may easily convert an unstable dune complex into a wandering dune. So, too, does a breach in the foredune by the sea lead to destruction of the dune complex whose members become undermined by the wind, and the increased sand-supply helps to bring about a flatter condition, hollows being filled, and extensive sand-drifts resulting.

Frequently the wandering dune is quite unconnected with the dune complex and with the perennial sand-supply of the shore, in which case, as no fresh sand is arriving, and as waste is ever present, either 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, 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 in so much 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.

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.

(4.) *Cliff Dunes.*

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 (see Photo. No. 22). Dunes similar in origin are formed in front of high sandhills, or even on dunes themselves. These "cliff dunes," to give them a name, the "*Stufendünen*" of Jentzsch (15, p. 72), are of two kinds—the under cliff, as just described, and the upper cliff dune.

The Upper Cliff Dune.

Where a 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.

Between Wanganui and Cape Egmont there is, except in a few places, a long line of coastal cliffs (see Photo. No. 9) on which are dunes, some extending inland, and "wandering."

Possibly these dunes have a twofold origin. Thus they may be the remnant of what occupied the site of the cliff-surface now weathered away,* or they may be in part upper cliff dunes such as described above. Personally, I had no opportunity of witnessing the effect of a high wind on the foreshore at their base. Where there are gullies in the cliff, even though very steep, the sand ascends by their aid to the summit (see Photo. No. 22), and such a drift may be considered a combination of upper and under cliff dunes.†

(5.) *Juvenile Dunes.*

Dunes are encountered in every stage of building. Certain plants—*e.g.*, *Carex pumila*—raise quite low mounds, only a few inches tall, which never attain any noticeable height, but do not drift to any extent. On sand-plains, fed by a rich supply of material, mound after mound, all touching, may be formed by the silvery sand grass (*Spinifex hirsutus*), and present a remarkable spectacle. Embryonic dunes are built by certain shrubs on their leeside or interior, or they finally bury the plant; in both these cases the form is but transitory, the wind rapidly removing the sand-heap.

(6.) *Sandspits* (see Photo. No. 3).

Sandspits are of great economic importance, in so much 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.

(7.) *Sand-plains.*

These have been already dealt with, and need no further comment.

(8.) *Swamps.*

Swamps are formed either by a shallow lake becoming occupied by vegetation, or through the natural drainage being blocked or checked by the sand-movement. In some places there are hundreds of acres of swamp right in the centre of the dune area, but generally it is nearer the landward than the sea boundary.

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* Pharazyn, who first called attention to these dunes, considered there had been such a weathering, and he calls attention to remains of trees and lignite, especially near Kai Iwi, buried beneath the sand (107).

† The dunes referred to here were quite active in 1849 according to Lieutenant C. H. Smith and Lieutenant C. Hutchinson. ("Notes on New Zealand," No. 6, p. 18, March, 1850.)