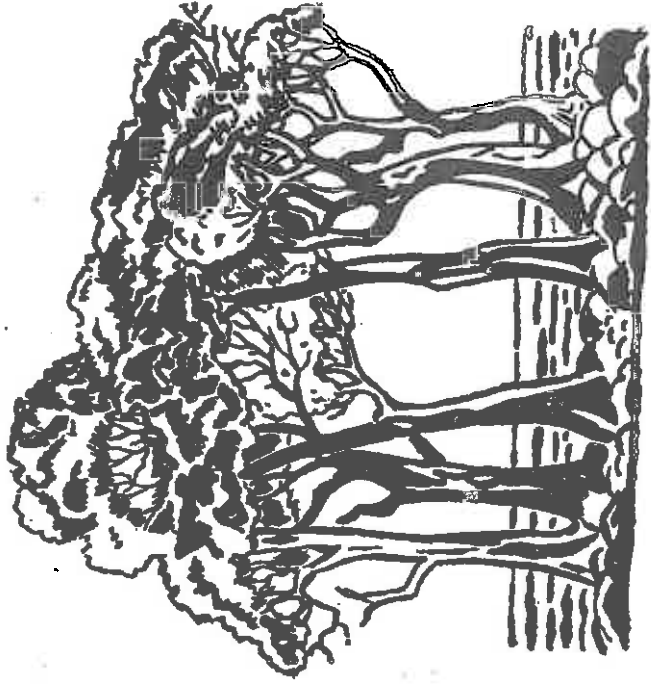


PLANTS OF THE
NEW ZEALAND COAST

by

Lucy B. Moore and Nancy M. Adams



PAUL'S BOOK ARCADE
AUCKLAND AND HAMILTON

Sand-dune Plants

IMAGINE yourself walking along a beach and you will remember that wet sand is hard and firm. Dry sand, though still heavy, gives to the foot and is easily moved, even by wind. Whenever wind carries sand, any projection reduces the wind force, causing it to drop some of its burden about the obstacle. Thus any stick or grass blade soon builds up around and over itself a mound of sand. Above high-tide mark such mounds grow and coalesce to form a typical fore-dune. Behind the fore-dune is the dune complex of hills and hollows, wandering dunes, and more or less fixed dunes. (Plate II.)

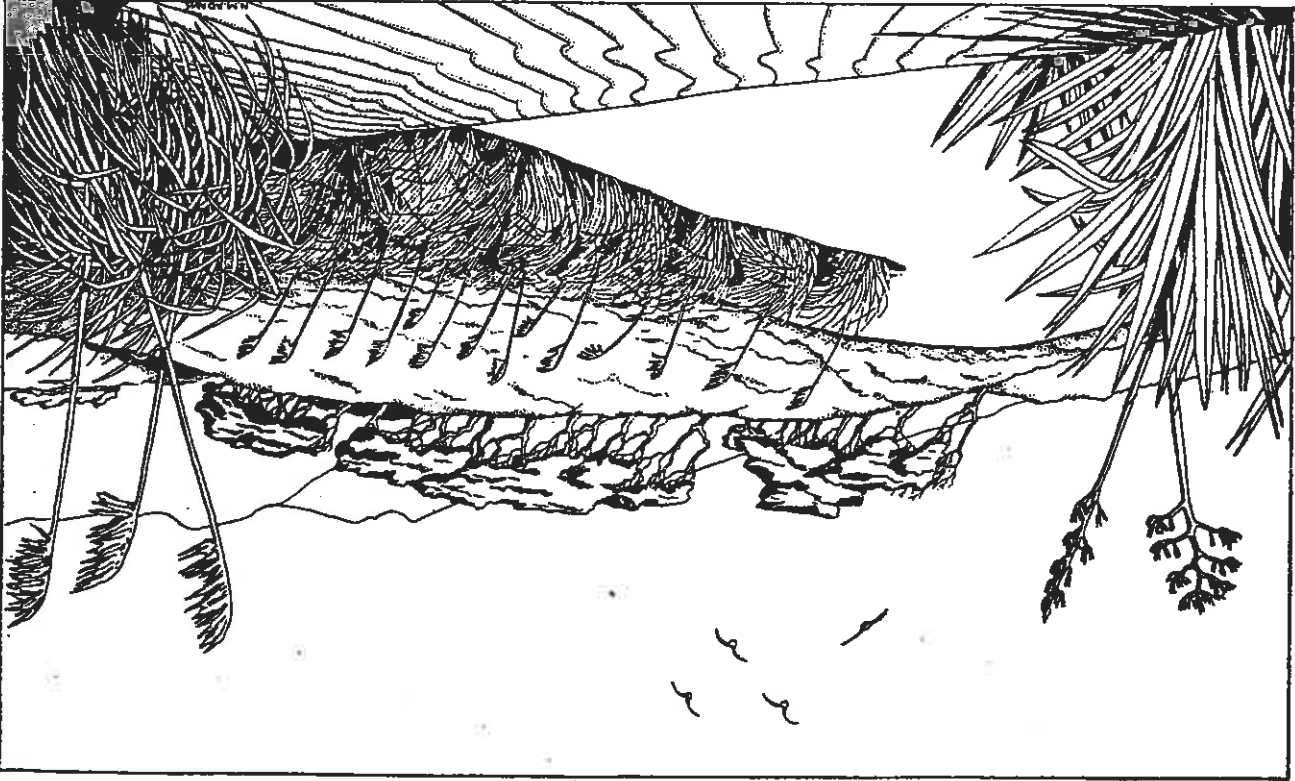
Dr. Leonard Cockayne wrote in his 1911 *Report on the Dune-Areas of New Zealand*: "Wherever there are loose deposits of sand liable to be moved by wind, those mounds and ridges known as dunes are to be found. The most familiar are those of the coast-line, but the great deserts of the world show examples on a much vaster scale. Were such hills of sand stable and not liable to move, except for their peculiar physical and chemical properties, they would not merit any special attention. But the material of which they are composed, so capable of easy transport to a longer or shorter distance according to the velocity of the wind, leads to their excessive instability, and makes a soil on which plants can only be established with extreme difficulty, and one moreover which, driven en masse by the prevailing wind, frequently overwhelms fertile lands, burying not merely the meadows but even forests and human dwellings. . . .

"The dunes of New Zealand are of special scientific importance. Those of the Old World have been materially changed by the many centuries of man's occupation. But in New Zealand there is an opportunity of observing what nature, quite unhindered, has done for their fixation. The native dune-plants are also of much interest, since some are endemic and also of quite remarkable form, while their value as "sand-fixers" is by no means generally appreciated."

Dry moving sand, at times so hot as to scorch bare feet, seems indeed inhospitable to plants; yet the dune is always moist not far down, and some plants prefer such places to all others. While the tops and sides of the hillocks are dry, the flats between are often damp; each type of place has its own vegetation. In one excursion you may see a number of different plant communities. Here we introduce you to some plants of real dunes, some of sand hollows, some of very sandy salt marsh, and some of the fixed dune with scrub or forest as its natural cover.

Sand plants can be seen by many beaches where there are no well-developed sand-hills covering acres of ground; on the other hand, sand-

PLATE II. FIXED AND WANDERING SAND-DUNES



dunes with their own peculiar plants occur far from the sea, as at Cromwell in dry Central Otago. Some of the species we illustrate are found in almost every district, some only in warmer or cooler parts of our long thin country. Most illustrations were drawn life-size, but have been reduced to half in printing.

On old fixed dunes there is close vegetation, the kind depending partly on the age and history of the dune, partly on the climate. The final stage in wetter districts should be true native forest, and there are still patches of this to be seen. Important trees in the south are rata or broadleaf, in other parts ngaio, akeake, kowhai, kohekohe, and in North Auckland pohutukawa. There are good matai trees in mixed forest on hillocks of black sand on the Manawatu coast.

True sand-dune forest is rare now, but a fixed dune with scrub cover is not hard to find. The scrub may be gorse or bracken, and will probably have some lupin. In less disturbed parts there will be a mixture of native shrubs, with clematis among the climbers. Manuka will be abundant and will form the biggest trees as in our picture. In southern parts the silver tussock may hold sway; weeds and smaller native grasses, like the pasture danthonias and rice grass (*Mitrolaena stipoides*), favour fixed dunes too, either in the open or under old manuka.

Many attempts have been made to turn fixed dunes into pasture land and some good swards have resulted. On the sometimes quite extensive hollows this is safe and good policy as long as the sand-hills around are held firmly and permanently; on the hills themselves pasture can be maintained only by endless vigilance and care.

There is an objection to using dunes for pastoral purposes not because they cannot carry grassland, but because stock so easily expose the raw sand, either by overgrazing or by breaking the sod along tracks they regularly use. Since hill-dunes under pastoral management are constantly threatened with erosion of this kind, the safest plan is to establish permanent managed forests on them.

Even amongst marram grass a small deep break will cause wind-funnels that rip out sand on either side, exposing the grass roots. In scrub dunes, sand is easily bared by fire, and scratching of rabbits may be enough to set off a train of disaster. Once sand movement begins it grows rapidly. In this way are formed 'wandering dunes', great bands of moving sand perhaps well away from the sea, that can engulf anything in their track. One is shown in our picture. The toetoe and flax suggest that it has been relatively stable for some time, but it remains a menace.

This brings to mind the responsibility each one of us has in relation to sand movement. Plants of the right kinds will hold sand better than any fence or wall or mechanical device, yet we notice them much less. On the North Sea coast of Holland it is a punishable offence to so much as walk on the carefully vegetated fore-dune. Access paths to the beach

are planned so as not to make wind-funnels, a fence runs along the toe of the fore-dune, and the beach is regularly patrolled to ensure that no careless human foot endangers the work carried out by slowly growing and skilfully chosen plants. It would be much to our advantage to be equally careful and a beginning has been made by banning the removal of drift-wood in places. Four acres out of every thousand of New Zealand's land surface is covered with sand. By knowing something of the plants peculiar to this medium and their very effective methods of working for us, we may appreciate their importance more fully and respect them accordingly.



SAND-BINDERS

74. *Desmoschoenus spiralis* (*désme*, bundle; *skhainos*, rush; *spiralis*, spiral) or *Scirpus frondosus* (*scirpus*, rush; *frondosus*, leafy), pingao. Outstanding amongst all our native sand-plants is pingao. A real sand-binder, it often grows alone in the full blast of the sea winds. Against the blue-black sands of the Taranaki coast or the paler east coast dunes, its strong bronze colours stand out strikingly. The dark brown spiral flower heads are best seen in spring. Deep down in the sand is the stout rhizome sheathed in old leaf bases and held firmly by long cord-like roots. To make fresh growth a bud pushes out just below the present sand level of any head, and from it new roots and leaves emerge. A single plant then can go on growing indefinitely, keeping pace with the sand that blows over it and binding the whole hillock from its base with rope-like thongs.

Dr Cockayne says: '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 (sclerenchyma), into opposition with the wind.'

Check all these points. Then look at other plants and list the structural details that may help them to live in the sand.

Found throughout New Zealand and the Chatham Islands, pingao grows nowhere else in the world. The Maoris used the strong fibrous leaves that dry a kowhai yellow to weave a bright pattern on kit or belt.

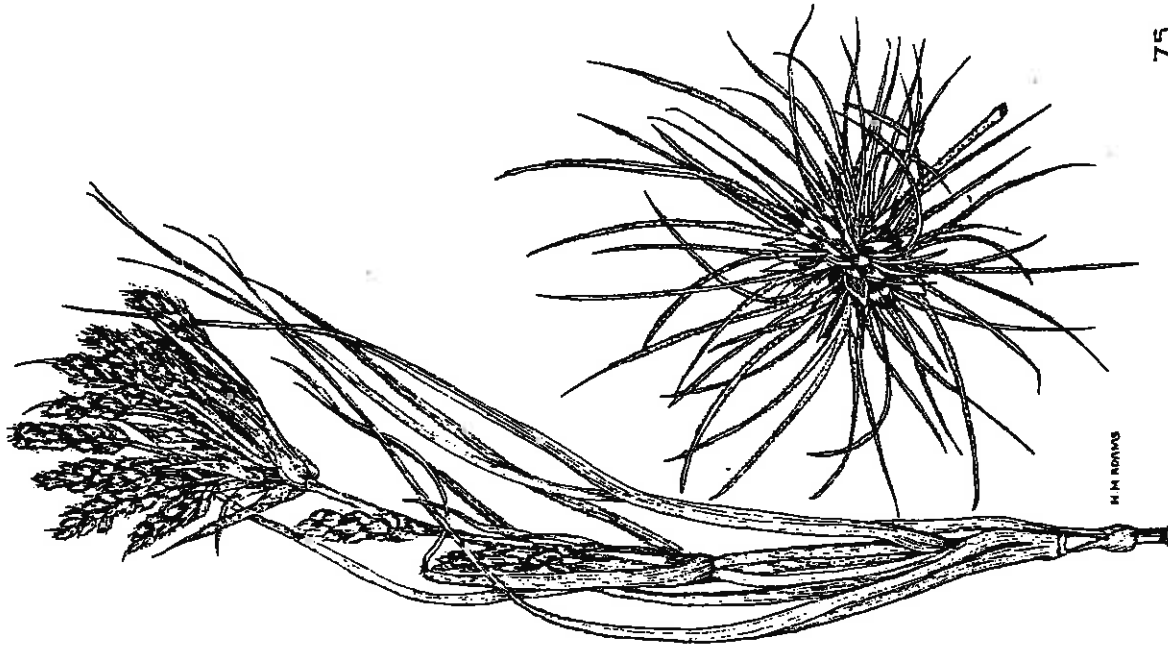


75. *Spinifex hirsutus* (*spin*, spine; *-fex*, producing, hence spine-bearing; *hirsutus*, shaggy), silvery sand grass. A fore-dune begins as a ripple, then becomes a ridge, and may be some feet high before it is colonized. Any plant attempting to settle here has to contend with a moving sand surface, repeated sand-blast from the sea, blown salt, and occasional burying. *Spinifex* can cope with all these things. The big seed head (on right) bowls far along the beach, but finally, perhaps in some rainy week, it settles down in a sodden mass. The long spines help to hold a jacket of sand about it until the seeds can germinate and the silvery leaves emerge. Strong runners, leafy along their length, stretch out over the sand, and at any leaf anchoring roots and side runners can come off. The fixed but flexible leaves cause the wind to drop some of the sand it is carrying and so the grass aids in its own burying. But burying here and there is easily dealt with by the sending up of shoots that again set out over the surface; in time the plant builds up a mound some feet high.

If *spinifex* grows all along the fore-dune the whole becomes relatively stable. It may then cause a sufficient wind-eddy in front of it to start the formation of a new fore-dune nearer the sea. On the *spinifex* dune the surface is now less mobile and plants like sand coprosma and sand daphne gain a footing. These are good sand collectors, and shrubs like *tauhinu* can find suitable places. So we pass from the grass-dune, formed and dominated by *spinifex* or by pingao, or, since pakeha times, by the introduced marram, to shrub dunes.

Spinifex is dioecious, and the twig illustrated is from a male plant. The pollen-producing flowers, seen in spring, have no long spines like those of the seeding head, and differ also in being arranged in definite spikes. Frequently, extensive patches are all of one sex, suggesting that the whole patch may have developed from a single plant.

Spinifex is not found in the southern part of the South Island.

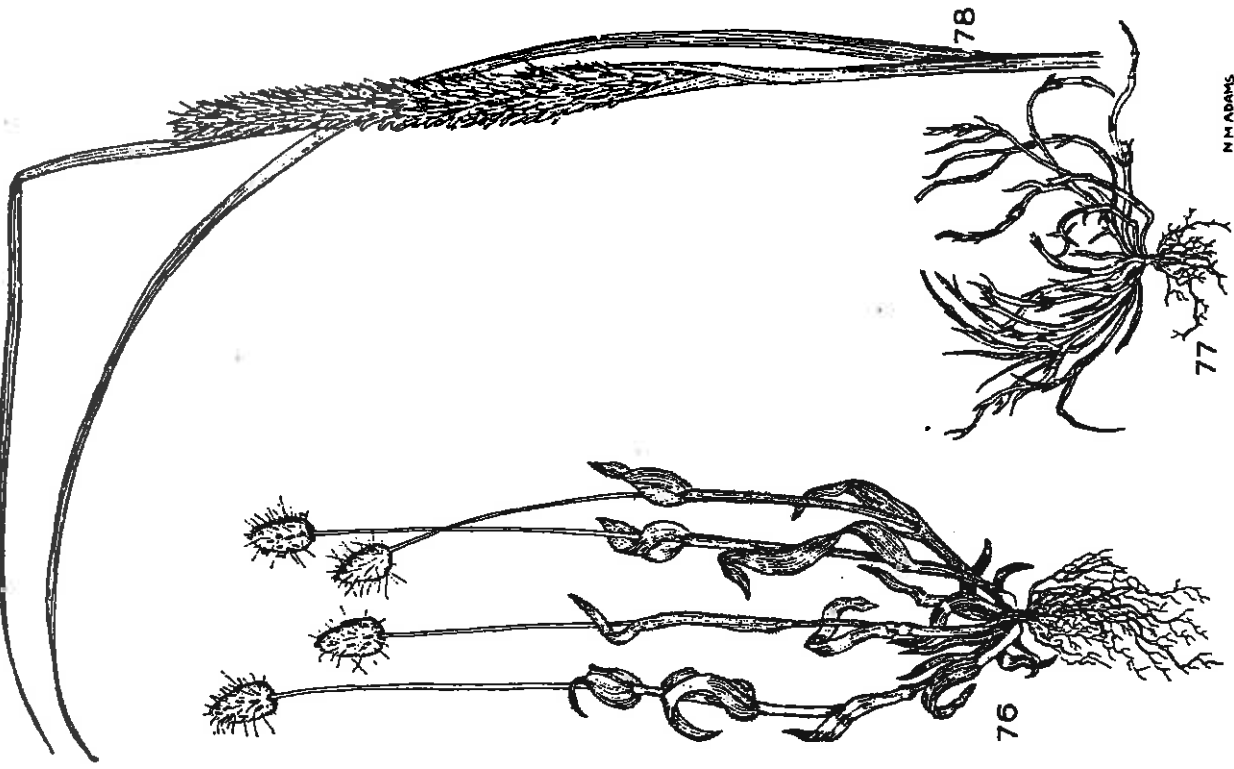


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76. *Lagurus ovatus* (*lagos*, hare; *oura*, tail; *ovatus*, egg-shaped), haretail grass or 'bunnies'. This annual grass shoots up its soft broadish leaves in autumn, making a patch of lawn-like green on not-too-mobile sand. By November the flowerheads are out and through the summer as they dry the woolly inflorescences are conspicuous. The roots are copious, but neither long nor strong, pointing to the contrast between the needs of this annual and the demands of sand plants that live through hot dry summers. Haretail grass comes from Mediterranean Europe.

