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‘Wilderness to Orchard’: The Export Apple Industry in Nelson, New Zealand 1908–1940

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ABSTRACT

The orchard is suggestive of the ways in which commercial apple growing was represented as an idealised lifestyle linking rural economy and nature. But it was dependent on spraying as a means of controlling pests and disease and shaped increasingly by apple importing countries.

KEY WORDS

Apples, sprays, nature, New Zealand

The forum on environmental history in *Pacific Historical Review* in 2001 reveals US environmental history in the early twenty-first century as less interdisciplinary and more fully incorporated into the domain of history than in earlier years. Nevertheless, two insights from the *Pacific Historical Review* forum papers are, first, the observation that environmental history notwithstanding the recent interest in global environmental history, must ‘be based firmly on the local’¹ and, second, evidence that a rapprochement has been reached between Worster, who essentialised environmental history as the study of capitalist agriculture, and Rosen and Tarr, who asserted the case for urban environmental history.² Cronon separately argued that,

we need to embrace the full continuum of a natural landscape that is also cultural, in which the city, the suburb, the pastoral, and the wild each has its proper place, which we permit ourselves to celebrate without needlessly denigrating the others.³

He eventually settles on the garden as an appropriate site for understanding people's place in nature and the meaning of sustainability. A further gendered layering of meaning has been added by Norwood who accentuates feminine nature and a masculine gardener.⁴

Commercial apple growing in New Zealand differs from Cronon's garden. Fruit consumption increased in industrialising nations from the late nineteenth century. The demand was incipiently global even in the early twentieth century, when New Zealand apples were sold in the UK competing with US, Canadian and Australian fruit. Orchardists had to confront a variety of old and new pests and diseases in order to maintain production for local and British markets. Howard Seftel uses the phrase 'fruit pests in the entrepreneurial garden',⁵ deftly linking gardens and orchards to encapsulate the Californian experience, and stresses that 'fruit growers regarded pest control as absolutely essential to the long-term success of their enterprise'.⁶ Increasing insecticide usage was a response to commercial monocultures and international trade.

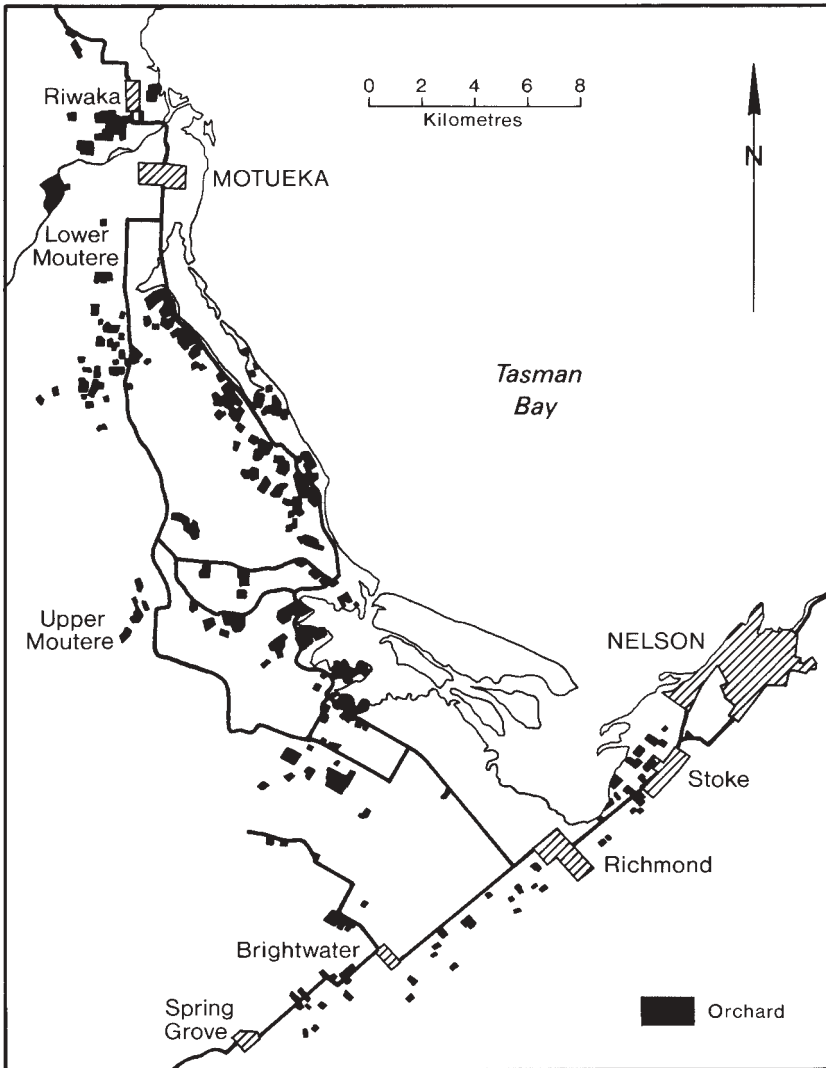
To look at orcharding in New Zealand is to recover rural narratives overshadowed by the dominant sheep and dairy industries. In terms of environmental history, it provides an opportunity to uncover the particular values and attitudes invested in apple growing as a lifestyle and the orchard as an ideal relationship with nature. The inconsistencies in the depiction of orcharding as an Arcadian lifestyle are simultaneously apparent in the amount of spraying that was required to produce the quantity and quality of apples destined for export.

