# Leonard Cockayne, the one-man research organisation

**Dr Brian Molloy**

Research Associate, Allan Herbarium, Landcare Research

During his 53 years in New Zealand, Leonard Cockayne's achievements in the natural and applied sciences were quite remarkable and without peer (Figure 1). From 1907 onwards he was commissioned by the Lands and Survey Department to provide botanical reports on Kapiti Island, Waipoua Kauri Forest, Tongariro National Park, Stewart Island, and the sand dunes of New Zealand, each published under separate cover, together with a monograph of New Zealand beech forests for the New Zealand State Forest Service in 1926.

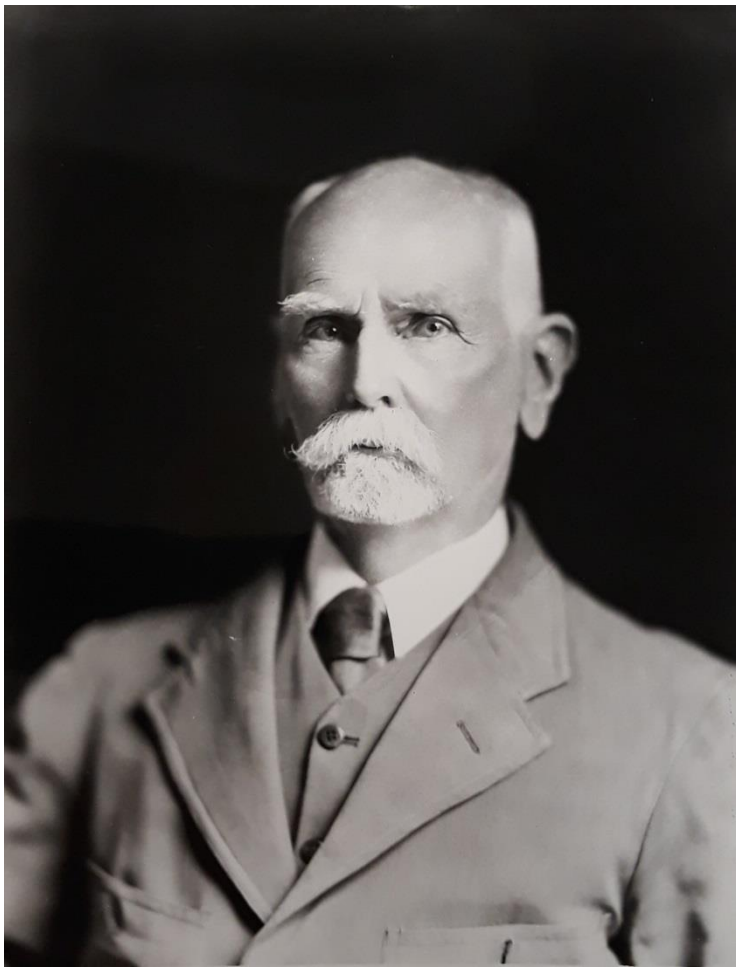

**Figure 1.** Dr Leonard Cockayne (1855–1934) FRS, FNZInst, FLS, Hon PhD (Munich), the foremost New Zealand botanist who spent 53 years investigating the country's native and introduced plants, including their distribution, origin, botany, ecology, hybridism, and cultivation. He died in Wellington aged 79 and is buried there in the Otari Open-Air Native Plant Museum along with his wife Maude. Image from the Andrew D Thomson photographic collection, Christchurch Botanic Gardens, originally from the the S P Andrew Collection, supplied by Alexander Turnbull Library (20 Nov 1972) Reference No. 183771/1.

In 1918 he undertook an economic investigation of the montane tussock grasslands of New Zealand for the Department of Agriculture, which he completed in 1922. This work was published in a series of articles in the *New Zealand Journal of Agriculture* from 1919 to 1922. Much of what Cockayne wrote about montane tussock grasslands and their ecology is as relevant today as it was then. Especially noteworthy were his benchmark studies of the causes and processes of depletion of semi-arid vegetation, the relative palatability of native and introduced plants by direct observation, the establishment of grassland following the burning of beech forest, and the effects of spelling grassland from grazing animals, both sheep and rabbits.