77. *Parapholis incurva* (*para*, beside; *pholis*, scale; *incurvus*, incurved), sickle grass. This is another annual grass of very different form, coming from Eurasia, and found on sandy flats especially in the North Island. Leaves are reduced to little scales so that the sickle-shaped stems are easily seen. The whole turns red in autumn.

78. *Ammophila arenaria* (*ammos*, sand; *phileo*, to love; *arena*, sand), marram grass. Marram grass, that comes to us from the Northern Hemisphere, is probably the most important sand plant of all. It prefers to grow in pure sand, and does not survive for long after the surface is stabilized. It will stand repeated covering and the bamboo-like stems push up new leaves and root afresh as sand collects. Planted in neat rows, marram has reclaimed vast areas of sand, and in all temperate places is the species most used for this purpose. It is often planted too where small dunes fringe city beaches or threaten railway lines. Marram leaves are much less silvery than those of spinifex, and its narrow seed head is quite distinct even from the male inflorescence of spinifex. In habit of growth it differs too, since its branch system is all under the sand and never lies, like the runners of spinifex, in lines on the surface.



ARTIFICIAL RECLAMATION OF SAND-DUNES

When our forefathers came to New Zealand there were, inside the coastal sands, many low hillocks formed of old sand-dunes that had been fixed and consolidated, and that carried either scrub or forest. Fire, foraging stock, and farmers' efforts to turn this warm country into grass paddocks all tended to expose the sand, which in many places began to move and to build up new series of dunes. When pastures and forests inland were overwhelmed by the advancing sand, farmers and local bodies attempted to stem the flow. Bigger reclamation schemes under Government direction came later and the results may be seen at Woodhill, Hokio, New Brighton, or Oreti.

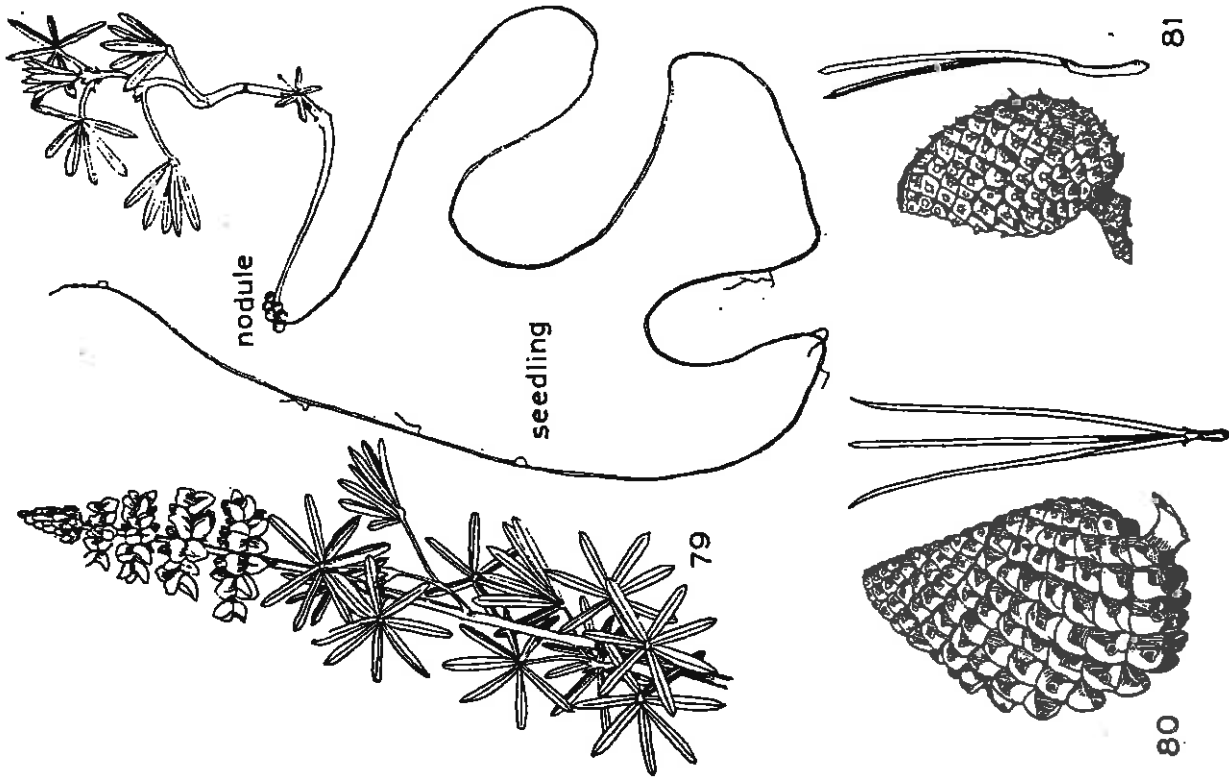
Any sand reclamation demands a continuous fore-dune of uniform height, and often this must be built up deliberately. The method is easily demonstrated in open sand on a windy day. Make a little fence with short sticks or boards and see how quickly a miniature dune grows. Then break the fence in the middle and notice that the gap soon develops into a channel where the wind has extra force.

To build up an artificial fore-dune a long fence several feet high is made, usually of manuka but occasionally of other material that happens to be readily available such as pine branches or even drift-wood. When this has been buried, and perhaps another similar one above it too, marram is planted to bind and hold the sand. Then seed of the Californian tree lupin is sowed. The seedlings grow quickly, making a good root. Lupin, common wherever there is sandy soil, here has special value as a nurse plant. When it is tall enough to give some shelter, one- or two-year-old trees of pine or macrocarpa are planted in carefully spaced rows, and with proper later care the artificial dune forest is established. The two pines most commonly used here are *P. radiata* (formerly called *P. insignis*) with blunt knobs on the cones and needles in threes and *P. muricata* with sharp prickles on the cones and needles in twos.

79. *Lupinus arboreus* (*lupus*, wolf; *arbor*, tree).

80. *Pinus radiata* (*pinus*, pine; *radiatus*, radiating).

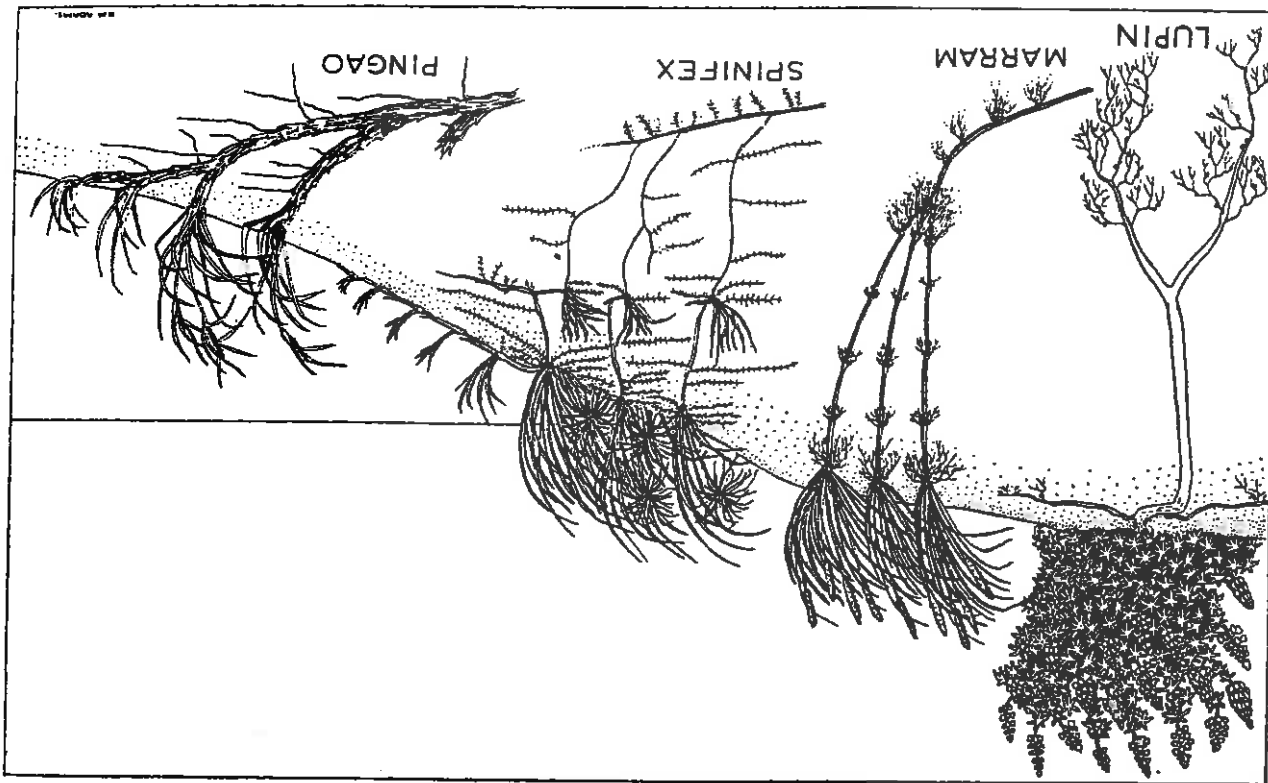
81. *Pinus muricata* (*muricatus*, pointed).

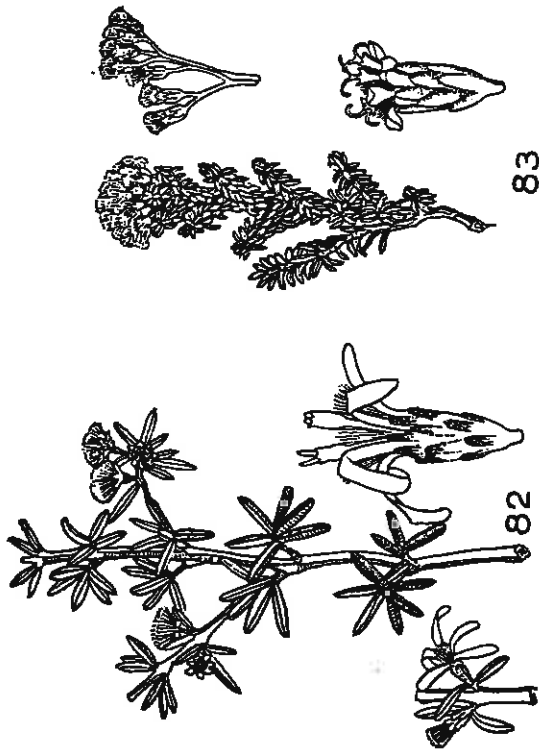


UNDERGROUND PARTS OF SAND PLANTS

In most plants the subterranean parts are at least as large and as important as portions above ground, but roots are rarely easy to trace out. Dune plants are very suitable for the study of root-systems since the sand is easily moved and falls away cleanly; also blow-outs, abnormally high tides, and flooded streams cut into sand hillocks and expose vertical sections where the lower parts of the plants can be seen nearly in their natural position. By studying a series of such exposures we can, without doing any deliberate damage to the dunes, build up a composite picture of the size and space relations of all parts of the principal sand-binding and sand-holding plants. Our illustration, though not drawn to scale, shows the kind of diagram that might be constructed. In preparing this we had help from Miss A. Lush who had made a detailed study of the Piha sand-dunes.

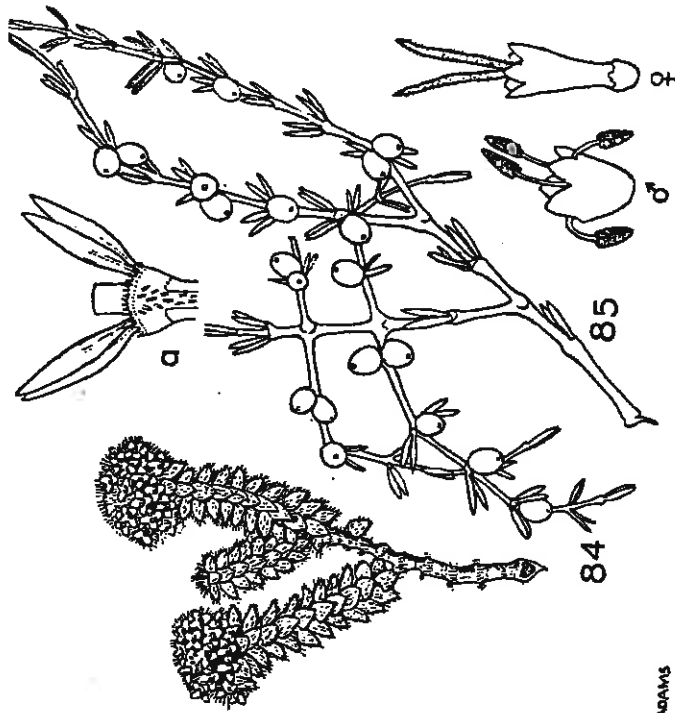
As with many plants, it is very true here that all is not root that is buried. In the sand-binding plants particularly, a great deal of the underground material is stem, and it is the ability of the stems to grow upward, producing successive crops of feeding roots at higher and higher levels, that fits sand grasses to their special living conditions. Some woody plants also root from the stems as they are covered, for example, sand coprosma, and at least one of the sand cassinias (see next page). Lupin, on the other hand, has a more permanent root system, with a heavy tap root, and this is one of the reasons why it cannot successfully colonize actively moving sand. For growing in fixed sand lupin roots have two advantages: the conspicuous warty nodules contain nitrogen-fixing bacteria that help in obtaining food in the rather hungry sand; also, the roots dive deeply down and may reach the water-table. When you see side roots near the surface exposed, consider their distribution and see if they are likely to have any anchoring function in relation to direction of prevailing winds.





82. *Olearia solandri* (*olearius*, oily, from *olea*, an olive, since leaves of some species are olive-like; Solander, Swedish botanist with Capt. Cook). In the North Island and northern parts of the South Island this daisy grows to be a shrub with trunk 4-5 inches through covered with grey stringy bark. Leaves, dull green above, are covered below with tawny short pile. Flower heads are white-rayed, solitary and lateral.

83. *Cassinia leptophylla* (Cassini, a French botanist; *leptophyllus*, thin-leaved), taubinu. The genus *Cassinia* is usually represented by at least one species in partly stabilized dunes. The top of the leaf is smooth and green, while the underside is felted—whitish in the Auckland *C. retorta*, and in *C. leptophylla* from East Cape to Nelson, brownish in those species found in most of the South Island. Capitula bunched at the ends of the stems, and daisy flowers without ray florets, help to distinguish *Cassinia* from *Olearia*.



84. *Pimelea arenaria* (*pimele*, fat, from the oily seeds; *arenarius*, sand-growing), native sand daphne. The flowers are arranged as in daphne. All plants can set fruit but only some have flowers with large bright orange anthers. This is a true sand plant, often with most of its woody stems buried. In its bigger leaves, silky below, it differs from another sand pimelea (*P. prostrata*) with small, smooth, bluish leaves. In the south there is a sand species with small, very silky leaves (*P. lyallii*).

85. *Coprosma acerosa* (*kopras*, dung; *asme*, odour; *acerosus*, sharp-leaved), yellow sand coprosma. A coprosma always has opposite leaves joined at their bases by fused stipules embracing the stem (a). The small greenish flowers are unisexual and are followed on the female plant by semi-translucent drupes, which in sand coprosma are blue or white. This is a good sand catcher that will hold a fore-dune where there is not too much movement.

86. *Diosphyma australe* (dis, doubly; *phyma*, tubercle; *australis*, southern), ice-plant, pig-face. The native ice-plant is of medium size with pale heliotrope flowers. Perhaps more common as a sand-catcher is the related South African *Mesembryanthemum edule* with leaves three inches long and big yellow flowers (*mesembria*, noon; *anthemion*, flower; *edulis*, edible).