Apples arrived in New Zealand with European contact. They were grown for local consumption as fresh fruit, for cooking and for cider. A local commercial industry was quick to develop, shaped by soils, climate, the perishability of fresh fruit and the proximity of urban markets.⁷ From 1910 Nelson was transformed into an export-oriented apple growing region.

THE ROLE OF THE STATE IN ENCOURAGING FRUIT GROWING

State involvement in fruit growing rested on legislation for the control of pests and diseases, the creation of a Biology and Pomology Division within the Department of Agriculture, and provision of export incentives. The *Codlin Moth Act, 1884* provided for the proclamation of districts within which orchardists had to make declarations about levels of infection and contribute to a fund to pay for orchard inspection. Infected trees were to be banded to capture the caterpillars, and infected fruit destroyed. The *Orchard and Garden Diseases Act, 1896* extended the earlier legislation by requiring the destruction of diseased trees and fruit and more closely regulating the importation of plants and fruit. A revised 1903 Act included in its definition of disease Phylloxera, which was devastating the grape industry as well as San Jose Scale, Mediterranean or Western Australian Fruit Fly and Queensland Fruit Fly. Except for Phylloxera and

Australian Fruit Fly all of these could infect apples, as could all those listed in a second schedule including American Blight (later known as Woolly Blight), Apple Scab, Codlin Moth, Mussel or Oyster Scale and Red Mite. These checks to the spread of introduced pests and diseases, though rudimentary, encouraged additional investment in the industry from the 1890s, although with commercialisation and new inexperienced growers the regulations were on occasions disregarded.⁸



MAP 1. The Moutere Hills orchard region.

THE NELSON ORCHARD BOOM, 1910–1915

A closely subdivided landscape coupled with high annual sunshine levels (2500 hours or more), reliable rainfall (800 to 1200 mm) and a long frost-free season (late October to mid April), led to commercial orcharding in the 1860s.⁹

Successful apple export trials began in 1908, stimulated by a government export price guarantee of 1d per lb, when local firm E. Buxton & Co., copying Tasmanian methods of packing, dispatched 1236 cases of apples to the UK.¹⁰ Consignments of 4499 cases to the UK in March 1910 and subsequent shipments to Montevideo in 1912 were important triggers to the expansion of the New Zealand industry. In 1914 the government even sent Nelson grower G. C. Tacon to Argentina to report on the prospects for apple exports.¹¹

Land in Nelson was available for orchards. The Moutere Hills area was originally cleared of bush and grassed by settlers in the 1870s. Because of a trace element deficiency farming had failed except for some rough sheep grazing and a few orchards. Land development syndicates in the 1910s subdivided, planted and sold orchard blocks in the area. Centrally identified with the promotion of export apple growing in Nelson was Arthur McKee (1863–1943) who migrated to New Zealand from Liverpool in 1890. Although not the first commercial orchardist in the Moutere Hills, McKee was a tireless promoter of apple growing in the district. He was convinced that New Zealand should follow Tasmania in exporting apples, and unsuccessfully lobbied politicians for a state-assisted community fruit growing export scheme. In 1910 his earlier publishing and real estate experience came together in his promotion of the Moutere Hills area for apple growing for export. He acquired a 300 acre block in 1911 and later 2000 acres, which he named ‘Tasman’, after the Dutch navigator Abel Tasman who visited this coast in 1642. Here his company Tasman Fruitlands Ltd. developed small orchard blocks for sale. A promotional coup for McKee was the sale of a block to T. W. Kirk, head of the Biology Division of the Department of Agriculture.