An enduring legacy of his tussock grassland work is the altitudinal sequence of fenced experimental plots established in 1919 on Northburn Station, Dunstan Mountains, facing the town of Cromwell. Here he demonstrated in an inspirational way that depleted semi-arid land could be revegetated productively with pasture species or trees, provided certain initiatives were taken. In 2001 these historic plots, known as the Cockayne Plots, were protected in perpetuity by an Open Space Covenant agreement between the Queen Elizabeth II National Trust (QEII Trust) and the present landholder as a lasting memorial to Cockayne's contribution to ecological and pastoral science. To further mark the occasion, the QEII Trust, with funding support from allied bodies, published a facsimile edition under one cover of Cockayne's New Zealand Journal of Agriculture papers from 1919 to 1922 (Cockayne 2001).

Here I wish to focus briefly on Cockayne's experimental plots on Northburn Station (Figure 2, *see photo series starting page 17*). Throughout his tussock grassland work from Marlborough to Otago, including several other experimental areas, Cockayne freely sought the advice and assistance of landholders and officials of the Department of Agriculture and the State Forest Service, who also arranged the plant material he used in his experiments. Northburn Station was chosen for the plots by Cockayne, DS Middleton of Northburn Station, RK Smith of Morven Station, Tarras, and JL Bruce of the Department of Agriculture.

The location was representative of the most severely depleted semi-arid montane tussock grassland, and was readily accessible. Initially 12 plots, each covering a quarter of an acre, were established on different aspects from an altitude of nearly 1000 feet to the borderline between the depleted and the grassed areas at about 3000 feet (Figure 3). Later a third plot, a fenced area of about one and a half acres at about 1000 feet, was chosen to compare several treatments.

The objects, principles, methods, materials, and the results of these experiments are covered in the Christchurch Public and Botanic Gardens libraries. In brief, the plots were set up and enclosed with rabbit-proof fencing in 1919, and the sowing of seed and planting of plants of introduced pasture grasses, legumes, conifers and eucalypts available at that time were made in the autumn and spring of 1920, and the autumn of 1921. Throughout this project Cockayne was helped by his able assistant WD Reid who also took most of the photographs to

illustrate the experiments. Cockayne spent several days dividing the plots into sections for various treatments and taking notes on existing plants. Time of sowing, whether plants or seeds were used, broadcasting versus raking, aspect, and spelling formed the main treatments. The plots were assessed seasonally (Figure 4).

Before commencing the experiments, Cockayne and JL Bruce persuaded two experienced local landholders, DS Middleton and RK Smith, to form a small committee with them. At Cockayne's invitation, on 2 November 1922, two years eight months after the plots were fenced, the committee and a few runholders and others interested in the experiments paid a visit of inspection to all the experimental plots (Figure 5). Before the inspection, Cockayne invited the committee, himself standing aside, to provide a report to the Director-General of the Department of Agriculture "giving their candid opinion concerning the results of the experiments". After reviewing the results in some detail the committee considered "it had been demonstrated beyond doubt that the pastoral land of Otago and New Zealand generally can be economically developed to the advantage of the State and the individual by improved methods of husbandry" (Figure 6.). The committee placed on record their appreciation of the valuable work carried out by Cockayne and his assistant. "Their energy and enthusiasm in this matter have been beyond praise."

Cockayne's investigation and the committee's report are assembled in full, together with many informative illustrations, in the facsimile publication to which I have already referred. Apart from its significant contribution to pastoral science, Cockayne's tussock grassland work is a mine of information on botanical and ecological issues, and his beliefs and forthright views. In the years that have followed, the Cockayne Plots have been reported on several times by different agencies and individuals. They have been re-fenced and rabbit proofed, and surveyed accurately. The pines and eucalypts planted by Cockayne have been removed following their assessment by the Forest Service as their progeny were spreading outside the plots. These plots are now regularly monitored and reported on to the QEII Trust and the landholder by the Trust's regional representative for Central Otago, Robert Wardle. Robert is the great grandson of a member of Cockayne's 1922 inspection party, Albert Butterfield of Cromwell, and son of the late renowned ecologist Peter Wardle, thus ensuring a fortuitous linkage of like minds and interests (Figures. 7-11).

