

Pittosporum cornifolium is a sparsely branched shrub made up of long, slender, flexible twigs, covered with blackish bark, giving off occasionally branches in whorls of three, and bearing brownish-purple flowers having a slight vanilla-like scent. The leaves are somewhat glossy, dark-green, thick, coriaceous, and rather stiff.

Pittosporum Kirkii is also a scantily branched shrub with long, naked, straggling main branches and final short, straight, fairly flexible, smooth, dark-purple twigs, which branch forking and diverging from one another. The leaves are opposite or in whorls of 3 or 4 near the extremities of the twigs. They are fleshy, thick, coriaceous, glossy, dark-green, with a much paler under-surface and a distinct, yellowish, raised midrib, and much reticulating venation.

The case of *Metrosideros robusta* is of special interest, since this lofty forest-tree begins life as an epiphyte high up on a rimu, for instance, and puts down roots to the ground, which give off lateral holding-roots, these quite encircling the tree (16). The roots gradually increase in thickness, and finally the host is killed, and, it decaying, the root-stems more or less coalesce and form a distinct though most irregular trunk. Other New Zealand trees do the same thing, especially *Nothopanax arboreum*, which makes a tree-fern its host, and on the Chatham Islands *Dracophyllum arboreum*. (See also Carse, 1A.)

4. FILMY FERNS AND TREE-FERNS.

The important ecological classes, the filmy ferns and the tree-ferns, can only receive brief mention. Besides the Hymenophyllaceæ, *Leptopteris hymenophylloides* and (were it present) *L. superba* would be included. With the exception of the kidney fern (*Trichomanes reniforme*), the fronds of the Hymenophyllaceæ consist of a tissue formed of only one layer of cells, which have the power of absorbing water from without. The condition of such organisms is then not unlike that of aquatic plants, and when the average monthly rainfall of the Waipoua Reserve—nearly 10 in.—and the number of rainy days—twenty-two—are considered, the leaves must be as frequently wetted as they require. Even after a shower the drip within the forest prolongs the rain-effect for many hours, while the almost constantly moisture-saturated atmosphere reduces transpiration to its minimum. The rhizomes are usually far-creeping and often form close mats. They are surrounded by muscinæ, fern-tree roots, and so on, and so have their short roots usually in a quite moist substratum. *Hymenophyllum ferrugineum* is covered with hairs, on which the moisture collects freely and falls from the drooping fronds in large drops. The forms of the fronds of these ferns are most varied, and they are frequently deeply cut, which guards them against damage. *Trichomanes reniforme* has, however, broad, entire* fronds, but their erect habit and extra thickness is a protection. In dry weather some of the species, especially *Hymenophyllum multifidum*, curl up their leaf-segments and reduce their transpiring surface, while the kidney fern also rolls up its margins for a similar purpose, sometimes looking withered and dead. *Trichomanes elongatum* grows only in the damper situations, such as on the sides of moist gullies, where intense hygrophytic conditions prevail. Its fronds are sometimes half a foot tall, raised on long stiff leaf-stalks, and are given off, four or so, from a short erect rhizome, which is clothed with the bases of old stipites and is analogous to the trunk of a tree-fern. This gives off numerous wiry, rather long, descending or spreading roots, furnished with lateral rootlets. The fronds are very dark-green and they are frequently covered with epiphytic mosses and liverworts, which, through their water-holding power, are a benefit to the fern; in fact, this appears to be a distinct case of symbiosis.†

The tree-ferns belong, strictly speaking, to the genera *Cyathea*, *Hemitelia*, and *Dicksonia*, but various other ferns, notably, so far as the Waipoua Forest is concerned, *Blechnum discolor* and *Dryopteris pennigera*, have frequently trunks of considerable size. On the other hand, *Dicksonia lanata* may have no apparent trunk, as is the case throughout the whole southern part of its range. The trunks in some of the species are closely covered with adventitious roots. In *Cyathea dealbata* these form more than one-half the bulk of the trunk. Such roots are positively geotropic, as on a leaning trunk masses may occasionally be seen pointing at right angles to the ground. They are formed in great quantities at the base of the trunk, which becomes in consequence much expanded, and this is of moment to the plant, since it is not deep-rooting. The leaves of the tree-ferns are usually more or less coriaceous. They are annual or nearly so in duration, but are not deciduous, and fall over as they wither, clothing the upper part of the trunk with a beneficial moisture-retaining covering. At the apex of the trunk are the thick buds coiled circinately, pressed together, and well protected by their firm, scaly hairs and position.

Blechnum Frazeri occurs in extensive colonies, usually on the drier ground, the slender, dark-chocolate-coloured stems, not thicker than a moderately stout walking-stick, and covered with persistent leaf-bases, rising up side by side and raising their dark-green, shining fronds at various heights into the air, some frequently much overtopping the others. These colonies may occupy many square yards, and there are few parts of the kauri or tarairi associations where they may not be met with. The leaves are on slender stalks, which are a little shorter than the blades. They are given off at a narrow angle, gradually diverging from the erect main stem through arching, and thus finally bringing the blade into a semi-horizontal position, the whole of the fronds thus forming a broad wine-glass-shaped structure. The texture is stiff but not thick, and the colour a shining dark-green. The most interesting point ecologically about this fern is that, notwithstanding its arborescent habit, from the bases of the erect trunks numerous runners pass off horizontally, spreading in all directions just beneath the surface of the ground. They are covered with scaly hairs and put forth roots. After spreading for four or five inches or more a

*Mr. A. Hamilton shows me at time of writing this a lobed form which he had just collected in the western Ruahine forests.

†*H. scabrum*, too, is frequently covered in a similar manner.