THE HISTORY OF THE APPLE INDUSTRY

IN NELSON

WITH SPECIAL REFERENCE TO THE WORK

OF THE CAUTHRON INSTITUTE

A

THESIS

for the degree of

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An attempt has been made in this short study to trace the history of one of New Zealand's primary industries. The social and economic changes which have taken place in the century of the Dominion's history have been outstanding. As New Zealand is chiefly a primary producing country, land utilization plays an important part in its development. New Zealand was almost entirely forested when the Maoris came and they did little to alter its appearance. The pakeha has, on the other hand, destroyed most of the primitive vegetation and has established a cultural vegetation of exotic plants. So in districts within Nelson artificial communities of apple trees have supplanted natural communities.

The full story of these changes has yet to be told. One of the most interesting aspects hitherto neglected is the way in which, comparatively recently, such plant formations as the Leptospermum shrubland on the Moutere Hills, previously left untouched as
poor land, have been disturbed and the soil developed by the application of science. There is no history of the various ways in which the lessons of science have been brought to bear on the course of New Zealand industry, and this has stimulated the writer to attempt some account of the part played by science in the development of the apple industry, largely through the work of the Cawthron Institute.

The material is to be found largely in the published accounts of the Institute's experimental work in connection with fruit research. Owing to the fact that no Annual Reports of the Institute were published before 1935, the work involved much time in sorting out and assessing the data. It has been the more difficult because of the many aspects of the work of the Institute, and the large degree to which the work of all the departments is interdependent. But in this connection I have to thank the Director, Sir Theodore Rigg, the Assistant Director, Dr. David Miller, and the staff of the Institute for their generous and invaluable assistance in indicating the most useful sources.

In the preparation of this work I have interviewed many persons connected with the industry
and gratefully record my debt to them — Sir Thomas Easterfield, Director of the Institute from 1919 to 1933 and now Honorary Research Chemist; Mr. McKee, author and collector of many interesting papers which he kindly placed at my service; Mr. Nottage (Tasman) and Mr. J. H. Thorp (Department of Horticulture, Wellington), both one-time orchard instructors in Nelson; Mr. Callaghan and Mr. L. Tiller (D.S.I.R., Wellington); Officers of the Department of Agriculture, Nelson, and Mr. Palmer, editor of the "Nelson Evening Mail".

In conclusion special thanks must go to Mr. Davies, Secretary and Photographer of the Cawthron Institute for supplying information when the writer was in Christchurch, and for providing the illustrations which are incorporated in this work.
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[NOTE: Plates are not inserted in this copy but are in the author's personal copy only]
CHAPTER I

PHYSICAL BACKGROUND

In this survey, concerned as it is with the history of the apple industry in Nelson, I have dealt mainly with the development of the apple lands there. This development has been a feature of the last three decades.

Particular attention is given to what is known as the Hills Fruitgrowing Area, situated on, and near, the Moutere Hills. In this area occur the orchard districts of Tasman, Mapua, Mariri and Mahana. Further to the west are the orchards of Motueka and the Motueka Valley, while still further west, in the Riwaka Valley, there are considerable areas devoted to fruit farming. Orchards on the Waimea plain, especially at Stakes and Richmond, and on the border at Redwoods Valley, are also included in the 4,601 acres in orchards in Nelson province. Five hundred and

1 See Plates I and II.
fifty-three orchards, the average size of which is 8.32 acres, contribute to make this total.

A comparison of these figures with corresponding figures for other land districts 2 shows that Nelson has the largest acreage in orchards. Most of these orchards are of apples and pears but there are many large peach orchards.

It is clear that, although fruits of temperate climates can be grown in most parts of New Zealand, there is a tendency to concentration of production in certain localities; as regards apples the chief of these are at Nelson and Hawke's Bay. This tendency is due to various factors of which Campbell 3 considers the most important are facilities for transportation and nearness to markets. Other factors, too, are important, especially superiority in topography, soil and climate.

The chief topographical features of Nelson province are depicted in the map to which attention has been

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2 Appendix A.

3 Belshaw : Agricultural Organisation in New Zealand, Chapter XXV, p. 519.
drawn. Even a rapid glance at once discerns the very mountainous nature of the region. Charles Heaphy in 1839 recorded his disappointment with the first view he had of the district of Nelson in these words: "On first sighting New Zealand we were disappointed with the appearance of the coast. The high mountain ranges of the middle island, terminating abruptly in the south side of Cook's Strait in several large promontories, seem to leave no space for cultivable land while the land generally appears sterile and unworthy of settlement." When he had had opportunity to explore the region further, Heaphy changed his opinion.

Other early descriptions in some respects accord remarkably well with the facts of topography as they are revealed to-day. From the sea it was seen that Nelson possessed many steep and bush-clad mountains running down to the water's edge. But many level stretches of land had been observed.

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4 Narrative of a Residence in New Zealand: Chas. Heaphy, Chapter I, p. 1-2. Heaphy was a member of the first expedition (1839) despatched by the New Zealand Company.

In his "Narrative of a Residence in New Zealand" (1839), Heaphy had expressed the belief that though there was little available cultivable land probably there were, in the interior, large agricultural districts, accessible from the natural harbours which probably existed between the promontories. A description written a little later spoke of "tracts of level or gently undulating country extensive enough to be called plains" at the south-west extremity of Blind (Tasman) Bay. Fox's summary of information about Nelson was less hopeful. It dwelt on the very mountainous nature of the place — on the high bluffs and abrupt appearance of the shore, except for about twelve miles at the head of the bay. The land, Fox considered, offered no great advantage for cultivation. Blind Bay, he estimated, contained a mere 60,000 acres of land sufficiently level for agriculture, yet not more than half, he believed, was of a quality adapted for that purpose.

7 Earl: New Zealand, Chapter XII, p. 104.
8 See Appendix B.
Though in estimated areas of productive land, early observations naturally proved false, some of the rough and tentative early descriptions were true in a general way. Nelson topography shows certain very definite features among which mountains are very prominent.

At the head of Tasman Bay there is a triangular block of gravels and sands, the Nelson Lowland. This block, which is twelve to twenty miles in width, extends about fifty miles from the head of the Bay to Lake Rotoroa. It is bounded by mountains; on the east by the continuation of the hard rock axis of the South Island, and on the west by the high Pikikiruna Range. This forms a distinctive barrier of granitic rocks between the land bordering Tasman (Blind) Bay and that bordering Golden (Massacre) Bay.

The part which is of more geographical significance is the Lowland. It is the main centre of settlement in the provincial district ⁹. Settlement is by no means evenly spread over this area, nor over the province itself. There are large uninhabited areas especially in the very mountainous north-west.

⁹ See appendix C.
corner. The total population of the province at the last census was 58,700, representing 5.47 persons to the square mile. The two main centres of population are Nelson, on the Waimea plain (population - 13,800), and Motueka (population - 1,730) on the Motueka plain.

The Lowland is composed of undulating hilly country interrupted by these two level alluvial plains of the Waimea and Motueka rivers. Together they comprise in area only a small proportion of the Lowland but they support most of the rural population 10. The Waimea plain, although built up by the smaller river, has a flood plain and low terraces which are greater in extent than those of the Motueka. It is wide near the sea and narrows in at Wakefield 11. The Motueka plain, also a valley lowland of alluvial silt, is somewhat smaller in extent. The relation of these two plains to the rest of the Lowland and to each other, is best explained by considering the

10 See above p. 5

11 About twenty miles from the city but about twelve miles from head of the Bay.
genesis of this part of the South Island.

