

A commencement was made with the dunes of western Wellington, an area of more than 90,000 acres extending for about 170 miles along the coast, my instructions being to pay special attention to the Crown lands. The work on these dunes was concluded on the 8th February, and till the 18th February the time was spent in investigating certain coastal tree-planting which had been undertaken in the South Island, including that by Dr. Truby King at Karitane, near Waikouaiti, Otago.

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.

Leaving out of the question the above private studies, the recent investigation has been devoted in the first place to the economic aspect, and in the second to the scientific, so far as one may divide two aspects which can hardly be distinguished, so much do they dovetail and depend on one another. The origin of dunes, cause of movement, relation to climate, and their special flora are certainly matters of pure science, but a knowledge of these is absolutely requisite before any intelligent scheme dealing with their reclamation can be elaborated or discussed. Furthermore, the dunes have been much altered by human occupation, new factors for change have entered in, and a knowledge of these changes and factors is essential. Finally, without going into further details, comes a study of the reclamation methods pursued elsewhere, and the consideration of such with regard to the special circumstances in New Zealand.

From the above it may easily be seen that a three months' investigation of one special dune region does not by any means entitle me to formulate a conclusive scheme as to dune reclamation in New Zealand as a whole. Dogmatic utterances at this stage of the inquiry would be not only useless but dangerous. The reclamation of the dunes on the coast of the Baltic and North Seas has occupied the highest scientific thought for more than a hundred years, and, although the general principles on which success has been there attained are doubtless applicable here also, local conditions and the very different climate must materially modify methods.

This portion of the report seeks rather, then, to explain the general principles on which dune reclamation depends by giving an account of the natural history of the dunes, so as to pave the way for those final conclusions which are only to be derived from a knowledge of the New Zealand dunes as a whole. The study of the Wellington dunes has opened up many questions which can only be solved by the examination of other areas, and, on the answers to such, important details of procedure depend.

Although certain owners of dune areas are fully aware of the sand-drift evil, and are making brave efforts to overcome it, these are in no few instances misdirected (see Photo. No. 1). Others, again, are doing nothing; they recognise the need for action, but have no idea as to the methods to be pursued. Some even hold the most strange or dangerous views, such as that the sand did not originally come from the sea-shore, or that a belt of shrubs will stop a wandering dune. Even where the best successes have been won there has been only a planting of marram grass (*Ammophila arenaria*) or tree-lupin (*Lupinus arboreus*), which is at most but a makeshift, except under special circumstances. *The final treatment of dunes should assuredly be afforestation*, and yet by many this is thought to be impossible, and, except in a few specially favourable localities, nothing of the kind has been attempted.

The dunes of New Zealand are of special scientific importance. Those of the Old World have been materially changed by the many centuries of man's occupation. Their reclamation was for the new and unnatural conditions. But in New Zealand there is an opportunity of observing what Nature, quite unhindered, has done for their fixation. The native dune plants are also of much interest, since some are endemic and also of quite remarkable form, while their value as "sand-fixers" is by no means generally appreciated.

I must express my warmest thanks to those various runholders and others interested in dune reclamation who have rendered me welcome and valuable assistance, and especially to Dr. Truby King, Messrs. K. W. Dalrymple, A. W. Amon, D. L. Blyth, D. Simpson, and J. Handley. I am also highly indebted to Mr. W. H. Field, M.P., for some most excellent photographs of dunes and for assistance and advice; also to Mr. R. Speight, B.Sc., who has contributed the section on the origin and material of dune sand. For help from outside New Zealand my grateful thanks are due to Professor C. R. Barnes, Chicago University; Professor J. W. Harshberger, University of Pennsylvania; Professor L. Diels, University of Marburg; and Dr. B. T. Galloway, Chief Bureau of Plant Industry, United States Department of Agriculture. Finally, I must express my indebtedness to Mr. W. C. Kensington, Under-Secretary of Lands, who put at my disposal a MS. report prepared by his Department in 1903 on the sand-drift question, and which has been of considerable assistance.

#### (B.) OBJECTS OF DUNE-CULTURE.

It seems needful to state briefly the objects of dune culture or reclamation, since usually in New Zealand the only point considered is the fixing of such sands as threaten fertile land.

In Europe the culture of dunes has been in progress for more than one hundred years. There the first object is not reclamation at all, but the *protection of the coast-line*. This is a matter which as yet has received no attention in New Zealand, nor has my examination up to the present revealed any pressing need for action in this direction. At the same time, the sea does make encroachments, as at the Ocean Beach, Dunedin; at various points on the coast of western Wellington (see Photo. No. 2); near New Brighton, Canterbury; and elsewhere. When really close settlement fills the Dominion the coast-line will need attention. So urgent is this matter in the Mother-land that a Royal Commission has recently dealt with the question and issued a voluminous report.