McKee’s newspaper advertisements in December 1910 promoted Tasman as the ‘New Fruit Colony’. More impressive was his lavishly illustrated pamphlet *Apples for Export*, successive editions of which extolled the economic merits of apple growing and labelled Nelson as ‘The Fruit-Growers’ Paradise’. McKee contrasted city versus country life:

The city man who desires to change his mode of life for the better should study this fruitgrowing proposition. There is nothing surer in farming, nothing more interesting nor so easily learned ...Tasman is the type of country that appeals to the practical fruit grower. While the sunbathed slopes are all that can be desired for apple and pear cultivation the deep sandy loams of the flats – rich drained swamp land – will give to perfection stone fruit, hops, raspberries, cereals &c.¹²

The booklet *Sunny Nelson* also proclaimed a transition from ‘wilderness to



FIGURE 1. The pictorial record of the Nelson apple industry is replete with images of young women posed with trees in blossom, with ripe fruit and actually picking fruit. Harvesting was, however, typically undertaken by men, women and children, though sorting and packing fruit was typically women's work, while pruning and spraying were carried out by men. (Photo: Nelson Provincial Museum)

orchard'.¹³ The soils and climate of the district were claimed to be ideal for apple growing enabling 'trees to make such a robust and solid growth that insect pests and disease have no terror for the orchardist of Nelson Province'.¹⁴ *The Colonist*, a local newspaper, observed in 1915 of McKee's scheme that:

The manuka-clad hills had been cleared, ploughed and planted in orchard. Smiling homesteads have arisen, and the district is carrying a population of nearly two hundred persons, where formerly only one or two families resided. The transformation has been rapid, but judging by the satisfactory growth of the trees, the district in the near future promises to be a thriving and prosperous one.¹⁵

Similar sentiments were expressed in the *New Zealand Stock and Station Journal*, which, reporting on the rapid expansion of the industry, asked 'What impulse, what fairy's wand, has conjured up this miracle – the conversion of once-barren and despised hills into potential gold mine?'¹⁶ Fruit growers from elsewhere in New Zealand were more circumspect, one commenting that, 'there has been an overeagerness to utilise every acre, and some of it is certainly too steep for the purpose'.¹⁷

McKee's 'Fruit Colony' was to be a rural Arcadia; 'there would be all the delights of the country combined with the principal conveniences of the city, without the drawbacks inseparable from city life'.¹⁸ Other companies joined McKee to plant the Moutere Hills. From 4,125 acres in 1910–11 the orchard area in Waimea County expanded to 10,081 acres by 1917–18. The more unsuitable areas were subsequently abandoned and the acreage reduced to 5,080 acres by 1928–9.¹⁹

Some came to regret their involvement. A Wellington schoolteacher, Mary Piggford, who had purchased a 10-acre lot in the Tasman West subdivision in 1915, brought a court action against McKee's company in 1922, alleging misrepresentation about the suitability of the land for apple growing, the profit levels, and the claim that orchard blocks would support a comfortable lifestyle. The Supreme Court found for the appellant, leading McKee to the Court of Appeal, where his case was successfully put by a leading barrister in what was described as a 'characteristically bizarre judgement' on the part of Chief Justice Stout.²⁰

SCIENCE AND APPLE GROWING

Nelson, although without a university, was the site of the privately endowed Cawthron Institute, established in 1919 to undertake agricultural research.²¹ Cawthron scientists carried out research vital to the local apple industry. This enabled growers to overcome the limitations of the Moutere Hill soils, which were found to be low in phosphoric acid and required liming and green manures,

'WILDERNESS TO ORCHARD'

without which tree growth suffered and yields were low.²² Their efforts were also linked to imperial science: the Empire Marketing Board provided a grant as part of a much larger biological control project.²³ Scientific research locally carried out in Nelson was thus partly driven by imperial concerns about the quality of local UK fruit and for securing of empire-wide supplies. New Zealand government and industry funding enabled a research orchard, agitated for since 1915, to be established in 1930 under Department of Scientific and Industrial Research (DSIR) control at Appleby in Nelson.²⁴ R. G. Hatton of the UK East Malling Research Station produced a Fruit Research Scheme for DSIR in 1931.²⁵ Later initiatives included frost control work, and cool storage experiments.²⁶