The mountain ranges already described are huge crust blocks bounded by faults. The Nelson Lowland, between these faults, is usually regarded as a depressed block — a depression filled with coarse gravel during the late geologic ages, the Pliocene and Pleistocene periods. The gravel deposit, composed of angular gravel near Lake Rotoraia, and of finer gravel towards the Bay, is enormous in extent.

"Although its origin is a matter of some controversy it may be regarded as fluvi-glacial material washed out from the retreating front of the glaciers, that once occupied the mountain valleys in the vicinity of the lakes."

A most striking feature of Nelson topography is the remarkable uniformity in summit level of the hills of this gravel area, viz.: the Moutere Hills. These hills, with the two valley plains already described, make up the three elements in the present-day Tasman Bay landscape. The uniformity of summit level is taken by Professor Jobberns to suggest that the gravel was

12 et passim. Professor Jobberns.
formerly evenly spread by streams issuing from the retreating ice of the interior. The low undulating hills are cliffs to the sea. These cliffs have been cut by the sea in front of the gravel deposit, while the two rivers, the Waimea and the Motueka, have become entrenched in the same deposit.

All these three "elements" of the landscape are important when considering the apple industry. Some apple lands do occur on the valley plains, but the majority of orchards are established on the Tasman Bay margin of the Moutere Hills. Some of the higher (inland) portions of these hills have soil so poor as to cause deficiency diseases in stock feeding on their pastures. The lower coastal hills, however, have an overlying mantle of finer clay, and such areas, with the aid of science, have been developed to support most of the Nelson orchards.

It has already been mentioned that the topographical factor is but one of the many factors influencing land utilisation. Easiness of transportation and nearness to markets were particularly mentioned as

13 These cliffs are nearly 100 feet high.
important influences. Indeed, "transportation and markets have played a greater part in the geographical distribution of fruit culture than any other factor." It is strange, however, that the two largest fruit-growing areas are exceptions to this rule. Nelson owes the development of the industry to its fine climate, lack of wind, and the considerable area of poor quality, low-priced land available.

New Zealand possesses a very long coast line in proportion to its area, but there is a deficiency in natural harbours. On Tasman Bay there are the two tidal ports at Mapua and Motueka, and the deep water harbour of Port Nelson. The first two ports are important for local trade, especially the shipment of fruit, but most trade is through Port Nelson.

14 see above p. 2.
15 et passim: Belshaw: op. cit.
16 Hawke's Bay owes its popularity as a fruit growing district to its excellent climate and very fertile soil.
Actually, Wellington is the nearest port of which
the fullest commercial use can be made. Overseas
vessels do, however, sometimes sail directly from
Port Nelson. Just as fruit is transported from
Motueka and Mapua to Nelson by small boats, so do
the smaller boats take fruit from Nelson to Wellington. Transportation within the province is by motor-
lorry, the only railway communication with the port
being down the Waimea valley. On the other hand, the
lowland districts are well roaded.

Nelson harbour is a fine natural harbour with
excellent yachting facilities. As a centre for big
shipping it has its limitations, and existing facilities
have to be improved by dredging. The harbour affords
480 feet of berthing space for vessels drawing up to
22 feet of water. The approach to the harbour is an
easy one but only small vessels can enter at any state
of the tide. Some large vessels, if they do enter
Nelson waters, lie outside the Boulder Bank and do
not enter the harbour itself through the "cut" 17.

17 Work was commenced on this artificial entrance in
1902 and in 1906 was officially opened.
The early settlers and visitors had a more exalted opinion of the possibilities of Nelson harbour. The most interesting feature then, as now, was the Boulder Bank. There are early accounts drawing attention to the peculiar formation of this natural breakwater. Until 1906, the entrance to the harbour was through the narrow gut between the southern-most end of the Boulder Bank and the main land. Behind the bar lay the sheltered waters of the Haven.

E. Jerningham Wakefield said that "once inside the bar you may fancy yourself in a dock" 18.

Ships in those days anchored outside the bar and awaited a favourable tide to enter through the gut. This navigation to the inner harbour required the services of a practised pilot 19. The first reason was the narrowness of the channel between the


19 To-day, also, the services of a pilot are required to lead ships through the artificial "cut".
Boulder Bank and the Arrow Rock \textsuperscript{20}; the second was the rapidity of the tides race. Wakefield reported that, inside the harbour, a rapid tide swept along the land for about a mile. The Boulder Bank side of the harbour, being free from its influence, was evidently the usual anchorage place.

In the late forties, when the Nelson settlement was being firmly established, great interest was felt in the possibilities Nelson harbour afforded as a natural dry dock. The great rise and fall of the tide were considered to afford unusual facilities fitting the harbour for this purpose. The abundant and handy deposits of coal also strongly favoured the possibilities of such a scheme \textsuperscript{21}. The story of

\textsuperscript{20} This high rock is now called the Fifeshire rock. Wakefield, op. cit., "As we pulled out we saw the wreck of a large ship, "Fifeshire", which had come out of the harbour imprudently with no wind to assist her in steering and had been drifted by the ebb directly on to the Arrow".

\textsuperscript{21} Coal had been already discovered at South Wanganui; at Metupipi in Massacre Bay (where it was worked); and also in small strata on the east shore of Nelson Haven - Handbook for New Zealand Company, 1848, Chapter VII, p. 251.
repairs done to H. M. S. "Racehorse" was often cited in support of the arguments advanced. It was also pointed out that the only large dry docks existing in the whole of the Pacific and Indian Oceans were at Bombay and Calcutta.

At the head of the harbour was a natural site for a town. Steep but low hills came down to the sea on the eastern side of the Haven. Beyond that, the Haven itself spread into an expanse which was a mudflat at low tide, across which there branched the streams of the Maitai. Though much of the mudflat area has been reclaimed, there is still a large expanse of flat exposed at low tide.

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In 1847, a Man-of-war, H. M. S. "Racehorse" was hove down high and dry on the Boulder Bank to have her bottom cleaned.

23 It is interesting to note that India was in the thoughts of the founders of some of the New Zealand settlement, as presenting peculiar attractions to the Civil Service and Navy. Leaders of the Canterbury Association expressed hopes that the College to be established at the very beginning of the Canterbury Settlement would attract students from India. See "Canterbury Papers".
Beneath the abruptly rising mountains, on the south-east and extreme east, lay the natural site of Nelson — about a thousand acres of alluvial flat 24. This area was separated from the Haven by the low ridge of hills mentioned above. To-day the settlement of Port Nelson stands about a mile from Nelson City, the "low ridge of hills" being a residential area between the two.

As interesting as the early descriptions of topography are the corresponding descriptions of climate 25. Sunny Nelson, always proud and jealous of her sunshine record, even in the very early days of the settlement, was renowned for her climate. Fox 26 declared it was not really necessary to say anything about it. Yet he does say "With a very great amount of sunshine, the heat is never excessive,

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24 The acreage of Nelson, according to the 1941 (April 1st) Statistical Report of Population and Buildings, was 4,996 acres.

