way, but is at the same time pressed down by the hand — this reproduces the movement of a viscous fluid like lava; (3) in a similarly elastic, but triangular cylinder, which, whilst retaining its triangular form, is rolled along a plane surface — the path of the sand-particle on the surface and base of a dune. Strictly speaking, there is no motion on the under side of a dune, although the sand-particle does alter its position in relation to the mass of the dune, in that the progressive movement of the dune gradually brings it nearer to the leeward edge of its base. The difference between the orbital movement of the wave and the movement of the sand-particle

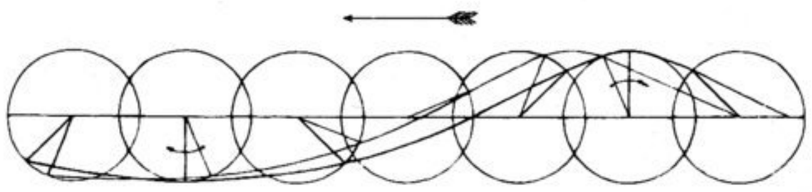

Fig. 185.

will become clear by a comparison of fig. 185 with fig. 186. In the former the water-particles describe their vertically revolving paths in one and the same position, whereas the sand-wave keeps moving forward. The oscillatory or »swinging» movement of such a water-particle is in part progressive, in part retrogressive, and the water-particle constantly returns to the same point, say the apex of the orbital revolution. In fig. 186 the triangle *a* a_1 a_2 stands for a dune; *b* b_1 b_2 for the same dune after a short advance; and so on until the dune reaches the position indicated by *x* x_1 x_2 (= m_1). Upon reaching the position *k* k_1 k_2 (for the sake of clearness k_2 is not shown), the dune has completed a full period; and a sand-particle, which was at a_2, has, in relation to the dune-mass, described its vertical triangular revolution, because it is there once again at the leeward edge of the base of the dune. Theoretically the angle in the path of the sand-particle is not the same at *a* and *k*; but it is somewhat less acute, because the dune, during the advance of the

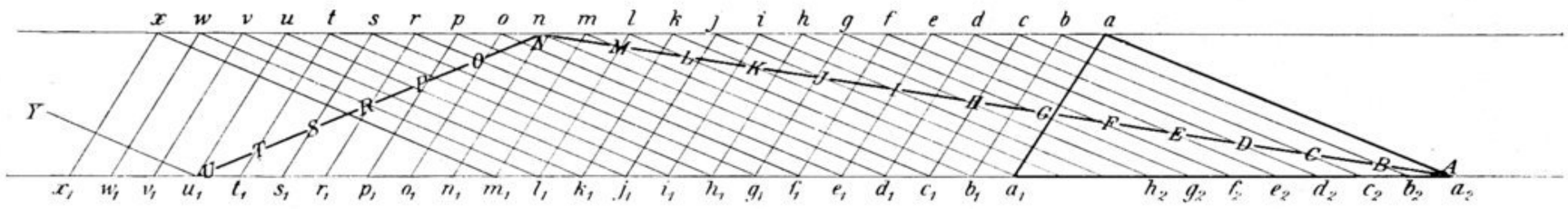

Fig. 186.

sand-particle up the windward side and its descent down the leeward side, itself progresses a little, so that the angle is in reality rather more obtuse than that of the dune. The actual path described by the sand-particle is shown in the blunted triangle *ABC—N-U*, though of course immensely exaggerated in relation to the progressive movement of the dune. The dune advances but an infinitesimally short distance, so that the velocity of the sand-particle is immensely the greater; for, while the dune *a* a_1 a_2 is travelling to *b* b_1 b_2, the sand-particle advances to *B*, and so on; and when it has reached *N*, it drops down the leeward face of the dune and assumes