COMBATING PESTS AND DISEASE BY SPRAYING

Chewing insects such as Codlin Moth were controlled by spraying the foliage and fruit with a coating of poison that was ingested. Arsenate of lead was replacing other sprays for this purpose in the 1920s. Sucking insects (e.g. San Jose Scale), which inserted a proboscis into the tree leaf or fruit were unaffected by a poisonous coating on the foliage. They were destroyed by using chemicals that had a solvent action, known as contact sprays. Fungoid diseases were countered by a film spray such as Bordeaux Mix so that spores settling on the foliage were destroyed.²⁷ From the 1920s orchards and sprays developed in conjunction with each other. As such the orchard was a blending of nature and rural economy where sprays were essential to the defence of the natural equilibrium of the orchard.

Orchard work from the 1910s included increasing amounts of spraying. McKee's orchard as an idealised amalgam of family, economic unit and nature was from the first fraught with contradictions. *The Colonist* in 1910 contained advertisements for insecticides, fungicides, arsenate of lead (3 January) The latter was used to control Codlin Moth (5 June) and at the meeting of a local fruit growers association members listened to papers on Bitter Pit and Bordeaux Mixture, and on Woolly Aphid. Department of Agriculture advice on spraying with lime and sulphur to combat aphid and various soap sprays to counter apple sucker (*Psylla mali*) were also reported (2 August). Nelson firm Tasker and Levien advertised that it could supply growers with an array of chemicals and pumps (1 August). An article in *The Colonist* in 1915 is typical of advice presented to orchardists:

The devout preacher says 'let us pray'. The successful orchard says 'Let us spray'. We need always to pray, but proper and thorough spraying will help the prayer immeasurably in the production of first class fruit ... spraying is one of the great things which mark the difference between success and failure in the apple business.²⁸

Harry Everett, a pioneering Nelson orchardist, later recalled:

Our chief troubles were Mussel Scale, Red Spider, Codlin Moth, and some San Jose Scale which it seems we had for years without discovering it. For Scale we used lime, salt and sulphur and crude black oil which was sometimes difficult to emulsify: sometimes a few trees got all the oil and others got all the water. In such event the oil certainly controlled the Scale, an in many cases the tree, too.²⁹

Spraying trials were undertaken by individual growers at their own expense on various orchards in Nelson in order to identify what chemicals were reliable locally. These experiments resulted in Bordeaux Mixture being replaced by lime sulphur for Black Spot.³⁰

Unseasonably wet or warm weather further disrupted the spray regimes. Not only was Lime Sulphur more effective than Bordeaux Mixture but it was also much easier to make up and to use. By 1924, however, Bordeaux Mixture was again favoured to combat Black Spot.³¹ Underneath McKee's Arcadian vision lay agrarian capitalism. As one grower observed 'it is essential nowadays to do everything possible with the idea of saving labour, and the details attached to Bordeaux mixture would not be missed if they could be avoided'.³²

Fireblight (*Erwinia amylovora*), a significant bacterial threat to the apple industry in New Zealand in the 1920s, never established itself in the Nelson district.³³ The major problems faced by Nelson growers were Black Spot [or Apple Scab], Woolly Aphis, Mealy Bug, and Codlin Moth. Growers depended on both export sales and spraying, as the Nelson Correspondent for the *New Zealand Fruitgrower and Apiarist* observed:

Spraying has naturally taken up the greater part of the time, as everyone is anxious to secure as much first grade fruit as possible ... many growers who in the past were more or less proud of the fact that they could dispose of Black Spot and other fruit showing blemishes, are now coming around to the opinion that the way to deal with low grade fruit is not to grow it.³⁴

Spray systems developed from simple pump and bucket apparatus of the 1890s to motorised pumping systems towed by horses, in use until the early 1930s, and tractor-towed sprayers from the 1920s. Other innovations included agitators to prevent the chemicals from settling, higher water pressures, and from the 1940s dispersal with fan powered units. Some Nelson growers from the mid 1920s also experimented with fixed spray systems. The advantages included savings on horses and labour and the ability to spray when ground conditions were wet.³⁵ Initial problems with pipe systems of spraying related to uneven spray mixes. Some innovations such as dry powder chemical application proved to be dead-ends of limited success.