25 In 1848, Handbook p. 242-3, there are two meteorological Registers for 1846-1847. One by Stephens for Rewaka (Riwaka) 1846, and one by Barnicoat for Waimea Plains 1846-7. See Appendix D.

26 Earp: "New Zealand", Handbook for N.Z. Company, 1849, p. 113 (containing summary by Fox.).
or ever disagreeable; while, with an abundance of
rain, there is no continual wet season. Nelson, situat
ed in a favoured country he believed to be
favoured above all other districts. With these
factors already in her favour she had the additional
good fortune of immunity from heavy winds. "The only
defect in any part of New Zealand is that there is too
much wind to be agreeable." In respect to wind
E. Jerningham Wakefield noticed the great difference
between the climates of Nelson and Wellington towns
on almost the same latitude.

27 Earp, op. cit.
28 Earp: op. cit.,
29 E. J. Wakefield: Adventure In New Zealand, Part II,
Chapter VII.
"The climate in this deep bight of a bay is very
remarkable. The wind which blows almost
incessantly one way or the other through Cook's
Strait seems suddenly to lose its power before
reaching the southern part of Blind Bay... "This very remarkable immunity from wind causes
an almost incredible difference between the
climate of Nelson and that of Wellington..."
In his map of climatic districts, Kidson places Nelson within regime B. This region falls within the limits of Koppen's cool temperate moist climate, there being no marked seasonal variation in temperature and precipitation. Benson describes the Waimea country as a distinct geographic unit of low hills enclosed by high ranges on three sides and lying open to the sheltered waters of Tasman Bay. The climate can safely be described as mild and equable but there is a noticeable difference between day and night temperatures. This was noticed in the early forties by Jerningham Wakefield. The climate of New Zealand as a whole is insular, there being no

32 Belshaw, op. cit. p. 56.
33 Adventure in New Zealand, op. cit. p. 475. "During the month I remained here the climate was certainly magnificent..." "If I had any complaint to make it was that I thought it too dry and hot in the day time, and that nights were on the contrary very cold, when a light air breathed down from the lofty peaks inland."
great extremes in temperature owing to the influence of the sea. Thus the mildness of the Nelson climate is no doubt due in part to its being surrounded by shoal waters of land-locked harbours. Kidson attributes it also to the effect of branch currents in Cook Strait.

Early references to Nelson's immunity from winds, especially her protection by high mountains from the cold southerlies which blow directly on to Wellington from the sea have been noted. There is a remarkable lack of strong land breezes in Nelson although a regular sea breeze sets in on most clear days except in the winter months. This lack of wind is important to a fruit-growing district. The cold dry south-west wind in Nelson may cause serious damage to tender buds and young fruit. When the fruit is larger it may be damaged on the trees by strong winds or may even be blown off. More serious loss still may be incurred if whole trees are blown out, as is frequently the case with loaded trees in gales.

34 Belshaw, op. cit. p. 84.
35 p. 16 above.
Danger is most imminent after heavy rain. An unfortunate gale in March or April of this year caused such damage. In one district along (Stoke) 10,000 cases were lost while in one orchard sixty-five trees were blown out.

It is temperature and rainfall that in the main determine the climate of a locality. Relief maps show how completely the control of rainfall is governed by topography, while vegetation maps in their turn show how complete is the control of plant life by rainfall 36.

Introductory remarks about temperature and rainfall have already been made 37. There is very little range of temperature 38 nor is there a marked seasonal variation in rainfall. In his map 39 Kidson shows Nelson and the Wairau as having 30 inches to 45 inches of annual rainfall. A narrow bordering

36 See Plate III.
37 Above, p. 16.
38 Belshaw, op. cit. Table facing p. 100. The difference between the highest and lowest monthly mean is 16.5.
39 Belshaw, op. cit. p. 91.
area, including the Moutere Hills and Motueka Valley, has an average of 45-60 inches. The Riwaka Valley, very close to the Takaka Hills (Pikiriru Range) probably comes within the 60-100 inches limit. As Kidson points out, rainfall is unreliable in Nelson, and though in general the climate is ideal for apple growing, the relatively common, acute dry spells, of from one to three months, may cause serious losses in crops. On an average, most rainy days occur in the months October–November, while February is usually the driest month. Too much rain within a limited period is also inimical. Actual damage to fruit is negligible, but rain favours the development of fungous and other diseases, and also interrupts spraying schedules, or may nullify the effects of recent sprays.

When one speaks of Nelson's ideal climate for apple growing, it is the factor of sunshine which

40 Belshaw : op. cit. p. 92.

41 Abundant sunshine and warmth are essential in the ripening stages to produce fruit of good quality, colour, flavour and keeping qualities. The apples, especially on the north-east slopes of the Moutere Hills, are noted for their "satin finish". Plant growth is stimulated and adequate drainage is ensured.
springs to mind. Nelson, thanks largely to protection by surrounding mountains from the prevailing winds, has the best sunshine record for the Dominion, over a period of years \(^{42}\). The amounts of winter sunshine in the years' total are remarkable. Even as early as 1849 there were references to this feature of the climate. There are "days and even weeks almost perfectly calm, with brilliant sunshine by day and magnificent moonlight at night ... " \(^{43}\). Wakefield also spoke of the charm of the "cloudless skies" and "calm air". \(^{44}\)

In addition to these factors of wind, rain and sunshine, such phenomena as hail and frost, which directly affect fruit, must be considered. \(^{45}\) Frosts are local phenomena which vary widely within comparatively narrow limits. In a general sense, they are more frequent inland than on the coasts. In Nelson, however, frosts are relatively frequent near the coast

\(^{42}\) Belshaw : op. cit. Table XXV - see Appendix E.


\(^{44}\) E.J. Wakefield : Adventure in New Zealand, p. 474.

\(^{45}\) Late frosts, e.g. September 1936, caused serious losses in Nelson orchards.
owing to the fact that it is a district of clear skies and windless nights. Wellington, with its continuous winds, is not so susceptible to frosts. Wakefield's remarks on the immunity of wind in Nelson have already been noted 46. Following this there is an extract 47 comparing liability to frost in the two settlements of Nelson and Wellington 48. "The proximity of such high land (in Nelson) appears to cause night frosts, which are more frequent and more severe than at Wellington".

Young fruit which is affected by hail is pitted so much as to be unsaleable when mature. The frequency of hail storms is irregular in Nelson. Some districts may be affected severely in some years and others be completely free from damage 49.

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46 See p. 16 above
47 1848, Handbook of N. Z. Company, p. 241
48 The mean temperature for the year for Nelson is 53.6 with a range of 16.5. The corresponding figures for Wellington are 54.8 and 14.0. Belshaw, op. cit. Table XXII
49 In the season just past,1941-42, the Redwoods Valley area suffered two or three heavy hailstorms, whereas the Waimea area completely missed them.
All these factors of climate had as great an influence on the indigenous vegetation as they have had on the introduced vegetation. Up till 1840 they were practically the only factors affecting the plant life. The Maoris' influence was exerted in a minor degree only, and only in the immediate vicinity of their villages. Then, too, a striking feature of pre-white New Zealand was the lack of grazing animals (except the Moa, Dinornis).