87. *Euphorbia glauca* (Euphorbos, Greek physician; *glaukos*, greyish green or blue), sand milkweed. In somewhat sheltered places this species forms compact, blue-green colonies, held together by fat-creeping rhizomes and long roots. It is found throughout New Zealand but is nowhere common. If you find it, compare its peculiar floral arrangements with those of the common milkweed. The dry fruits open explosively.

88. *Calystegia soldanella* (*kulax*, cup; *stega*, roof; *soldanella*, from *soldo*, an Italian coin), shore convolvulus. The shore convolvulus has long rhizomes and covers wide areas with its glossy leaves. The flowers, more than an inch across, are pale with bands of deeper lilac pink down the throat. This is a common sand plant on almost all temperate shores. The related coastal 'morning glory' *Ipomaea palmata* is mostly tropical and reaches its southern limit about Auckland. (*Ips*, convolvulus; *homoios*, like; *palmatus*, hand-shaped.)

89. *Tetragonia trigyna* (*tetra*, four; *gonia*, angle, from shape of fruit; *tri*-, three; *gynae*, woman, hence three-styled), New Zealand spinach. This species, common in dunes, has a fleshy magenta berry. The garden 'New Zealand Spinach', *T. tetragonoides*, with hard fruit, is rarely seen wild here now, though it is widely cultivated in Europe.

90. *Raoullia hookeri* (Dr Raoul collected plants about Akaroa, 1840-1842; Sir J. D. Hooker, a famous director of Kew Gardens). This is a relative of the scab-weed and the famous 'vegetable sheep'. Growing on shingly spots between sand-hills, it forms a compact mat, but where much sand blows the rosettes are more widely spaced. It grows on Cook Strait and South Island coasts. A cushion 2½ inches across may have roots up to 3½ feet long.



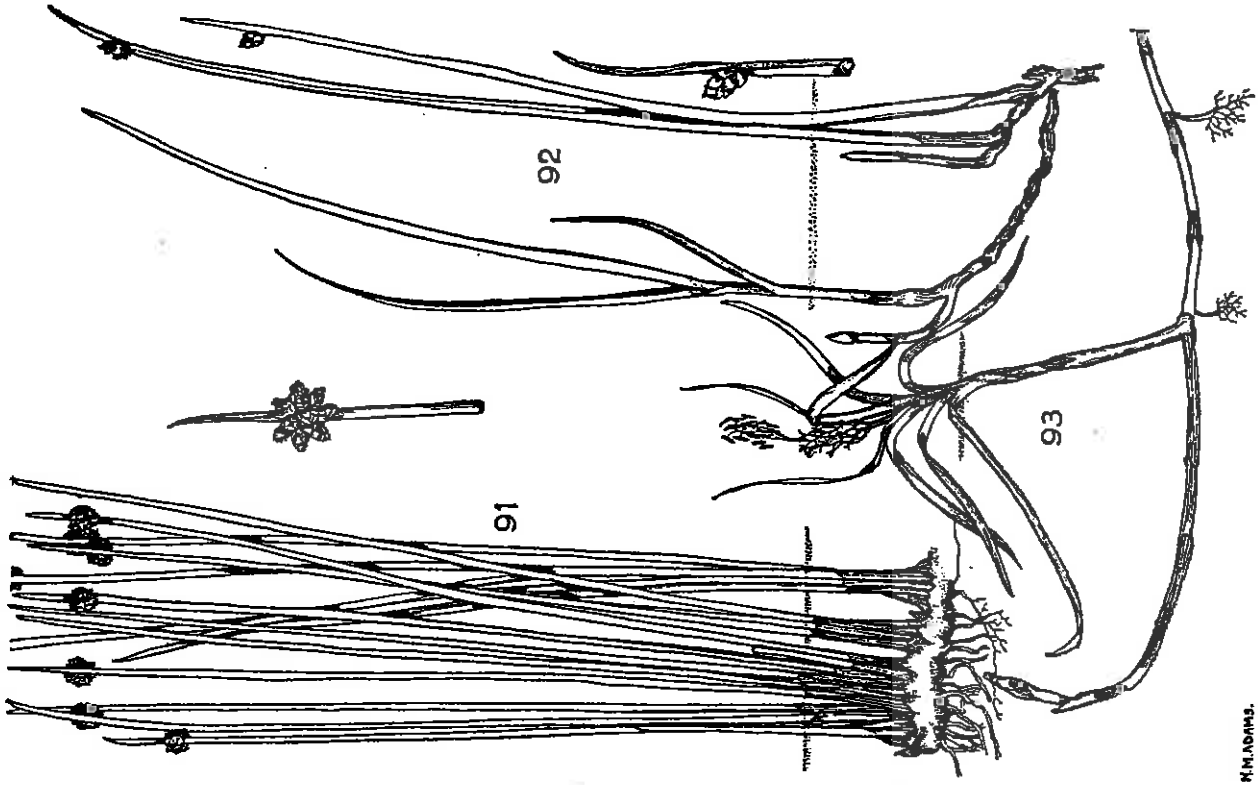
**SEDGES OF SAND HOLLOWES AND
MOIST SAND FLATS**

91. *Scirpus nodosus* (*scirpus*, rush; *nodosus*, many-noded, from *nodus*, knot). Growing in tall rush-like clumps this sedge is easily recognized by its inflorescence. The long reeds are really stems, the leaves being represented by scales at the base. The knob is a cluster of spikelets, each with many small flowers tucked in amongst scaly bracts. Such little spikelets are not easy to examine, but in flower arrangement they resemble the bigger ones of the next species.

S. nodosus may be abundant on moist sand flats and will tolerate dry blown sand too. It grows also in muddy or clayey places near the coast.

92. *Scirpus americanus*, three-square. Though by name American sedge, this plant is not uncommon in many temperate countries. A patch of bluish green 'rushes' on a damp sand flat beside a brackish stream usually turns out to be three-square. The leaves are folded about a sharp keel but more conspicuous and standing higher are the triangular stems bearing the dark, reddish brown seed heads. The spikelets are usually single and big enough to dissect (see Pl. IV). Try to pull up a plant or two and you will see how the underground stems permeate the wet sand throughout the colony.

93. *Carex pumila* (*carex*, sedge or rush; *pumila*, dwarfish). This little dwarf *carex* is also bluish green, showing above the sand surface as isolated tufts with rather plump green seed heads. Look for the details with the help of Pl. IV. You will need to pull up the plant to see the long pale rhizome shown in the sketch. This *carex* will tolerate lots of drift sand, growing up and up through it, and so, starting in a damp hollow, will build up from drift sand a small dune on which other plants may establish. In winter the pale nut-like fruits fall and lie thickly between the plants.



FLOWERS OF SOME MONOCOTYLEDONS

Many sand plants are of grassy, rushy, or sedgy form. To know them with any confidence you must learn something of the flower structure characteristic of different families.

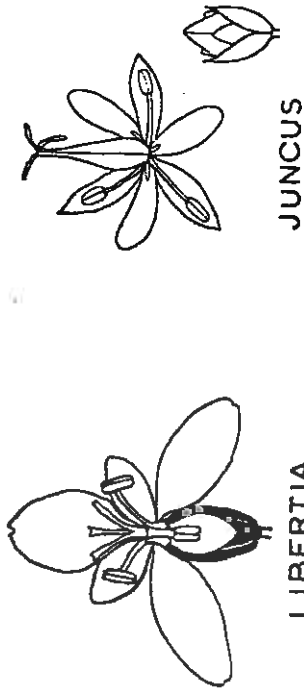
Libertia, example of *Iridaceae*, iris family. The native iris flower shows parts familiar in tulips and tiger lilies; the three inconspicuous outer perianth segments alternate with three larger inner ones. Inferior ovary, three stamens and three-branched style are easily recognized.

Juncus, example of *Juncaceae*, family of true rushes. The rush flower, though less showy than the iris, has similar floral parts. The six perianth segments are membranous and usually greenish or brown; three, or sometimes six stamens, superior ovary, and divided styles make up the regular little flower. Rush flowers may be clustered, but not in spikelets. Chaffy perianth segments surround the three-angled fruit.

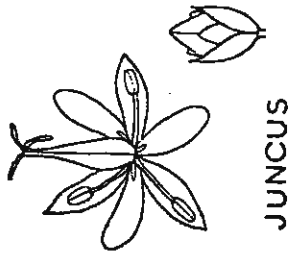
Ammophila, example of *Gramineae*, grass family. The flowers are grouped together in spikelets. Each flower has a scale above and one below. There are usually three stamens with long filaments and two feathery style branches.

Scirpus, example of *Cyperaceae*, sedge family. Flowers are grouped in spikelets. At the base are one or two protecting scales, then follow similar scales each enclosing a tiny flower. There is no real perianth, but a few bristles may take its place. Stamens are usually three, arising from the base of a fat little ovary that carries aloft a two- or three-branched style. In the upper flowers of the spike the ovary may not develop, though stamens do.

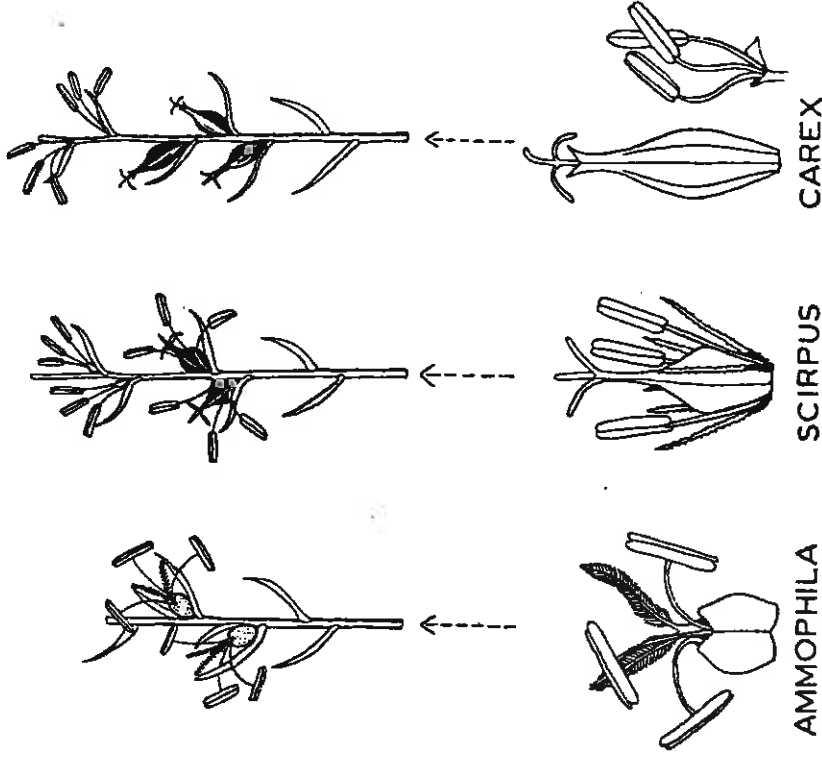
Carex, example of *Cyperaceae*, sedge family. Here staminate and pistillate flowers are distinct, but usually grouped into one spikelet. Each flower is protected by a scale. The male flower consists simply of three stamens; the female is enclosed within a horny flask-shaped case or utricle from which the style branches project. This utricle is a characteristic feature of carex.



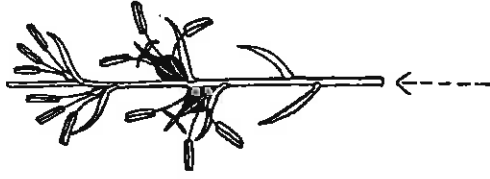
LIBERTIA



JUNCUS



AMMOPHILA



SCIRPUS



CAREX

PLATE IV. FLOWERS OF SOME MONOCOTYLEDONS

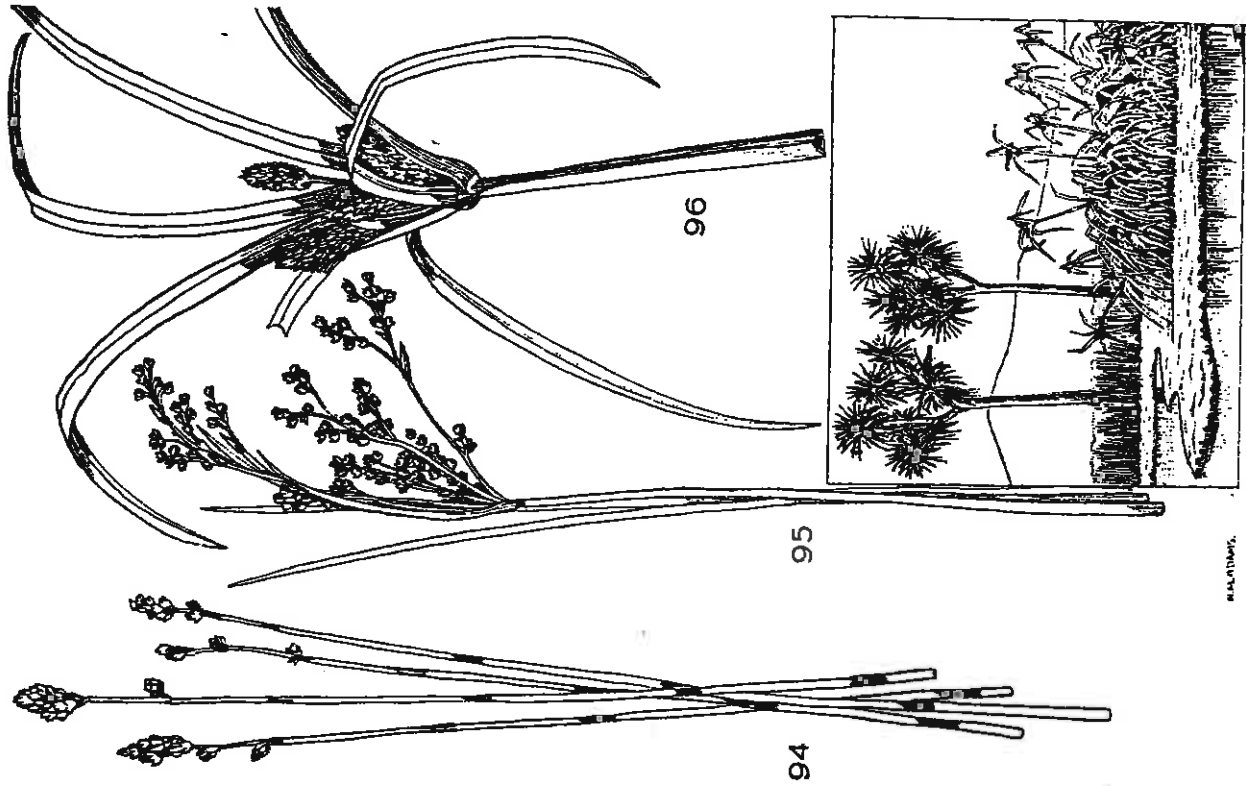
SOME RUSH-LIKE PLANTS

94. *Leptocarpus simplex* (*leptos*, thin; *karpós*, seed; *simplex*, simple), jointed rush. This is a true New Zealander, found only round our coasts and by the shores of lakes like Taupo and Manapouri. On sandy flats between dune-hills it may cover an acre at a time, spreading outwards by strong horizontal rhizomes. The bright brown stem is ringed with dark membranous scales, the only remnants of leaves. Small rather rush-like flowers grow in tight chaffy clusters, the male and female flowers on different plants. See if you can find both kinds and decide which is illustrated here.

95. *Juncus maritimus* variety *australensis* (*juncus*, rush; *maritimus*, by the sea; *australis*, southern, -ensis, inhabiting), sea rush. Of nearly twenty native rushes this is one that is found mostly on salty sand flats where the tide occasionally reaches it.

96. *Mariscus ustulatus* (*mariscus*, medieval Latin for a marsh plant; *ustulatus*, scorched, from the dark brown colour of the flower head). The shining dark heads, closely packed in the centre of radiating grassy leaves distinguish this cutty-grass from all others. It belongs to the sedge family, that also includes the classical papyrus of not very different general form. *Mariscus* is not found in Southland.

Streams finding their way to the sea through sand-dunes are usually bordered by flats with plants that can withstand occasional drifts of sand and floods of either fresh or salt water. On such flats where the sand is too wet to be moved by wind grow the three species illustrated here. There is usually a ground layer, either of scattered little plants recovering from recent drowning by drift sand, or in the form of a close carpet built up of many species, some of which are illustrated in the following pages. Where sand has been fixed for some time and is above the level where tide affects it, variety may be added by cabbage trees (*Cordyline australis*, *kōrdūle*, a club, from the shape of the downward projection of the stem).



