

sex, in which case probably there may be only a few plants. The male spikes are arranged in a terminal umbel; the spikelets are two-flowered, and about  $\frac{1}{2}$  in. long. The pollen is being shed from the middle of November to the beginning of December. The female inflorescence is a large globose head sometimes 1 ft. in diameter; the usually one-flowered spikelets are at the base of long sharp-pointed spines, each about 5 in. long, and spreading out radially. The roots are of great length, and descend deeply into the sand.

( $\beta$ .) *Scirpus frondosus* (*the Pingao*). (For rhizome-development see Photo No. 17.)

Found only in New Zealand, occurring on dunes in all parts, except on the Kermadec and Subantarctic Islands.

The important features of this plant with regard to drifting sand are: (1) The great power of vegetative increase by means of the much-branching, stout, excessively long rhizome; (2) the tendency of the growing point to seek the surface—*i.e.*, the light—and the rapid lengthening of the stem; (3) the protection afforded to the very tender growing point, young stem, and leaves by the overlapping of the broad leaf-bases and their fastening together by a resinous exudation; (4) the leaf-texture so suitable to withstand the sand-blast; (5) the close packing of the inner leaves, owing to the concave upper surface; (6) the arching of the leaves so as to bring the convex undersurface, which is strengthened by abundant stereome, into opposition with the wind.

The rhizome is stout (about  $\frac{5}{8}$  in. diameter), somewhat woody, stiff, much-branching, covered with old leaf-sheaths, and many yards in length. Normally, it creeps close to the surface of the ground, branching near the apex into leafy shoots given off rather closely, but it is soon buried, finally forming a complete network of rope-like stems reaching to far down within the dune. The leaves are in bunches, tightly bound together at the base by their sheaths, the diameter there being about  $\frac{7}{8}$  in., but they gradually open out, also curving gently inwards. Each leaf consists of sheath and blade. The sheath is about 4 in. long and 2 in. broad at the base, somewhat triangular in shape, moderately thick in the middle, but translucent and membranous at the margins, and everywhere sticky with a resinous exudation. The blade is about 2 ft. long by  $\frac{1}{4}$  in. broad, tapering very gradually to a long trigonous point; the texture is very thick, coriaceous, stiff but flexible. It is concave on the upper surface and convex on the under. Its colour is rather dark glossy green near the base and on the undersurface, but on the upper it is frequently orange or reddish, especially above. The branches are given off quite close together, so that the separate leaf-bunches touch, making tussocks or lines. The inflorescence is 4 in. to 8 in. long, and consists of clusters of sessile reddish-brown globose spikelets spirally arranged round the stem, each cluster subtended by a linear bract similar to the leaf above described. The roots are of great length, very numerous, as may be seen when the wind lays them bare, and descend deeply.

Juvenile plants, growing in hollows or sand-plains, show little trace of the far-creeping rhizome, whose extreme development depends upon an abundant sand-supply.

( $\gamma$ .) *Euphorbia glauca* (*the New Zealand Spurge; Waiuatua*).

Found in all parts of New Zealand along the coast, except in the Kermadec and Subantarctic Islands. Also occurs in Norfolk Island.

*Euphorbia glauca* is a tall herbaceous plant, forming considerable colonies, and capable of much extension through its far-creeping rhizome.

The stout, terete stems stand erect above the sand for 3 ft., more or less, and descend for a variable distance. They are naked for the lower two-thirds, but marked with old leaf-scars; above they are covered closely with leaves. The naked portion of the stem is red or green, the former colour depending on excess of light. The leaves are alternate, of obovate type, but differing in width, 2 in. or 3 in. long, entire, sessile, and fleshy. All the parts are full of milky juice. The roots are long.

( $\delta$ .) *Calystegia Soldanella* (*the Shore-convolvulus, or Bindweed*).

Found on all parts of the coast-line, except in the Subantarctic Islands; elsewhere it occurs throughout the Temperate Zones. As well as on the dunes proper, it grows on sandy and even gravelly shores.

There is a long creeping rhizome, very variable in thickness, attaining a maximum of about  $\frac{3}{4}$  in. It is terete, brittle, brownish, and much-branching. The stems are prostrate and trailing, variable in diameter, frequently many feet in length, very flexible and cord-like, and branch abundantly, the final slender branches bearing many leaves. The leaves have long stout petioles 1 in. to 3 in. long, which raise the blades above the sand. The blades are reniform, broader than long, being 1 in. long by 2 in. broad, more or less. They are bright glossy green, thick, fleshy, brittle, and the basal lobes are frequently brought close together, rendering the leaf funnel-shaped. The leaves all touch, and together with the prostrate stems form a close mat (see Photo No. 61) about 3 in. in depth, which absolutely prevents any sand moving. Such mats are frequently several square yards in area, and small dunes may be quite covered, forming green oases absolutely stable in a moving waste of sand. The flowers are on stalks about equalling the leaves. The corolla is very showy, being 1 in. or more in diameter, and pale lilac in colour, but paler still in throat, with a band of this colour down the centre of each division of corolla. The roots are numerous, and when given off from the stems help to bind them to the sand; but many of the trailing stems are for the most part without such roots.

( $\epsilon$ .) *Carex pumila* (*the Sand-sedge*).

Found on dunes and sandy shores of the North and South Islands, the Chatham Islands, and Stewart Island. Also indigenous in Australia, temperate South America, and eastern Asia.