

ON THE THERMAL WATERS OF THE ALPS.

THIS paper was published by the Author in the "Philosophical Magazine and Annals," January 1827; and a nearly similar account was given in his "Travels in the Tarentaise," in 1823. The thermal waters of the Alps had before been regarded as merely local and unconnected phenomena, scarcely deserving the notice of geologists.

When we approach a range of lofty mountains, like that of the Pennine Alps, and observe the calcareous strata on the outer part of the range, bent and contorted in various directions; when we further observe beds of limestone and pudding-stone alternating and placed in an elevated position, as we advance to the central part of the range; and that the beds of granite in the central part are frequently vertical; we feel assured that their present contorted or vertical position, is not the original one. The opinions of geologists have been much divided respecting the cause or causes that have elevated mountains, and given a vertical position to beds that once formed the bottom of the ocean. Those who maintain that subterranean heat has expanded and broken the solid crust of the globe, and has raised from vast depths the ancient bed of the ocean, appeal to a cause that is known to exist, and which seem sufficient to explain most of the various appearances which Alpine regions present.

In opposition to this theory, it is asserted that there are no remaining vestiges of the action of subterranean fire in the Alps: but this I am convinced is erroneous. It is true that from near the source of the Rhone, to the foot of the Little St. Bernard, there does not occur any known rock of a volcanic character, with the doubtful exception of some rocks in the valley of Sass, and in the Valorsine. I have examined various parts of this range on the northern side of the highest mountains in the Alps, along a line of one hundred and twenty miles; and though I could discover no indications of the action of subterranean heat in the rocks themselves, I was greatly surprised to observe the numerous thermal springs that are abundantly gushing out at the feet of the primary mountains, near the junction of the mica-slate, or the dark schist passing into the mica-slate, with the lowest calcareous beds of that vast series of limestone strata, which forms the outer ranges of the Alps. Numerous as these hot springs are on the northern side of the Alps, and not unfrequent on the southern side also, it appeared to me remarkable, that they had hitherto been regarded as isolated phenomena; and that their geological position had not been noticed. It is true, some of the warm springs in the Valais and in Savoy had been long known and visited. But the greater number has been discovered since Saussure published his *Voyages dans les Alpes*; and it appears probable, that they would every where be found near the junction of the primary and secondary rocks, were it not for *éboulements* that have covered them with a heap of ruins, or that torrents from the glaciers have mixed with them, and reduced their temperature. Since I visited Savoy in 1821 and 1822, another considerable warm spring has been discovered near the village of Chamouni, at the foot of a glacier; and in 1820 several thermal springs were discovered in that branch of the Alps which extends to Grenoble.