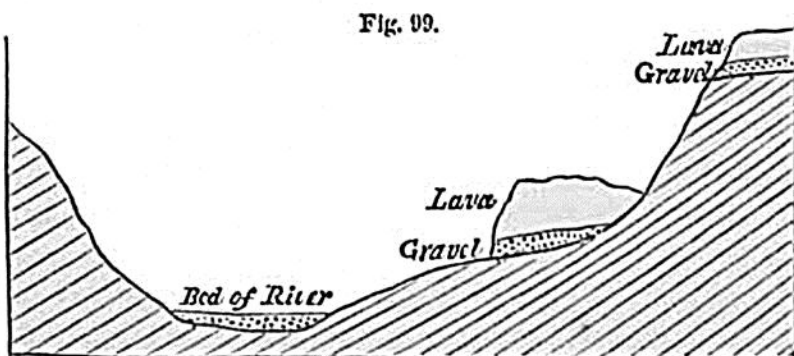


able connection with the agency of floating ice and glaciers will be treated of more particularly in the eleventh and twelfth chapters.

The student will be prepared, by what I have said in the last chapter on denudation, to hear that loose gravel and sand are often met with, not only on the low grounds bordering rivers, but also at various points on the sides or even summits of mountains. For, in the course of those changes in physical geography which may take place during the gradual emergence of the bottom of the sea and its conversion into dry land, any spot may either have been a sunken reef, or a bay, or estuary, or sea-shore, or the bed of a river. The drainage, moreover, may have been deranged again and again by earthquakes, during which temporary lakes are caused by landslips, and partial deluges occasioned by the bursting of the barriers of such lakes. For this reason it would be unreasonable to hope that we should ever be able to account for all the alluvial phenomena of each particular country, seeing that the causes of their origin are so various. Besides, the last operations of water have a tendency to disturb and confound together all pre-existing alluviums. Hence we are always in danger of regarding as the work of a single era, and the effect of one cause, what has in reality been the result of a variety of distinct agents, during a long succession of geological epochs. Much useful instruction may therefore be gained from the exploration of a country like Auvergne, where the superficial gravel of very different eras happens to have been preserved by sheets of lava, which were poured out one after the other at periods when the denudation, and probably the upheaval, of rocks were in progress. That region had already acquired in some degree its present configuration before any volcanoes were in activity, and before any igneous matter was superimposed upon the granitic and fossiliferous formations. The pebbles therefore in the older gravels are exclusively constituted of granite and other aboriginal rocks; and afterwards, when volcanic vents burst forth into eruption,



Lavas of Auvergne resting on alluviums of different ages.

those earlier alluviums were covered by streams of lava, which protected them from intermixture with gravel of subsequent date. In the course of ages, a new system of valleys was excavated, so that the rivers ran at lower levels than those at which the first alluviums and sheets of lava were formed. When, therefore, fresh eruptions gave rise to new lava, the melted matter was poured out over lower grounds; and the gravel