There is no doubt that Cockayne had devoted much time and physical effort to his economic investigation of the montane tussock grasslands of New Zealand. In a letter to Sir David Prain, Director of the Royal Botanic Gardens, Kew, dated 17 January 1921, he said "I have about decided to give up my tussock grassland work for the Dept. of Agriculture at the end of this year. I am finding being away from home month after month rather trying, and climbing mountains is getting very hard work" (Figure 12).

## Reference

Cockayne L 2001. *An economic investigation of the montane tussock-grasslands of New Zealand (1918-1922).* Facsimile edition compiled by BPJ Molloy. Wellington: Queen Elizabeth II National Trust.

## Photo Series: Figures 2 - 12

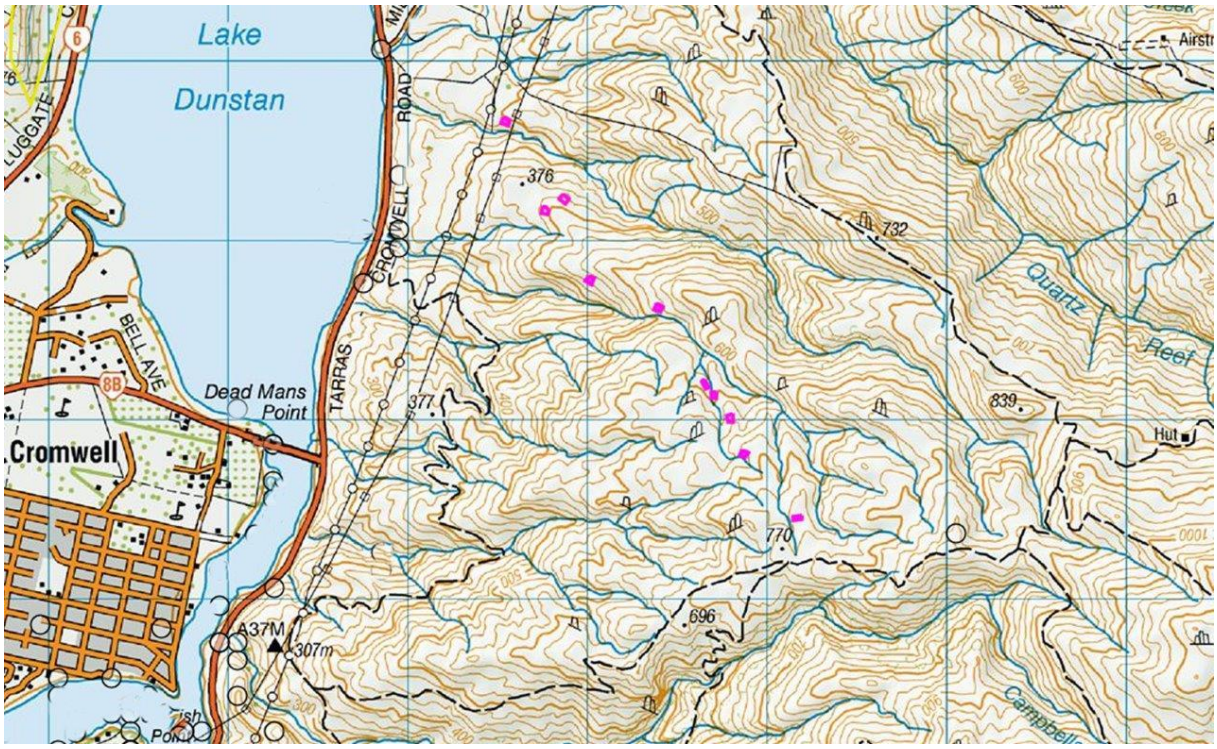


**Figure 2.** Location of the Cockayne Plots (purple dots), showing their altitudinal distribution on Northburn Station opposite the town of Cromwell and Lake Dunstan, the latter not present in Cockayne's day. Initially, 12 quarter-acre plots were established and enclosed with rabbit-proof fencing in 1919, followed by two additional ones, Plot 3a and 13, shortly afterwards. Several years after the plots were reported on by the official inspection party in 1922, Plots 1, 2 and 13 in the station's homestead paddocks at the lowest altitude were discontinued and the fences dismantled. Plot 3a was discontinued much later. The remaining plots 3-12, as shown in Figure 2, were re-fenced and surveyed and protected in perpetuity by an Open Space Covenant agreement between landowner and the Queen Elizabeth II National Trust in 2001. *[Refer paragraph 3, page 15]*

**Figure 3.** Aerial view of the Cockayne Plots (yellow dots) 3-12, including the abandoned Plot 3a, showing their distribution in relation to aspect and altitude and the dissected nature of the formerly severely depleted land selected for the experiments undertaken by Cockayne. Note the 4WD track providing vehicle access to the plots. Understandably, this track was not available in Cockayne's day, with the landholder DS Middleton providing assistance with fencing and other materials. *[Refer paragraph 4, page 15]*

**Figure 4.