"From the historico-geographical viewpoint, the story of the transformation of forest-clad Aotearoa to a pasture-biased New Zealand falls into five clearly defined periods of cultural activity. 50. The fifth of these periods began in the nineties. Various causes led to further modification of the vegetation cover, and to an increase of the already large acreage of cultural vegetation. "On plowable tussock country in the South Island a true, mixed arable economy has developed since bonanza wheat growing led prematurely to declining yields". In Nelson, on the Motueka and Waima plains a new agricultural economy of apple-

orchards, tobacco and hop-gardens occurred, as it did in orchards, alone, on Moutere Hills from 1910 onwards.

On the 1840 map of vegetation the Nelson area is shown as predominantly forest-clad, with a small coastal fringe of scrubland. On this same land, the 1940 Land Utilisation map shows areas of commercial orchards interspersed amongst land devoted to permanent exotic pastures and long and short rotation (temporary) pasture with cereals, root and green fodder crops. There is a little land utilised for plantations of exotic trees, and a considerable amount of virgin bush still remains on the hilly and mountainous areas.

The main apple lands, on the Moutere Hills, were originally covered with Danthonia spp. and Arundo spp.

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51 See lll
52 See IV
53 Probably D. semiannuaria. The writer is indebted to Mr. F. G. Gibbs for this statement regarding original vegetation.
54 Probably A. conspicua and A. fulvida
Bush, probably *Nothofagus solandri*, filled the valleys between the hills. It was not until the "burns" had been carried out by Europeans that the *Leptospermum* scrubland described by Cockayne 55 developed.

The rest of the country must have been very heavily bush-clad. Heaphy described the mountains, which came down slightly to the water's edge, as being covered "luxuriantly with foliage". Of this coastal bush but a very small portion is left near the city 56. There is another small portion at the Moutere Bluffs where they meet the sea at Ruby Bay.

On the hills around the city, and over most of the province, *Nothofagus* forest is dominant. Southwards from latitude 38° to North Nelson forests of *Nothofagus solandri* and in Nelson *Nothofagus truncata* is also plentiful. Then southwards

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55 "Vegetation of New Zealand" : L. Cockayne

56 Whitwell's bush at the Glen. There is no dominant big tree but beech, matai, totara, tawa and rimu trees occur as individuals. In the second tier the dominant tree is the mahoe. Broadleaved shrubs, e.g. rangiora and nikau palms and tree ferns, are also common. This bush is, then, different from the majority of that in the province.
from the Thames Mountains to the Teremakau River in Westland, where there is an abrupt break in the montane and lower subalpine belts, extensive forests of *Nothofagus menziesii* and *Nothofagus fusca* stretch. These forests, in Nelson, occur mainly in the north-west of the province. South and west from the city there extends, along the low montane belt, a large formation of *Leptospermum* shrubland 57.

The generally hilly country, interrupted by open land, of Motukaka was described as having rich timber sections scattered throughout, especially on the river banks. In the upper reaches of the river, the ground was more broken and was covered with fern, toi-toi, native grasses and tall manuka. At the narrow part of the Nelson Lowland, near Wai-iti, the land was covered with fern, flax and grass.

The rest of the land of the Waimea Plain was lumped together as "Nelson Suburbs, Waimea West and Waimea Islands". The latter were sand hillocks and the land at Waimea West was barren clay hills only.

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57 The 1848 Handbook, p. 239, description of this area was "barren clay hills covered with stunted fern and manuka". These were the Moutere Cliffs and behind "were low undulating clay hills covered with tawa and rimu principally".
Waimea West, to-day, is assumed to be accounted a fertile part of the plain proper. The \textit{Nelson suburbs}, the rest of the Waimea Plain presumably, were described as marshy ground, covered with flax, raupo and grass. The facility with which this land could be drained was emphasised.

From other early descriptions it seems certain that there were large areas of swamp around the Haven, near the city. Heaphy was of the opinion that the export of flax would be one of the principal activities of New Zealand. He remarked on the luxuriant growth of the plant \textit{(Phormium tenax)} especially as he had observed it in Nelson. "The most luxuriant growth which I have seen was at the head of Tasman's gulf, in country now occupied by the Nelson Settlement, which in my idea is the finest flax district in New Zealand". More details were given by Fox \textsuperscript{58} who estimated that stretching behind the Boulder Bank was an area of about 800 acres of flax swamp. They took this as the original site of a forest because of the number of roots and trunks of trees buried therein but no trees remained. Beyond this swamp, at low tide, stretched about five miles

\textsuperscript{58} Earp, op. cit., p. 105.
of mudflat. Saunders, one of the original settlers states 59 that the site of the city was an area of high fern with abundance of such shrubs as tutu (Coriaria spp.)

Heaphy's descriptions are interesting as he relates vegetation with soil types. He had, at first, formed the impression that the land in Nelson was sterile. He reversed this opinion, however, when he saw the luxuriant growth of bush and, under it, the deep black vegetable mould which had accumulated with time. The land under such forest he judged to be the best for agriculture. Where there was a covering of high fern and flax (as in Nelson) he considered the land very little inferior to the first type. Poor vegetation, such as stunted fern, was a clear indication of poor land.

With its fertile soil, its sufficiently moist atmosphere, and its mild climate, he advertised New Zealand as having everything necessary for the successful pursuit of all European agricultural and pastoral activities. He pointed to the fact that all English vegetables and fruits, and many others besides, grew in New Zealand. The most interesting

point is his wild forecast of the possibilities of wheat growing in New Zealand. He predicted that New Zealand would soon supply the Australian colonies with wheat "the climate of New Holland not being adapted for its culture in consequence of the excessive drought to which it is liable" 60 For his more modest predictions there is support. An extract from a letter dated at Nelson, October 22nd, 1847 61, gives the following information: "We have made an orchard this year and grafted some five dozen apple stocks so that in three years, which is the age at which apple trees come into bearing in New Zealand, we shall be well stocked with fruit". In a letter from the Rev. Mr. Nicholson 62 we read "The vine flourishes in the open air; and the apricot, peach, nectarine, and almond trees are now in blossom".

60 Heaphy, op. cit.
An early table giving the amounts of land surveyed, and the estimated amount of cultivable land, also shows the real powers of observation used regarding quality of soils. The soils were discovered to be very variable and this fact was conclusively proved and demonstrated later. There are in Nelson soil types varying from some of the poorest in the Dominion to some of the most fertile.

In 1848 all that could be said of the poorest soil, the Moutere Hills type, was that the hills of this soil were "barren clay hills...with a small portion of rather better land near the cliffs". The estimated amount of land, even of average quality, was nil. In 1942, although we have to admit that the higher inland portions have soil so poor as to cause deficiency diseases in stock, the lower coastal hills have been developed by scientific methods to support most of the orchards in the most important apple-producing district in New Zealand.

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63 See Appendix B and see also Appendix F.
The success of the New Zealand Company's first settlement at Port Nicholson, 1840, induced that society to formulate a scheme for a second settlement to be called Nelson. This settlement was to consist of 221,000 acres of land, valued at £300,000 which was to be sold in allotments, each comprising 150 acres of rural land, 50 acres of suburban land and one acre of town land.

