Succession After Forest Fires in the Southern Tararua Mountains

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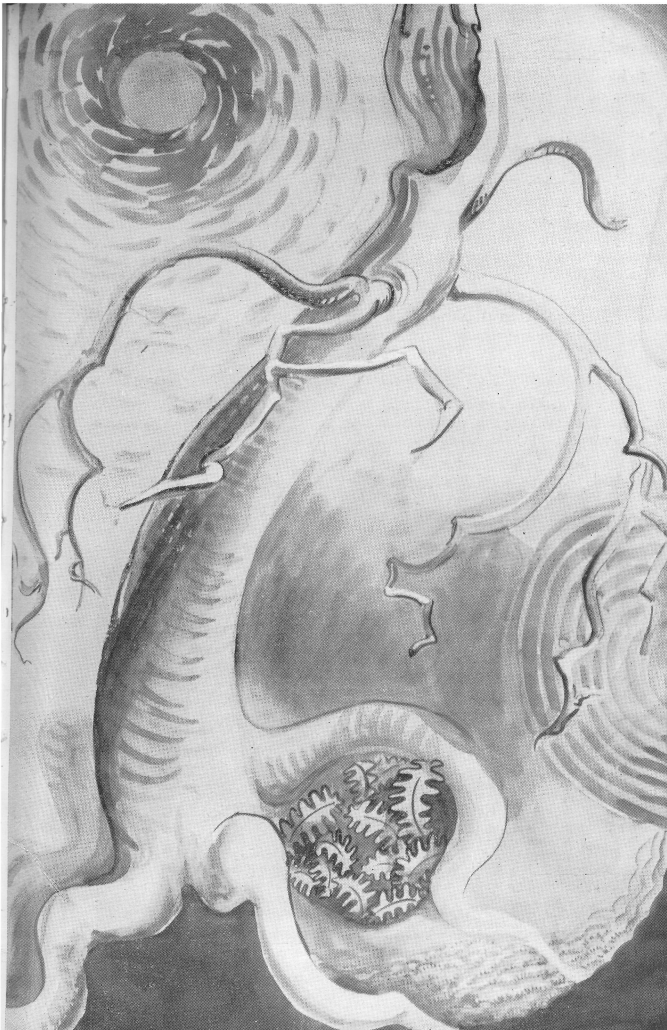
Thirty to thirty-five miles north of Wellington lie the lower ridges of the Southern Tararua Mountains. Whereas the main ridges of these mountains rise to 5000 feet, the subsidiary ridges run for many miles between 2000 and 3500 feet. Apart from occasional bogs and windswept openings with natural scrub-forest, these ridges are covered with silver beech forest with the addition of red beech and kamahi below 2900 feet.

These forested hills, with steep slopes and often narrow tops, were considered suitable for clearing and grazing by the surveyors who compiled the original 1881 map. No clearing was done, however, apart from the felling on trig areas. The Lands and Survey Department stated that the practice of surveyors firing these areas was frowned upon, but whether intentional or not, by surveyors or others, fires which occurred on a number of hilltops do appear to have started from trig stations.

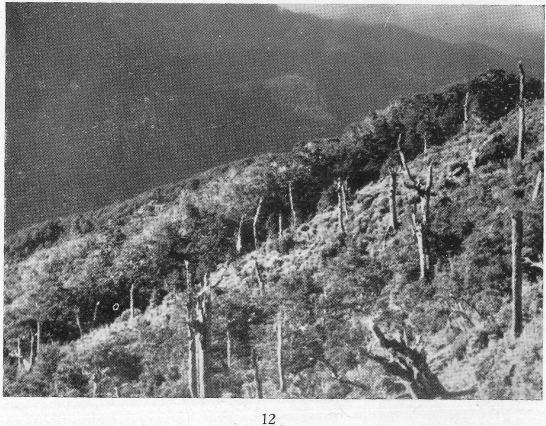
Apart from these there have been few fires in the southern part of the range which have occurred above 2000 feet. Two which did burn areas of silver beech forest at about 3000 feet were on the Quoin Ridge in February, 1947, and on the Marchant Ridge, just across the Eastern Hutt River from the Quoin Ridge, in January 1938. These burns and one further east on Mt. Reeves, were selected for a study of revegetation between 1948 and 1950. Although they are at the same altitude it is probable that the two westerly burns receive more precipitation on their northerly and westerly faces than does Mt. Reeves. It was seen in the field and from Kelburn, Wellington, that cloud of the prevailing north-west winds often broke up after passing over the Marchant Ridge, and either did not re-form over Mt. Reeves, or did so far less densely. The effects of cloud on the forest vegetation can be seen in the dense epiphytic and ground cover of bryophytes, lichens and filmy ferns (for convenience "moss") in the Quoin and Marchant forests. It must be remembered, then, that the succession followed through on Quoin and Marchant may not lead to the same scrub vegetation as occurs on Mt. Reeves, but to a tussock-dominated community, such as is found on Kapakapanui, 3615 feet, on the west side of the range. (See Wgtn. Bot. Soc. Bull. No. 22, March 1950). More likely it may lead to the *Danthonia cunninghamii - Astelia cockaynei - Dracophyllum filifolium* community of Mt. Climie, in a similar position to north-west winds as are the Marchant and Quoin Ridges. Seelye's rainfall map shows Quoin, Marchant, Kapakapanui and Climie in the 80-100 inch belt, and Reeves in the 60-80 inch belt, but there are no measured rainfall figures available for more than one year.