** Leonard Cockayne in 1921 recording his observations of experimental plantings in Plot 6, one of three plots installed on shaded ridge slopes. These plots had relatively deep, moister soils than the shallow, drier skeletal soils on sunny slopes, and provided a comparative test of aspect on the success or otherwise of the various pasture species sown or planted at different times of the year. Note the rabbit-proof netting fence and the rapid growth of Californian thistle (*Cirsium arvense*) following the exclusion of sheep and rabbits. (Photo: WD Reid) *[Refer paragraph 1, page16]*

**Figure 5.** The official inspection party taking a lunch break near Plot 4, 2 November 1922.The arrow points to Leonard Cockayne's assistant with these experiments, 22 year-old WD (Bill) Reid, later a foundation member of the Plant Diseases Division DSIR, and a noted bacteriologist. Cockayne, with hat, and mug in hand, is seated in the middle of the group looking out across the gully. The person nearest the dog, and looking at the camera, is Albert Butterfield of the Cromwell Development Company, grandfather of prominent ecologists John and the late Peter Wardle. (Photo: DS Middleton, Northburn Station) *[Refer paragraph 2, page16]*

**Figure 6.** The official inspection party standing in Plot 12, the uppermost one in the sequence at 2,660 feet, 2 November 1922. The three-member special committee tasked with preparing a report on Cockayne's experiments were (from far left) DS Middleton, Northburn Station, JL Bruce, Department of Agriculture, and RK Smith, Morven Hills Station, with his dog. Leonard Cockayne is positioned on the extreme right of the group. Note the growth of resident tussocks and planted pasture grasses inside the enclosure, and the severely depleted slopes covered with abundant scabweed (*Raoulia australis*) in the background. (Photo: WD Reid) *[Refer paragraph 2, page16]*

**Figure 7.** QEII Trust Directors and staff standing in Plot 12 on 19 November 2008, eighty-six years later than the time of the first official inspection party. Left to right Tom Pinkney, Northburn Station, and his dog, Sir Brian Lochore (QEII Trust Chairperson), Y Sharp, J Hunter, J Ritchie, M McKee (QEII Trust CEO), B Card, E Ellison, and B Molloy (QEII Trust high country field representative). Note the continuous dense growth of resident native and introduced pasture grasses inside the enclosure, and the dramatic recovery of the vegetation on the formerly depleted semi-arid grasslands in the background. (Photo: QEII Trust) *[Refer paragraph 3, page16]*

