Root Behaviour in Metrosideros

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Our representatives of the genus *Metrosideros* display a complicated assortment of root activities. In climbing species, which are found only in New Zealand, attaching roots are produced quite freely along the woody stems. In pohutukawa (*M. excelsa*) a common occurrence is the abundant production of descending aerial roots, either twisted round the tree's large trunk (Cockayne, 1928, Fig. 4), or hanging in matted bunches from the branches. Seedlings of northern rata (*M. robusta*), if they germinate on the ground, give rise to either much-branched bushy shrubs or small trees with only short straight trunks and no recorded root peculiarities. More frequently seedlings of this species grow epiphytically high on some forest tree and send down aerial roots which ultimately reach the ground, perhaps twenty metres below. By the continued growth and fusion of roots produced in this way the huge irregular trunks of the adult trees are formed. Some other and less well-known features of roots in New Zealand *Metrosideros* are recorded here.

Root swellings in M. robusta. Early in 1928 the late Mr. Arthur Percy dug up some small plants of *M. robusta* to esablish as epiphytes on various trees on his property which is now the well-known Percy's Gardens on the Western Hutt Road, Petone. He was surprised to find that some of these plants had one or more lumps or swellings of considerable size on their roots (Fig. 1). Twenty-five small plants with similar swellings of many shapes and sizes were later sent to the Plant Research Bureau, then at Palmerston North: the Mycologist, Dr. G. H. Cunningham, reported that there was no mycorrhizal tissue in the lumps, and suggested that they were concerned solely with water storage. Here, then, is perhaps a partial explanation of the northern rata's

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Fig. 1. *M. robusta.* Small plants showing root swellings. One-quarter natural size.

power of sending down a thread-like rootlet an enormous distance during a period of many years, for it may be that only those plants with special water-tissue can ultimately gain the ground.

Of the transplants in Percy's Gardens some survived more than ten years. The most advanced had a rootlet 215 cm. long, growing at a rate of about 30 cm. per year. The tip of such a rootlet is greyish white and thickened, and it travels down closely pressed to the shady side of the tree trunk, occasionally sending out laterals which cling to the bark and help to anchor the main root. The most successful transplant was on a cabbage tree (*Cordyline australis*), but in the later stages the swelling of the trunk and consequent alterations in the bark corrugations seemed to have the effect of bursting loose the rootlets and finally to cause the death of the tip. Similar dying back occurred on the much shorter roots (less than one metre long) of another transplant of the same age on a large tree of *Plagianthus betulinus*. Though the transplanted ratas were thriving, every host tree was destroyed before any aerial root reached the ground. Most of the plants experimented with were dug out of old road cuttings and the root lumps of many of them were more or less flattened from growing in crevices in rock. These lumps can also be found on small plants in forest, and they are then more shapely. In some collections as many as half of the plants had these lumps.

It has been pointed out by Miss L. B. Moore that these swellings in *M. robusta* strongly resemble the lignotubers of eucalypts (Kerr, 1925). Jacobs (1951) states that the great majority of eucalypt species develop lignotubers, and he illustrates in his Figure 3, A and B, how they begin as little swellings in the axils of the cotyledons or of the first pair or two pairs of leaves formed in seedlings. Older eucalypt plants (C and D in his Fig. 3) share several features shown in the photograph here presented of rata plants at about the same stage. The irregular swellings are now quite large and envelop the upper part of the root and (as in the right-hand rata plant) sometimes show constrictions. The production of several secondary leafy shoots in the two rata plants is paralleled in the eucalypt D. Jacobs says "The aerial portion of the young plant may be destroyed by fire, drought or animals, but the buds and reserve foods in the lignotuber permit it to shoot again when conditions are favourable.... They (lignotubers) are most prominent in difficult localities.... They are the most important factor of all in determining the nature of eucalypt regeneration." The so-called mallee-roots that form a popular firewood in parts of Australia are large underground structures formed by the continued development of lignotubers The presence of apparently equivalent structures in these two genera within the family Myrtaceae adds significance to the present record and should stimulate more detailed investigation of the phenomenon.

Aerial anchoring roots in M. robusta. Another type of root development in *M. robusta* was recorded in the Hinakitaka Stream, a tributary of the Mukamuka, Palliser Bay. Figure 2 shows a tree, old and dead when photographed, that had grown on a narrow strip of shingly ground between the stream and an almost perpendicular rock wall of the bare wind-swept gorge. The unusual feature is that, at about three metres up the trunk, adventitious roots had been sent out (left-hand side of photograph) and these anchored the tree to the rock. The underground roots could travel only up and down alongside the stream which here runs about north and south; to the east any extension was prevented by the stream, to the west by solid rock. This tree did not appear to have ever been epiphytic and the adventitious roots were probably produced rather late in life as an additional support. This root development may be compared with what is described by Cockayne (loc. cit., p. 98) in pohutukawa as "the tree's inate power to put forth abundance of aerial roots which spread over the cliff face and send down branches deep into the rock."