The Quoin and Marchant Burns. In both cases the fires appear to have started from shooters' camp-fires left unextinguished. The dryness of the "moss" layer in mid-summer allowed the fires to spread rapidly along the floor and up the trunks of the trees. Inspection of the Quoin area a month after the fire in 1947 showed that the leaves of the trees and shrubs were still green and that the bark had been only slightly scorched. Old dead trees had burnt in their drier wood. A year later the trees had lost all their leaves and were obviously dead. The death of the trees could have occurred in several ways. The scorching of the bark may have killed the cambium; the leaves may have been "cooked"; and the root tips in the soil may have been killed—the trees in these forests are shallow-rooted because the parent rock is very near the surface.

Revegetation of the Quoin Burn. The major part of the new vegetation on the Quoin burn consists of species not naturally occurring in the forest. There were, it is true, some survivors with subterranean rhizomes—*Blechnum discolor, Cyathea smithii, Enargea parviflora*—accounting for small colonies. But apart from *Blechnum minor* and an undescribed species of *Isolepis,* the forest ground plants were not spreading at all in 1949-1950.

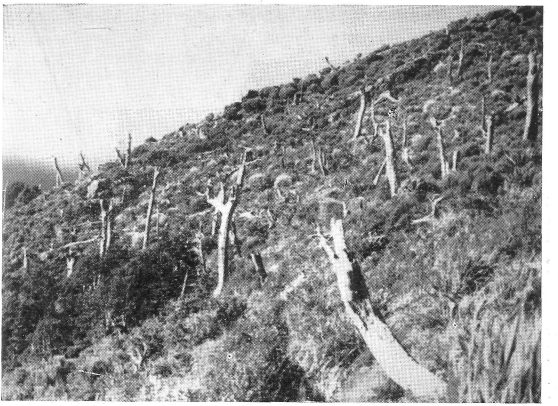
Of the newcomers, the liverwort *Marchantia berferoana* was the first to appear. By March 1948 it had covered between one-third and one-half of the charred litter. In July of the same year water-fern (*Histiopteris incisa*) fronds were appearing through the *Marchantia* and the litter. In August 1949 the liverwort covered the



whole area, except for a few very wet places where the forest floor vegetation had survived. The moss *Polytrichum juniperinum* was pushing up through the liverwort mat and *Isolepis* was spreading in the moister parts.

In April 1950 there was a definite pattern visible. *Polytrichum* was most plentiful on small ridges with drier soil, *Marchantia* was still dominant on slopes, and *Isolepis* was very abundant in hollows and small gullies. Near the forest margins water-fern had grown over the *Marchantia*, which was forming long sterile ribbon-like thallus branches. Seedlings of woody plants were rare, but included *Nothopanax sinclairii*, horopito (*Pseudowintera colorata*) and *Suttonia divaricata*, all ridge-top forest plants; fuchsia, a gully forest plant; and koromiko (*Hebe salicifolia*), a non-forest plant. The ridge-top forest seedlings may have been survivors, but the fact that they were growing in the *Marchantia* mat is significant.

In spite of a good seed year for beech in 1948-49, no seedlings



Mt. Reeves

Above and on left: A view across part of the north-west face showing regenerated beech in the gully in the middle foreground. The scrub on the spur just beyond is *Dracophyllum*-kamahi, with pure *Dracophyllum* in the upper parts. On the left the edge of the unburnt beech forest can be seen.

were found on the burnt area in 1950. Even in the forest, however, there were only occasional seedlings, and these mainly on south faces. In contrast, about 500 feet lower down the ridge seedlings were numerous.