1 The New Zealand Company, first called the New Zealand Land Company, was formed in May, 1839. It was the union of three distinct associations which all existed for the purpose of planting a British colony in New Zealand. These three associations were: The New Zealand Company of 1825, the New Zealand Association of 1837, and the New Zealand Colonisation Company of 1838.
During the years 1840-1841, approximately 150,000 acres of land having been sold in England, the preliminary expedition of three ships set sail on 2nd May, 1841, under the leadership of Captain Arthur Wakefield. On arrival it was found that no land had been secured in New Zealand to meet the demands of the land-orders of the purchasers. The condition of sale stipulated that the land sold was to be from "the best site available" in the South Island "at the time of selection being made". There were to be three weeks of controversy as to where the proposed site was to be before the expedition was finally sent to Blind Bay.

Kaiteriteri was the place at which they arrived and this was on the point of being chosen as the site for the settlement. Captain Wakefield was, however, dissatisfied with the prospects of this place as a port, and with the fact that there seemed to be little available agricultural land. A successful expedition sailed south-east across the Bay and reached Wakatu, or the site of Nelson to-day, on November 4th, 1841.

The main body of emigrants, the wives and children of the men of the expedition, the land purchasers, merchants and labourers, had arrived at the settlement
by the end of February, 1842. Although misfortune hung over the town, in the shape of problems over the labour question, the Wairau Massacre, and the suspension of operations by the New Zealand Company, settlement grew until it had spread over the Waimea and Motueka plains and over the low hills between. Finally, the lower valleys of the Takaka and Motueka rivers were occupied also. By 1844 the total population of the town and country was 3037, and roads extended to Wakefield on one side and to Wakapuaka on the other.

Road making was also being extended at Riwaka, Motueka, and up the Motueka Valley. On October 9th, 1841, landing parties had been made at Kaiteriteri, Wakefield's first place of anchorage. One such party reached the native village of Motuweka (Motueka) and during the next few days the surrounding Motera (Moture) country was explored. When the settlement at Nelson became established, the first survey party was sent out to Riwaka and surveys were conducted throughout the Motueka district. The first survey of Motueka

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2 & 3 These are the original spellings of Wakefield in his diary. Peart in "Old Tasman Bay" gives the original spelling of "Motueka" as "Motuweka".

4 2nd May, 1842, under the leadership of Mr. Stephens. His place was taken by Thomas Brunner after 30th September 1843. Three years later he did pioneering work in opening up the West Coast district.
was begun in June, 1842, and was directed from the main camp at Riwaka. "Thus it may be rightly claimed that Motueka was founded from Riwaka."  

In the period before 1840, when systematic colonisation was begun, New Zealand was visited by numerous Europeans including navigators, whalers, traders and missionaries. Except for the activities of explorers and navigators it was a period of exploitation when plants and animals were needlessly destroyed. The sealing which started in 1792 resulted in the annihilation of all seals in New Zealand waters. Whalers visited the islands about the turn of the century, and as a result of their activities the whale population was severely reduced also.

After settlement took place, it was the turn of the resources of the earth to be exploited. Coal was discovered at two points on Blind Bay, as well as at Port Nelson itself, in the early forties. Then Brunner discovered valuable seams on his journey of 1846, in the district which now bears his name. The discovery of this mineral did not have such wide-

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reaching effects as the discovery of gold. This occurred in the Motueka district in 1856, and a year later at Collingwood.

Although the population of Nelson fell after the discovery of gold in large quantities in Central Otago, the economic life of the city and the surrounding country became more stable and progress was renewed on sounder lines. At first other mining industries, gold-quartz mining and coal mining, took the place of alluvial gold mining but development of the land was not long in beginning.

The first industry which arose in the young settlement was timber-sawing. After the essential housebuilding was finished, the most necessary thing to be done was to grow food. Thus it was not long until the first attempts at permanent agriculture were made. This was, as Condliffe says, "a clear step forward from the exploitation and destruction of wasting assets like timber, flax, whales and seals" 7

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6 Nelson was created a city by royal warrant on 29th September, 1858. The letters patent of Queen Victoria on the occasion read: "We do further by our letters patent ordain and constitute the town of Nelson, in the province of Nelson, to be a Bishop's Sec, and do ordain that the said town of Nelson be a City"

7 Condliffe, J.B.: New Zealand in the Making, p. 120 et passim. With properly regulated conservation even the whaling and sealing industries might have become organised on a permanent basis as the flax and timber trades have become organised.
In the experimental stage of agriculture crude methods of cultivation were used. In 1842-1843 at Motueka and Riwaka wheat was just chipped into the rich soil with an adze, while potatoes were planted in small grubbed patches just large enough for one plant. Yet surprising crops of wheat and potatoes were grown in this way.

A further increase in farming was caused by the encouragement which the Company gave to labourers to settle on the land as cottier farmers, while Fox's system of piece-work made cultivation of land a condition which had to precede employment by the Company. Although a few families were settled in the Riwaka Valley, Moutere 8, and the Waimeas, these schemes were not very successful.

It took years of endurance and courage to clear the land and make even a bare living from the soil. Still, the crops of wheat and potatoes increased in quality with the years, while there was an increased production of such commodities as butter, bacon and eggs. Such produce had proved more profitable when gold was discovered at Collingwood and, in the sixties,

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8 See Chapter III, p. 60.
Motueka's market expanded still more with the discovery of gold on the West Coast. The demand was especially high for wheat and barley, much of the latter being used for brewing. Fat stock and animal produce were also in great demand, and settlement began to spread away from Motueka, up the valley of the river and its tributaries to Pangatotara, Ngatimoti, Pokororo, Dovedale, Woodstock, Lower and Upper Moutere, &c.

Although the Moutere Hills were tried, they were found useless for ordinary purposes, and agriculture was abandoned there.

In 1877, the building of the first bridge over the Motueka river transformed the primary production of Riwaka and Motueka. The growing of grain and potato crops had proved unprofitable, and seeing that a change in items of production was imperative the enterprising Riwaka people had learnt by experience that they could grow any kind of produce of a temperate climate. This was the first district in New Zealand in which hop gardens, commercial apple, pear and peach orchards, small fruits such as gooseberries, raspberries, black currants, etc. were planted on a large scale.

Hop growing became established in the late seventies and this development led to the opening up
of much land. When a set-back was received by this industry, in the mid-eighties, an economic crisis did not occur because many growers had had enough foresight to establish raspberry gardens and orchards which from that time onwards, became increasingly important as sources of profit. It was these people who first realised what a tremendous benefit would be direct trade with Wellington from Motueka. The building of the bridge gave Riwaka the necessary access to Port Motueka. The foresight of these pioneers was well justified for the district's wealth still remains in its agricultural and pastoral industries. Both the Riwaka and Motueka districts changed over from the production of grain and root crops to a system of intensive cultivation. Even the despised Moutere Hills area was developed with the largest apple orchard district in the Dominion.

Land development on the Nelson side of Tasman Bay was also rapid. On 25th May, 1842, "the plough was for the first time put into the ground — Mr. John Kerr had the honour to hold the plough and turn the first furrow in the Nelson Settlement". Wakefield

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also recorded an interesting observation when he said, 10
"From the heat of the day I fancy there will be no
fear of Indian corn or melons ripening well here. Peas,
turnips, lettuce are beginning to show in the garden".
Intending emigrants were recommended to bring out seeds
of all useful kinds, especially vegetable, fruit, and
forest tree seeds.

