

an overall length of a few hundred yards and a height of about 50 feet. There are only twelve species present, of which two are woody (ngaio and taupata) and the remainder herbaceous (*Phormium colensoi* and *Agropyron scabrum* among them). Sentinel Rock is the northern outlier of the Chetwode Group and is very similar in height and steepness to North Trio. Ngaio and taupata are again present but *Phormium colensoi* and *Agropyron scabrum* are not represented. The total number of species is eleven.

Vegetation of the Middle Clarence Valley

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THE Clarence River flows for 125 miles on one of the most circuitous courses in the South Island. Rising in the Spenser Mountains, it runs south to St. James, just north of Hanmer, turns east around the large bend to the Acheron junction, then runs north-east between the Inland and Seaward Kaikoura Ranges, finally cutting across the Seaward Range to the sea north of Kaikoura. It traverses very little forested country and its sudden floods are well known to the few people living along its banks. The following account is of the middle part of the Clarence Valley, extending from the Gore River to the headwaters of the Ouse River, and lying between the two Kaikoura Ranges. The middle valley has two out-stations in it. 'Quail Flat', near the Seymour River, is inhabited only at intervals during the summer and is reached by pack-horse over the Kahutara Saddle, 3900 feet. The 'Bluff' is permanently inhabited and is reached either by intermittent plane service, or by pack-track from Quail Flat or Kekerangu along the north-west bank of the Clarence.

Geology. The valley is not a simple glacial or river-eroded trough but a complex structural depression with varying rock types. The high ranges on either side are made of strongly jointed greywackes which often form screes. A ridge of calcareous and flinty rocks, of Eocene and Oligocene age, is a feature of the area and rises to 3500 feet at the Chalk Range. This is thinly overlaid by later Tertiary mudstones and conglomerates. Below the limestone and flint beds as far north as Bluff there is a thick series of easily-eroded alternating sandstones and mudstones of Cretaceous age. In the vicinity and south-east of Quail Flat these Cretaceous rocks are replaced by

basalts, underlying the limestone to form prominent rounded hills culminating in Warder, 4800 feet.

The effects of parent rock on soil and vegetation are pronounced in the valley, especially in the drier areas towards Bluff. As far south as Branch Creek both manuka and kanuka (*Leptospermum scoparium* and *L. ericoides*) are absent from the highly calcareous rocks and are replaced by tussock grassland. The sulphurous Cretaceous rocks immediately beneath the limestone and flint beds south of the Dart Creek weather to produce an extremely acid soil which supports grassland with scattered manuka. *Cassinia* and *carmichaelia* are absent. Where limestone scree covers the sulphurous rocks, however, they are present and manuka absent.

Climate. Except at the northern end, the middle valley is partly sheltered from both north-westerly and south-westerly winds. Seelye's estimated rainfall figures for the whole valley are 40 to 50 inches, but a rain-gauge at Bluff has recorded from 1949 to 1953 an average of only 29 inches. Beech forest at the northern end, however, suggests that the rainfall there is closer to Seelye's estimate.

Vegetation. The following description is based on three trips into the valley. In early 1953, as a member of a Geological Survey party, I spent five weeks in the valley, based at Quail Flat and visiting Gore River, Bluff and Lake McRae. Later we visited the northern end of the Valley, going upstream as far as the Dee River. In the 1953-54 summer holidays Miss Ruth Mason, Pamela McQueen and I went into the northern end of the valley, climbed the Chalk Range, then tramped up to Bluff; from there we went up the Muzzle Creek and over into the Hodder tributary of the Awatere.

The principal types of vegetation are shown on the accompanying map; as most of the mapping was done with the aid of binoculars, it is subject to later amendment—particularly the areas of beech forest. The general pattern of the vegetation is the result of two main influences (apart from altitude): the decreasing rainfall up the valley; and the influence of calcareous rocks in extending tussock grassland into a forest climate.

Beech Forest. The largest forest areas are of beech. In the northern basin drained by the Ouse a form apparently intermediate between black-beech (*Nothofagus solandri*) and mountain-beech (*N. cliffortoides*) is found below 2000 feet, and mountain-beech above that altitude. Red beech (*N. fusca*) is abundant below 3000 feet. Mountain totara (*Podocarpus hallii*), broadleaf (*Griselinia littoralis*), *Nothopanax simplex*, and putaputaweta (*Carpodetus serratus*) are common in this forest. Scattered trees of the intermediate form of beech occur in the manuka shrubland as far south as the Dee River and have the appearance of being relicts. The position of some near

streams suggests that they may be colonies established from seed brought down from the main forest areas in the hills west of the valley. No beech was seen on the hills between the Bluff River and Lake McRae.

We passed through an area of mountain-beech at 3700 feet in the head of the Muzzle River. This was typical of beech forest as found on the eastern side of the main divide, and included *Phyllocladus alpinus*, *Podocarpus nivalis* and *Aristotelia fruticosa*. The forest areas high up in the other westerly-draining streams are probably also of this type (numerous leaves of mountain-beech were washed down the Mead in flood).

