Closely bound up with coast protection is the obstruction of waterways. This is exemplified by the bars of rivers and estuaries, which, although mostly of marine and fluviatile origin, are strengthened by sand from the dunes. Sandspits crowned by dunes also bear an important relation to harbours (see Photo. No. 3).

As for the dunes themselves, the damage they do is twofold. On the one hand, at their extreme landward boundary they bury good ground quite free from sand, adding it to the dune area, and, on the other, they overwhelm a great deal of fairly good low-lying land within the dune areas themselves (see Photo. No. 4). Besides fertile soil, valuable flax swamps are filled and destroyed (see Photo. No. 5). Also, watercourses are choked or diverted, and the drainage of the neighbouring country is much impaired.

Finally—and to my mind this is the most important of all, nor has it been approached to any degree as yet—the dune areas themselves, now simply deserts and always a menace to the neighbouring valuable land (see Photo. No. 6), even when supposed to be checked by shelter-strips, should be reclaimed and made productive by afforestation. The methods to be pursued and the trees to be made use of, on account of economic value of one kind or another, will be given in a succeeding part of this report. Here a few words will not be out of place as to afforestation of dune areas in Europe, since there is a belief amongst many that sea-spray is altogether antagonistic, and that afforestation, near the shore at any rate, is impossible. Such forget, or do not know, that natural coastal forests, and even dune-forests, exist in New Zealand, and that various trees and shrubs (pohutakawa, *Metrosideros tomentosa;* Chatham Island akeake, *Olearia Traversii*, &c.) grow even on cliffs subject to constant wetting with sea-spray.

Afforestation of Dunes in Europe.

The best-known and always-quoted example of afforestation* is that of the dunes of Gascony, in France. Here the justly celebrated Brémontier, during the closing years of the eighteenth century, using methods which have since been modified and improved, covered extensive areas with the maritime pine (*Pinus Pinaster*)†, which have yielded large quantities of turpentine.

More important still, because the work has been accomplished in the face of greater difficulties, has been the afforestation of the German dunes. Without going into details, the various photographs in Gerhardt's splendid work on dune reclamation are most illuminating, as may be seen from the one reproduced (Photo. No. 7). And it must be impressed upon the reader that the climate of North Germany is not in the same category with ours, since there the severe winter forbids the use even of gorse (*Ulex europeus*), let alone tree-lupin (*Lupinus arboreus*), and many other plants which are hardy with us.

(C.) PREVIOUS INVESTIGATIONS OF NEW ZEALAND DUNES.

Up to the present time comparatively little has been published as to the geology, botany, or economic possibilities of New Zealand dunes, so that a detailed account of what has been done would be of no moment. The geological writers usually mention dunes as existing in the locality dealt with, but supply no details. McKay's paper (98), however, is an exception, as it describes at some length the dunes of Northern Auckland, which form such a striking feature, especially on the west. Various botanical writers—Kirk, Cheeseman, Petrie, and others—have enumerated more or less fully the dune plants for certain parts of the New Zealand botanical region, and their distribution is probably now approximately known. Between the years 1873 and 1890 a few papers dealing with the economic aspect, but suggestive rather than instructive, were published by Messrs. Whitcombe, Crawford, Travers, and others, Mr. Crawford giving details as to the cultivation of marram grass, which he was probably the first to introduce into New Zealand. A list of the various papers in which dunes are mentioned, even if only casually, is given at the end of this part of the report.

(D.) THE DUNE AREAS OF NEW ZEALAND.

The following account is condensed from the unpublished report of the Department of Lands and Survey already mentioned, written in 1903. A few minor details are added by myself.

(*a.*) Auckland. (Area of Dunes, about 183,940 Acres).

Commencing on the west at 3 miles south-east of Cape Maria Van Diemen, the dunes extend southwards for a distance of 1·7 miles, with an average width of 1·7 miles. Then the coast is rocky to Scott's Point, when a vast stretch of high sandhills forms a belt 47 miles long, with an average breadth of 3 miles (1 mile to 5½ miles), as far as Ahipara Bay. Reef Point then forms a break, but south of it is a small area 3 miles long by 3 miles broad at the widest part. A small tract lies at the mouth of the River Herekino. Between the Hokianga Harbour and Whangape Harbour lies a belt 7½ miles long, and varying in width from ½ mile to 2½ miles. Between Kawerua and Maunganui Bluff is a narrow belt of dunes. North of Kaipara Heads a broad belt extends northwards for 29 miles, with a width varying from ½ mile to 3¼ miles; and south of Kaipara Heads is a still larger area 30½ miles long, with an average width of 1¼ miles (1 mile to 4 miles). Then comes a rocky coast to the Manukau Harbour, south of which is a patch of considerable size near the lighthouse, and thence, with a short break, dunes extend for 16 miles to the mouth of the River Waikato, having an average width of 1 mile. South again are dune areas at the entrance to Aotea Harbour; between the latter and Kawhia Harbour, extending 6 miles, with a width of 1 mile; south of Kawhia is an area 2½ miles long by 1½ miles in the widest part, and

* Almost every article hitherto written on New Zealand dunes merely gives an account of what was done in France.
† Usually sold under the name of *Pinus maritima* by nurserymen.