Several farms were already occupied, and under
cultivation, early in 1842. Fifteen acres were down
in wheat and the estimated area of root crops (potatoes
and turnips) for the next season was a hundred acres.
Supplies of livestock had been brought from Wellington
and Sydney so that, by 1844, the sheep and cattle
population numbers were given at 5,782 and 918 respect-
ively, and the amount of land under cultivation was
1,262 acres. Most of this was planted out in cereals
and potatoes, barley being increasingly grown.
Marking the growth in land development two villages,
Richmond and Spring-grove, had already sprung up on the
Waimea Plain.

10 Wakefield Diary, 19th November, 1841.
The great wealth of Nelson was as yet thought to lie in her minerals and Blind Bay was not ranked equal with other agricultural districts of New Zealand, although it was acknowledged that its fine climate, and comparative immunity from wind, storms and floods, compensated for many of its disadvantages. Vogel maintained that much of the "bad" farming which has been associated with Nelson was due to the high price of labour as well as to the fact that much of the land was in the hands of cottier farmers, who were not good husbandmen.

Agriculture was beginning by the seventies to be followed out on a more extensive and improved system. The demand for fruit, poultry and dairy provisions created by the presence of the gold districts was highly beneficial to the primary producers in the Nelson provincial districts. The old haphazard system of agriculture was not sufficient. This had seen a

11 At an Industrial Exhibition held in Nelson, November, 1873, the exhibits of natural products were very numerous — Specimens of coal, iron-ore, pig-iron, bar iron, ores of lead and copper, and numerous preparations from chrome ore, were displayed.

12 Vogel: Handbook of New Zealand, 1875, p. 177.
series of experimental stages, starting with the introduction of the pig and potato by Captain Cook. These two items had a considerable effect on the economic life of the Maoris, and from that time onwards, the possibility which Cook had foreseen, that Maori agriculture might be developed along European lines, was built upon.

By the eighteen twenties an export trade had been built up in both pork and potatoes, and the kumara and maize were also cultivated in quantities. With this Maori development of agriculture, missionary experiments were closely connected. Marsden, in his latest years, devoted himself to the task of promoting agriculture to make up for the agricultural and physiological ignorance which had prevailed at the first mission stations. Maoris had been fed on a diet of white bread, meat and tea instead of on natural foods which they could have been producing themselves.

On his sixth visit to New Zealand, March, 1830, Marsden purchased an estate of 250 acres which was to be developed as an agricultural station. In five years a thriving farm was established where before only fern had grown. The tragedy was, as Condliffe says,
"that the first adaptation to a new economic order should have been thwarted by the early outbreak of war and racial misunderstanding."

A Nelson settler, writing to his parents in the forties, described the Maoris there as being fine, well-made men, but lazy. Research has shown that the South Island was probably a place of refuge for weak and defeated tribes of the North Island. The Nelson natives, in the forties, would be remnants of many tribes. These Maoris of Tasman Bay seemed to have kept their interests almost entirely separate from other folk of the South Island. After European settlement, the greater part of these tribes returned to their old homes in Taranaki and Ngawhenua. Those who remained were decimated by the prevalence of European diseases. But there are evidences that the district once carried a fairly large native population.

The old Maori kumara plantation grounds of Waimea West prove this. During the progress of the Cawthron Institute soil surveys, in the early part of the nineteen-twenties, attention was drawn to the

13 Due to natural mountain barriers.
so-called Maori gravel soil. Prior to European settlement these areas were presumably used, when the soil had been prepared, for the cultivation of the kumara. Examination of the soil in the field, and experiments in the laboratory, revealed several facts of interest about Maori methods of agriculture. The scientists who carried out the analysis had no special knowledge of the agricultural technique of the Maoris. The results of their analytical experiments showed that the natives had purposely burnt quantities of scrub, probably manuka, and had mixed the ash with the soil. By this method they produced a black, fertile soil rich in phosphates, potash and lime. The richness of the soil of the area is entirely due to the Maoris and is not the result of European farming practice.

Yet, "the soil prepared by the Maoris and the general treatment of the land agrees well with the specifications for soil and treatment demanded by agricultural experts for the successful growing of

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14 This soil type comprises about a thousand acres on the Waimea plain. Pits had been dug to obtain sand and gravel which, after the larger stones were removed, was spread over the natural top soil loam.
sweet potatoes" \(^{15}\). Thus there were scientific agriculturists in the Waimea plains in the days prior to white settlement. Indeed, the Maoris were in a sense the "empirical precursors of the scientific staff of the Cawthron Institute" \(^{16}\).


\(^{16}\) Buck, P. H. (Te Rangi Hiroa): The Coming of the Maori, Cawthron Lecture, 1922, p. 1.
CHAPTER III

GENERAL HISTORY OF THE APPLE INDUSTRY

There have been marked tendencies in the trend of development of New Zealand's agricultural organisation. Most notable has been the expansion in dairying until that industry has risen to be the chief primary industry in the Dominion's economy. There have been tendencies no less substantial in extent, and important in result, in the development of what Belshaw \(^1\) calls "subsidiary products" such as fruit, vegetables, poultry, eggs and honey. In Nelson, the development has culminated in the establishment of a "mixed agricultural economy" \(^2\) in which fruit growing is the predominating industry.

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\(^1\) Belshaw: Agricultural Organisation In N.Z., 1936, p. 18. et passim

In the days of pre-European settlement, before 1840, when organised settlement took place 3, and even after that date, when European settlements were actually established, fruit trees were not unknown. Along the water-courses in the North Island, groves of trees (especially peach trees) grew from stones planted unsystematically by the Maoris. The first systematic planters, in any sense of the word, were the early missionaries who introduced various fruit trees from abroad. This was the start of the naturalisation of fruit trees in New Zealand. The first settlers were, in many cases, sufficiently interested to bring plants and seeds to the Colony, and in the Handbook of the New Zealand Company, amongst all the information for intending colonists, were set forth gardeners' calendars and cultural directions regarding the cultivation of exotic plants and seeds. Quite comprehensive lists of seeds and plants, which emigrants were well advised to bring

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3 Op. cit. p. 3: The first organised attempt to colonise New Zealand occurred in 1826 when a New Zealand Company was formed and sent an unsuccessful expedition to Hokiang. In 1839 the New Zealand Colonisation Company was constituted and that year sent a body of emigrants to Port Nicholson where they landed in January, 1840. Later offshoot settlements were made at New Plymouth, Wanganui, Nelson, Canterbury and Otago.
with them, were given. However, as the missionaries were the first real planters of fruit trees, the first attempts at fruit growing co-incided with the establishment of the first mission stations — at Auckland, Waikato and Rotorua in the North Island, and at Nelson and Motueka in the South Island.

The first attempt at orcharding was probably the establishment of an orchard in the Birkenhead district (Auckland) about 1840. Within the next decade numerous small orchards were established in the same district. Subsequently, throughout the Dominion, the growth in fruitgrowing occurred, side by side with, and in proportion to, the increase in population. New Zealand soon proved to be eminently suitable for the growing of fruit, sub-tropical and temperate, although the latter types, especially pip fruits, have naturally increased most in importance. Although New Zealand is, then, a fruitgrowing country, it is only comparatively recently that a really systematic development of orchards, on a commercial scale, has taken place. There are, even to-day, large areas which are suited for fruitgrowing but

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4 The first nursery, that of B. T. Hawkins, was also established there, between 1840 and 1850.
which are not being used for that purpose owing to the stronger appeal of other products. The expansion of the industry is restricted by certain obvious conditions, the chief of which is transportation with its closely connected problems of accessibility to markets, convenience of roads, railways, etc.

