

windward side of which is covered with a series of ripple-marks. In a strong wind these travel with a velocity which must no doubt be a hundred thousand times greater than that of the dune itself; the difference increasing proportionally with the dune, partly because the velocity of the dune's progress decreases proportionally to its mass, partly because the ripple-marks advance faster in proportion as they become more exposed to the wind. The ripple-mark *a* travels up towards the crest of the dune through the stadia *bcd* . . . etc. When it reaches the crest of the dune (fig. 190 ), it plunges over it, the level of the dune-crest varying at a given point, or rather in the vertical line *a—b*, according as the crests or hollows of the ripple-marks surmount it. The extent of this oscillation is equal to the wave-height of the ripple-marks, and the period of the pendulum-like

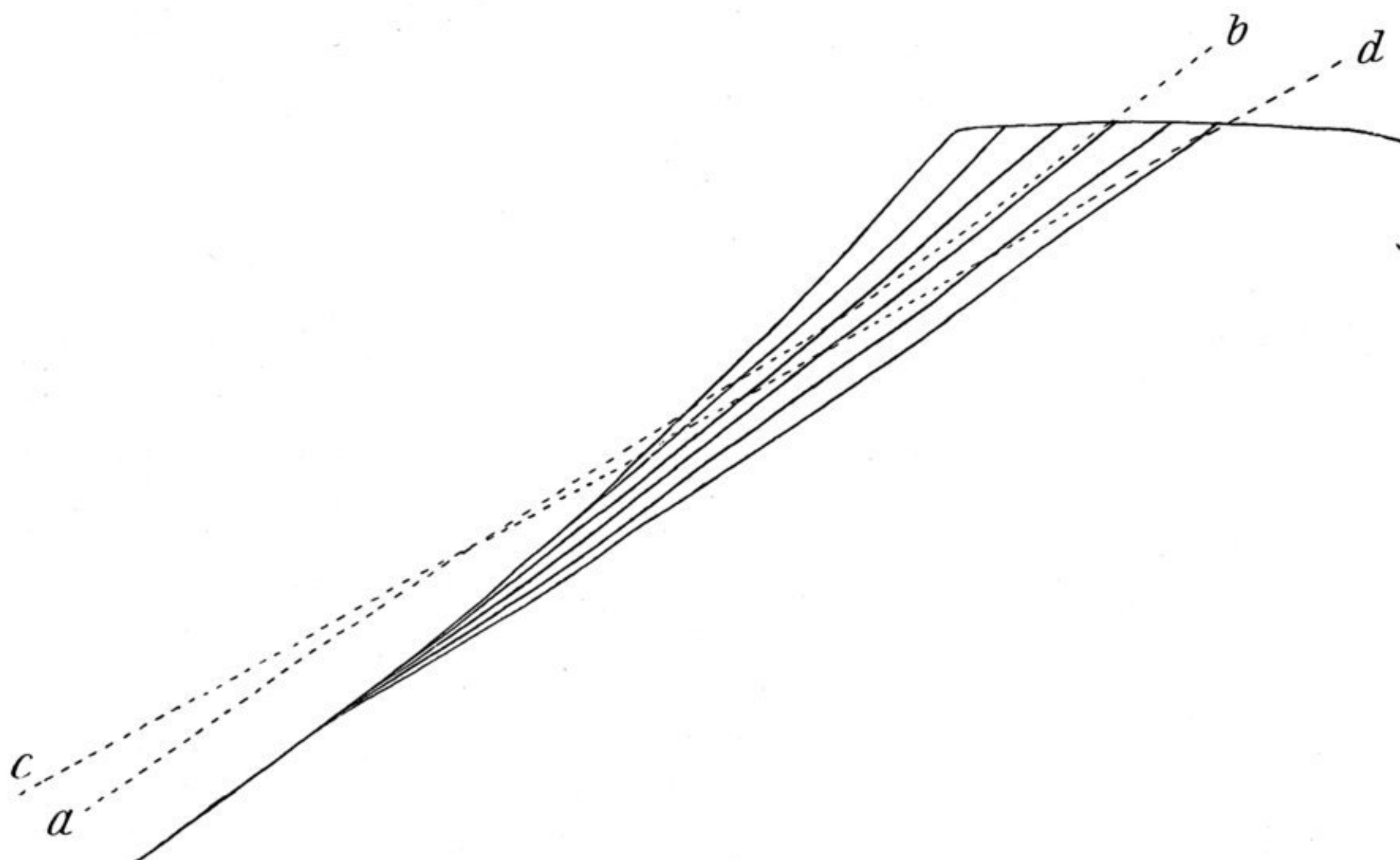


Fig. 191.

swing of the dune-crest on the vertical line is equal to the period of the ripple-marks themselves. As fast as the ripple-mark *a* (fig. 189) advances to the position *b*, a new wavelet is created at *a*, and so on. In a word, fresh wavelets keep coming into being without cessation at *a* and plunging over the crest at *b*. It is due solely and alone to this procedure that the dunes progress, and it alone explains fully how it is that, while the dune advances in the direction of the wind, it is likewise able to maintain its form and its definite individuality. Were it not for the successional creation of the ripple-marks, the dune would either be stationary or would gradually crumble to pieces, and disappear as the grains of sand were blown away. But since the dune does go on increasing in size, and the leeward slope does grow longer, the successive increments of sand which the ripple-marks make to its mass grow increasingly thinner, owing to the fact that the sand is spread out over increasingly larger areas on the leeward side, while the velocity of the dune's advance decreases at the same rate.