

(δ.) *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. An interesting example is that shown in Photo No. 64, where on the slope of Reef Point a gully with a considerable stream was first dammed up forming a pond, and this latter is now in process of obliteration from a dune-fall. The vegetation of swamps and lakes hardly concerns this report, except for the economic plants they may contain. Thus the swamps are often occupied by a close growth of *Phormium tenax*. In Auckland they will usually contain more or less of the valuable fodder grass, *Isachne australis*, so much relished by cattle. The lakes contain various aquatic plants—to give an example from Wellington, e.g., *Potamogeton Cheesemanii*, *P. ochreatus*, *Myriophyllum elatinoides*, and *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, the last-named excepted, do not affect to any great extent the dune economics.

(ε.) *Dry Hollows.*

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 occupied by the sand-sedge (*Carex pumila*) (see Photo No. 39), 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 recognized 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." Dry hollows where there is coarse sand, as at Fortrose, Southland, contain an abundance of the low cushions or mats of *Raoulia australis*, usually a river-bed or scoria-desert plant. This is of no importance as a fodder plant, but is a rapid former of humus, and so of considerable economic value. The deep-rooting *Geranium sessiliflorum* is a common Southland and also Stewart Island plant.

(ζ.) *Rapid Drift on to Sand-plain.*

Where there is a rapid increase of blown sand *Carex pumila* will be buried, but generally the indigenous sand-grasses appear, and dune-building commences, the further progress of the hollow towards heath or meadow ceasing. *Spinifex hirsutus* in some parts of the Wellington dunes 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, there will be *Calamagrostis Billardieri* and frequently *Mariscus ustulatus* (but not south of Nelson or Marlborough) and *Scirpus nodosus*.

The sand-catching shrubs also occur under these circumstances—indeed, it depends upon the rapidity and volume of the drift whether sand-grasses or shrubs—i.e., heath eventually—are established. But if the drift continue unabated, the embryonic sand-grass dunes will rise higher and higher, and a new dune-chain come into being out of the wreck of those behind.

If the drift is on to a heath—and this is very frequently the case—the shrubs, being at the best poorly equipped as sand-binders, will soon be buried; but *Phormium tenax*, and especially *Arundo conspicua*, will make a brave fight and, rising up as they are buried, perhaps remain holding small dunes for months or even years. This is especially the case not in hollows particularly, but on the shallow sands of the Auckland cliff-dunes, when these are set in motion by cattle, &c. There many almost pure associations of toetoe (*Arundo conspicua*) occupy fair-sized areas.

(η.) *Stony Plain* (see Photo No. 40).

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 remains of the rock is still to be seen, shaped by the flying sand into tables, pyramids, or beehive-like forms, or flattened quite to the ground. Midway between the Wanganui and Wangaehu larger portions remain, showing the ancient surface, and covered with shrubs and stunted trees, part of the original vegetation probably before the weathering took place. Nothing can be more desert-like than this stony plain, especially where it extends for hundreds of acres east of the River Waitotara, from near the sea-cliffs to the dunes some half-mile or more distant inland.

The vegetation reminds one more of the desert near Mount Ruapehu than of that of the dunes. Everywhere there are dotted about the shrubs *Pimelea laevigata* and *Coprosma acerosa* in about equal quantities, and both flattened to the ground. The *Coprosma* has long woody roots running parallel to the surface, a plant 7 in. by 5 in., having a root more than 3 ft. long. The branches are in small wiry mats, with the thick linear leaves pressed close to the stem. In the lee of each plant is a tongue of sand (see Photo No. 41). The *Pimelea* is pale-green in colour, and contrasts with the yellow *Coprosma*. The plants are about a yard apart. Here and there are cushions of the silvery *Raoulia*