The chief fruitgrowing districts are six in number:

A. Auckland  
B. Waikato  
C. Hawke's Bay  
D. Nelson  
E. Canterbury  
F. Central Otago

The most important of these, fortunate both in climate and in location for transportation, is Nelson. It is further favoured in the possession of an outlet for any surplus fruit — Kirkpatrick's factory for jam and canned fruits. Nelson has led in export returns over a number of years and showed a phenomenal extension in orchard area about 1910. After that date considerable areas were added annually to the Dominion's

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5 A great impetus to the planting of fruit trees was given by the discovery that tracts of land, principally in Nelson (and district) which formerly were regarded as being practically useless, were eminently suited for growing fruit, particularly apples.

N. Z. Year Book, 1941, p. 383.
acreage of orchards. Subsequently it declined to become stabilized at approximately 25,000 acres. A further decline, however, set in about 1938 until the 1939-1940 figure showed a decrease of 3,957 acres as compared with the 1936-1937 total.

The growing of tree fruits, bush fruits, tomatoes and other horticultural crops is the all-important item to be considered in the economy of Nelson. Commercial fruit growing had already been carried on before 1910, after which there was extensive development. Transportation has already been stressed as a very important factor in development, and had to be borne in mind to avoid indiscriminate selection of land. Large companies took up land in localities suitable for fruit growing, surveyed the area, made roads, and sold the sub-divided lots. Provision was also made whereby absentee owners might have their orchards attended to until they came into bearing. This activity was the story of the sub-division and selling of the Moutere Hills area in Nelson, the largest fruit growing area in the most important fruit producing province in New Zealand.

But prior to this there was some commercial fruit growing already carried on in the Province, on the land south of Nelson in the neighbourhood of Stoke and down the Waimea.
The Stoke district was perhaps the oldest established fruitgrowing district in Nelson 6 but land was limited in quantity and costly. 7 Other orchards were, however, found stretching from the shores of Tasman Bay to the foothills on the eastern side. The land was variable in texture. Towards the shore a heavier type prevails while the rest varies from a light loam to a gravelly loam. On the light and shallow soils which overlie a gravelly stratum, trees are liable to suffer from drought, thus limiting the amount of land available for orchard purposes.

The Waimea Plains area has not been considered valuable for such purposes as much of the land, being light and shingly, is more suited to the growing of cereals, or for pastures. Hops, and vegetables such as peas, beans and carrots for canning purposes are extensively grown. With the exception, then, of a few areas near the foothills at Richmond, Hope, and Brightwater and towards the hills on the southwestern side, at Waimea West, the plains have not been

6 This is the opinion of Mr. M. J. Adamson (Dept. of Agricult. Officer, Nelson).

7 In 1927 unplanted land cost as much as £70-£150 an acre whilst bearing orchards realised as much as £300-£500 an acre.
used for fruitgrowing.

Before 1910, the industry had become established in Riwaka and Motueka also. It was not orcharding as we understand it to-day. In the very early days, every farmhouse had a few trees planted round it, and others flourished on old Maori camping grounds. All these trees bore heavily and grew luxuriantly. The fruit was consumed by the household or used on the farm or used for bartering purposes at the local store. Keswick Codlin and Fill Basket were two old varieties found everywhere, but already some other excellent varieties such as Sturmers, Ribston Pippins, Lemon Pippins and Nonparell Russets had secured a foothold, as well as other fruits of many kinds 8.

After the set-back to the hop industry, in the mid-eighties of the nineteenth century, a few farseeing people had established orchards and raspberry gardens. The supply of young trees was, however, meagre, with a very limited choice of varieties. Even in 1912, perhaps forty years after they had been planted, such trees were still cropping heavily. This was a justification of the foresight of the orchard pioneers and a

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8 See p. 36 above.
reward for their enterprise. Others had followed their example through the years, so that, gradually, the odd acres here and there were joined up until the land became striped with fruit trees. Some orchards were abandoned but the more patient growers persevered until the industry was holding its own. Simultaneously with the growth in size of the orchards better and more varieties were planted and general attention was also improved so that the old time kitchen-garden-orchard was being supplanted by the commercial orchard.

Those farmers who had an inclination towards orcharding naturally selected their richest paddocks for the purpose. After 1910, however, although this view had proved the soundest it seemed to have need of qualification. One probability had been overlooked by the earliest orchardists. This was that, though certain soils were utterly useless for ordinary agricultural purposes, they might not be useless for fruit culture. "The capabilities of the long gentle slopes of the Moutere Hills, for the purpose of fruit growing had so far escaped the eye of prospective orchardists"

The first commercial orchard on these Hills
was planted by Mr. Valentine Rowling in 1906, in the face of much discouragement and ridicule. But it was the initial step in what was to be one of the greatest industrial enterprises in New Zealand. This pioneer did not hold his property long and the orchard for some three or four years had a chequered career. When the next owner, Mr. G. T. Tacon, bought his property, sheep had been allowed to graze amongst the almost entirely overgrown trees. In six months, however, the weeds were eradicated and the appearance of the orchard was such that other orchardists were attracted to the district in spite of the sceptical attitude of most of the local residents and public interest grew, culminating in a boom about 1910. Meanwhile the second orchard had been planted by Messrs. L. and R. Rowling about the same time as one by a Mr. Simpson ⁹. Land values after this began to rise with the years.

In 1910 there were orchards planted by Messrs. Nancy, Morrissey and Allport on the Tasman estate owned by Mr. McKee. He has been intimately connected with the development of the Nelson fruit industry in all its aspects. Not only was he one of the first practical

₉ Simpson's orchard was abandoned later.
orchardists there himself, but he was also a pioneer in
the export trade. About the turn of the century, after
a breakdown in health, and a subsequent trip to England,
he had returned to New Zealand to take up residence at
Riwaka, where he had previously bought an orchard. The
change led to a restoration of his health and he bought
the adjoining land and extended his orchard.

It is rather significant that in the Report of the
Conference of New Zealand Fruitgrowers and Horticultur-
ists, held at Dunedin in 1901, there is no official
Nelson representative listed. A glance at the figures
compiled by T. W. Kirk shows how great had been the
increase in the apple industry in Nelson. The increased
acreage in the Dominion over four years, 1908-1912,
was 7,413 acres and Nelson in particular was reported
to be making phenomenal progress in this development of
commercial orcharding.

Mr. McKee was instrumental in forming the
Companies which undertook the sub-division and selling
of the Tasman lands, the addition of which sent up the

10 Although Mr. R. Hursthouse is mentioned on one committee
   See Chapter IV, p. 70

11 T. W. Kirk (Director) Agricult. Report, 1912
total acreage figure. He purchased the freehold of two blocks of manuka-clad land (2,600 acres), then called the Moutere Bluffs, but renamed Tasman by the buyer. This land had been regarded as totally useless for agricultural purposes but Mr. McKee said "The information I had received from various quarters led me to believe that it was suitable for the growing of apples".