SMALL PLANTS OF DAMP SAND FLATS

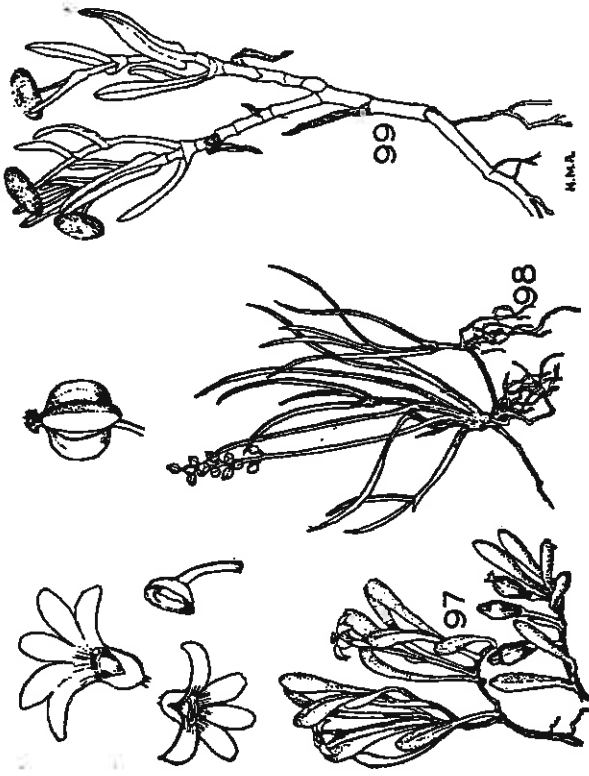
97. *Selliera radicans* (Natalie Sellier, botanical artist; *radicans*, creeping and rooting). *Selliera* forms a sward either open to the sun or shaded by taller growth. The mat of fleshy green leaves is dotted with white flowers, each one lop-sided because of its split corolla. *Selliera* belongs to the typically Australian family Goodeniaceae in which a little cup surrounds the stigma.

98. *Triglochin striata* (*tri-*, three; *glochis*, point, referring to fruit; *striatus*, lined). The narrow leaves are insignificant, but the seed heads with three-angled fruits are unmistakable.

99. *Cotula coronopifolia* (*korula*, cup; *korone*, crown; *pus*, foot; *folius*, leaved), bachelors' buttons. The yellow button-like flowers are conspicuous in damp salty places, either sandy or muddy. The smooth leaves can be either simple and entire, as in the drawing, or variously lobed and more or less crowsfoot-like.

100. *Samolus repens* (*samolus*, pigs' food; *repens*, creeping), sea primrose. This is our only native member of the primrose family. After a little dissection you might see with the help of a lens that the seeds are not attached to the walls of the ovary, but are in little groups on a column jutting up from the floor of the cavity. You will see the same arrangement in a primrose. The white flowers are sometimes covered at high spring tide.

101. *Plantago coronopus* (*plantago*, plantain, from *planus*, flat), buck's horn plantain. This plantain differs from the related ribgrass (soldiers) in its much-divided, antler-like leaves, but the flower head shows the same genus characters. At the top of a young spike, flowers scarcely open have thread-like styles projecting, while farther down older flowers have perianths spread and stamens hanging out. A mature spike shows how the fruits open. Each splits horizontally and the top lifts off like a little lid.



102. *Gunnera arenaria* (Dr Gunner, Norwegian bishop and botanist), sand gunnera. This sand gunnera is found only in New Zealand and is confined to dune hollows or wet cliffs. The fleshy fruiting stem is two inches tall and reddish, bearing the drooping yellow fruit like a tiny bunch of bananas. About Foveaux Strait there are other gunneras in the sand—a big red-fruited one and a small one with little round white fruits.

103. *Lilaeopsis orbicularis* (*Lilaea*, a plant genus named for the French botanist Delile; *opsis*, appearance; *orbicularis*, globular). This glossy green little plant can always be known by its tape-measure-like cross markings and its sheathing bases. Minute white flowers in umbels are followed by fruits a tenth of an inch across.

104. *Ranunculus acaulis* (*ranunculus*, tadpole, from *rana*, frog; *a*, without, *kaulos*, stem, hence stemless), sand buttercup. The shining divided leaves lie close on the sand, and the pale yellow buttercup flower is almost stemless and scarcely rises above them. This plant is not uncommon in sandy places throughout New Zealand.

105. *Glossostigma elatinoides* (*glossa*, tongue; *stigma*, point; *Elatine*, another genus of plants; *-oides*, resembling). *Glossostigma* forms a turf with leaves smaller than those of *Selliera*. The white flowers, about an eighth of an inch across, have the features characteristic of the snapdragon family but show an unusual mechanism related to pollination. At first the spoon-shaped stigma is bent forwards and downwards with the rough stigmatic surface uppermost. Touched lightly, as with a pin, it jumps suddenly upwards and backwards, revealing four stamens. The flower now seems to have six petals instead of five. An insect crawling in may deposit foreign pollen on the bent stigma as it passes; only as it creeps out again does it acquire pollen from this flower. The stigma can return slowly to the bent position when all risk of receiving its own pollen is past.



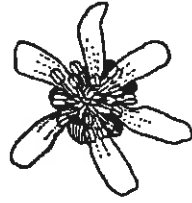
102



103



104



105

SHOWY MONOCOTYLEDONS OF THE INNER DUNES

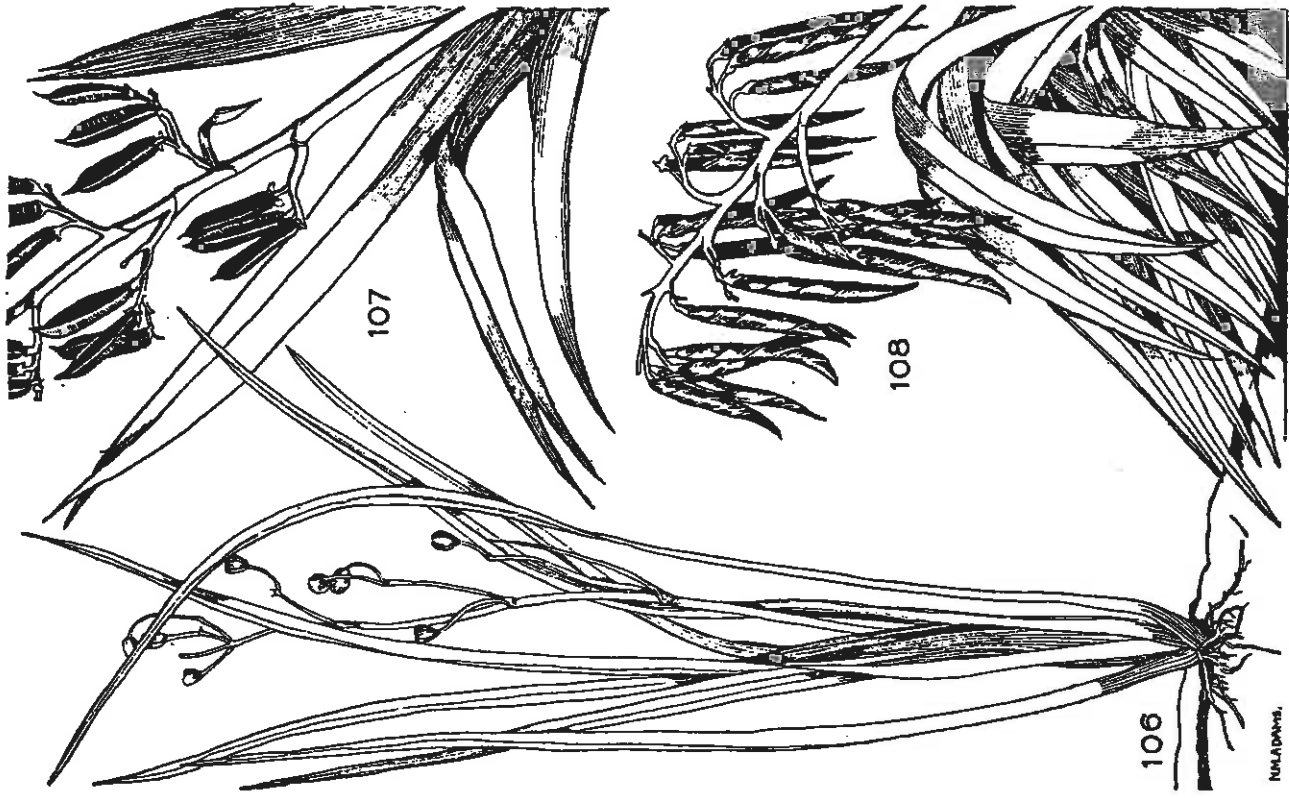
106. *Libertia peregrinans* (Mlle Libert, Belgian botanist; *peregrinans*, roaming), native sand iris. In damp sand hollows, perhaps amongst the jointed rush, the native sand iris pushes up coppery sword-shaped leaves. Underground stems roam about and can produce new fans of leaves a foot or more from the original one. In spring the waxy white flowers (see Pl. IV) appear on stems a foot high.

107. *Phormium tenax* (*phormos*, wickerwork; *tenax*, holding fast). The big flax plays an important part in dune cover. Less adaptable than toetoe, it does not establish in moving sand, and usually it indicates that the shrub dune stage has been reached. At this stage conditions are becoming suitable for a fairly wide variety of woody plants. A few of these are illustrated in the next page but Dr Cockayne places the number of native species on sand-dunes at about 100. Of these more than half are to be found in shrub dunes.

Notice that the big flax has stiff, erect leaves and straight, hard, keeled, upstanding pods; also, its flowers are always red. Manawatu flaxcutters call the tall stalk and flower head a 'claddy'. This word comes by steps from the Maori *korari*—*koradi*—claddy. The flower-stalk of the toetoe (*Arundo conspicua*) also was so useful to the Maori that it had a special name, *kakaho*; thousands are taken from sand-dunes to make the patterned lining of Maori meeting-houses.*

108. *Phormium colensoi* (Colenso, printer, missionary, botanist). The so-called mountain flax grows also on the coast; though not common on sand it is worth watching for. It differs from *P. tenax* in the shorter, softer, drooping leaves and greenish yellow flowers. There is no mistaking the pendant twisted pods that hang on after seed fall, until only the pale fibrous sheaths are left.

* The toetoe, long known as *Arundo conspicua*, is now considered to belong to the genus *Cortaderia* and to include three species, *C. richardii*, *C. toetoe* and *C. futeoides*.



A FEW SHRUB DUNE PLANTS

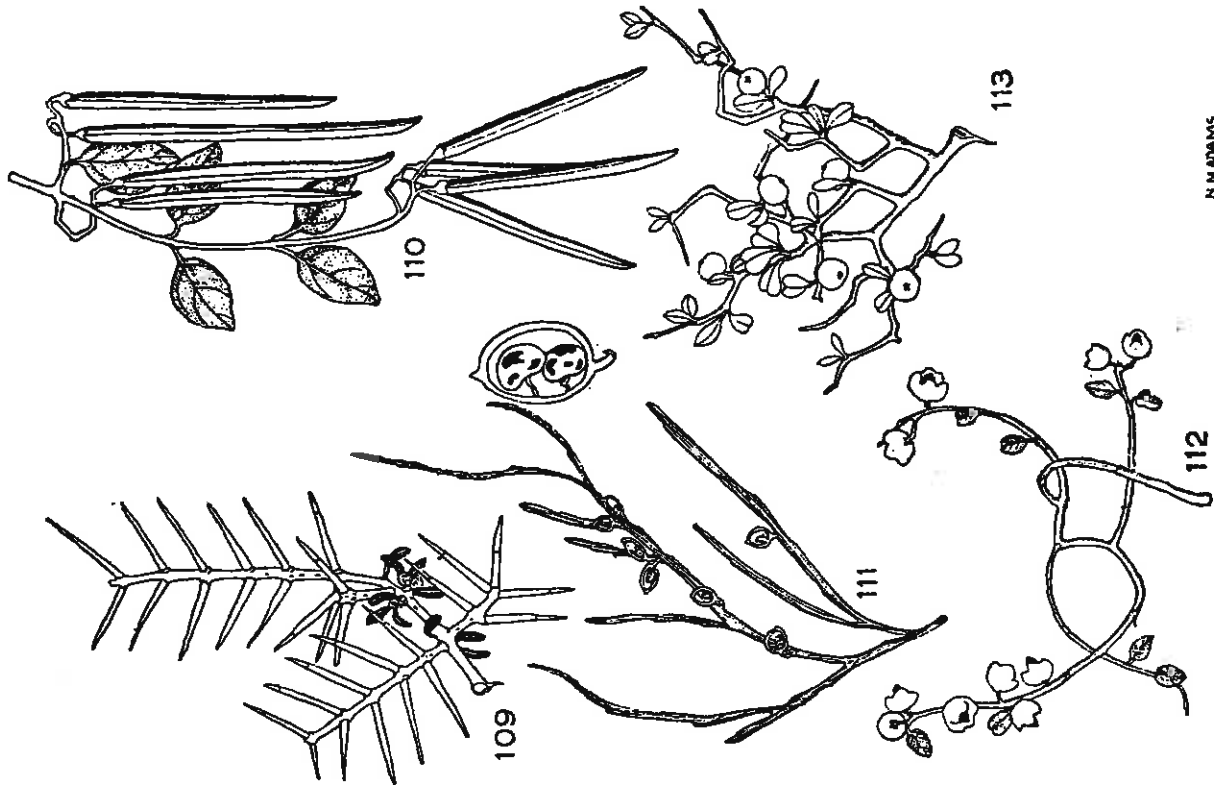
109. *Discaria toumatou* (*discus*, quoit, from ring round ovary; toumatou, from Maori, *tumatu-kuru*), matagouri, derived from *tumatu-kuru*; wild Irishman. The prickly matagouri, well known in tussock grassland, is, in the North Island, usually a coastal or fixed-dune shrub, not recorded north of the Waikato. As a low shrub it grows also on South Island sands.

110. *Parsonia heterophylla* (from personal name, Parsons; *heteros*, differing; *phylon*, leaf), kaiku. This twining climber has a great variety of leaf shape. Trusses of creamy flowers, conspicuous in spring, are followed by long pods containing the seeds, each with a parachute of silky hairs. *P. capsularis*, with narrow oblong leaves and smaller scattered flowers, is also found on shrub dunes.

111. *Carmichaelia flagelliformis* (after Capt. Carmichael; *flagellum*, whip; *forma*, form), native broom. The flattened stems do the work of leaves, as well as bearing the pea-like purplish flowers. Like several other *carmichaelias*, this plant sheds the walls of its ripe pods, leaving the bright-coloured seeds attached to the persistent rims as shown on a larger scale.

112. *Muehlenbeckia complexa* (Muehlenbeck, Swiss botanist; *complexus*, tangled), pohuehue. The wiry stems may form a shrubby clump or scramble over taller plants. Leaves are small and variable in shape. Flowers are inconspicuous, but as the black three-angled fruit ripens the perianth segments swell up to surround it with white fleshy lobes.

113. *Corokia cotoneaster* (from Maori *korokia*; resembling the genus *Cotoneaster*), korokio. This bush or small tree has brownish twigs that branch widely and tangle with one another. The small scattered leaves are white below, and smooth and brownish above. The starry yellow flowers are nearly half an inch across and can outnumber the leaves. The fruits, shown in the sketch, are red or black.



ECOLOGICAL GROUPING OF THE SAND PLANTS ILLUSTRATED

I. Plants of hill dunes

(a) SAND-GRASS DUNES:

Ammophila arenaria, *Calysetegia soldanella*, *Coprosma acerosa*, *Desmoschoenus spiralis*, *Disphyma australe*, *Euphorbia glauca*, *Lagurus ovatus*, *Pimelea arenaria*, *Spinifex hirsutus*.

(b) SHRUB DUNES:

Arundo conspicua, *Carmichaelia* (several species), *Cassinia* (several species), *Corokia cotoneaster*, *Discaria tomatou*, *Ipomaea palmata*, *Leptospermum scoparium*, *Lupinus arboreus*, *Muehlenbeckia complexa*, *Olearia solandri*, *Parsonia heterophylla*, *Phormium colensoi*, *Phormium tenax*, *Tetragonia trigyna*.

(c) FIXED DUNES:

Pasture grasses, or scrub, or pine or native forest.

II. Plants of flats and hollows

(d) MOIST FLAT OR HOLLOW

(i) usually affected by tide:

Juncus maritimus, *Parapholis incurva*, *Plantago coronopus*, *Sambolus repens*, *Scirpus americanus*, *Triglochin striatum*.

(ii) not necessarily affected by tide:

Carex pumila, *Cotula coronopifolia*, *Glossostigma elatinooides*, *Gumera arenaria*, *Leptocarpus simplex*, *Libertia peregrinans*, *Lilaeopsis orbicularis*, *Mariscus ustulatus*, *Ranunculus acaulis*, *Scirpus nodosus*, *Selliera radicans*.

(e) DRY HOLLOW:

Carex pumila, *Raoulia hookeri*.

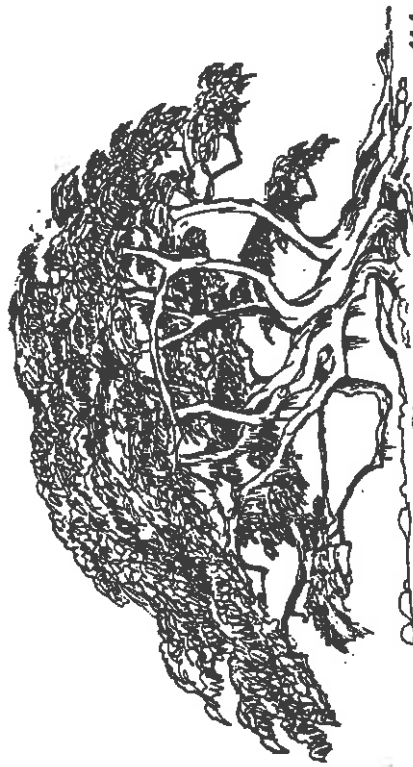
(f) SHRUBBY HOLLOW:

Cassinia, *Cordyline australis*, *Leptospermum scoparium*.

