

to a depth scarcely, if at all inhabited by testacea and zoophytes. Meanwhile, during the formation of the unstratified and unfossiliferous mass in deeper water, the smoothing and furrowing of shoals and beaches would still go on elsewhere upon and near the coast in full activity. If at length the subsidence should cease, and the direction of the movement of the earth's crust be reversed, the sunken area covered with drift would be slowly reconverted into land. The boulder deposit, before emerging, would then for a time be brought within the action of the waves, tides, and currents, so that its upper portion, being partially disturbed, would have its materials rearranged and stratified. Streams also flowing from the land would in some places throw down layers of sediment upon the *till*. In that case, the order of superposition will be, first and uppermost, sand, loam, and gravel occasionally fossiliferous; secondly, an unstratified and unfossiliferous mass, called *till*, for the most part of much older date than the preceding, with angular erratics, or with boulders interspersed; and, thirdly, beneath the whole, a surface of polished and furrowed rock. Such a succession of events seems to have prevailed very widely on both sides of the Atlantic, the travelled blocks having been carried in general from the North Pole southwards, but mountain chains having in some cases served as independent centres of dispersion, of which the Alps present the most conspicuous example.

It is by no means rare to meet with boulders imbedded in drift which are worn flat on one or more of their sides, the surface being at the same time polished, furrowed, and striated. They may have been so shaped in a glacier before they reached the sea, or when they were fixed in the bottom of an iceberg as it ran aground. We learn from Mr. Charles Martins that the glaciers of Spitzbergen project from the coast into a sea between 100 and 400 feet deep; and that numbers of striated pebbles or blocks are there seen to disengage themselves from the overhanging masses of ice as they melt, so as to fall at once into deep water.*

That they should retain such markings when again upraised above the sea ought not to surprise us, when we remember that rippled sands, and the cracks in clay dried between high and low water, and the foot-tracks of animals and rain-drops impressed on mud, and other superficial markings, are all found fossil in rocks of various ages.

On the other hand, it is not difficult to account for the absence in many districts of striated and scored pebbles and boulders in glacial deposits, for they may have been exposed to the action of the waves on a coast while it was sinking beneath or rising above the sea. No shingle on an ordinary sea-beach exhibits such striæ, and at a very short distance from the termination of a glacier every stone in the bed of the torrent which gushes out from the melting ice is found to have lost its glacial markings by being rolled for a distance even of a few hundred yards.

The usual dearth of fossil shells in glacial clays well fitted to preserve organic remains may, perhaps, be owing, as already hinted, to the

* Bulletin Soc. Géol. de France, tom. iv 2do sér. p. 1121.