

CHAPTER XI.

NEWER PLIOCENE PERIOD—BOULDER FORMATION.

Drift of Scandinavia, northern Germany, and Russia—Its northern origin—Not all of the same age—Fundamental rocks polished, grooved, and scratched—Action of glaciers and icebergs—Fossil shells of glacial period—Drift of eastern Norfolk—Associated freshwater deposit—Bent and folded strata lying on undisturbed beds—Shells on Moel Tryfan—Ancient glaciers of North Wales—Irish drift.

AMONG the different kinds of alluvium described in the seventh chapter, mention was made of the boulder formation in the north of Europe, the peculiar characters of which may now be considered, as it belongs in part to the post-pliocene, and partly to the newer pliocene, period. I shall first allude briefly to that portion of it which extends from Finland and the Scandinavian mountains to the north of Russia, and the low countries bordering the Baltic, and which has been traced southwards as far as the eastern coast of England. This formation consists of mud, sand, and clay, sometimes stratified, but often wholly devoid of stratification, for a depth of more than a hundred feet. To this unstratified form of the deposit, the name of *till* has been applied in Scotland. It generally contains numerous fragments of rocks, some angular and others rounded, which have been derived from formations of all ages, both fossiliferous, volcanic, and hypogene, and which have often been brought from great distances. Some of the travelled blocks are of enormous size, several feet or yards in diameter; their average dimensions increasing as we advance northwards. The till is almost everywhere devoid of organic remains, unless where these have been washed into it from older formations; so that it is chiefly from relative position that we must hope to derive a knowledge of its age.

Although a large proportion of the boulder deposit, or "northern drift," as it has sometimes been called, is made up of fragments brought from a distance, and which have sometimes travelled many hundred miles, the bulk of the mass in each locality consists of the ruins of subjacent or neighboring rocks; so that it is red in a region of red sandstone, white in a chalk country, and gray or black in a district of coal and coal-shale.

The fundamental rock on which the boulder formation reposes, if it consists of granite, gneiss, marble, or other hard stone capable of permanently retaining any superficial markings which may have been imprinted upon it, is usually smoothed or polished, and exhibits parallel striæ and furrows having a determinate direction. This direction, both in Europe and North America, is evidently connected with the course taken by the erratic blocks in the same district being from north to south, or if it be 20 or 30 degrees to the east or west of north, always corresponding to the direction in which the large angular and rounded stones have travelled.