**Figure 8.** Plot 9 in 2002, showing the growth of pines planted by Cockayne in 1920 – 21 in the low and mid-altitude plots, with Monterey pine (*Pinus radiata*) and Corsican pine (*Pinus nigra*) conspicuous. Cockayne also planted the Australian swamp gum (*Eucalyptus ovata*) in mid-altitude plots with some success, especially in Plots 4 and 5. In both cases the object was to determine if the revegetation of depleted semi-arid lands could be achieved by planting trees as well as pasture species. While the establishment of these trees from seed was slow by comparison with pasture plants, their subsequent growth was successful to the point that their progeny were beginning to spread outside the plots. Following an assessment by the Forest Service, the trees were removed from the plots and the wilding plants outside the plots cleared. (Photo: B Molloy) *[Refer paragraph 3, page16]*

**Figure 9.** A recent view of Plot 3, now the lowermost in the sequence, situated on a shaded aspect. The pines planted by Cockayne in the now abandoned Plots 1, 2, and 13 nearer the homestead and station buildings can be seen in the background. These trees have been retained for their historic interest. Note the difference in the vegetative cover according to aspect and the presence or absence of grazing animals, both sheep and rabbits. These "home" paddocks are grazed more intensively by livestock held there during routine farm operations, such as shearing. Plot 3 shows how a dense growth of pasture grasses, in this case the introduced tall oat grass (*Arrhenatherum elatius*), can compete strongly for soil moisture, thus suppressing the recruitment of native woody plants, and even the aggressive adventive sweet briar (*Rosa rubiginosa*), shown here as green shrubs. Though dominated by introduced pasture plants, Plot 3 still retains a complement of native herbs and woody plants, especially around the margin or dripline of embedded rocks. These species include *Melicytus alpinus*, *Discaria toumatou*, *Muehlenbeckia complexa*, *Oxalis exilis*, *Vittadinia australis*, *Rytidosperma clavatum*, *R. maculatum*, *Cheilanthes sieberi*, and other resident and volunteer natives. (Photo: B Molloy) *[Refer paragraph 3, page16]*

**Figure 10.** A recent view of Plot 12, the uppermost in the sequence, situated on rolling terrain in the less stressful transition between the former moderately depleted and severely depleted lands above and below the plot. Like Plot 3, this plot is dominated by introduced pasture plants, including the originally planted sheep's burnet (*Sanguisorba minor* ssp. *muricata*), chicory (*Chicorium intybus*), and yarrow (*Achillea millefolium*). Of particular note is the presence of a few volunteer plants of the native Spaniard (*Aciphylla aurea*) and the originally present and actively recruiting semi-arid blue tussock (*Poa* aff. *colensoi*), a tall, unnamed entity that Cockayne labelled "Poa intermedia", a name applied to tall greenish tussocks of coastal South Canterbury and Otago by John Buchanan. When this plot was re-fenced following the formal protection of the sequence, the original fence was retained on the inside of the new one for historic reasons (note the line of the old fence on the left hand side of the plot). This plot and others in the sequence are now 93 years old and must rank as some of the oldest, if not the oldest, fenced plots in the country. (Photo: B Molloy) *[Refer paragraph 3, page16]*

**Figure 11**. Ever watchful for something new or novel in his experience, Cockayne collected a specimen of a hebe (of the type shown here) near Plot 5 from the "Dunstan Mts on rocks at about 1800 ft. alt.", almost certainly while conducting his experiments here. In 1926, with co-author HH Allan, they described this plant as *Hebe pimelioides* var. *rupestris*. Subsequently, the varietal name was found to be superfluous and illegitimate, and Cockayne's plant was re-named *Hebe pimelioides* ssp. *faucicola*, but that is another story among the many involving Cockayne, perhaps our most famous plants-man. (Photo: B Molloy) *[Refer paragraph 3, page16]*

**Figure 12.** "I have decided to give up my tussock-grassland work for the Dept. of Agriculture at the end of the year. I am finding being away from home month after month rather trying, and climbing mountains is getting very hard work." (Extract from a letter from Dr Cockayne to Sir David Prain FRS, Director Royal Botanic Gardens, Kew, 17 January 1921.) Image dated 1987 and inscribed "Otago depleted land c. 1920" from the Andrew D Thomson photographic collection, Christchurch Botanic Gardens. *[Refer paragraph 4, page16]*