The Marchant Burn. The effects of exposure to north-west winds are more evident on the Marchant Ridge because the burn extends well down on both sides. There are two main communities, easily seen to be later stages of those of the Quoin burn. On northerly and westerly faces there is a sward of *Polytrichum,* on southerly and easterly faces a dense cover of water-fern. *Marchantia* has preceded these communities, for scattered relicts occur in damp places in both and remains of the plant are common under *Polytrichum.*

The *Polytrichum* mat, which is two to four inches deep, carries numerous plants of *Epilobium pedunculare* and *Raoulia glabra,* and occasional plants of *Blechnum minor. Isolepis* is common in the damper situations. Succession by larger plants is not very marked, but *Astelia cockaynei* and *Phormium colensoi* are fairly common, and there are occasional plants of *Coprosma parviflora* and *C. pseudocuneata.* Mingimingi (*Leucopogon fasciculatus*) is rare. *Nothopanax sinclairii,* putaputaweta (*Carpodetus serratus*) and fuchsia appear only in the shelter of logs where water-fern is sometimes established. A significant fact about *Astelia* and *Phormium* is their occurrence in large numbers on all parts of older burns, for example on Reeves, Climie and Kapakapanui.

The *Polytrichum* community also occurs on flatter areas, benches and saddles along the ridge. In these places retarded drainage has apparently had the same effect as exposure to north-west winds in preventing the complete invasion of *Polytrichum* by water-fern. The associated species are similar, with the addition of *Juncus polyanthemos.*

The water-fern forms a green canopy between October and June, 18 to 30 inches high. The density of this canopy and its complete collapse each winter have lead to the production of a coarse litter up to six inches deep. On this litter, which is always damp, there are numerous plants of *Epilobium linnaeoides* and *E. pedunculare,* the later where the fern canopy opens out. *Isolepis* occurs in the damper parts. Apparent survivors of the fire, none of which form more than small colonies, include *Blechnum discolor* and *Cyathea smithii.* Only near the forest, however, do these ferns grow with well formed fronds free from wind scorch. Occasional plants of horopito in gullies also appear to be survivors. Succession towards woody vegetation is slow. Seedling fuchsia, *Nothopanax sinclairii,* broadleaf (*Griselinia littoralis*) and *Coprosma* species are frequent, but all these plants are favoured by deer and well browsed. The only new woody plants appearing above the water-fern canopy are horopito and mingimingi, neither of which is browsed.

Mingimingi is a rare plant on the Marchant burn, whereas on both faces of a 1938 burn lower down the ridge, near Dobsons Hut at 2000 feet, it is plentiful. The few plants on the north-west faces of the Marchant burn, like those on the north-west faces of Mt. Reeves (see below), are in poor condition, but those on the south-east faces are quite tall and well developed. At Dobsons succession

appears to have taken place via *Marchantia* and water-fern, and here, in 1950, mingimingi was 10 to 11 years old, up to three feet tall and in flower. There is very little mingimingi in the Marchant forest to supply seed for the burn there, but the fleshy fruit should be carried the short distance from the lower burn.

The occurrence of fuchsia and horopito as ridge-top plants on the Marchant burn is puzzling. Fuchsia is normally confined to gullies in this area, and it is only where the weather is nearly always cloudy, as on Kapakapanui and Mt. Matthews, that it is usual on ridge-tops. It occurs at a higher altitude on the burn than it does, even in gullies, on Mt. Reeves. Horopito is a ridge-top plant on the Marchant burn, whereas on Mt. Reeves it occurs only in gullies on the damper faces.

At the moss-waterfern boundaries on ridge-tops there is an increase in the number of wind-scorched fronds towards the north-west, and a gradual dwarfing of the fern to four inches or less. The fern has advanced recently, for drawn up *Polytrichum* plants are present up to two feet in from the edge. Observations over the 1949-50 growing season showed that the fern spread up to nine inches in one place.

Mt. Reeves. So far as could be determined from burn scars on old trees at the edge of the burn, the fire occurred about 1890. It destroyed a large area of silver beech forest on the northerly faces and a smaller area of mixed silver and red beech on the southerly faces. The burnt area consists of a small flat top at about 2950 feet with six radiating spurs and ridges. It can be resolved into three main aspects: *the north-west facing,* receiving the full intensity of the north-west winds coming over the main divide; *the north-east facing,* sheltered from the north-west winds and from the southerly winds; and *the south facing,* exposed to the southerly winds from the Wairarapa. The north-west winds are most prevalent in summer and autumn, and are very drying. In addition to climate, slope is an important factor affecting the nature of the plant communities sixty years after the fire.

On the partly eroded tops of the ridges facing *north-west* there is an open *Dracophyllum filifolium* scrub two to three feet high. *Lycopodium fastigiatum* and *Gaultheria depressa* grow on the soil remnants around the shrubs, and *Raoulia glabra* and *Helichrysum filicaule* form mats on the bare rock.