Mountain-totara and Lacebark Forest. *Podocarpus hallii* and *Hoheria lyallii* form another type of forest, usually on steep rocky ground with a south-easterly aspect. In addition traces of burnt forest with mountain-totara were seen above the Spray River. This type of forest, with the inclusion of *Phyllocladus alpinus*, is the only subalpine forest present on the eastern face of the Seaward Kaikouras, and its distribution may be controlled by the frequency of easterly mists.



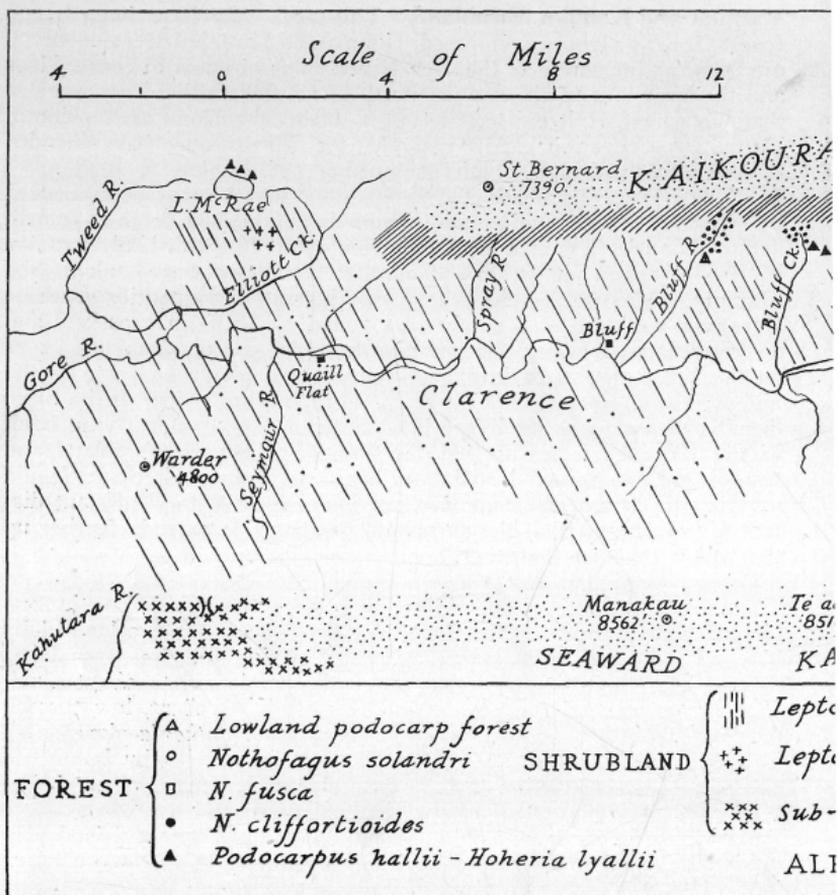
View from Whernside Saddle looking east to Tapuaenuku, 9465 feet, showing kanuka shrubland, a beech-covered knob lower right, tussock grassland on the white calcareous hogback, and patches of mountain beech on the steep slopes in the distance. The tussock cover of the calcareous hogback stops at the geological contact at its base, and is replaced by kanuka shrubland on the mudstones of the valley floor.

Manuka and Kanuka Shrubland. This area may have been beech forest, for, as already mentioned, clumps and scattered trees of beech are found as far south as the Dee River. The absence of charred logs and the large size of the kanuka north of Coverham, however, suggest that the forest, if it existed, left the main shrubland area prior to European occupation. Alternatively, the shrubs may have invaded tussock grassland as a result of burning (cf. Holloway, 1948).