Plants of rocky Coasts and Islands

CLIFFS, rocky headlands and spray-drenched shingle deposits support many salt-tolerant plants that require more stability than is offered by shifting sand. Low-growing plants find themselves a place in the sun by rooting amongst stones and rock, but it is where more soil has built up that most coastal tree species thrive.

Dr Cockayne has pointed out that plant communities where truly coastal trees are most in evidence belong to the Auckland district. 'In preceding southwards', he says, 'such trees gradually decrease in number until from Banks Peninsula to Foveaux Strait, only *Myoporum laetum* (ngaio) remains, while in the Western, Fiord and Stewart districts the true coastal tree element is absent.' Hardly any of the strictly coastal trees can tolerate more than a few degrees of frost, and nearly all belong to families that have representatives in the tropics. Pohutukawa and karaka are examples of true coastal trees but kowhai, common as it is near the sea, grows also inland.



114. *Metrosideros excelsa* (*metra*, matrix, heartwood; *sideron*, iron; *excelsus*, lofty), pohutukawa. Though most of the original pohutukawa forest has gone the species is still very common on the Auckland coast and it has been widely planted as far south as Wellington. Big clusters of pale velvety buds contrast with the dark leaves in late spring and in December the tree covers itself with crimson blossom and is affectionately called the Christmas tree. The flowers produce abundant nectar that attracts birds, especially tuis. The narrow seeds, like wisps of brown

thread, fall in May in such quantities that they lie inches deep at the curbs of some city streets. The closely related South Island rata, *M. umbellata*, is equally generous with bright red flowers in summer, but it is not, like pohutukawa, confined to coastal and lakeside habitats.

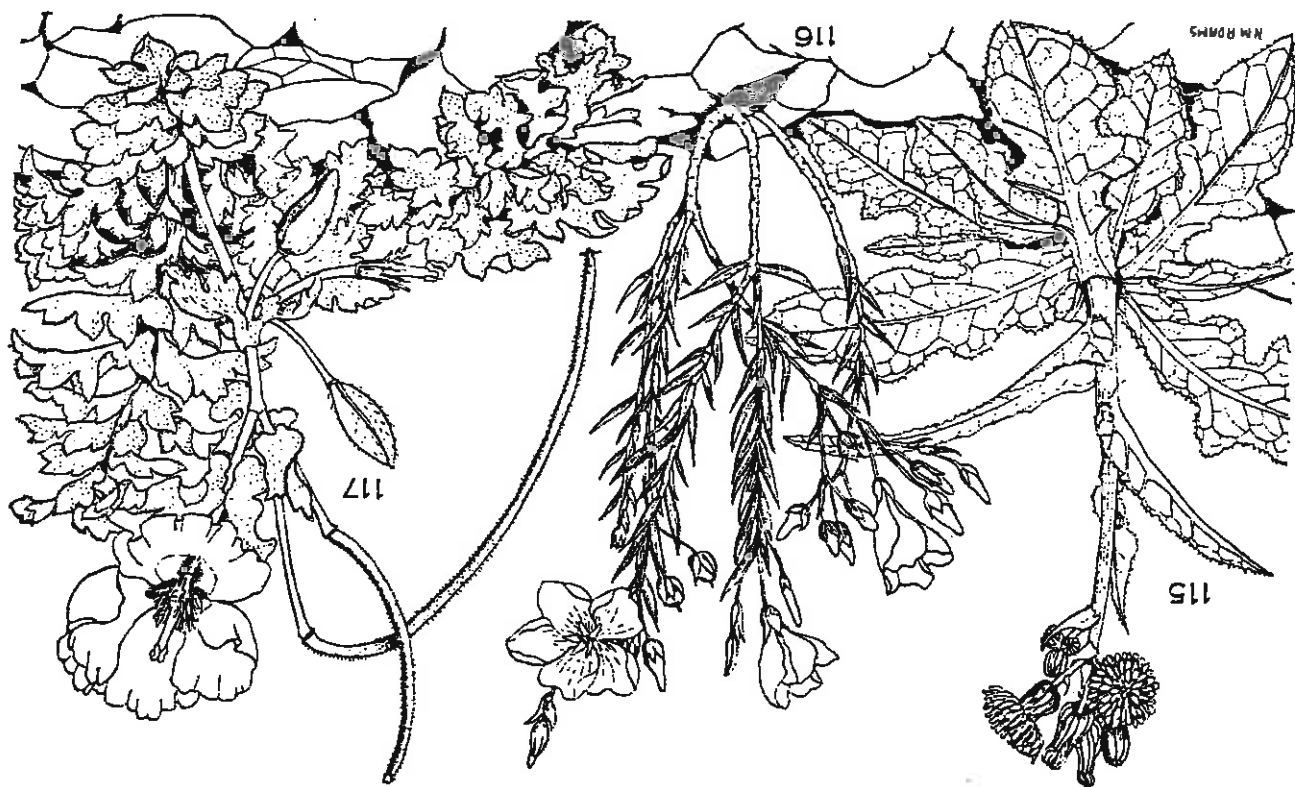
HERBACEOUS PLANTS

Every plant is grist to the botanist's mill, but Captain Cook's first interest in the 'Produce of the Country' was for fresh food for his seawary crew. Most famous of the wild plants he used as vegetables is the scurvy grass, which is really a cress, but he also made use of the native celery. He found sow-thistles too, which could be cooked like the English ones. Probably he recognized the likeness between our white-flowered *Linum* and the blue-flowered linen flax of his native Yorkshire, but the European wild flowers that we now know as common weeds were not to be seen here at that time.

115. *Sonchus litorealis* (*sonkos*, sow-thistle; *lititus*, shore), shore sow-thistle. The rather oblong greyish leaves, mostly in broad, flat rosettes, are more fleshy than in ordinary garden sow-thistle, and the yellow flowers are on stouter stalks. This plant is found on maritime cliffs, often half under a shady bank.

116. *Linum monogynum* (*flaxum*, flax; *monos*, one, *gyne*, woman), hence single-styled, since the five styles are united at the base), New Zealand linen flax. (See also Plate V.) Pure white flowers an inch across make this plant conspicuous on cliffs throughout the summer. The straw-coloured fruiting capsule splits into ten segments, each containing one seed. Though mostly a coastal plant, this same species may be seen on inland bluffs, sometimes at high altitudes. It has not been used as a commercial source of linen fibre, but is valued in England as a rock garden plant.

117. *Glaucium flavum* (*glaukos*, blue-green; *flavus*, yellow), horned poppy. This European species is one of hundreds of 'new settlers' since the time of Captain Cook. It is plentiful round the southern part of the North Island, but has not established in many other parts of New Zealand. The plant is easily known by the much-cut blue-green leaves, and the large saffron-yellow poppy flowers. The capsules are narrow, sometimes as much as a foot long, and as they ripen they become curved into the 'horns' that give the popular name.



ROCK CREVICE PLANTS

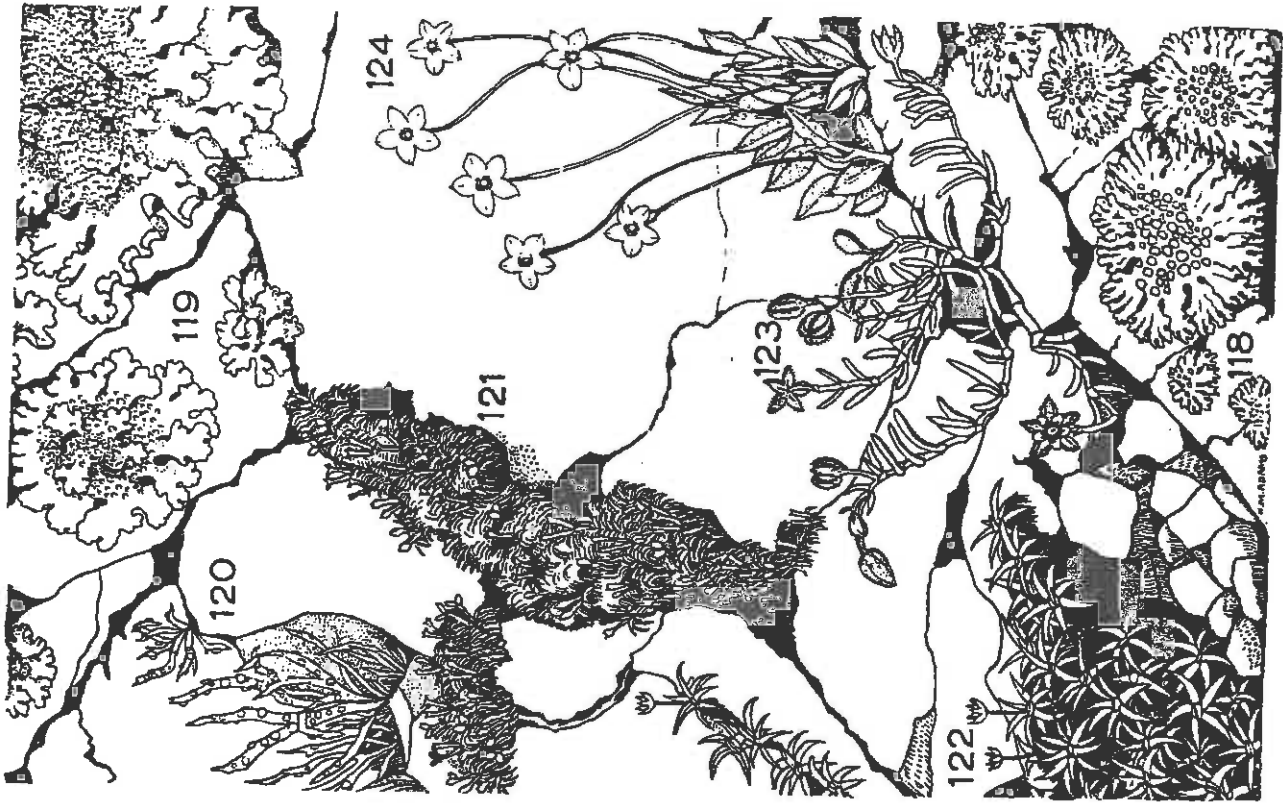
On a rocky shore there is usually a rather bare-looking belt between high-tide level and the proper land vegetation. This belt displays a multitude of lichens—pale grey crusts of many kinds, flat rust-coloured ones (*Xanthoria*, 118), grey-green sheets attached by blackish threads (*Parmelia*, 119), or erect twiggly little yellowish grey bushes a couple of inches high (*Ramalina*, 120). The maritime rocks are good places to study lichens or to collect them for dye-stuffs. In crevices in this lichen belt grow characteristic small plants, some of which are shown here.

121. *Scleranthus biflorus* (*skleros*, hard; *anthos*, flower; *bi*, two; *flor*, flower), double flower. Densely packed narrow leaves and stems form a cushion a few inches across, attached by one tap root; it can grow in the driest places and is usually yellow and brittle. The tiny flowers are mostly in pairs, on the top of a stalk that persists long after the fruit has fallen, like a dry stick surmounted by four minute wings.

122. *Colobanthus muelleri* (*kolobos*, curtalled, i.e. imperfect because petals are wanting; Ferdinand von Mueller). 'Cuttygrass'-like leaves barely an inch long form shining green tufts amongst grey lichens. The minute flowers are short-lived, but it is easy to find an open capsule with five yellow lobes and seeds at the bottom like eggs in a nest. *C. muelleri* is not found in the Auckland district. A species of *Colobanthus* and a grass are the only seed plants on the Antarctic continent.

123. *Spergularia marginata* (*spergula*, spurry; *marginatus*, margined), sea spurry. The pretty pinkish flower is less than half an inch across, and the leaves are rather succulent. The dark seed has a wide pale margin. This is a common plant on many temperate and sub-tropical shores.

124. *Wahlenbergia gracilis* (Wahlenberg, Swedish botanist; *gracilis*, slender), native harebell. The flowers are blue or white and about half an inch across. The rootstock running down between the rocks is thick and strong for so slender a plant.



SHINGLE PLANTS

Shingle of various sizes often gives a chance to small herbs that cannot tolerate the shade of taller plants. These herbs grow also in other places, but always where competition is not too strong. Of the five plants shown here the *Craspediá*, the *Geranium*, and the *Eryngium* do not occur as far north as Auckland.

125. *Craspedia uniflora* (*kraspedon*, fringe; *unus*, one; *flos*, flower). The button-like daisy flower-heads are usually white, occasionally cream, and in variety *maritima* of the Wellington coast, a good sulphur yellow. Each head is doubly compound—a capitulum of capitula. Leaf margins are fringed with white hairs and the leaves when broken are often sticky and aromatic.

126. *Geranium sessiliflorum* (*geranos*, crane (from shape of fruit); *sessilis*, seated on, hence stalkless). The white geranium flower is very short-stalked, nesting in the centre of a circle of lobed leaves that are usually quite brown, though you will find green plants, too.

127. *Senecio lautus* (*senex*, old man; *lautus*, handsome), shore groundsel. This yellow-flowered daisy has leaves that differ in shape, size, and fleshiness with differences in growing places. The introduced *S. elegans*, common about Wellington, is very similar except that its flowers are magenta-coloured.

128. *Lobelia anceps* (Lobelius, French botanist; *anceps*, two-edged), shore lobelia. The lop-sided pale mauve flowers have the same structure as the much more showy royal blue ones of border lobelias of gardens. The rather weak stems are winged (hence two-edged). This inconspicuous plant is not hard to recognize and can be found very commonly except south of the level of Oamaru.

129. *Eryngium vesiculosum* (*eragomai*, to vomit, referring to medicinal use; *vesicula*, small blister or cavity), sea holly. The blue-green leaves lying close to the ground are spiny enough to be uncomfortable for a bare hand or foot, and often form a carpet over several square yards in a damp gravelly place.



SEA-SHORE SUCCULENTS

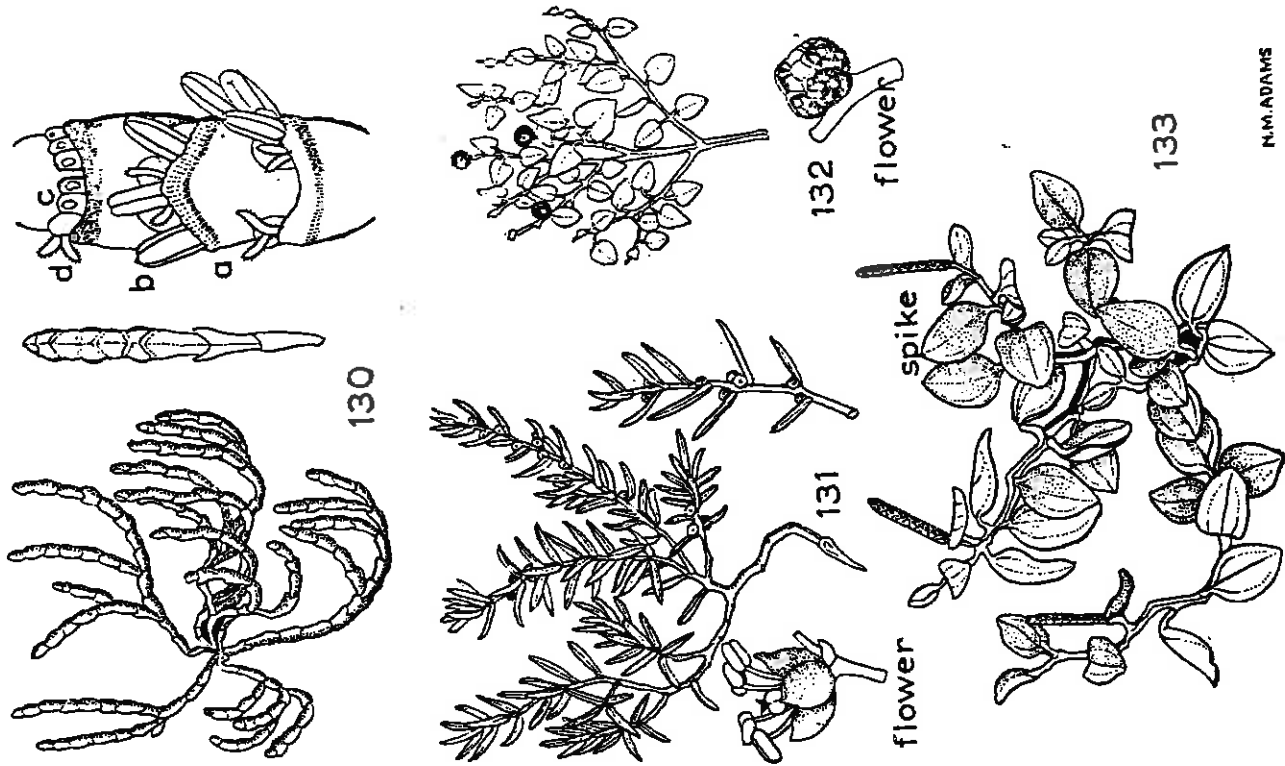
The most succulent sea-shore plant is the ice-plant (*Disphyma australe*) already described and figured on page 58. Other species, many of them in the beet family, also have the fleshy water-storing tissues that give the name 'succulent' to the whole group.