Further down the slopes where the wind is less intense, kamahi occurs mixed with the *Dracophyllum.* The *Dracophyllum* is up to four feet high, but the kamahi is not much more than two feet and grows as a much branched, flattened shrub. This dwarfing was at first attributed to browsing by deer, but few of the other plants on this face were browsed, not even *Coprosma* species or *Astelia.* In October 1950 the young growth on the kamahi shrubs at this level was found to have been scorched. Apparently, then, the dwarfing is

the result of dry winds continually scorching back all new shoots projecting above a certain level. The outer leaves are at a stage intermediate between juvenile and adult, and the shrubs appear not to flower even though they are at least thirty years old. Lower down the ridge and in sheltered positions, however, plants of the same approximate age do flower. Subsidiary plants of the scrub include *Gaultheria rupestris, G. antipoda,* koromiko and mingimingi. In the more exposed places *G. antipoda* is not as common as *G. rupestris* and the plants have many dead branches. Koromiko and mingimingi are likewise in poor condition, flowering sparsely and fruiting not at all. Under and between the shrubs, *Astelia cockaynei* and *Phormium colensoi* are plentiful, the former increasing in abundance with increase in shelter. The ground layer consists for the most part of *Lycopodium scariosum* and *Blechnum minor.*

As the original forest is approached and the spurs become more defined there is an increase in shelter, and kamahi up to eight feet tall becomes dominant. Mingimingi is more frequent here and tall shrubs of koromiko are common. The forest plants *Coprosma colensoi, C. foetidissima, Nothopanax sinclairii* and putaputaweta, are plentiful. The canopy of this scrub is dense and there is a reduction

Mt. Reeves.

A view down the south-east face of Mt. Reeves, with the Wairarapa Plains in the background. In the foreground there is an *Astelia-Phormium* community, with occasional *Dracophyllum* plants. The scrub on the northerly face in the left-hand middle distance is *Dracophyllum*-kamahi.

in the amount of *Astelia, Phormium* and *Lycopodium scariosum* under the shrubs. *Blechnum minor*, on the other hand, is tolerant of the increased shade. *Coprosma parviflora* grows here but is more loosely branched than it is further up the slopes. Silver beech increases from scattered wind-shorn plants in the uppermost part of the kamahi scrub to poles eight feet high, almost co-dominant with kamahi and koromiko, near the forest margin.

There is little change in the vegetation from a 25 to 30 degree slope on the north-west face, but where there is a seepage there is some variation. *Astelia* becomes abundant and *Danthonia cheesmanii* frequent. In three shallow gullies near the original forest the increase in moisture has allowed regeneration of silver beech, though increase in shelter may also have been a factor. Age-counts along a line up from the edge of the original forest showed that the new forest had advanced about 70 feet in 40 to 50 years. There was a definite gradient of ages uphill, suggesting that successive lots of beech had grown up in the shelter of those already established. Rates of diameter growth were calculated and it was found that just above the margin of the pole beech, where the young saplings are overtopped by tall *Astelia* tussocks, the growth rate decreases. This appears to be a shade effect, for where the *Astelia* community is more open and not so tall, further up, the beech saplings though few in number show an increase in growth rate. They have not grown as rapidly in height, however, as have the poles lower down. The presence of drawn-up shrubs and tussocks amidst the older pole beech also seems to indicate succession to beech through the *Astelia* tussock community.

The spur of Mt. Reeves facing *north-east* shows the effect of shelter well. On a slope of 25 to 30 degrees there is plentiful regeneration of beech (mostly silver) through six-foot high *Dracophyllum*-kamahi scrub. On more gentle slopes of 10 to 15 degrees there is a community showing succession from *Carpha alpina* to *Astelia*, in which very small plants of beech and larger ones of *Dracophyllum* are frequent. The beech in the poorly drained areas supporting *Carpha* has a growth rate even lower than it does in deep shade in forest, but unshaded beech in *Astelia* grows rapidly.

On the *south* face of Mt. Reeves, on a steep slope of 30 degrees, there is a dense stand of pole-beech (again mainly silver). In this stand, which is 15 to 20 feet high with the shortest trees about six feet, trees of different age-groups are fairly evenly distributed between the original forest and the crest of the ridge. The oldest group consists of trees aged 40 to 50 years; it would seem, therefore, that the stand originated 10 to 20 years after the fire. There is no sign of overtopped scrub or tussock vegetation. A layer in the litter under the trees contains fragments of a liverwort similar to, if not actually *Marchantia*. It is possible that succession to beech took place directly through the liverwort, for beech leaves lie immediately above this layer.

