PART II.—THE RECLAMATION OF THE DUNES.

I. INTRODUCTION.

(*a.*) GENERAL.

As seen from the preceding part of this report, the dunes of New Zealand are no longer in their virgin condition. Large areas which were firmly fixed by nature when the early settlers arrived are now in a state of great instability, and not only useless in themselves but daily encroach upon, and so render valueless, the neighbouring fertile ground (see Photo No. 42). The checking of such encroachment is obviously the first aim of dune-reclamation in this country. But the amelioration of the sand-areas goes much further than this, and *the final goal should be their improvement as a whole through their occupation by a continuous plant covering that shall be of commercial value.*

The methods in vogue for the artificial fixation of dunes are based altogether upon those which nature herself uses. Thus a clear grasp must be gained of the following fundamental principles which clearly follow from the geological and botanical data of Part I:—

1. The motion of the surface under the influence of frequent wind is the essential factor which has to be met in dune-cultivation.
2. No motion of the sand can occur if the surface be altogether covered by either a living or a dead covering.
3. When the surface of the sand is wet no movement is possible.
4. On drifting sand, only sand-binding plants can become permanently established.
5. A sand-binding plant is a perennial which has the power of growing above the sand as it is buried, and putting forth new roots from the rising stem.
6. Where there is no drift a close covering of almost any plants will hold the surface, but those of long life, such as trees, are the most efficacious.
7. Non-sand-binding plants such as tree-lupin and forest-trees will be buried by a drift, and a moving naked dune will result. It follows then that before trees be planted the drift should be stopped.
8. Two contiguous hills will lead to the presence of a wind-channel, in which the air is compressed and has special erosive power.
9. Any prominence rising above the general level of the surface is liable to damage by the wind.
10. Building of isolated mounds by the uneven planting of sand-binding plants may finally lead to their destruction in accordance with principles 8 and 9.
11. Dunes are always moist at a few inches below the surface, so there is little fear of death from drought by plants tolerant of dune conditions once they are established.
12. Plants which form an abundance of humus are of special value, since they not only increase the cohesion of the sand-grains but supply nutritive matter and a water-holding mulch.
13. Burning, grazing of animals, and indeed anything that can damage the plant covering or disturb the surface may lead to the movement of the sand.
14. Every blade of grass, unevenness of the surface, or obstacle of any kind helps to break the force of the wind.
15. Average sand-dunes without any manure whatsoever will support a remarkable number of species.*

The experience of considerably more than a hundred years in Europe, and the more recent attempts to cope with drifting sand (United States, Cape Colony, Australasia), have proved beyond a doubt that the most efficacious of sand-binding plants is marram-grass (*Ammophila arenaria*), a native of Europe, North Africa, and North America, and that when it is planted correctly drifting sand, even where the winds are exceptionally violent, can be fixed. There is therefore no need for the experimental planting of other sand-binders in the first instance, except under exceptional circumstances. Gerhardt in his most exhaustive treatise goes into the various methods of planting marram-grass at great length and with much detail. Although I have drawn upon his work freely, I have refrained from quoting his methods at length, since many details and excessive minutiae would deter those for whom this report is intended from commencing the work of sand-planting, as being too technical and difficult. Some of the methods herein advocated may seem crude to the European planter, but, so far as I can judge, they have been efficacious in New Zealand, and possess the merit of simplicity and comparative cheapness.

Notwithstanding that certain methods of dune-reclamation are recommended by me, it must not be concluded that success depends upon any hard-and-fast rules. To be sure, the general principles detailed above must not be violated, but the local climate of any particular locality, a knowledge of the intensity of the wind and its average direction, the degree of coarseness of the sand, the selection of material for sand-fences, and so on—all these matters will be the concern of the local "sand-planter," while his experience and sound judgment will have an important bearing upon his success.

* In certain instances there are layers of more fertile soil within the dunes; in other cases the dunes overlie clay, loam, rock, &c. Thus a plant growing apparently in pure sand may have its ultimate rootlets in a much more nourishing soil.