

*australis*. *Spinifex hirsutus* forms lines in places, as does *Scirpus frondosus*, but this is where the sand is finer. The small grass *Zoysia pungens* forms colonies here and there, its wiry rhizome spreading through the sand and gravel. Other plants present are tussocks of *Festuca littoralis* and small yellowish cushions of *Scleranthus biflorus*. A slight breeze drives the sand along the ground, but in a gale much flies high into the air, striking one's face with stinging force.

The vegetation of the old land-surface, as seen on the summit of table-like hills south of Wanganui, consists of the ngaio (*Myoporum laetum*), the mapau (*Rapanea Urvillei*), the shrubby corokia (*Corokia Cotoneaster*), the akeake (*Dodonaea viscosa*). All are much wind-swept, and the *Myoporum*, elsewhere generally a small round-headed tree, is almost prostrate.

(iv.) INLAND DUNES.

(a.) Central Otago.

There is little plant-life on the rapidly drifting sands of Otago. As the sand advances over the tussock-clad plain it collects in great tongues on the lee side of the tussocks of *Poa caespitosa* or *Festuca rubra* var., as the case may be, and as the drift continues these tussocks grow upwards, much after the manner of marram-grass. This is the more remarkable as it is no hereditary adaptation on the part of the tussock-form, for that is "adapted" for a quite different end. *The tussock is, in fact, a potential sand-binder.*

Where the soil has all blown away, and an old river-bed once more brought to the surface, the ground is soon thickly studded with the cushions of *Raoulia lutescens*, and as the sand blows away from their sides the cushion-form becomes more accentuated. Further wind-action cuts away the windward side of the cushions, and a few small grasses and stunted sorrel grows in their lee.

(β.) Canterbury Plain.

The low dunes near the Rivers Waimakariri and Rakaia are occupied by *Phormium tenax*, kowhai (*Sophora microphylla*), toetoe (*Arundo conspicua*), *Cassinia fulvida*, *Discaria toumatou*, *Scirpus nodosus*, and *Poa caespitosa*.

(γ.) Volcanic Plateau.

A full account of the dunes of the volcanic plateau are given in my report on the Tongariro National Park (89, p. 25). Here it need only be pointed out how certain plants with potential sand-binding adaptations build dunes 6 ft. or more tall. The plants are various subalpine and alpine shrubs, which grow elsewhere for the most part under quite different circumstances. When nature has made these desert dunes stable, even the tree *Nothofagus cliffortioides* settles at times upon them, but of course merely as stunted examples.

(δ.) Ancient Dunes of Stewart Island.

These, again, are sufficiently dealt with in another of my reports (92, p. 26), so that a brief mention will suffice. Many parts are covered with a heath ecologically equivalent to that, not of dunes altogether, but rather of the boggy or wet heath of the Auckland gumfields. An interesting member of their vegetation is the tiny taxad *Dacrydium laxifolium*.

(ε.) Ancient Dunes near the Bluff Harbour, Southland.

Between these ancient dunes and the actual estuary there is a considerable extent of bog. The sand is covered with a steppe or semi-steppe vegetation. Tussocks of *Danthonia Raoulii* are abundant. There is some stunted bracken-fern (*Pteridium esculentum*), a heath-plant. The following plants, few of which are found on dunes proper, are common: *Helichrysum bellidioides*, *Blechnum penna marina* (small creeping fern, generally subalpine), and *Gaultheria perplexa*. Certain heath-plants more or less common on dunes are also present—e.g., *Gnaphalium filicaule*, *Dichondra repens*, *Pimelea laevigata*, and *Styphelia Fraseri*. The instructive feature is, from the point of view of this report, that *increase of humus-content, owing to climate and long stability of dune, permits a non-dune vegetation to flourish naturally.*

(B.) FLORISTIC BOTANY.

(a.) GENERAL REMARKS.

It is not an easy task to decide as to what species should be cited as actually belonging to the dunes, since some occurring there are very rare indeed, and probably only temporary occupants, while others are present only on the border-land of the dune-area and belong perhaps to some adjacent association.

According to my list the number of dune species is 147, of which 82 are endemic, 43 Australian, and 15 South American, leaving out the cosmopolitan element in the two latter cases. Fifty-one families and 104 genera are represented. The most important families are: *Compositae* 20 species, *Gramineae* 16, *Cyperaceae* 12, *Umbelliferae* 7, *Myrtaceae* and *Campanulaceae* 5, *Orchidaceae*, *Onagraceae* and *Halorrhagaceae* 4.

With regard to the species, only about 50 are common dune-plants, of which 15 are confined, or nearly so, to the dune-area, the remaining 97 occurring only occasionally, or being more or less local in their distribution. Within the botanical region the distribution, according to the botanical provinces, is as follows: Kermadec 26, Northern 113, Central 124, Southern 118, Chatham 58, Subantarctic 16. But these figures refer to the distribution generally in the botanical provinces, and not to the dune species alone, of whose numbers the following is an approximation: Kermadec 5, Northern 100, Central 92, Southern 90, Chatham 19, Subantarctic 6. With regard to vertical distribution, 60 species do not ascend above 1,000 ft., of which about 42 may be considered true coastal plants, 22 above 2,000 ft., 26 above 3,000 ft., and 39 are alpine or subalpine and occur at 3,000 ft. and upwards.