

3. EPIPHYTES. (Photos 5 and 6.)

It is the epiphytes, together with woody lianes, tree-ferns and Hymenophyllaceæ, which give to New Zealand mixed forests their tropical character. Perched high in the tree-tops, clinging to erect stems, or forming long lines of luxuriant growth upon a leaning trunk, the epiphytes mark the forest as distinct from those of the temperate Old World.

Strictly speaking, an epiphyte should be a plant which should be invariably found seated upon another. This in the kauri forest is true only for certain filmy ferns, mosses, liverworts, and a very few spermaphytes. These latter generally are also to be found on rocks, while some pass their existence quite well upon the forest-floor.* Thus *Senecio Kirkii*, invariably a ground-plant of the Waipoua Forest, is nearly always an epiphyte in the southern forests of the North Island. It is plain that epiphytes have been evolved from ground-plants, as so admirably demonstrated by Schimper in his pioneer work (26c). This process of evolution can be seen in its various stages in the forests of New Zealand. Tree-fern stems offer ideal conditions for the germination of seeds, and are usually occupied by seedlings of many ground-plants, especially *Weinmannia sylvicola*. Palm-stems, too, are favourite stations for seedlings, owing to their decaying leaf-sheaths. *Astelia trinervia*, essentially a plant of the undergrowth, ascends at times into the trees and there thrives. All that is needed in an epiphyte is a certain amount of xerophytic structure, not so much for the purpose of every-day use as for those quite special occasions in a moist forest when the soil in which it is growing becomes too dry. Thus most of the epiphytes have very thick or at least coriaceous leaves; *Astelia Solandri* holds considerable quantities of water in its leaf-bases, so that showers fall to the ground when the plant is shaken strongly; the epiphytic orchids have special water-absorbing roots in abundance. Some plants are of a drooping habit and are more shaded thus than when erect—e.g., *Asplenium adiantiforme*, *Lycopodium Billardieri*. Furthermore, the epiphytes have either small seeds or spores suited for wind carriage, or succulent fruits which can be borne by birds.

Most essential of all for their welfare is a suitable water-retaining soil, and this is to be found in surprisingly large quantities where they are present. Such is produced quickly by the mosses and liverworts, the forerunners of the higher epiphytes. Trees, large and small, bear on their trunks and boughs, more or less abundantly, various species of muscinæ, which owe their epiphytic habit to the power of absorbing water directly through their leaves, and in many instances to special and peculiar adaptations, some being so constructed as to hold much water by capillary attraction, thus being veritable vegetable sponges, while others have certain of their leaves actually converted into small flasks or cups, which are usually full of water. Indeed, these very plants whose station is the wet forest—typical hygrophytes, in fact—need protection against sudden drought much more than desert plants. These mosses, &c., quickly form sufficient soil from their decay to support seedling epiphytes, and these more or less, each according to its specific capability, make much more soil from their decaying leaves, &c. Thus really enormous quantities of vegetable matter in varying state of decay collect on horizontal boughs and in the forks of trees and hollows, and veritable gardens exist high on the tree-trunks, numbers of epiphytes being joined together into a society, and being for the most part of mutual benefit the one to the other.

The following are the principal epiphytes of the Waipoua Forest: (Filices) *Asplenium flacidum*, *A. adiantiforme*, *Polystichum adiantiforme*, various Hymenophyllaceæ, *Polypodium graminoides*, *P. Dictyopteris*, *P. Billardieri*; (Lycopodiaceæ) *Lycopodium Billardieri*, *Tmesipteris tannensis*; (Orchidaceæ) *Dendrobium Cunninghamii*, *Earina mucronata*, *E. autumnale*, *Bulbophyllum pygmaeum*; (Liliaceæ) *Astelia Solandri*; (Pittosporaceæ) *Pittosporum cornifolium*, *P. Kirkii*; (Myrtaceæ) *Metrosideros robusta*; (Cornaceæ) *Griselinia lucida*.

Some of these have special peculiarities of which brief mention must be made.

Polypodium Dictyopteris has a short, scaly rhizome, from which are given off the bright-green, entire, lanceolate, moderately thick, quite flexible fronds, which are provided with two parallel rows of sori on their under-surface on each side of the centre, these giving a very distinct appearance to the plant. From the rhizome many soft, slender, woolly roots, covered most densely with short brown hairs, are given off and spread out laterally, putting forth at intervals buds which develop into new plants. Thus by degrees a dense mat of roots is formed, several square feet in area, which may be stripped off in its entirety from a tree-trunk, especially that of a palm, where it is very common. It is about $\frac{1}{4}$ in. thick, and so interwoven are the roots that the mat can only be pulled in pieces by force. A young plant with two leaves $1\frac{1}{2}$ in. long had a horizontal root 4 in. long which gave off a younger plant near its extremity with a leaf $\frac{3}{4}$ in. in length.

Tmesipteris tannensis in the northern forests of New Zealand is nearly always a plant of tree-fern stems, thrusting its long rhizome beneath their adventitious roots; but in the Southern Floristic Province it grows much more luxuriantly, and is a plant of decaying wood and humus on fallen logs, with all the appearance of a hemi-saprophyte.

Astelia Solandri forms enormous tufted masses high up on the tree-trunks,† its basal part and earlier leaves having decayed and formed a great quantity of loose vegetable matter, usually extremely wet. Here growing also will perhaps be large, scantily-branched, drooping or semi-drooping bushes of *Pittosporum cornifolium* or the very thick-leaved *P. Kirkii*; the shining-leaved *Asplenium adiantiforme*, its fronds, several feet in length, hanging down; as also long, pendent cords of *Lycopodium Billardieri*; while at its side may be a close-growing mass of the orchid *Dendrobium Cunninghamii*. The above-mentioned *Astelia* is a densely tufted plant with a great number of ensiform, coriaceous leaves, 3 ft. or 4 ft. long and 2 in. or 3 in. broad, provided with a black sheathing base, fleshy in its lower portion and there covered with a great quantity of long silky hairs. These sheaths hold large quantities of water, even in quite dry weather. (Photo 5.)

* I have even seen seedling plants of such a true epiphyte as *Pittosporum cornifolium* growing upon the ground in the forest on the Levin Experiment Farm.

† It is also quite common on upright and even quite slender tree trunks, in what looks at first sight a quite impossible position for such a heavy and massive plant.