

CHAPTER XXVIII.

RIPPLE-MARKS; ORIGIN OF DUNES; WAVE-MOVEMENTS.

The question of the relation which the so-called »ripple-marks» bear to the fully developed dune appears to be still subject of discussion. The point to be determined is how far the ripple-marks are genetically connected with the dune, that is to say how far they constitute a species of embryonic dune, out of which the fully developed dune is in process of time evolved, or whether they are simply superficial phenomena that are complete in themselves and unable to develop into any »higher» form of sand-wave. Strange to say, two such accurate investigators as Cornish and Chohnoky, both of whom have derived their experience and the *data* for their reasonings direct from nature, are in this matter diametrically opposed to one another. Cornish advocates the former view, Chohnoky the latter. Cornish arrives at the following amongst other conclusions:

»In the case of wind-formed ripples I concluded, from the fact that the wave-length increased steadily with the time during which the wind blew, that the sand-grains were the source of those regular undulations of the air the existence of which is attested by the uniformity of the ripple-pattern.» This conclusion Cornish confirmed by experiment in a sand-blast works: »In a few minutes the surface became rippled, and the ripples grew in height, in wave-length, and in regularity, under the constant blast»; and he enunciates the law that underlies the process in the following terms: »The rippling of sand takes place when the eddy in the lee of the larger grains is of sufficient strength to lift the smaller.» Then he goes on: »The ridges of wind-formed ripples advance almost entirely by the rolling of the larger grains of the top layer over the crest. The motion is slow, for the eddy opposes the wind; one foot per hour would be pretty good travelling. The rate of advance of a ridge diminishes with increase of amplitude, for the advance is by rolling of the top layer, and the number of layers of sand-grains is proportional to the amplitude. A growing ridge consequently lags, thus increasing its distance from the next leeward ridge. Again, the increase of height of the windward ridge is accompanied by increase of strength of the eddy and by increase of length of the air-billow which tops the eddy, so that the sand shower is thrown further to leeward. This is a part of the mechanism by which the ratio of amplitude to wave-length is kept constant. The remaining part of the mechanism