130. *Salicornia australis* (*sal*, salt; *cornu*, horn; *australis*, southern), glasswort. The name comes from the old-time use of the soda-rich ashes of plants of this genus in glass-making. The jointed stems are often reddish, and grow to a foot long from rock crevices or on wide areas of salty flats; the leaves are represented only by thin scales (a) at the nodes. In summer, anthers (b) fringe these scales, the quaint flowers being like squarish green lozenges (c) wedged in between the scale and the stem. As each floret matures the lozenge opens by a vertical slit, through which two feathery stigmas (d) emerge. Before these shrivel a fat yellow anther pushes out. When it sheds its pollen, a second anther joins it and opens later.

131. *Suaeda novae-zelandiae* (*Suaeda* from an Arabic word meaning blackish), sea blite. Related to one of the most cosmopolitan shore plants. The narrow fleshy leaves are often reddish, the flowers small, and each fruit is surrounded by a fleshy perianth.

132. *Rhagodia triandra* (*rhax*, *rhagos*, grape; *tri*, three; *andros*, man). Amongst a twiggly low-growing shrub a cluster of small raspberry-coloured *Rhagodia* berries may catch the eye. The stem bears mealy leaves quarter to half an inch long and slightly succulent. The whole plant is weak and either grows through a stronger one or hangs in a soft sage-green curtain down a bank.

133. *Peperomia urvilleana* (*peperi*, pepper; *homois*, like; Admiral d'Urville). In this little plant the whole upper surface of each leaf is occupied by colourless water-storing cells, as you may see by cutting a transverse section. The spike is fleshy too, with minute flowers sunk in small pits on its surface. *Peperomia* is common on Auckland coasts and a few plants appear as far south as Wellington and Golden Bay, Nelson.



COASTAL FERNS

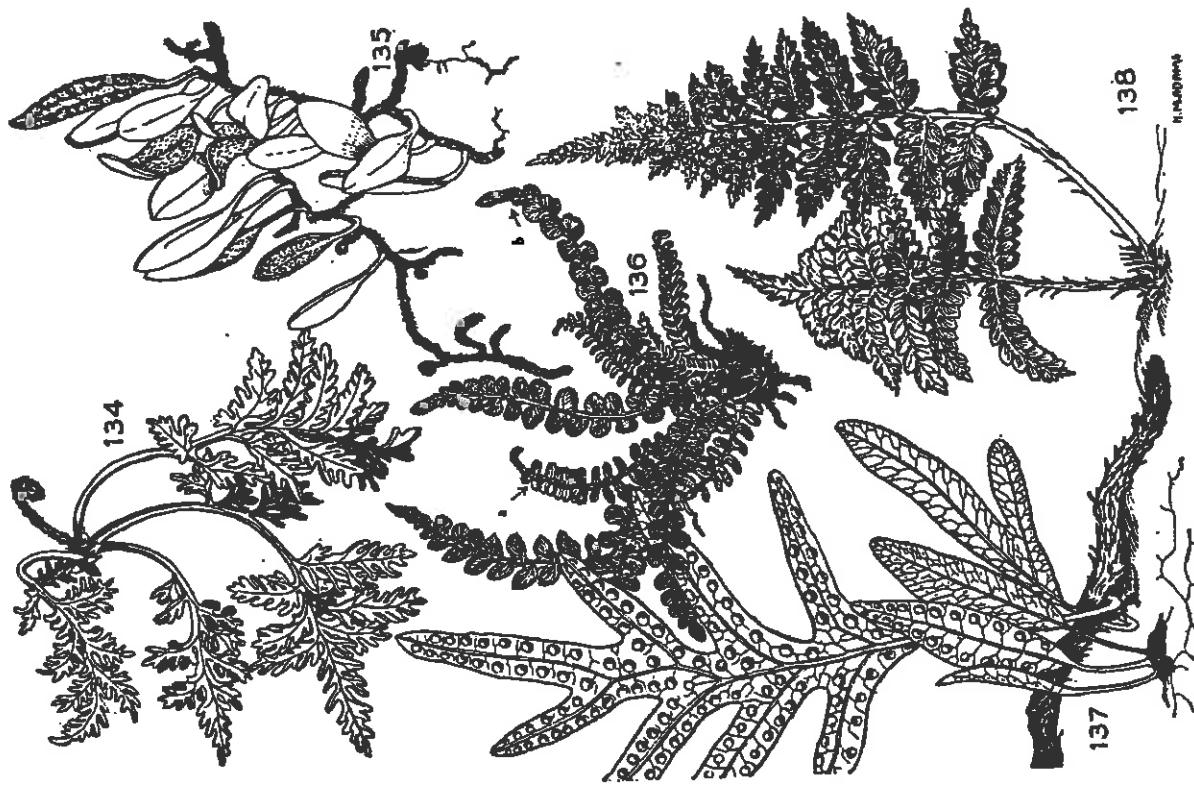
134. *Asplenium flaccidum* (*splen*, spleen; *flaccidus*, limp), drooping spleenwort. Maritime forms are much more robust than the drooping spleenwort that hangs from forest trees. This one is from Wellington. Like every other *Asplenium* it has linear sori (spore-bearing areas) making a herring-bone pattern on the back of the frond.

135. *Pyrrhosia serpens* (*pyrrhos*, red; *serpens*, creeping). Un-fernlike in its simple entire leaf, this little creeping fern bears crowded rounded sori. The narrow fronds are sometimes six inches long.

136. *Blechnum banksii* (*blechnon*, some fern; Sir Joseph Banks), Banks's hard fern. This fern, four to twelve inches tall, was first collected by Banks and Solander, and is found only right on the coast. As in all species of *Blechnum*, fertile fronds (a) that bear the spores are distinct from vegetative ones (b). In Otago and farther south the much larger, strictly coastal *B. durum* (*durus*, hard) forms handsome dark green tufts, with thick-textured pinnules that are elegantly pointed.

137. *Phymatodes* (*Microsorium*) *diversifolium* (*phyma*, tubercle; *-oides*, resembling; *mikros*, small; *soros*, heap; *diversus*, different; *folium*, leaf), climbing polypody. The thick green stem with scattered black scales hugs close to rock or tree trunk. The big glossy leaves of various shapes have round dark sori dotting the under-sides. An alternative genus name is given because there is, as with some other fern genera, some uncertainty about which of the two is to be preferred.

138. *Polystichum richardii* (*polys*, many; *stichos*, row; A. Richard, French author of 'the first publication dealing with the flora of New Zealand as a whole'), Richard's shield fern. The 'shield' part of the name comes from the shape of the cover (indusium) over the sorus.

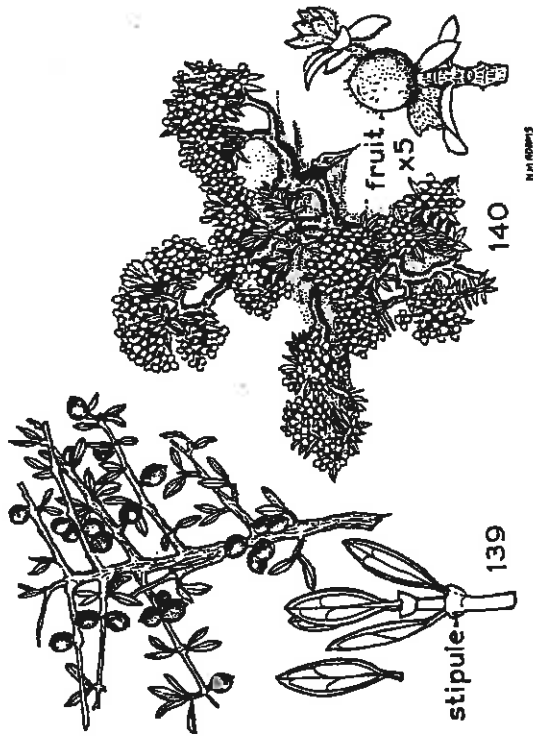


TWIGGY BUSHES

On exposed coasts many shrubs have small leaves and close branching. Species quite unrelated to one another are alike in these features, and the plants here figured belong to the coffee, daphne, violet and mallow families. (See also pages 56-57, 72-73.)

139. *Coprosma propinqua* (*kopros*, dung; *osme*, odour; *propinqua*, neighbouring). This plant has the essential marks of *Coprosma*, i.e. opposite leaves with stipules connecting the pair of petioles, unisexual flowers and fleshy two-seeded fruits, in this species of translucent blue. Near Auckland *C. propinqua* grows to ten feet tall, while on Wellington's raised beaches its variety *latiuscula* forms low cushions flat enough to walk over or to sit upon.

140. *Pimelea prostrata* (*pimele*, fat, from the oily seeds; *prostratus*, thrown down), prostrate native daphne. This common bluish green plant is often less than six inches tall, though it may be much broader. In summer it is dusted over with clusters of small white flowers. Similar plants growing inland are poisonous to farm animals. The finely hairy branchlets are marked with conspicuous leaf scars.



stipule 139

fruit x5

140

N. H. POWERS



141

142

141. *Hymenanthera crassifolia* (*hymen*, membrane; *anthos*, flower; *crassus*, thick). Thick in whitish stem as well as in leaf, this woody shrub often spreads close against the rock surface. The branches take the brunt of the wind and bear, on their under-sides, unisexual flowers (a) less than a quarter of an inch long. Birds, like the little silvereyes, creep underneath to eat the purple and white fruits. This *Hymenanthera* is easily seen about Wellington but not farther north.

142. *Plagianthus divaricatus* (*plagios*, oblique; *divaricare*, to diverge), salt-marsh ribbon-wood. This shrub, perhaps four feet high and bushy to the ground, grows near salt-marshes or in pockets between boulders. The small leaves are sparse and deciduous, and the bush takes its dull hue from the many thin stems. Flowers (b) and fruits (c) are inconspicuous, but the lacy inner bark, that is easily stripped off, shows that this plant belongs to the group of ribbon-woods or lacebarks.

A COOK STRAIT CLIFF

This cliff, on the south coast at Wellington, shows a variety of sites for plants. We have seen that lichens grow directly on rock faces. In cracks and crevices, accumulated soil holds enough water to provide cool, damp, but well-drained spots for seeds and spores to germinate; the fern *Polystichum richardii* has established in such a place. Horizontal shelves, covered with a layer of soil, in strong sun or cool shade suit different species of plants, for example *Phormium cotensis* (flax) and several grasses in the drawing. The native lincn flax (*Linum monogynum*) is at home here, and the ferns shown include the climbing polypody (*Phymatodes diversifolium*) and the shining spleenwort (*Asplenium lucidum*) with long, drooping, once divided fronds.

Angular stones, some of them prized off the parent rock by the growth of plant roots, pile up below cliffs, and water-worn shingle or boulders may be thrown up by the sea. These talus slopes and shingle terraces are colonized by plants with still other requirements. Even the sharp-pointed spear-grass or spaniard (*Aciphylla squarrosa*), whose closest relatives usually occur on mountains, thrives in such places on the shores of Cook Strait (bottom left). It is a good exercise to list the species that grow in different habitats.

Woody plants grow on the coast too and a number of them are illustrated in the following pages. Some, like the taupata shown at the top of the cliff in Plate V, become contorted from exposure; but in coastal forest the wind may trim off crowns of trees obliquely as smooth as a well-kept hedge.



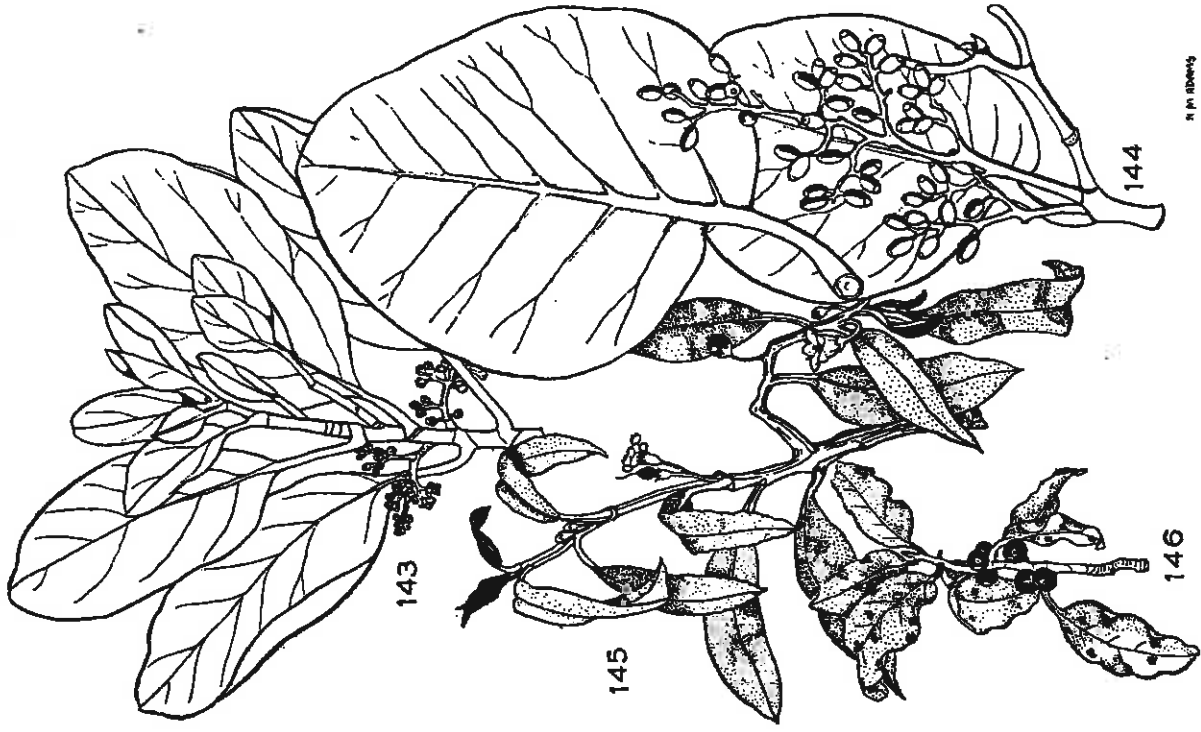
COASTAL TREES

143. *Griselinia littoralis* (Italian name *Griselini*: *littus*, sea-shore), papauma, broadleaf. On the Coromandel Peninsula papauma is found only above 1,500 feet altitude, about Wellington it rarely grows naturally below 500 feet altitude, in the South Island it extends right down to sea level. It was first collected in the south and the name refers to its littoral habitat there. The leathery light green leaves are about four inches long. Flowers and fruit are greenish and not very showy.

144. *Griselinia lucida* (*lucida*, shining), puka, shining broadleaf. This epiphyte (perching plant) often settles on top of a coastal rock and sends its furrowed rope-like woody roots down over the surface of the boulder to the soil. The broad shining leaves are always conspicuously lop-sided at the base.

145. *Myoporum laetum* (*muwin*, to shut, *poros*, pore; *laetus*, pleasing), ngaio or (in the south) kaio. A ngaio leaf held against the light shows minute pellucid colourless spots, commonly called oil-glands. These closely-spaced spots on leaves two to four inches long, the blackish leaf buds, the purple-spotted white flowers, and reddish purple drupes will distinguish ngaio from any other New Zealand tree. The Tasmanian *M. serratum*, planted widely here, is very like our species; but the leaves differ in their darker green under-sides, and in their larger and sharper serrations; the leaf buds are quite green, not blackish, and the 'seeds' are smooth, pointed and less than a quarter of an inch long, whereas those of ngaio are longer, broader, and distinctly four-angled. The foliage of both species is poisonous.

146. *Myrsine australis* (*myrsine*, myrtle; *australis*, southern), mapau. This small tree of bush edges is common on the coast, and sometimes forms a solid wind-scrub in the south. Watch for the reddish stems and the wavy-edged leaves which are blotched with red, very obscurely dotted with 'glands', and about two inches long. The short-lived unisexual flowers are not often seen, but the small dark berries are noticeable.



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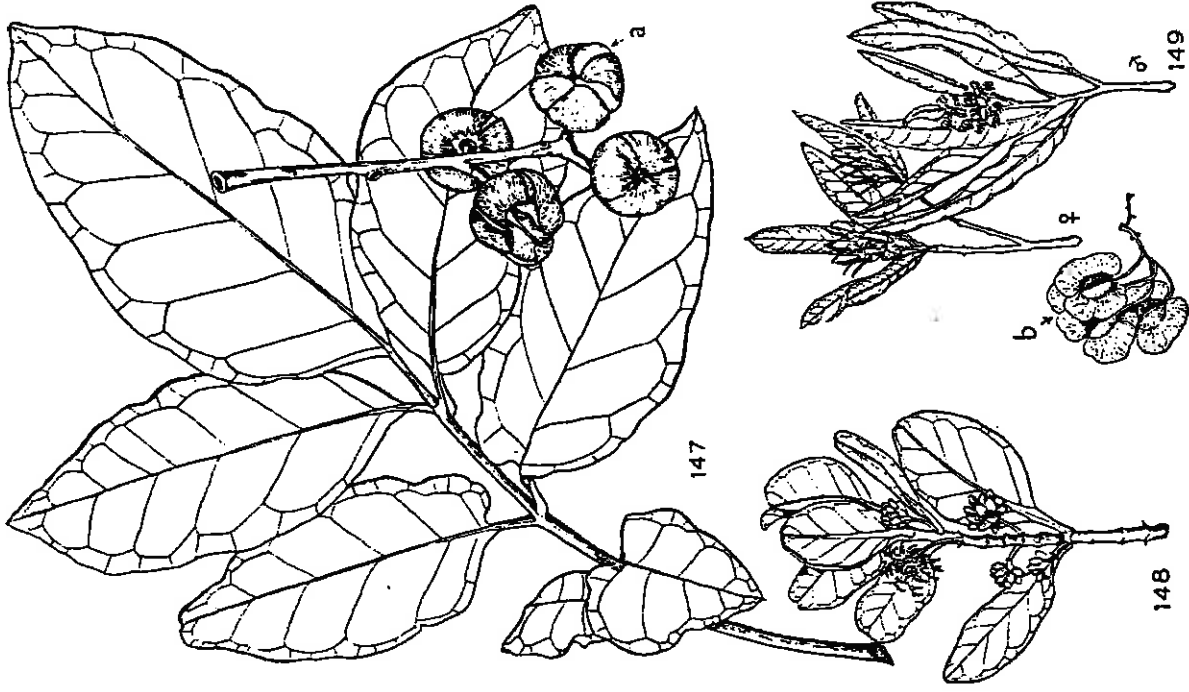
The three species illustrated here are common on North Island coasts but in the South Island are restricted to northern parts.

