters aſſume a great degree of hardneſs by fire; for nothing is harder than caſt iron. But ferruginous bodies may likewiſe acquire conſiderable denſity by the intervention of water. Of this fact I was aſcertained by putting a quantity of filings of iron into veſſels expoſed to the rain. Theſe filings formed a maſs

ſo hard, that it could only be broken by the hammer.

The vitreous rock which compoſes the interior maſs of the globe, is harder than common glaſs. But it is not harder than certain volcanic lavas, and much ſofter than caſt iron, which, however, is only glaſs mixed with ferruginous particles. This great hardneſs of the interior rock ſhows that it conſiſts of the moſt fixed particles of matter, and that, from the time of their conſolidation, they aſſumed the conſiſtence and hardneſs which they ſtill poſſeſs. Hence it cannot be objected to my hypotheſis of general vitrification, that bodies reduced to glaſs by our furnaces are leſs hard than the rock of the globe; ſince caſt iron, ſome lavas, or baſalts, and even certain porcelains, are harder than this rock, and yet they derive their hardneſs from the action of fire alone. Beſides, the elements of iron and other minerals which give hardneſs to matters liquified by fire, or attenuated by water, exiſted, as well as the fixed earth, from the time that the globe was firſt conſolidated: And I have already remarked, that the interior rock ought not to be regarded as pure glaſs, ſimilar to that we make with ſand and ſalts, but as a vitreous product mixed with matters the moſt fixed, and moſt capable of ſupporting the great and long continued action of the primitive fire, the great effects of which can only be compared in

in a very diſtant manner with the inconſiderable operations of our furnaces; and yet, from this compariſon, though unfavourable, we clearly perceive what effects are common to the primitive fire and to our furnaces; and it ſhows, at the ſame time, that the degree of hardneſs depends leſs on the degree of heat than on the combination of matters ſubmitted to its action.

V.

Of the Inclination of the Strata in the Mountains.

I Remarked, in vol. i. p. 15. that, *in plains, the ſtrata are exactly horizontal. It is in the mountains only that they are inclined to the horizon; becauſe they have originally been formed by ſediments depoſited upon an inclined baſe.*

The beds of calcarious matters are not only horizontal in the plains, but likewiſe in all mountains which have not been diſturbed by earthquakes or other accidental cauſes: And, when the ſtrata are inclined, the whole mountain is likewiſe inclined, and has been forced into that poſition by a ſubterraneous exploſion, or by the ſinking of a part of the earth, which had ſerved it as a baſis. We may therefore conclude, in general, that all ſtrata formed by the ſediments of water are horizontal, like the