REGULATION SPRAYS AND BIOLOGICAL CONTROL



FIGURE 2. Spraying fruit trees was part of the male orchardists' work routine. Note the absence of any protective clothing. The dangers of spraying to consumers and the orchardists were down played even in the aftermath of the UK arsenate scare of 1926. (Photo: Nelson Provincial Museum)

Spraying was essentially unregulated until 1913 when the Department of Agriculture issued certificates of competency in spraying and pruning. Subsequently there were few restrictions on the use of orchard sprays. Voluntary certification operated from 1937 but compulsory registration of orchard sprays was not required in New Zealand until 1959.

By the early 1900s Nelson apple growers had available to them several sprays developed in France, for example, Lime Sulphur in 1851, Bordeaux Mixture in 1882, Burgundy Mix in 1887 and others of US origin, notably spray oils and Lead Arsenate, the first use of which dates to 1880 and 1892 respectively.³⁶ Some of these chemical treatments had been further adapted for use in New Zealand conditions. The Department of Agriculture also undertook research into orchard diseases and pests and advised growers through a network of extension officers.

Of interest is the Department of Agriculture's stance on spraying versus biological control: Codlin Moth parasites had been imported from the United States and although it was considered too early to pronounce them an unqualified success, hopes were high in 1908.³⁷ Simultaneously some extension staff endorsed the use of sprays to combat Codlin Moth. By the 1920s however, most growers were depending on arsenate of lead sprays to counter Codlin Moth.

The way in which spraying was incorporated into the orchard arcadia was summed up by the *New Zealand Farmer Stock and Station Journal's* Nelson Correspondent in September 1917:

All the countryside is busy with the spray pump, and the smell of lime and sulphur is with us and in us. It is the prevailing smell throughout the district at the present time, a smell that one has to get used to like, but a healthy one withal. Add to this the magnificent view by night of the Aurora Australis, and who will say that Nelson is not the best fruit growing district in New Zealand.³⁸

Some growers were quite sanguine about their longer-term prospects while they had to 'wage war against all the pests that the apple is heir to'.³⁹ The very label 'pests' legitimates the use of chemicals for their destruction. In the longer term growers were increasingly locked into a spray regime because export markets could be lost if fruit was pest-ridden. In 1921 Australia banned New Zealand apples because of Fireblight. Argentina was similarly closed to New Zealand fruit, while France proposed to ban imports from countries with San Jose Scale.⁴⁰

There were, however, two competing streams within the research community, a group who strongly supported biological controls and another who championed the role of chemical sprays. The first was represented by DSIR scientist G. C. Cunningham, whose monumental *Fungous Diseases of Fruit-Trees in New Zealand* was notable for its description of the botany of fruit trees, their diseases and spray remedies; the latter by Cawthron entomologist R. J. Tillyard, whose investigations resulted in the introduction of a parasite (*Aphelinus mali*) which successfully countered the Woolly Aphis problem. This saved the apple industry by enabling more of the favoured export varieties to be established. The parasite was eventually successfully released in other apple growing districts. However, reflecting on US research, Tillyard did sound a cautious note about achieving complete success through biological control.⁴¹

THE FIRST SPRAY CRISIS

The first significant market reaction to arsenate sprays occurred in 1926 when arsenate deposits on imported apples exceeded that on local UK apples. The residue problem was eventually linked to late spraying to deal with a serious Codlin Moth outbreak amongst two apple varieties in selected US growing districts. The UK was supplied largely from Canada, Australia and the USA,

nevertheless the scare had implications for New Zealand growers.⁴² Tillyard, usually the detached scientist, expressed the view that the fruit trade henceforth be conducted within the British Empire, urging closure of the UK market to American fruit 'so as to prevent them dumping either cool-stored or arsenicated products on to our legitimate market and so ruining it'.⁴³

The Department of Agriculture from the 1910s widely published the results of chemical spray tests for orchards. This included a lengthy series of articles on different classes of sprays prepared by Cunningham in 1932–3.⁴⁴ DSIR and Cawthron research on biological control was continued into the 1920s. Cunningham however, was 'scathing about biological control'.⁴⁵ In reporting progress in orchard disease control he identified some areas where local practice was diverging from that of the US and Europe.⁴⁶ For instance, Lime Sulphur sprays (for diseases such as Black Spot) had by 1930 again replaced the traditional Bordeaux Mixture, which tended to scorch fruit and foliage. Lime Sulphur was also believed to have some desirable insecticidal properties.