147. *Dysoxylum spectabile* (*dys*, bad, i.e. bitter; *xylo*, wood; *spectabilis*, beautiful), *kohekohe*. This tall forest tree, which belongs to the mahogany family, yields a beautiful dark timber, seen to advantage in the panelling of one of the waiting-rooms at the Auckland Railway Station. The big compound leaves are light green, the waxy flowers are white, and the pale green fruit splits to show the bright orange arils (a) that envelop the seeds. The bitter milky juice can be seen, and tasted, in the fruit coat. Flowers open in winter, borne often on quite large woody limbs where they are sheltered within the forest.

148. *Coprosma repens* (*kopros*, dung; *osme*, odour; *repens*, creeping), *taupata*, mirror leaf. In exposed places the leaves are little more than an inch long, rolled to show mostly the glossy upper surface, and the branches are so flattened against the rock that specimens collected in Astrolabe Harbour, Tasman Bay, in 1827 were given the name *repens*, meaning creeping. This, the earliest name, is considered to be correct, although it seems inappropriate when the plant grows into an erect shrub to eight feet tall. *Taupata* is used for hedges, especially in Wellington suburbs. A twig with male flowers and buds is illustrated.

149. *Dodonaea viscosa* (Dodoens, a Belgian botanist; *viscosus*, sticky), *akeake*. *Akeake* is most noticeable in February when the papery-winged fruits (b) are full grown and straw-coloured or pinkish. Male (♂) and female (♀) flowers are on different trees; a twig with each is shown here. The tree reaches a height of about fifteen feet, and its trunk, covered with stringy bark, may be a foot in diameter. The wood is so hard and heavy that it makes good heads for mallets; for rulers and modelling tools it is as suitable as the wood of the Common Box (*Buxus sempervirens*) which is generally used for such articles. This widespread species is important also in coastal scrub in Tasmania.

Karaka (*Corynocarpus laevigatus*) is another tree of warmer coasts. It commonly occurs in groves (see title page) and is recognized by its large glossy laurel-like leaves and clusters of oval golden yellow fruits.



Whau, kawakawa and karo are small trees that are never found far from the coast and, like kohekohe, taupata and akeake, they prefer the warmer districts.

150. *Entelea arborescens* (*entelea*, perfect; *arborescere*, to become a tree), whau, corkwood. The soft pale green leaves, seven inches across, clothe the tops of light coloured, much-branched limbs. White flowers are followed by dark spiny fruits from which the small seeds shake out. The wood is exceptionally light and has been used for floats for fish-nets, hence the name corkwood. This is an attractive plant in gardens, but is now rare growing wild, except on some islands and towards the southern limit of its distribution in north-west Nelson.

151. *Macropiper excelsa* (*makros*, large; *peperi*, pepper; *excelsus*, lofty), kawakawa. The heart-shaped leaves, overlapping like tiles on a roof, shade the dark stems. Greenish fleshy spikes, an inch or two long, bear tiny flowers, male on some (a), female on others (b). In fruit the spike is bright orange, juicy, and palatable, as many birds know. The leaves have a hot spicy taste, reminding us that this tree (like *Peperomia*, page 82) belongs to the same family as the culinary pepper.

152. *Pittosporum crassifolium* (*pitta*, pitch; *spora*, seed; *crassus*, thick; *folium*, leaf), karo. The globular green capsule splits into three (c), exposing the black shiny seeds set in a bright yellow sticky substance; such sticky seeds are characteristic of the *Pittosporum* genus. The capsule valves become woody and black as they age, and some remain on the tree throughout the year. In winter, resting buds are covered with dull membranous scale leaves; from these the new growth bursts rather suddenly in spring and quickly develops into grey woolly leaves and umbels of dark crimson, sweet-scented flowers, some of which are male, some female, and some hermaphrodite. The mature leaves, two inches long, green above and white below, sometimes mimic pohutukawa leaves, but differ in being obovate instead of ovate. Karo and pohutukawa grow together and both belong naturally only to the Auckland Province, though both thrive when planted in suitable places even as far south as Dunedin. This, the largest of the tree species illustrated on this page, rarely reaches a height of twelve feet.

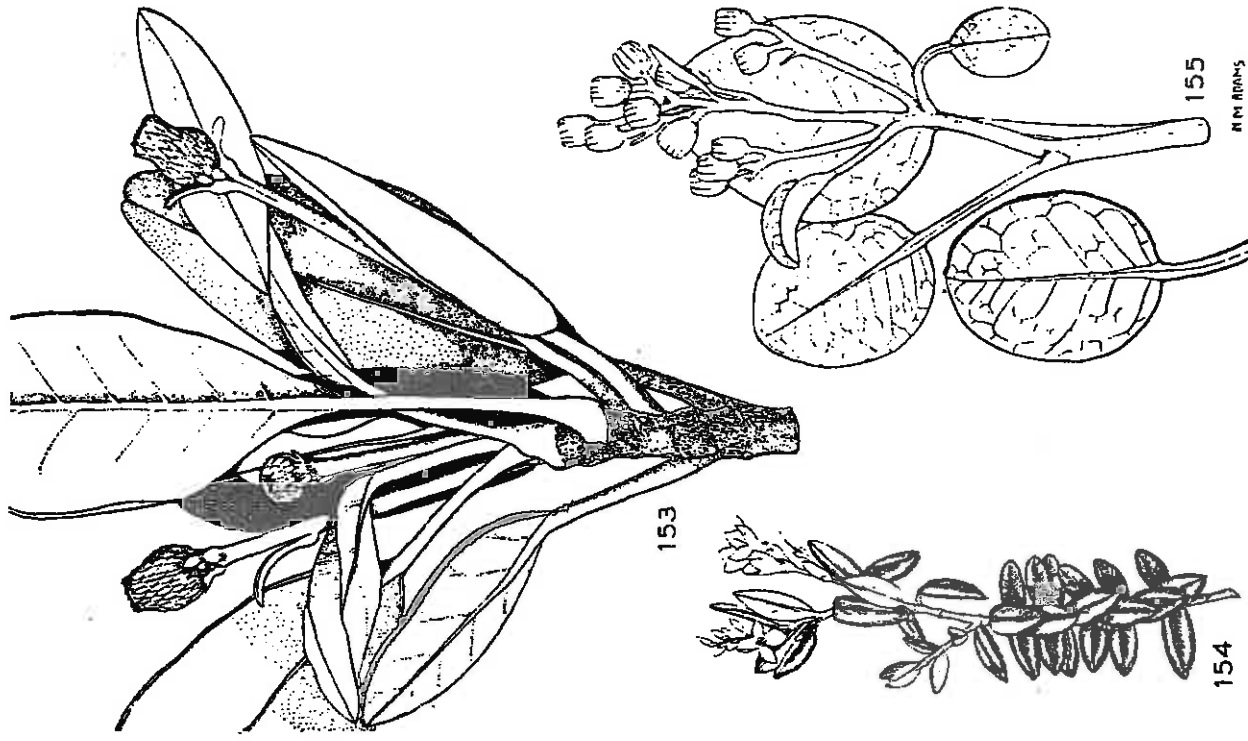


THREE WOODY SOUTHERN SPECIES

153. *Pachystegia insignis* (*pachys*, thick; *stega*, roof or covering; *insignis*, striking), Marlborough rock daisy. This handsome plant is at home on the cliffs of Marlborough, and, except for a slight overlap into Canterbury, grows naturally nowhere else in the world. The woody stems form a cluster three or more feet in diameter. From amongst the thick leathery leaves, shining above and white below, emerge the long pale flower stalks. On top of each, like the head of a clothes-peg, is a single large bud, covered with small overlapping bracts. These buds ornament the shrub for weeks before the white daisy flowers open to their full width of three inches. In a garden this attractive plant does well with good drainage and full sun.

154. *Hebe elliptica* (*Hebe*, goddess of youth), coastal koromiko. This koromiko has leaves about one inch long bearing, while they are young, a marginal fringe of minute white hairs. The flowers are big for a koromiko, often more than half an inch across, flushed with blue, and delicately scented. From North Otago southwards this species often forms a scrub facing the open sea, and it is seen along the west coast, occasionally as far north as Taranaki. This and one other of our many koromikos extend beyond New Zealand, being native also to southern South America.

155. *Senecio reinoldii* (*senex*, an old man; Reinold, a personal name), puheretaiko. This species is the main constituent of mutton-bird scrub which, as Dr Cockayne wrote, 'forms a girdle varying in width according to wind-velocity, round the inlets and sheltered parts of the Stewart Island coast and in portions of the Fiord district. . . . It extends from the margin of the rain forest almost to high-water mark. . . . Within the scrub there is an entanglement of prostrate trunks and branches.' Ferns grow on the peaty floor and mutton-birds burrow here, using the puheretaiko leaves to line their nests. The leathery leaf is up to four inches across, smooth and shining green above and covered below with short buff fur. Visitors to Stewart Island have used these leaves as postcards, writing in bold ink on the under-side. The flower heads lack ray florets.

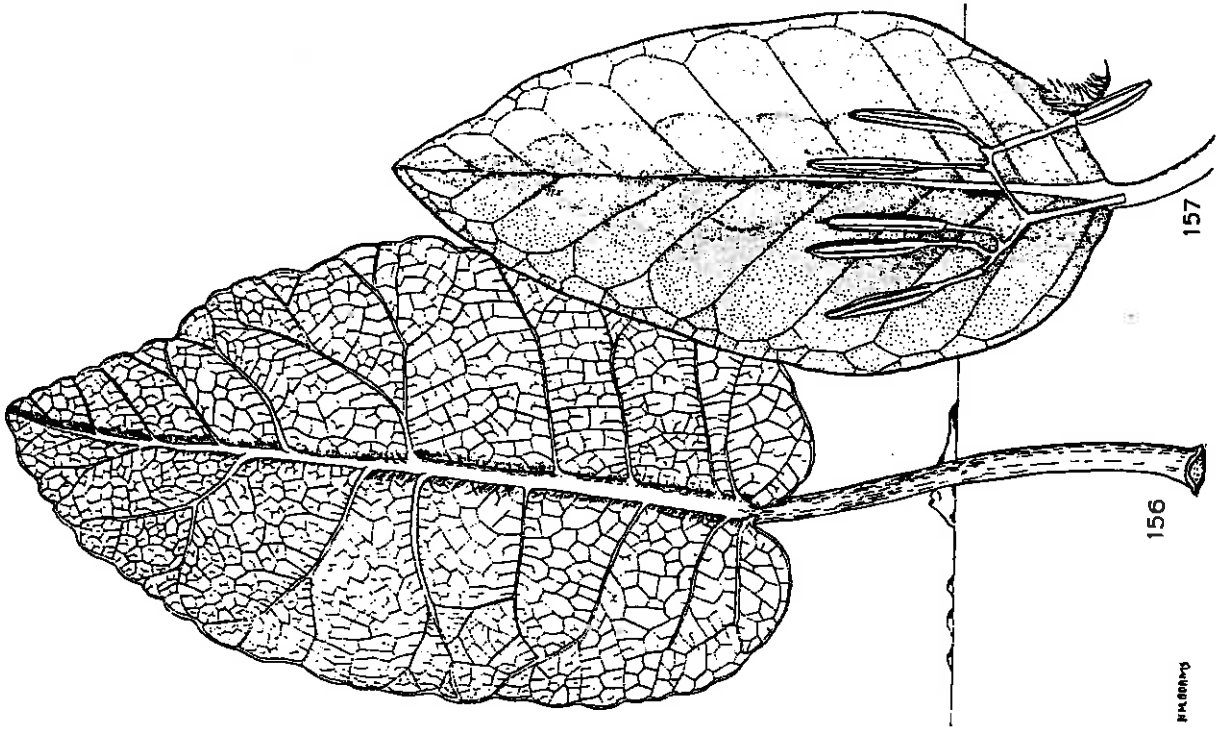


SOME ISLAND PLANTS

New Zealand's islands, counting small ones as well as large, total many hundreds. Some of the middle-sized islands carry the most nearly primitive vegetation left in New Zealand, especially where the island (a) is big enough to carry a bush cover, (b) rises fairly sheer from deep water, and (c) is far enough away from mainland centres to have escaped being burned. Within the great sweep of coast from Cape Runaway to North Cape Captain Cook gave names to the larger island groups, the Mayor and the Aldermen, the Mercuries, the Barrier Islands, the Hen and Chickens, the Poor Knights, and on to the Three Kings. Here are found species once common on the coast but now rare or lost altogether there. Here also occur several astonishing plants that have never been found on the mainland and some of them nowhere else in the world. Some of these rare trees, like the two illustrated here, are exceptionally large-leaved and because of their noble bearing are grown in gardens where they are familiar to many who can never visit the islands themselves.

156. *Meryta sinclairii* (*merumai*, to roll up: Dr Andrew Sinclair), puka (this Maori name is used for several large-leaved trees). The hand-some leaves, about a foot long, are clustered on the ends of branches, forming a rounded head to the small tree. The greenish flowers are inconspicuous, and the fruits, like biggish beads, are black when ripe; on the islands immature berries are often torn up by the strong beaks of kakas. In its natural state this tree grows only on the Three Kings and the Hen and Chickens Islands. It is not known on the Poor Knights, lying between these two groups.

157. *Heimerlodendron brunonianum* (Dr Heimerl; *dendron*, tree; *brunonis*, of Brown), parapara, bird-catching tree. The inch-long fruits are so sticky that small birds brushing against them are glued down by the feathers and then cannot get free. Parapara, found on islands, and also on a few outstanding headlands as far south as East Cape, grows to a tree thirty feet tall.



PLANTING

G*

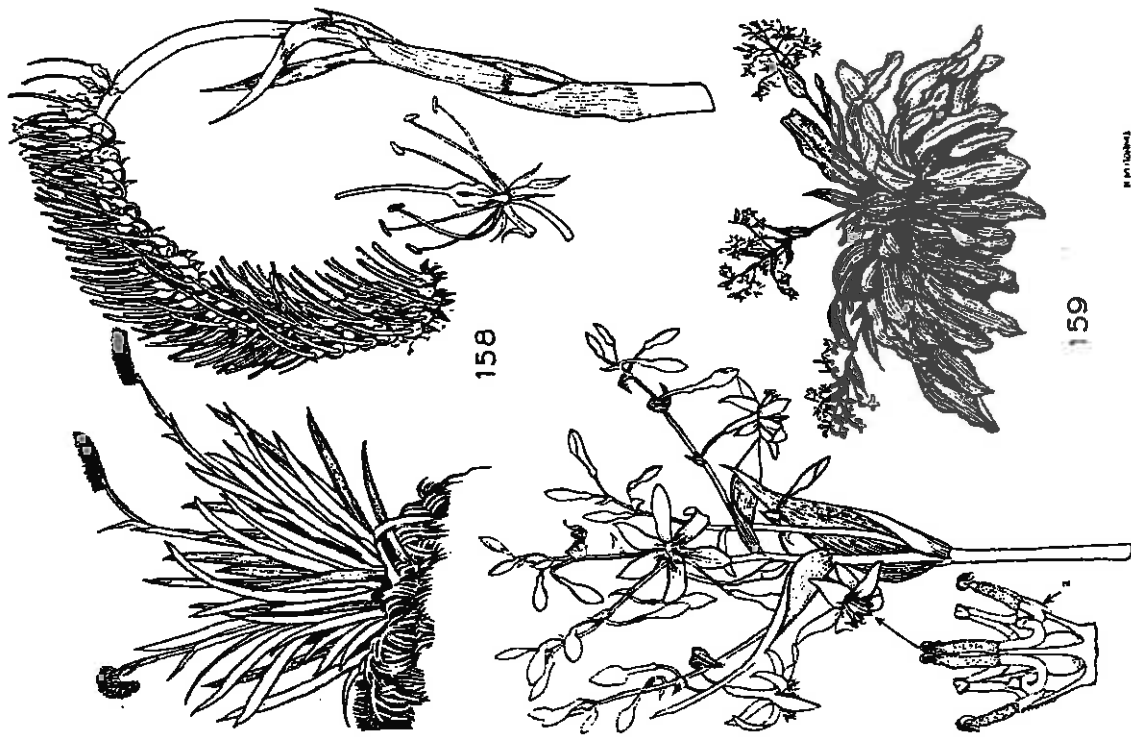
Coastal vegetation includes many monocotyledons, some conspicuous like flax (species of *Phormium*), toetoe (*Arundo conspicua*), and cabbage tree (*Cordyline australis*), some more modest like grasses, sedges, and half a dozen orchids. Aucklanders should know the coastal *Astelia banksii* whose drooping curled-under leaves form big silvery clumps on wooded headlands or steep cliffs. Two truly coastal members of the lily family are chosen for illustration here.

