

Where the ground is a little drier, and *Leptocarpus* does not occupy all the space, there will be a more or less continuous turf, which, even in close proximity to the sea as near the mouth of the Turakina River, will contain a number of fodder plants, especially white-clover (*Trifolium repens*), yellow suckling (*T. dubium*), some cocksfoot (*Dactylis glomerata*), Yorkshire fog (*Holcus lanatus*), meadow poa (*Poa pratensis*). The greater part of the introduced plants are, however, of little or no value—e.g., the melilot (*Melilotus arvensis**), the yellow rattle (*Bartsia viscosa*), the toothed medic (*Medicago denticulata*), the sorrel (*Rumex acetosella*), the soft brome grass (*Bromus hordaceus*), the hares'-tail grass (*Lagurus ovatus*), the silver hair-grass (*Airacaryophyllea*).

(β.) *Manuka Heath or Swamp.*

Further from the sea, with the increase in stability as well as greater age of the sand-plain, it is occupied by a manuka heath (see Photo. No. 34), or manuka swamp, according to the absence or presence of standing water upon the ground. Such an association will contain a fairly large number of indigenous species, of which the following may be the most conspicuous: The manuka (*Leptospermum scoparium*), the cabbage-tree (*Cordyline australis*), the common libertia (*Libertia ixioides*), the New Zealand flax (*Phormium tenax*), *Mariscus ustulatus*, *Hydrocotyle pterocarpa*,† *Viola Cunninghamii*, *Eleocharis Cunninghamii*, *Ranunculus macropus*, *Potentilla anserina* var. *anseroides*, *Scirpus inundatus*, *Carex secta*, *Carex ternaria*, *Olearia Solandri*, *Mazus pumilio*, *Coprosma propinqua*.

This shrubby sand-plain vegetation may arise either directly from bare ground occupied first by *Gunnera arenaria*, &c., followed by *Leptocarpus simplex*, or it may be the concluding stage of a series next to be mentioned, commencing with a shallow lake or pond and followed by a swamp. At any rate, no matter what its origin, when it becomes drier, through the incursions of cattle chiefly, it makes fair grazing-land.

(γ.) *Lakes and Swamps.*

It is not always easy to trace the origin of the lakes. Although some small ones arise directly from the sand-plain, as already shown, the majority owe their presence to bad drainage conditions, through streams, &c., being choked by the sand.

The lakes contain various aquatic plants—e.g., *Potamogeton Cheesemannii*, *P. ochreatus*, *Myriophyllum elatinoides*, *M. intermedium*—and on the margin there may be a zone of *Scirpus lacustris*. Next, *Typha angustifolia* may invade the lake, eventually converting it into a swamp, which with decrease of water is invaded by *Phormium tenax*. Finally such a swamp, as the vegetable matter accumulates, may be occupied gradually by manuka, and a manuka swamp or even heath result, such as described above.

The vegetation of these lakes, swamps, and even manuka heaths has been most briefly dealt with, since they are associations found commonly without the dunes, and do not affect to any great extent the dune economics.‡

(δ.) *Dry Hollows* (see Photo. No. 9).

Where the hollows are dry they are sandy, and liable to drift; also, any sand falling on them remains unwetted.

Hollows such as these are early on occupied by the sand sedge (*Carex pumila*), which increases vegetatively at a great rate by means of its far-creeping, slender rhizome. The whole of a hollow is frequently so covered, the plant building miniature dunes if there is drifting sand. Nor is it confined to the dry sand alone, but occurs in plenty on the wetter ground, as mentioned before, where, if invaded by the sand, it increases rapidly, fixing the drift at the same time.

Carex pumila plays a very important part in dune economics in checking drifting sand, a part which I did not find recognised by any of the settlers, who do not appear to have any special name for the plant. Where it is present in quantity in a hollow there is certainly no need, so far as the moving sand there is concerned, to plant marram grass, such procedure being in many instances unwise; for the sand sedge, having fixed the drift, is soon reinforced by certain introduced plants, even white-clover eventually appearing, whereas the "marram" has little value as a food, and may give rise to new dunes liable finally to "wander."

(ε.) *Rapid Drift on to Sand-plain.*

Where there is a rapid increase of blown sand *Carex pumila* will be buried, but generally the native "sand-grasses" appear, and dune-building commences, the further progress of the hollow towards heath or meadow ceasing. *Spinifex hirsutus* in some places builds up hundreds of small hillocks side by side—a most curious sight. *Scirpus frondosus* also plays its part, and *Spinifex* may be altogether absent. The sand tussock grass (*Festuca littoralis*) is also a plant of sandy hollows, constructing ephemeral dunes. Here, too, will be *Calamagrostis Billardieri* and frequently *Mariscus ustulatus* and *Scirpus nodosus*. Finally, the drift continuing, the hollow ceases to be, and a dune chain occupies its site.

(ζ.) *Stony Plain* (see Photo. No. 35).

In places not far from the sea, between the mouths of the Rivers Wanganui and Wangaehu, and to the south of the River Waitotara, the cliff has been weathered flat and a plain results, covered with sand-cut stones of various sizes, a small yellowish gravel, and coarse sand.

* The closely-related *M. officinalis* has been widely advertised as a valuable sand plant, but it is of no use whatever for growing on moving dunes, and is not relished by stock.

† So in my notes, but I have no specimen for certain identification.

‡ Of course, it is a great loss when a valuable *Phormium* swamp is filled by drifting sand, though in this case at first a good deal of the "flax" survives through its power of growing upwards with a drift.