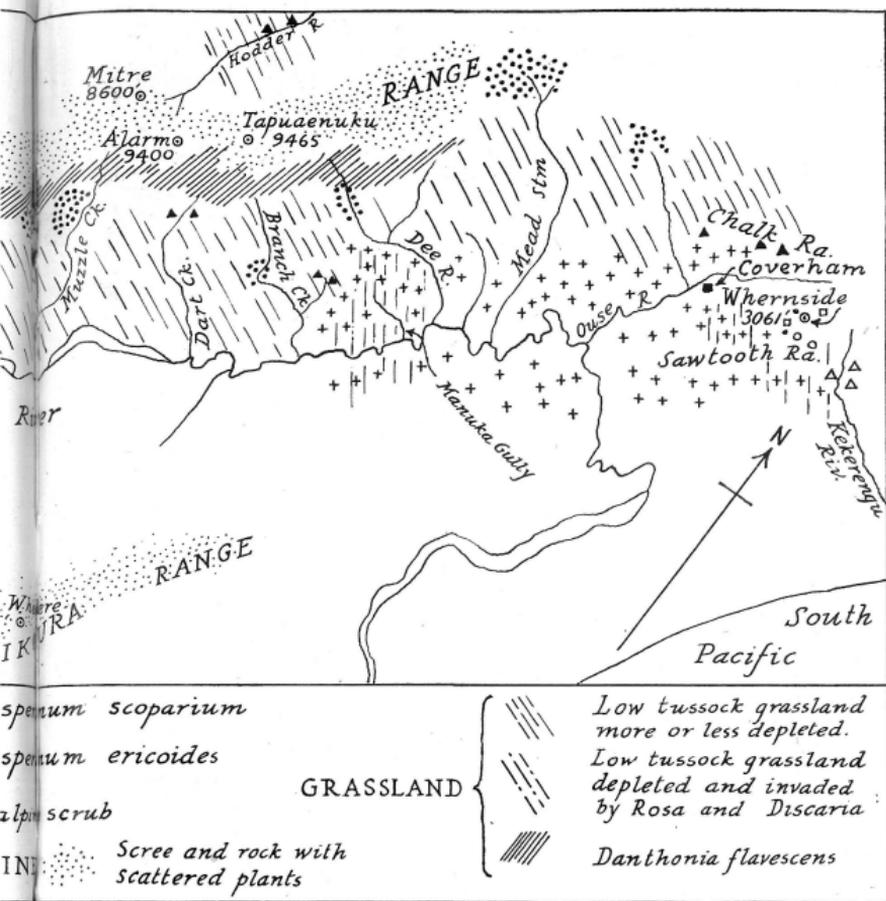
The relative distribution of manuka and kanuka may be influenced by climate. As the main tussock area is approached from the north kanuka becomes less common, and from about Manuka Gully to Lake McRae is absent altogether—at least on the north-west bank of the Clarence. Manuka, on the other hand, increases in quantity south of Coverham and scattered patches are found on bluffs in grassland and on river-flats all along the north-west bank. Scrub does not occur on the limestone hogback, except as scattered plants on scree in the higher rainfall-area about Coverham, or facing the river. In its place there is tussock grassland (see illustration). On the north-west bank of the Clarence it seems that the boundary between shrubland and tussock, as determined by climate, lies near Branch Creek. We did not visit the south-east bank further downstream than Bluff, but distant views suggest that the shrubland on that side extends further up the valley than on the other.

Tussock Grassland. In the limestone area tussock is continuous along the valley except for occasional patches of scree, colonized by blue borage (*Echium vulgare*). Local depletion to bare ground has occurred on the steeper dip-slopes of the basalt sheets about Quail Flat, but in general the cover on the basalt is excellent, low tussock reaching 4800 feet on Warder. Snow-grass (*Danthonia flavescens*) is absent from this area and the 'scoria' top is occupied by *Danthonia setifolia*. Local depletion to bare ground has also taken place on the 'Desert', a windswept area between the Branch and the Dart. Here the rock is deeply weathered sandstone and mudstone, and is deeply gullied. Depletion on greywacke is not common until the Gore River is reached, where the scarcity of all shrubby growth except matagouri (*Discaria toumatou*) suggests an even drier climate than at Bluff. Large areas of scabweed (*Raoulia lutescens*) and willow-herb (*Epilobium* spp.) are common here.

Tussock grassland has also been modified through the invasion by sweet-briar (*Rosa eglanteria*). Wild pigs are numerous and have spread the seeds throughout the wetter parts of the valley. Matagouri, cassinia and carmichaelia are all abundant. About Quail Flat repeated burning and overstocking have led to the formation of a shrubland dominated by these three plants and sweet-briar, with only occasional patches of tussock left. On limestone the only serious weed invasion—tall enough to overtop the tussock—is by thistle near Quail Flat. Blue borage is widespread but hardly competes with the tussock—at least not above the ground.



Subalpine Scrub. Two areas only were visited. The first, on the Kahutara Saddle between 3000 and 4000 ft., has already been described by Martin (1932) and is characterized by much hebe and aciphylla. Although this community appears to be widespread on the eastern face of the Seaward Kaikoura Range, it does not cross the divide onto the Clarence face. A few species, such as *Pachystegia insignis*, *Senecio monroi*, and *Traversia baccharoides*, characteristic of dry bluffs on the east side, are found on the rocky ground west of the saddle, but the main community is dominated by snow-grass. In a few gullies at about 3500 feet on the east side there are small patches of *Phyllocladus alpinus* and *Dracophyllum longifolium*.



The second area was in the basin at the head of the Muzzle Creek, on the Inland Kaikoura Range, where there is a narrow belt of scrub above the timberline at 4300 feet. The main species here are *Podocarpus nivalis*, *Phyllocladus alpinus*, *Cassinia albida*, *Dracophyllum uniflorum*, *Hoheria lyallii*, and *Aristotelia fruticosa*. The scree in this basin cut the scrub into very small areas.

References

- Holloway, J. T., 1949. *N.Z. Journ. Forestry*, 5: 401.
 Martin, W., 1932. The Vegetation of Marlborough. (Reprinted from "The Marlborough Express".)