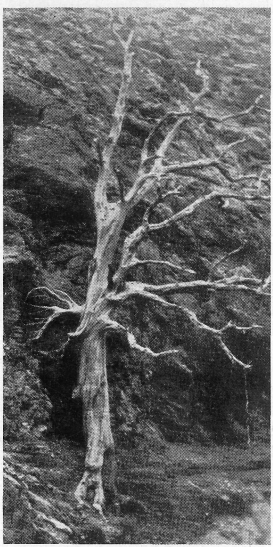

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Fig. 2. *M. robusta.* Dead tree beside Hinakitaka Stream showing adventitious anchoring root on left.

Aerial roots in M. umbellata. Southern rata (*M. umbellata*) has not been described as having aerial roots at all except on margins of cliffs. It seems, therefore, worth recording their occurrence on a tree growing in a small clearing at about 600 metres elevation near Mt. Renata on Frances Ridge, in the southern Tararuas. The tree, about fifteen metres tall, had a trunk more than four metres in circumference, and a large spreading top. For ten metres or more trunk and branches were densely covered with aerial roots, ranging from woody ones (up to 8 cm. or more through, and often loose and swinging clear from the trunk) to thread-like fibrous rootlets lying uniformly close to the trunk and branches, and covering most of their bark (Fig. 3). An occasional area free of roots showed some signs

of scorching and blackening, received presumably when the clearing had been burned off some years previously. Either injury at that time or subsequent exposure might have stimulated production of aerial roots.

To test whether roots would develop equally freely in a different environment, cuttings with aerial roots attached were taken from this tree and grown in the writer's garden in Petone. The aerial roots already present functioned as ordinary roots and cuttings with them grew very readily which is not the case with ordinary twig cuttings. The largest of the plants has now reached a height of 4 metres; leafy branches clothe the trunk almost to the ground and hide the quite abundant growth of aerial roots close against the bark. As in the parent tree the aerial roots are of many differest sizes, the largest being 2-3 cm. in diameter and penetrating the ground. Cuttings taken from the Petone plant have been struck in other parts of the Hutt Valley; two of the resulting plants examined recently (one 2.5, one 1 metre tall) both show active development of aerial roots with some of them firmly rooted in the ground. The production of aerial roots seems to be a characteristic of the vegetative progeny wherever they have been grown.

On the Frances Ridge one of the larger aerial roots of the rata sprawled across the ground and reached and encircled the only other living tree in the clearing, a silver beech with a trunk about 30 cm. in diameter. The beech has since died, possibly from exposure or other causes, but construction by the rata root may have had its share in the matter. *M. umbellata* is extremely rare in the Tararuas, the only representatives known to the writer being this tree and a few smaller plants near the edge of the same clearing. The leaves are larger than is usual in *M. umbellata* and it seems to be a rather distinct form.

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Fig. 3. *M. umbellata*. Copious growth of aerial roots on trunk of tree on Frances Ridge.

Summary. Undoubtedly there is a great deal still to be learned about root behaviour in *Metrosideros*. The present paper has contributed some information about the following: the presence in *M. robusta* of root swellings that probably correspond to the lignotubers of eucalypts; the transplanting of small *M. robusta* and the rate of growth of descending aerial roots; the production of aerial roots for anchoring terrestrial *M. robusta* into a rocky cliff; the development of abundant aerial roots on a tree of *M. umbellata*, and a comparison of these roots with those on vegetative progeny grown in gardens, the observations extending over fifteen years.

References

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Orchids of the Egmont Ranges

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In the account of his ascent of Mt. Egmont in February 1867, John Buchanan wrote (Reports of Geological Exploration No. 4): "Although all who go up do not collect plants still many do, and probably no locality in New Zealand has been better searched. Plants have been passing to Britain from there through various channels for many years. All idea therefore, of finding much novelty may be dismissed, and the result of the present expedition has proved that the botany of this isolated mountain was well ascertained prior to my visit."

Buchanan recorded about 180 species of flowering plants and ferns from Mt. Egmont and neighbourhood, and to this day his list remains the only published attempt at a complete enumeration. (An unpublished list, compiled by Cockayne, is deposited at the Dawson's Falls Hostel.) Needless to say, Buchanan was mistaken in his views as to how well Mt. Egmont had been searched; since 1867 many other plants have been found there and the flora is now known to contain over 400 species.

The present contribution on the botany of the Egmont Ranges deals with the orchids only, which number twenty-eight as compared with the four determined by Buchanan in 1867. The notes on distribution have been condensed from much detailed information contributed by each of the three botanists who have studied the orchids in this part of New Zealand. Besides Mt. Egmont itself (8260 feet), the Egmont Ranges include the Pouakai Range (4590 feet) and the