and in no very long time a revivified wandering dune, itself originally good ground capable of growing rape or oats, as the photograph shows (Photo No. 35), is invading and burying land of much greater value. At the present time *the neglect of wounds in the turf by the farmer is perhaps the greatest source of danger to the adjacent fertile lands.* These wounds seem trivial, but they are capable of the most profound mischief, and their neglect must already have cost the Dominion thousands of pounds.

New Zealand is not alone in having once more set in motion the dunes fixed and made not only harmless but valuable by nature. The moving dunes of Cape Cod, in North America, had originally three-fourths of their area covered with trees, the destruction of which, through fire and the pasturing of stock on the sand-area, led to a state of affairs endangering a most important harbour, and "the problem of controlling the drifting sands has concerned the municipal, State, and national authorities for two hundred years" (Westgate, 65, p. 10).

The wandering dunes of the Kurische Nehrung, too, were forest-clad, and the felling of this forest for timber has cost Germany vast sums of money, and a considerable annual outlay is still expended in refixing the dunes so well fixed by nature.

In Holland, according to a most interesting communication from the British Vice-Consul at Flushing, the dunes have been rendered unstable in some places through potato-growing on the sand-plains, the ground having been finally abandoned and left to the mercy of the wind. The Dutch dunes are also used as a drink-water reservoir for the many adjacent towns and villages. "Long canals traverse the inner dunes, and the water is pumped from them into large basins and afterwards to the drink-water towers in the towns. All the towns near the coast get their water from the dunes (Amsterdam, Haarlem, Leyden, The Hague, Delft, Middelburg, Flushing, &c.), and the result of this water-withdrawal is sinking of the water-table in the dune-area."*

(*j.*) INLAND DUNES.

(i.) The Volcanic Plateau.

Drifting sand made of pumice, scoria, and ash is quite a common feature of the flat, bare parts of the volcanic plateau (see Cockayne, 89, Photo No. 24). Except where the coach-road crosses the Rangipo desert the drifts do no harm. The dunes are low, often isolated, and frequently held firmly by vegetation. Sometimes wide breadths of the flat surface may be slowly advancing and burying an older surface.

(ii.) The Canterbury Plain.

Small isolated dunes or dune-chains appear in some of the wide river-beds or at some distance away on an older river-bed on the plain itself. They are generally quite fixed by vegetation, and are of no moment as agents of damage.

(iii.) Central Otago (see Photos Nos. 46 and 63).

The dune-area of Central Otago lies in the upper valley of the Clutha, chiefly in the neighbourhood of Alexandra, Clyde, Cromwell, and Tarras. The source of the sand is the Clutha itself, where the terrace against which the streams abut, or did abut, has been cut into either by the river itself, water-channels from above, or drifting sand. The great flood of 1878 is said to be responsible for the main drifts, though doubtless, as Park points out (129, p. 35), "the terrace on which Cromwell is built contains a large amount of drift-sand mixed with the gravels, and a constant supply of this sand, derived from the terrace-faces between Lowburn and Deadman's Point, is carried by the wind across Cromwell flat." The supply at Alexandra is, I believe, considerably augmented by the dredging operations in the Clutha. The commencement of what may become a formidable drift, if not stopped soon, may be seen on the bank of the River Kawarau, near Bannockburn, the sand blowing across the river from the Cromwell flat having cut into the terrace. Sand and gravel drifting from the above wound cuts deep into the soil of the flat above, which in its turn is broken up, its particles being driven along the ground. The finer sand and dust is also raised high into the air, and is finally deposited upon the Carrick Range.

As for the areas themselves, the dunes at Alexandra are the most active. They are of true barchan form—*i.e.*, they are low, with a crescentic dune-fall terminating in two horns, while the body of the dune is convex (see Beadnell, 1A, p. 386). Isolated barchans are present (see Photo No. 31), but generally they are joined together, and their true nature is more or less hidden. The advance of the isolated dunes is in the same direction as the wind, while the united hills are at right angles to the wind.

At Cromwell the principal dunes are the result of high catching-fences, which they have either buried or are in process of burying (see Photo. No. 29). As well, there are many low dunes, sand-ridges, and deep or shallow layers of sand on many parts of the plain, there being a special advance towards the River Kawarau between Cromwell and the Bannockburn Bridge.

At Tarras there are few dunes, but, instead, a very powerful drift along the ground.

Here the sand, much of it extremely coarse, came in the first instance from the broken river-terrace, over the summit of which it was at times driven with such strong velocity that in its progress it cut into the surface soil, exposing by degrees the stones, gravel, and sand of the old river-bed. Thus an ever-increasing source of sand was added until, at the present time, the flat above the river, and not the face of the terrace itself, is almost the sole supply of sand. But this supply is decreasing, since owing to the laying-bare of the large stones and the depth of the sand beneath the surface, the upper layer having been removed, the power of the wind to raise the sand has much decreased. It is drifting sand rather than true dunes which distinguish the sands of the Clutha valley. When the powerful westerly winds blow with their full might the drifting is excessive. Not only sand, but gravel and

* Extract from letter to Lands Department from the British Vice-Consul at Flushing.