from superficial drifts, from the sand borne away high in the air, or from that kept firm by wet ground, the dune must finally by degrees lose its power, come to rest, and be occupied by vegetation. But before this can happen it buries all before it as it advances—meadow-lands, swamps, crops, and even dwellings, if such should lie in its path—leaving behind a desolate sand-plain or an exposed rock-surface, the buried trees, &c., being again uncovered as it continues to advance.

So far as New Zealand is concerned, the wandering dunes as now met with inland are not an evolutionary product of dune-change, destined when finally fixed by nature and covered by scrub or forest to be the climax of dune-development; on the contrary, they are a *reversion* from perfectly fixed sandhills, held in position not only by shrubs or grass but by loam, to the original wandering state. Their origin is traced further on, under another head. Here it need only be pointed out that they are indistinguishable from the primary wandering dune, except insomuch as they are frequently continuous with loam-fixed grassy hills. Also, as they are often quite unsheltered by contiguous chains of sandhills, being cut off from the general dune-mass by wide flats covered with manuka or grass, the wind can attack them with full force, and their power for mischief is consequently great.

The most remarkable wandering dune in New Zealand, and one of the wonderful natural objects of the Dominion, is that which at the mouth of the Waikato River extends from the shore to the Maioro Stream, a distance of about three miles, and occupies an area of nearly 3,420 acres. In its highest part it can hardly be lower than 250 ft., but this is due to the sand overlying rock. The view from the summit is that of an undulating tableland of bare sand as far as the eye can reach, with long low ridges and rounded advancing parasitic hills which have crescentric dune-falls. All is brown in colour, save where long stripes of black mark the innumerable ripples. In some places there are long rows of huge secondary ripples—low ridges, in fact, giving the sand the appearance of a furrowed field. There are no plants of any kind. A few flies creep along the surface, and rise in the air for a short distance when disturbed: these are the only signs of life on this desolate spot. As the actual shore is approached there are sand hollows and gullies which contain a scanty vegetation. The sand finally pours into the Waikato and the neighbouring swamp.

Very frequently in New Zealand the wandering dune advances in more than one direction, since it will be fully exposed to all the common winds.

It is the fixing of wandering dunes which is the most difficult problem in dune-reclamation, and, as they vary much in character, various cases will obviously require different treatment.

(*e.*) *Cliff-dunes.*

(a.) *The Under Cliff-dune.*—Wherever there is a wall-like obstacle, such as a cliff, a dune will be built some distance in front by the eddying wind, as described in section (*c*). Dunes similar in origin are formed in front of high sandhills, or even on dunes themselves. For ridges of this character I propose the name of "under cliff-dune." An excellent example of such a dune on the Taranaki coast is shown in Photo No. 24. Another well-known case occurs at Sumner, Canterbury, at some considerable distance from the actual shore.

(b.) *The Upper Cliff-dune.*—Dunes are very common on the summit of cliffs at many parts of the New Zealand coast. The origin of such may be twofold. Where the cliff-face abuts on a sandy shore the whirlwind caused by the stroke of the wind raises the sand high in the air, depositing it upon the ledges of rock, and finally on the summit of the cliff, where a line of dunes will be formed. These are the upper cliff-dunes. According to Jentzsch (18, p. 74) sand-grains can be raised 30 metres (118 ft.) into the air by the strong winds of an open coast. Cornish (7, p. 301) thus describes the phenomenon: "A cliff facing the wind deflects the current of air, which rises in a billow above the edge of the cliff. Below the billow is an eddy, which assists in bringing down the sand borne by the wind. Thus a cliff may be capped with blown sand which deposits in a position apparently exposed, but in reality well sheltered." It seems to me very probable that many upper cliff-dunes in New Zealand had their origin at a time when the land was lower and the sand travelled from the shore in the usual manner. Personally I have had no opportunity of witnessing the effect of a high wind on the foreshore at the base of cliffs. Where there are gullies in the cliff, even though very steep, the sand ascends by their aid to the summit (see Photo No. 24), and such a drift may be considered a combination of upper and under cliff-dunes. Reef Point, north-west Auckland, 700 ft. in height, is an excellent example of sand from the shore covering a rocky promontory. There the southern side is almost completely covered by wandering dunes and drifts, which pass over almost the highest point and are descending on the northern side towards Ahipara, burying the forest in their descent. Watercourses have been dammed up, deep gullies filled with sand, rocks fantastically cut, and the face of nature completely changed (see Photos Nos. 64 and 31).

(ii.) Sandspits.

Sandspits are of great economic importance, insomuch as they may enclose harbours, and, when crowned by fixed dunes, prevent the drifting sand from filling up these waterways. Their origin has already been sufficiently described. In the case of a tidal river its course may be much diverted, a growing spit forcing the river to run parallel with the coast for a considerable distance, as in the case of several of the rivers of western Wellington.

(iii.) Sand-plains.

The origin of these has been already explained, and further details are given in the botanical section. They are the most important part of the dune-areas from the farming standpoint, and their treatment is gone into at considerable length in Part II.