The effect of southerly winds and impeded drainage is most noticeable on the more gentle slope of 15 to 20 degrees to the south-east of the trig. *Astelia cockaynei* and *Phormium colensoi,* two to three feet high, are co-dominant, and *Juncus* species and *Danthonia cheesemanii* are plentiful. *Blechnum minor* and *Lycopodium scariosum* are the commonest ground plants. In the local seepages *Carpha alpina* is dominant with *Juncus antarcticus, Blechnum penna-marina* and *Lycopodium fastigiatum.* Large *Dracophyllum* shrubs, 40 or so years old, occur only on rocks and a few of the steeper parts. Younger plants 10 to 15 years old, however, are frequent within the main *Astelia* cover.

At the north-west edge of the *Astelia* community there is a narrow belt of silver beech. This fringe is in a sunny area, sheltered from the wind and frequented by deer as a result. *Astelia* is favoured by deer as a food, especially on the south-east face, and since young beech is frequently associated with *Astelia* in the open, the establishment of further beech seedlings may be difficult. The bases of dead *Astelia* tussocks, however, hold water well, and seedlings are growing on them.

Succession on Mt. Reeves. A photograph taken in 1914 on the north-west face of Mt. Reeves shows large tussocks of *Astelia* and *Phormium.* Although still numerous these plants are now displaced in dominance by *Dracophyllum* and kamahi, except on less well-drained areas such as the gully on the north-west face and the gently sloping portions of the southern faces. In these places the succession to *Dracophyllum* is only just beginning.

The extent of beech regeneration on the burn is seen to be rather small when the whole area is considered. There are pole-stands on the steeper southern faces, tongues of beech extending up the gullies on the north-west face, and young trees coming up through the *Dracophyllum*-kamahi scrub on the north-east spur. These are the only sizeable areas of regeneration. The marginal pole-stands on the north-west and south-east faces only extend a short distance out from the original forest—20 feet in the more favourable situations.

Several factors could be responsible for the lack of regeneration over large areas on the south-east and north-west faces. The supply of seed might be inadequate; but an examination of the litter on a slope facing north-west showed nuts and full cupules present up to 300 feet from the edge of the forest, even in very small samples. They were likewise present, though fewer in number, on the south-east face, where the winds are not so strong. Deer may eat the young beech seedlings, in the more sheltered parts of the south-east and north-east faces; but on the north-west face far more palatable plants, such as *Astelia, Danthonia* and *Coprosma,* are scarcely touched. Poor drainage has been shown to have retarded the growth of sapling beech on the flatter parts of the north-east face. This may also be the case to a greater extent on the south-east face—beech saplings are rare on the main face.

The most significant factors, then, may be climatic. Very little measurement of these factors was possible. A series of humidity readings showed that the humidity on the north-west face during a strong dry north-west wind was up to ten per cent. lower than on the south-east face and five per cent. lower than on the north-east face. The scorching of kamahi leaves on the north-west face, mentioned before, supports the idea that dryness in the growing season is a significant factor preventing regeneration in the more exposed parts. But dryness may not be the only factor, for beech does occur well up the north-west faces of ridges 500 feet lower down on the same burn. Other work (Raeside 1948, Holloway 1949) has suggested that climatic change is causing a lowering of vegetation belts in New Zealand. Perhaps a change towards a colder, less humid climate has affected regeneration of forest at the altitude of Mt. Reeves, 600 to 800 feet below the timber-line of the eastern side of the Tararuas.

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Field Trip to Western Lake, Wairarapa

R. Mason

On December 2 a party of about fifteen travelled by private car to the reserve at the edge of Lake Wairarapa, on the Western Lake Road, and spent the morning looking at the plants at the lake edge and the afternoon in the bush above the road.

The shore of the lake is stony with the stones in places overlaid by silt. On this silt and around the base of clumps of *Leptocarpus simplex* there is a close turf with many interesting plants. Some of these—*Hydrocotyle tripartita* var. *hydrophila, Myriophyllum votschii, Pratia perpusilla, Mazus pumilio,* and *Isotoma fluviatilis*—had recently been noted as new records in Bulletin No. 23. The last three were in flower at the time of our visit. Other plants growing here were *Limosella lineata, Selliera radicans, Triglochin striatum* var. *filifolium, Asperula perpusilla,* a species of *Lilaeopsis,* and a *Schoenus,* possibly *Schoenus nitens* var. *concinnus.* Dr. Oliver found *Dichondra brevifolia* in flower; and a few plants of the native sea holly *Eryngium vesiculosum* were seen—this is usually a coastal plant.