Cunningham's research was intended to foreshadow regulations for the certification of chemicals under the *Fungicides and Insecticides Act, 1927*.⁴⁷ This act was a response to local New Zealand grower dissatisfaction with the variability of chemicals, both within and between brands.⁴⁸ The legislation lacked detailed standards, which were left to be established by Order-in-Council in the future. Given the lack of scientific analysis, this was not an unreasonable option. DSIR tests in 1931 confirmed orchardists' opinion about their ineffectiveness and variable quality of available chemicals.⁴⁹ In 1937 the Plant Diseases Division (PDD) of the Plant Research Bureau of DSIR assumed responsibility for the certification of sprays and fumigants (collectively termed therapeutants).

Subsequently the PDD introduced its certification system, inviting manufacturers to send samples for analysis and field trials. The first certification list in 1937 specified four acid lead arsenates, one colloidal sulphur, one nicotine sulphate, three polysulphite sulphurs and seven spraying oils. With the exception of two of the spraying oils, the copper sulphate and three of the lime sulphurs, the rest of the suppliers were from the UK (four), USA (four), and Australia (five). They included Cooper, McDougall & Robertson, makers of the 'Arsinette' brand. This company, founded in 1843, had branches in Australia, USA, Uruguay, Argentina and South Africa. Approved red and white spraying oils included the Avon brand of the Tide Water Associated Oil Co of San Francisco. By 1944 some 36 products were listed.⁵⁰

Copper sulphate for Bordeaux Mixture was initially sourced from the UK, although some was later made locally from scrap copper. Some 133 tons of copper sulphate valued at £3,911 and other spray oils, arsenites, and nicotine sulphates valued £20,917 were imported in the period 1926 to 1930.⁵¹ Orchard chemicals were supplied by British, Australian and (after World War One) by American firms, another aspect of global reach into the Nelson region. Arthur McKee, however, was importing orchard sprays from 1910. Difficulties in

securing supplies prompted him to form in 1931 a family-run private company, Fruitgrowers' Chemical Co., to manufacture lime sulphur at Mapua in Nelson. It later expanded production to include spraying oils and sulphur compounds.⁵² By 1941 they were producing a certified 'Consul 40', a colloidal sulphur, 'Polysol', a polysulphide sulphur, 'Sprayol White' and 'Sprayol Red' spraying oils.

Government scientists played a dual role in extending knowledge about orchard pests and disease as well as developing competing chemical and biological controls and actually developing regulatory systems. Although biological control advocates enjoyed some successes, powerful establishment scientists such as Cunningham were disparaging and championed chemical solutions to the pest problem.

CONCLUSION

Grown under quite specific environmental conditions, fresh fruits are seasonal and perishable. Apples among fresh fruits are comparatively durable, but to ship



FIGURE 3. The actual experience of orchard establishment on the Moutere Hills was somewhat at odds with the promotional material. This family is shown picking fruit in what is still a comparatively barren landscape. (Photo: Nelson Provincial Museum)

them half way around the world and through the tropics to provide a counter-seasonal supply for UK markets awaited the application of quite sophisticated cool storage technology. Fruit buyers demanded higher quality fruit of specific varieties making spraying a necessity for growers which was reinforced by the threat of transporting pests and diseases on infected fruit. Possibly the spray regime was more intensive in New Zealand than in the UK, for exporters could not risk dispatching poor quality shipments. Scientific co-operation was also global in terms of British funding of orchard research in New Zealand. UK and US chemical companies and their Australian subsidiaries also offered competing spray products to Nelson growers.

The orchard is worthy of the status that Cronon ascribes to the garden as a site for better understanding people and/in nature. The New Zealand orchard lay between the city or town and the pastoral economy based on sheep for meat and wool and the dairy industry. It was a smaller scale enterprise than dairy farming, it evoked different images of nature for owners than farmland hewn from forest land a generation earlier or the tussock grasslands converted to pasture. The orchard as constructed by McKee placed people in a 'nature' that was a combination of metabolic and social processes. McKee's orchard lifestyle, where a family by honest toil could build a home and business by harvesting nature's bounty, was superior to that of the city. Ever the entrepreneur, he always saw orcharding as providing better financial returns than conventional pastoral agriculture. The contradiction between the orchard as idealised lifestyle in a beneficent natural setting while at the same time maintaining it by applying more and more sprays to keep waves of pests and diseases at bay went unnoticed.

