

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 (18) 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 europaeus*), 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 time of my first report comparatively little had 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 (116), 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 New Zealand 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.

(i.) 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  $5\frac{1}{2}$  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  $7\frac{1}{2}$  miles long, and varying in width from  $\frac{1}{2}$  mile to  $2\frac{1}{2}$  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  $\frac{1}{2}$  mile to  $3\frac{1}{2}$  miles; and south of Kaipara Heads is a still larger area of  $30\frac{1}{2}$  miles long, with an average width of  $1\frac{1}{2}$  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  $2\frac{1}{2}$  miles long by  $1\frac{1}{2}$  miles in the widest part, and on the north shore, at the entrance to Whaingaroa Harbour. On the north coast is an area 8 miles in length at Spirits Bay, and smaller tracts at various places. On the east coast dunes composed of a glistening white sand extend, with one or two small breaks, from the North Cape Isthmus to Rangaunu Bay, having a length of 17 miles, and varying from  $\frac{1}{4}$  mile to 2 miles wide. There is a small area at Henderson Bay and another between Grenville Point and Perforated Point. South from Houhera is a strip 6 miles long and averaging  $\frac{1}{2}$  mile in width. Finally there is a long strip on the shore of the Bay of Plenty, from Tauranga Harbour to the Waiaua River beyond Opotiki, 92 miles in length, with an average breadth of 37 chains.

(ii.) TARANAKI. (Area of Dunes, 6,333 Acres.)

From south of the mouth of the River Mokau are scattered areas extending to New Plymouth, with an area of about 11,621 acres. From about 8 miles north of Cape Egnont are also scattered areas extending to Patea, having an acreage of about 4,712 acres.

(iii.) HAWKE'S BAY. (Area of Dunes, 5,345 Acres.)

The dune-areas are mostly small. They are situated at the mouth of the River Waipuu; on the shore of Poverty Bay; at Pukenui Beach, 6 miles north of Table Cape; near the Township of Mahia; a strip 5 miles in length on either side of the mouth of the River Nuhaka, having an average width of  $\frac{1}{4}$  mile; on the beach at Waimarama, 8 miles south of Cape Kidnapper; at the mouth of the Porangahau River; near Cape Turnagain.

(iv.) WELLINGTON. (Area of Dunes, 92,270 Acres.)

A belt extends right up the coast from Paekakariki to Patea, a distance of about 170 miles. From the mouth of the River Manawatu to that of the Wangaehu there is an average width of about  $2\frac{1}{2}$  miles and a greatest width of about 6 miles. There are also small areas on the shores of Wellington and Porirua Harbours, and at Lyall, Houghton, and Island Bays.

(v.) NELSON. (Area of Dunes, 4,515 Acres.)

The most important dune-area is at Farewell Spit, with a length of 14 miles and an average breadth of  $\frac{1}{2}$  mile (see Napier Bell, 73). There are also small areas at West Wanganui Inlet, Cape Farewell, Golden Bay, Tasman Bay, and for some distance north and south of Westport.

\* This will not be the case in a few years' time, as the sand has crossed right over the point and descended to some distance on the northern side.