

have been carried southward cannot be doubted; those of granite, for example, scattered over large districts of Russia and Poland, agree precisely in character with rocks of the mountains of Lapland and Finland; while the masses of gneiss, syenite, porphyry, and trap, strewn over the low sandy countries of Pomerania, Holstein, and Denmark are identical in mineral characters with the mountains of Norway and Sweden.

It is found to be a general rule in Russia, that the smaller blocks are carried to greater distances from their point of departure than the larger; the distance being sometimes 800 and even 1000 miles from the nearest rocks from which they were broken off; the direction having been from N. W. to S. E., or from the Scandinavian mountains over the seas and low lands to the southeast. That its accumulation throughout this area took place in part during the post-pliocene period is proved by its superposition at several points to strata containing recent shells. Thus, for example, in European Russia, MM. Murchison and De Verneuil found in 1840, that the flat country between St. Petersburg and Archangel, for a distance of 600 miles, consisted of horizontal strata, full of shells similar to those now inhabiting the arctic sea, on which rested the boulder formation, containing large erratics.

In Sweden, in the immediate neighborhood of Upsala, I had observed, in 1834, a ridge of stratified sand and gravel, in the midst of which occurs a layer of marl, evidently formed originally at the bottom of the Baltic, by the slow growth of the mussel, cockle, and other marine shells of living species, intermixed with some proper to freshwater. The marine shells are all of dwarfish size, like those now inhabiting the brackish waters of the Baltic; and the marl, in which myriads of them are imbedded, is now raised more than 100 feet above the level of the Gulf of Bothnia. Upon the top of this ridge repose several huge erratics, consisting of gneiss for the most part unrounded, from 9 to 16 feet in diameter, and which must have been brought into their present position since the time when the neighboring gulf was already characterized by its peculiar fauna.* Here, therefore, we have proof that the transport of erratics continued to take place, not merely when the sea was inhabited by the existing testacea, but when the north of Europe had already assumed that remarkable feature of its physical geography, which separates the Baltic from the North Sea, and causes the Gulf of Bothnia to have only one-fourth of the saltness belonging to the ocean. In Denmark, also, recent shells have been found in stratified beds, closely associated with the boulder clay.

It was stated that in Russia the erratics diminished generally in size in proportion as they are traced farther from their source. The same observation holds true in regard to the average bulk of the Scandinavian boulders, when we pursue them southwards, from the south of Norway and Sweden through Denmark and Westphalia. This phenomenon is in perfect harmony with the theory of ice-islands floating in a sea of

* See paper by the author, Phil. Trans. 1835. p. 15.