Initially the pest problems were played down. Yet spraying was essential to the maintenance of the orchard as an 'island' of nature. It was less a case of an imperfect nature improved by human intervention than an invading nature that had to be held at bay with chemical sprays. British economic entomologists of the time viewed spraying as a means of restoring an equilibrium in nature. Some Nelson entomologists experimented with biological predators, but for other scientists and growers the spray regime remained the only means of combating successive waves of pests and disease, a threat to the apple crop as their economic livelihood and the orchard as their home in nature. From a point in the mid 1920s biological control lost out to the chemical sprays, the latter being a much more powerful alliance of scientists, industry growers, and regulators.

This discussion of the early years of export apple growing perhaps unfortunately reinforces environmental history as essentially rural. A fuller examination of apple consumption would however bring a domestic and overseas urban population into focus. Changing varietal preferences and fruit quality expectations from afar increasingly shaped the spraying regime in Nelson orchards. Apple growing in Nelson provides an example of the ways in which the local and the global in environmental history are simultaneously and mutually constituted.

NOTES

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¹² Arthur McKee, *Apples for Export* (Nelson: Riwaka, 1910).

¹³ Leo Fanning, *Sunny Nelson* (Wellington: Evening Post, 1915), 40.

¹⁴ Fanning, *Sunny Nelson*, 43.

¹⁵ 'Colonist Summary for Abroad', *The Colonist*, March 1915 (no pagination).

¹⁶ 'The Romance of the Moutere Hills, The Beginnings of a Great Industry', *New Zealand Farmer Stock and Station Journal*, July 1916: 1005.

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- ¹⁹ *New Zealand Statistics, 1907–1917, New Zealand Agricultural Statistics 1929.*
- ²⁰ James McAloon, *Nelson: A Regional History*, 158.
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- ³⁸ Our Correspondent, 'Orchard News from the Nelson District', *New Zealand Farmer Stock and Station Journal*, September 1917: 1056.

³⁹ Our Correspondent, 'Moutere-Motueka Notes', *New Zealand Farmer Stock and Station Journal*, July 1917: 814.

⁴⁰ 'Fruit Industry', *New Zealand Smallholder* July 1932: 583. See also Keith Sinclair, 'Fruit Fly, Fireblight, and Powdery Scab: Australia–New Zealand Trade Relations, 1919–1931', *Journal of Commonwealth and Imperial History*, 1 (1972): 27–48.

⁴¹ Robin Tillyard, 'Position of the Fruit-Growing Industry in NZ', *The Orchardist of New Zealand*, 1 March 1928: 5.

⁴² T. Parker, 'Insecticidal Sprays: "Arsenic Scare" and its Lessons', *New Zealand Fruitgrower and Apiarist*, 6 June 1926: 489–90; and R. L. Andrew, 'Arsenic in New-Zealand-Grown Apples', *New Zealand Journal of Science and Technology*, 9 (1927): 206–9.

⁴³ Tillyard, 'Position of the Fruit-Growing Industry': 5.

⁴⁴ These were reprinted in consolidated form as Gordon Cunningham, *Plant Protection by the Aid of Therapeutants*. (Dunedin: John McIndoe, 1935).

⁴⁵ Galbreath, *Making Science Work*, 89

⁴⁶ Gordon Cunningham, 'Five Years' Progress in Orchard Disease Control', *The Orchardist of New Zealand*, 1 September 1930: 9–12.

⁴⁷ Cunningham, 'Orchard Sprays in New Zealand'.

⁴⁸ *New Zealand Parliamentary Debates* 214 (1927): 219–20.

⁴⁹ Gordon Cunningham, 'Certification of Therapeutants', Supplement to *The Orchardist of New Zealand*, 1 July 1937: 1–2; and Gordon Cunningham, 'Certification of Sprays', *The Orchardist of New Zealand*, 2 October 1939: 257–8.

⁵⁰ Gordon Cunningham, 'Certification of Therapeutants', Supplement to *The Orchardist of New Zealand*, 1 February 1944: 1–2.

⁵¹ A. Mouat and A. Rodda, 'Exports and Imports', in Department of Agriculture, *Farming in New Zealand* (Wellington: Department of Agriculture, 1950) 273–327.

⁵² Cunningham, 'Orchard Sprays in New Zealand', 185.