

INTRODUCTION.

(a.) GENERAL REMARKS.

WHEREVER there are loose deposits of sand liable to be moved by the wind, those mounds and ridges known as dunes are to be found. The most familiar are those of the coast-line, but the great deserts of the world show examples on a much vaster scale. Were such hills of sand stable and not liable to move, except for their peculiar physical and chemical qualities, they would not merit any special attention. But the material of which they are composed, so capable of easy transport to a longer or shorter distance according to the velocity of the wind, leads to their excessive instability, and makes a soil on which plants can only be established with extreme difficulty, and one moreover which, driven *en masse* by the prevailing wind, frequently overwhelms fertile lands, burying not merely the meadows but even forests and human dwellings.

So far as New Zealand is concerned, dunes are an extremely frequent character of the sea-coast. They also occur inland to some extent, as in the neighbourhood of certain of the rivers of the Southern Alps, on the volcanic plateau of the North Island, and especially near Lake Tekapo and in Central Otago.

It is the coastal dunes, however, which are of prime moment, as, in the first place, they form a natural defence to the land against the encroachment of the sea, and, in the second place, *their movement inland is a national concern*, since through their advance much valuable land has been ruined in the past, while yearly further destruction takes place, the evil at the same time becoming more difficult to suppress.

Such depredation, confined as it is to a limited and little-visited area, and appearing to be the affair merely of the few whom it affects, is apt to be overlooked, while the comparative slowness of its action tends to make its extreme importance for mischief underestimated. Nor is it generally known how large an area in New Zealand is occupied by these more or less moving sands and virtually a desert, but which, judging from the experiences of Europe, might be rendered not only harmless, but a source of wealth to the nation. *Roughly speaking, there are in the North Island 290,000 acres and in the South Island 24,000 acres.* Figures such as these bring home at once the importance of the dune question. This has indeed to some extent been recognized by the passing of the Sand Drift Act of 1907, but which has not as yet been put into force. Also, a bonus is given to such lessees of Crown dune-areas as plant them with certain specified plants, but this arrangement as now existing is not likely to lead to any useful results.

Towards the end of the year 1908 the Minister of Lands, the Hon. Mr. McNab, and a little later, his successor, the Right Hon. Sir J. G. Ward, thoroughly recognizing the importance of the question, decided that, as a preliminary to further advance, a scientific study of the dunes of the Dominion should be made, so that a more complete knowledge of their present condition could be gained and an examination of their capabilities made, while, as a result of such field-work, suggestions could be offered as to their reclamation and future treatment. For this purpose my services were engaged by the Department of Lands and Survey.

The field-work was commenced in November, 1908, and continued until the 8th February, 1909, during which time the dune-areas of western Wellington and part of Taranaki were examined, as also the Waikouaiti dunes, those near Normanby (South Canterbury), and the coastal planting carried out by Dr. Truby King at Kaikōura.

Previously, on my own account, I had studied the dunes in many parts of New Zealand (northern Auckland, Southland, Martin's Bay, Stewart Island, Chatham Island, the Auckland Islands, &c.), but this was rather from the botanical standpoint alone than with any idea of formulating a scheme for their reclamation. More in accordance with this latter was my keeping a private experiment garden for a period of some twelve years on the dunes near New Brighton, Canterbury, at about a distance of one mile from the sea, but for which experience I would never have undertaken the important duty of preparing this report.

As the outcome of the above studies my first report on the dune question was published by the Lands Department in June, 1909 (Cockayne, 91). It dealt with the scientific aspect of the matter only; since it was clear, as the Under-Secretary of Lands (Mr. W. C. Kensington, I.S.O.) explained in his letter of transmission to the Minister, that "a sound knowledge of general principles as well as of local conditions is a necessary preliminary to any attempt to cope practically with the sand-drift evil." So important, indeed, is a clear understanding of all matters pertaining to the formation of dunes, their movements, and their occupation by plants, that it has been decided to reproduce my original report in an amended form. Thus there is under one cover, for the information of all interested, a fairly full account of sand-dunes from both the scientific and practical standpoints. The botanical part of the first report dealt only with the dunes of western Wellington. Here, on the contrary, the whole dune-area of the New Zealand biological region, from the Kermadec Islands to the Auckland Group, is considered. The treatment, however, is comparatively brief, and the less-interesting details are omitted. Part II, dealing with the reclamation of dunes, is altogether new, and goes into the matter with some degree of thoroughness for the first time in New Zealand.

In December, 1910, by direction of the Right Hon. Minister of Lands, Sir J. G. Ward, my examination of the dune-areas was continued, and I was able to visit the extensive areas of western Auckland, as also Central Otago, Ocean Beach (Dunedin), and Southland as far east as Waikawa. Earlier in 1910, on my own account, I had examined the Otago dunes to the south of Dunedin and