158. Xeronema callistemon (*xeros*, dry; *nema*, thread; *callistemon*, the generic name of the Australian bottle-bush trees). This plant was first described only in 1924 and is still too little known to have acquired a popular name, and it is best called Xeronema, remembering that the X has a Z sound. The name comes from the dry thread-like stamens that form a tangle round the base of the ripe fruit. The fibrous base of the plant is composed of the crumbling remains of old leaves held together by tough strands that were once leaf veins.

The stiff leaves are fleshy and yellow-green and the flowers are a glowing red, perhaps two hundred of them standing erect on an inflorescence up to fourteen inches long. The picture shows a whole iris-like plant, one inflorescence, and a single flower.

This is one of the most showy of New Zealand plants and is gradually being grown in gardens as far south as Wellington and Nelson, far from its home on the sunny cliffs of the Hen and Chickens and the Poor Knights Islands. Its only near relative (*X. mooret*) is found at high altitudes in New Caledonia.

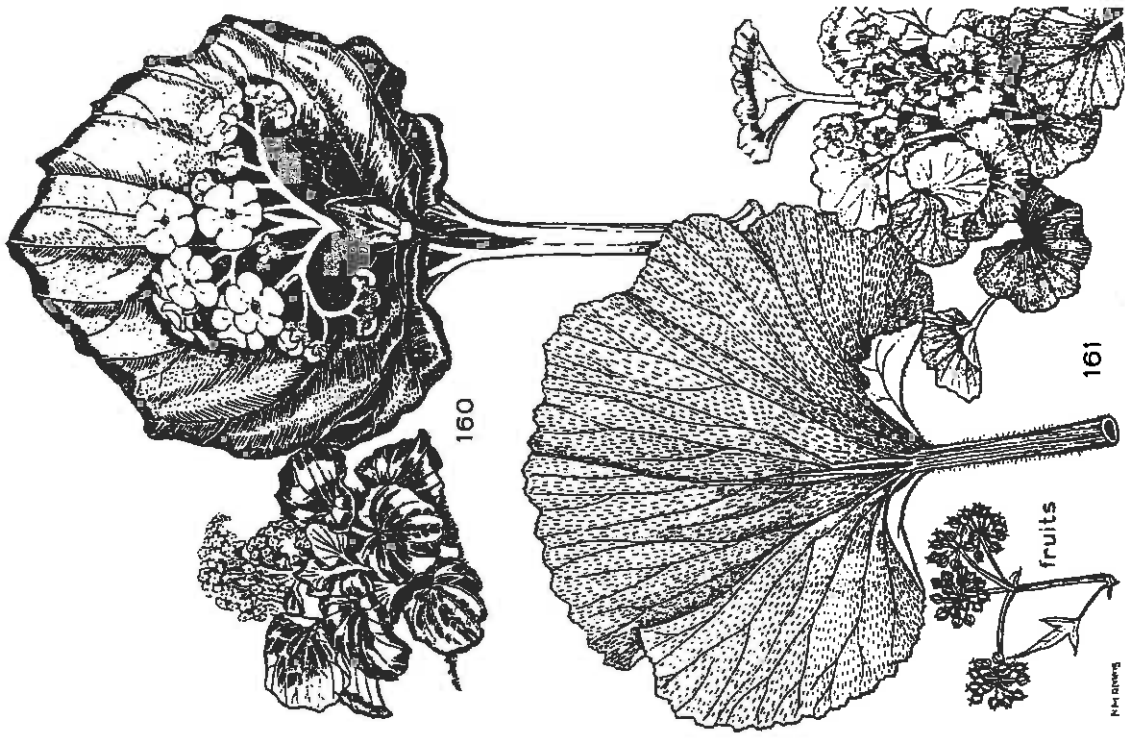
159. Arthropodium cirratum (*arthron*, joint; *pod-*, foot; *cirrus*, curl), rengarenga lily. This, like Xeronema, is a rock-dwelling plant, but is much more widespread, extending, on the mainland as well as on islands, from the North Cape to a southern limit in Marlborough Sounds and Nelson. Many tourists admire it on Mabel Island, near Picton. The broad open panicles, standing about eighteen inches high, carry large numbers of white flowers brightened by gaily coloured yellow and purple stamens whose quaint curling appendages (a) give rise to the specific name.



The most easterly part of New Zealand's territory is the Chatham Island group, 536 miles east of Lyttelton. Not so far from the mainland, and south of the latitude of Stewart Island, are the Subantarctic Islands, also part of New Zealand; Macquarie Island, farther south still, is administered from Australia, but botanically it belongs essentially to New Zealand too. These Subantarctic Islands are uninhabited except for a few men maintaining two weather stations, and the vegetation is relatively undisturbed. These more southern island groups, like those farther north, have plants which are peculiar to them, numbering nearly one hundred species.

160. *Myosotidium hortensia* (resembling *Myosotis*; *hortis*, garden), Chatham Island forget-me-not. The only place in the world where this plant grows naturally is in the Chatham Islands, and even there it is becoming rare except where it is beyond the reach of sheep and pigs. In New Zealand gardens this species is well established, and in cool places on peaty soil it grows to perfection, the dark green, grooved, and glossy leaves reaching eight to ten inches across. The flowers are sometimes whitish or even pink, but usually a deep blue, or blue and white.

161. *Kirkophytum Iyalli* (Thomas Kirk, author of *The Forest Flora of New Zealand*; *phyton*, plant; Dr D. Lyall, early plant collector), punui. This species provides a further example of large leaves on an island plant. Punui leaves are quite as large as those of rhubarb, and of stouter texture. Stewart Island and the adjacent islands are the home of this giant herb. The plant spreads by a thick rhizome, and on the mutton-bird islands the rank growth fills up tracks between one season and the next. For this reason the species is looked upon with disfavour by the mutton-birders; on the other hand they are glad to have the hollow petioles (leaf stems) for blowing up the kelp bags (see page 19) in which the mutton birds are preserved for marketing. This remarkable genus contains only one other species, known only from the Snares; the closely related *Stribocarpa polaris* grows on the subantarctic Auckland, Campbell, Antipodes and Macquarie Islands.



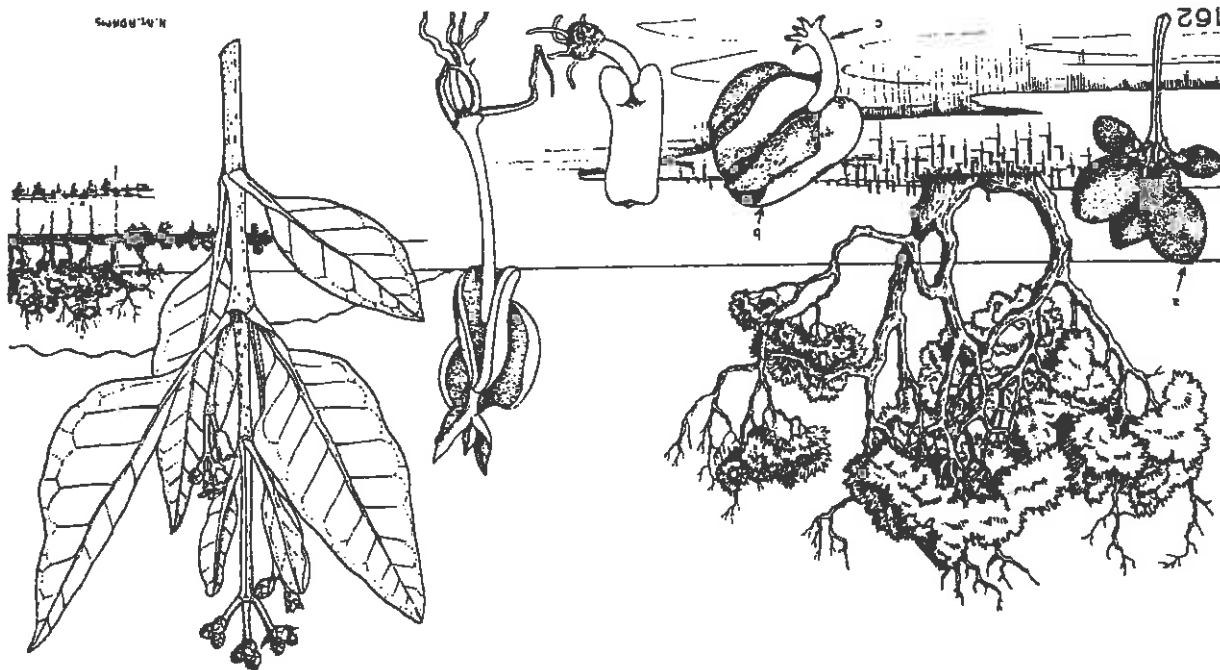
Mangroves

162. *Avicennia resinifera* (*Avicenna*, Arabian philosopher; *resina*, resin; *fero*, bear), mangrove. This specific name is based on an error of the first collectors, Banks and Solander, who found lumps of kauri gum floating amongst mangrove roots and believed that this resin had been produced by the mangrove trees.

Mangroves are trees that live partly in salt water. They are mostly tropical or subtropical and belong to several families. Our one species of mangrove grows only in the warmer waters and reaches its southern limit about Opoitiki and Kawhia. In North Auckland the grey trunks may be as thick through as a man's body, carrying the olive-green leafy leaves thirty feet above the tide; at Tauranga the closely growing woody bushes are little taller than a well-grown crop of potatoes.

Our mangroves grow only in muddy estuaries. About the trunks, roots of a specialized kind impede the flow of water, and the fine silt that is deposited accumulates as black, smelly, gluey mud up to four feet or more deep. Mangrove roots, like all others, need to breathe, and in the water-logged and poorly aerated mud this is achieved with the aid of special breathing roots called pneumatophores. They arise from the upper sides of horizontal roots, and push straight up until their pointed tops stand a few inches to a foot above the mud. At high tide they are surrounded by water, at low tide by air. They have spongy cortex and the thin bark is full of lenticels through which air enters.

Yellowish flowers give rise to round flattened fruits nearly an inch long. The velvety fruit-coat (a) splits soon after the fruit falls, exposing the fleshy cotyledons (b) that are already green and well-developed. The whole sturdy embryo is soon freed and floats with the tide until the stout hypocotyl (c) has grown out and is ready to attach itself by a ring of rootlets. Mangrove plantlets, with their folded cotyledons reminiscent of the compartments of an old-fashioned purse, are familiar objects amongst light drift-wood on many Auckland beaches. Mangrove flats have their own assemblage of smaller plants and animals, lichens on the trunks, seaweeds, barnacles, and sometimes oysters on the breathing roots, and crabs in mud holes, the whole making a natural community.



Systematic Grouping of Genera

(Latin names of plant Families (with a few exceptions) have the ending -aceae; Orders, consisting of groups of Families, have names ending in -ales.)

ALGAE

CHLOROPHYTA (green seaweeds)

- Ulvales: *Enteromorpha*, *Ulva*
- Cladophorales: *Chaetomorpha*, *Cladophora*
- Siphonales: *Bryopsis*; *Caulerpa*; *Codium*

PHAEOPHYTA (brown seaweeds)

- Sphacelariales: *Halopteris*
- Cutleriales: *Microzonia*
- Dictyotales: *Glossophora*, *Zonaria*
- Chordariales: *Leathesia*; *Myriogloia*, *Papenfussiella*; *Splachnidium*
- Sporochinales: *Carpomitra*
- Desmarestiales: *Desmarestia*
- Dictyosiphonales: *Adenocystis*, *Colpomenia*, *Scytosiphon*; *Scytotamus*
- Laminariales: * *Laminaria*; *Lesonia*, *Macrocystis*; *Ecklonia*
- Fucales: *Durvillea*; *Hormosira*; * *Fucus*, *Margaritella*, *Xiphophora*; *Cystophora*, *Landsburgia*; *Carpophyllum*, *Sargassum*

RHODOPHYTA (red seaweeds)

- Bangiales: *Porphyra*
- Nemalionales: *Asparagopsis*
- Gelidiales: *Pterocladia*
- Cryptonemiales: *Coralina*, *Lithothamnion*; *Grateloupia*, *Pachymenia*; *Callophyllis*
- Gigartinales: *Gracilaria*, *Melanthalia*; *Plocamium*; *Apophloea*; *Stenogramme*; * *Chondrus*, *Gigartina*
- Rhodymeniales: *Epymenia*, *Hymenocladia*; *Champia*
- Ceramiales: *Ballia*, *Ceramium*, *Euphilota*; *Caloglossa*, *Hymenena*, *Lain-gia*, *Myriogramme*, *Schizoseris*; *Heterosiphonia*; *Bostrychia*, *Chondria*, *Cladhymenia*, *Euzoniella*, *Lenormanandia*, *Streptocladia*, *Yidalia*

LICHENES

- Parmeliaceae: *Parmelia*
- Usneaceae: *Ramalina*
- Teloschistaceae: *Xanthoria*

FILICES

- Polypodiaceae; *Phymatodes*, *Pyrrosia*
- Aspleniaceae: *Asplenium*
- Blechnaceae: *Blechnum*
- Dryopteridaceae: *Polystichum*

CONIFERAE

- Cupressaceae: * *Cupressus*
- Pinaceae: * *Pinus*

DICOTYLEDONES

- Ranunculaceae (buttercup family): *Ranunculus*
- Piperaceae (pepper family): *Macropiper*, *Peperomia*
- Papaveraceae (poppy family): * *Glaucium*
- Violaceae (violet family): *Hymenanthera*
- Aizoaceae (ice-plant family): *Disphyma*, * *Mesembryanthemum*, *Tetragonia*
- Caryophyllaceae (carnation family): *Colobanthus*, *Scleranthus*, *Spergularia*
- Polygonaceae (dock family): *Muehlenbeckia*
- Chenopodiaceae (beet family): *Rhagodia*, *Salicornia*, *Suaeda*
- Geraniaceae (geranium family): *Geranium*
- Linaceae (linen-flax family): *Linum*
- Haloragaceae: *Gummeta*
- Nyctaginaceae (Bougainvillea family): *Heimeritodendron*
- Thymelaeaceae (daphne family): *Pimelea*
- Pittosporaceae (matipo family): *Pittosporum*
- Myrtaceae (myrtle family): *Leptospermum*, *Metrosideros*
- Tiliaceae (linden family): *Entelea*
- Malvaceae (mallow family): *Plagianthus*
- Euphorbiaceae (milkweed family): *Euphorbia*
- Buxaceae (box family): * *Buxus*
- Papilionaceae (pea family): *Carmichaelia*, * *Lupinus*
- Corynocarpaceae (karaka family): *Corynocarpus*
- Rhamnaceae (buckthorn family): *Discaria*
- Meliaceae (mahogany family): *Dysoxylum*
- Sapindaceae (litchi family): *Dodonaea*
- Arabiaceae (ivy family): *Kirkcophyllum*, *Meryta*, *Stiibocarpa*

Cornaceae (dogwood family): *Corokia*, *Griselinia*
 Umbelliferae (carrot family): *Aciphylla*, *Eryngium*, *Lilaeopsis*
 Myrsinaceae: *Myrsine*
 Apocynaceae (periwinkle family): *Parsonsia*
 Rubiaceae (coffee family): *Coprosma*
 Compositae (daisy family): *Cassinia*, *Cotula*, *Craspedia*, *Olearia*,
Pachystegia, *Raoulia*, *Senecio*, *Sonchus*
 Primulaceae (primrose family): *Samolus*
 Plantaginaceae (plantain family): *Plantago*
 Campanulaceae (Canterbury bell family): *Wahlenbergia*
 Goodeniaceae: *Seligeria*
 Lobeliaceae: *Lobelia*
 Boraginaceae (forget-me-not family): *Myosotidium*
 Convolvulaceae (bindweed family): *Calystegia*, *Ipomaea*
 Scrophulariaceae (snapdragon family): *Glossostigma*, *Hebe*
 Myoporaceae (ngaio family): *Myoporum*
 Avicenniaceae (mangrove family): *Avicennia*

MONOCOTYLEDONES

Juncaginaceae: *Triglochin*
 Liliaceae (lily family): *Arihropodium*, *Astelia*, *Xeronema*
 Iridaceae (iris family): *Liberia*
 Agavaceae (agave family): *Cordyline*, *Phormium*
 Juncaceae (rush family): *Juncus*
 Restionaceae: *Leptocarpus*
 Cyperaceae (sedge family): *Carex*, *Desmoschoenus*, *Marriscus*, *Scirpus*
 Gramineae (grass family): * *Ammophila*, *Arundo*, * *Lagurus*, *Micro-
 laena*, * *Parapholis*, *Spinifex*

* Genus not native to New Zealand

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