One of the most important "quarters" was T. W. Kirk, Director of Orchards, Gardens and Apiaries Division of the Department of Agriculture. He had visited Nelson, after having already seen the orchard lands of Tasmania and North America, probably both in United States and Canada. Mr. McKee acknowledged that he was probably the first expert to "discover" the Moutere Hill land and as far back as 1895 advocated its suitability for growing high grade apples for export. He added that he was indebted to Mr. Kirk and Mr. Hallam, Orchard Instructor, for advice in procuring a block of suitable land on which to grow apples for export. Mr. Kirk supported his own opinion by acquiring a 120 acre block of Tasman land, which he intended to have planted in the 1911 season.

There were others whose opinions could be quoted as further evidence for substantiating the claims made. Mr. Thos. Horton, of Hastings and Pahiatua, head of one of the largest nurseries in the Dominion, whose business took him through all the fruitgrowing districts of New Zealand and Australia, was another expert who gave enthusiastic support. At a Lower Moutere Fruitgrowers' Meeting 13 he assured his listeners that the Moutere Hill land, through which he had been driven in company with Mr. Kirk, was of the same type as that land, which, in Australia, produced the highest quality of export apples. More material evidence was contained in the apples which were produced in the small backyard orchards of the farmers. The unanimous opinion of the experts was that the apples there were excellent in quality, both in colour and in texture. Mr. Horton recommended the growing of apples as high up as possible, believing the flats would be more suitable for pear culture. The flat would be too rich for apples and there would be a tendency to rank growth and the spread of diseases such as blackspot. He pointed to the mistake made by growers in Hawke's Bay, where bitter experience had taught that

13 Nelson "Colonist" October 29th, 1910.
rich land did not suit apples. He was convinced that this cheap new land (at £10 per acre) would grow better apples than his £120 an acre land in Hawke's Bay.

The local papers, the "Nelson Evening Mail", the "Nelson Colonist" and the "Motuska Star" continued to "boost" the Tasman lands by quoting such opinions.

"To the traveller from Nelson to Motuska by the main road the Moutere Hills appear to be barren wastes of undulating country incapable of growing anything except manuka, etc. This is certainly the popular idea, but between the main road and the sea-coast are some long, wide valleys, with stretches of flat land, and nice easy slopes, which experts state to be capable of growing fruit and root crops successfully". It was described as "ideal land for growing the famous Cox's Orange Pippin, the finest apple in the world". An Australian expert, Mr. A. C. McComas, of the Two Bays' Nurseries, Victoria, gave still more weight to the argument. He expressed surprise at the fact that the whole of the Moutere Hills area had not been put under tree cultivation years before. He described a large stretch of land near Melbourne which had in its natural state grown nothing but ti-tree,

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spear grass and stunted gums and was considered at the beginning to be too poor for pastures or crops but the whole of which in 1910 was either actually planted with fruit trees, or being prepared for that purpose.

It seemed as if the Motueka district was on the eve of big industrial developments, and the Tasman applelands area was hailed as the "coming place" on that side of Tasman Bay. The growing industry figured prominently, not only locally, in pamphlets and the ordinary newspapers, but in periodicals of Dominion wide circulation — e.g. the "N.Z. Farmer Stock and Station Journal" which issued special "Fruit Numbers". The praises were repeatedly sung to an ever widening circle. The ordinary man would probably be attracted by the assertion that no special scientific or technical knowledge was necessary to the fruit-farming novice. With the help of the Government experts, who worked in each district, a man of average intelligence could make a success of the undertaking. Mr. Horton had said that, during the period while the orchardist was waiting for the trees to come into bearing, strawberries, raspberries, and other small fruits could be grown. Potatoes and tomatoes were
other small crops which could be cultivated in the orchard area without retarding the growth of the tree. From such crops an immediate profit could be taken.

This campaign, to popularise the industry, was successful. Hesitating buyers had been warned that there the land would undoubtedly rapidly increase in price, as closer settlement took place. Any intending settlers should therefore lose no time in making his selection — advice which was acted upon, and by 1911 the young orchards were being planted out in the sub-division of the Tasman estate. Pictures of these even appeared while the trees were so small as to be indistinguishable.

Publicity was also given, about this time, to the older fruitgrowing district at Stoke where the industry had not been stationary. A fairly large acreage was planted in 1911, and in 1912 a large number of young orchards had come into bearing. The young orchards on the Waimas were all showing excellent promise, but there was a natural reluctance to plant extensive orchard areas on such high priced land, especially when so much land suitable for the purpose, yet at a much lower price, was available at Moutere. To the more cautious, however, the Moutere land was still more or less at an experimental stage whereas the higher-priced
land had been thoroughly proved.

The Motueka district was coming into its own, however, and Motueka town was destined to become the centre of the most important fruitgrowing area in the Dominion. Most of the orchards were in the most northerly and fertile part of the Motueka Plain, Riwaka, but already by 1912 many of the valleys and foothills were being extensively planted out. At that date, trees planted in the eighties at Riwaka were producing abundantly. Several hundred acres had been planted in the intervening years, but while hundreds of acres were yet available for orcharding, the profits from the rich farming lands were so considerable that many farmers had not taken to fruit growing.

In the central portion of the plain round Motueka itself, the land was also rich. Here there were young orchards, usually smaller than those at Riwaka, and yielding good returns. This area was gradually being increased but south of the town the plain was stonier and the little planting that was done there was not very successful.

Twelve miles to the southward extended the Moutere Valley. In the lower portion of this valley there was a fine and rapidly increasing orchard area although in the upper Moutere district where there was a considerable
number of German settlers the prospects of fruit farming had not appealed.

To the south-east, in the Valley of the Motueka and its tributaries, there were already many fine orchards and everywhere young trees were being planted. Although the undertaking was still at the experimental stage, and the trees were too young, and the care and cultivation given them too varied to justify a definite prediction as to the success of the industry, the general consensus

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15 The Colonisation Scheme of the New Zealand Company became known in Germany through the agency of Mr. John H. Beit, of Hamburg, who heard of it during a visit to London. His proposals to the old-established firm of merchants of Hamburg, D. C. Chapeau-rough and Co., resulted in their entering into negotiations with the Company and their purchasing of five allotments while the North German Missionary Society bought another allotment. Emigrants were gathered from all parts of Germany and sailed with Beit as leader in "St. Paul". They settled in the Moutere Valley. Severe reverses overtook them — floods swept away what they had cultivated and built and the N. Z. Company ceased to employ them. A second expedition of two hundred under the Bros. Kelling arrived on September 1st, 1844. These emigrants all came from Mecklenburgh and therefore had more unity but even then half of the second and nearly all the first expedition left for Australia. The Kellings' farm was at Ranau, in Waimaebast, but the Rev. T. W. P. Heine, taking advantage of the Company's proposals for a re-selection of suburban and rural land, selected Mission lands at Moutere and, when others were brought out from Germany, a settlement of three hundred and fifty was formed and called "Sarau".

Broad Lowther: Jubilee History of Nelson, 1842-1892 pp. 84-85.
of opinion among orchard experts was that the gentle slopes on all the low hills in this region were admirably suitable for apple growing.

By 1916 the orchards, planted in the years of boom about 1910, had come into bearing. "Six years ago the Hotere Hills were merely a topographical expression — a desolate waste of gorse and manuka. To-day from the Waimea to the Motueka Plain they are one of the largest apple orchards in the Dominion, ribbed and striped with countless rows of flourishing trees and dotted with dwellings" 16.

As has been shown people were cautious at first and orcharding on this area was slow to begin. Gradually, however, land values rose until land which could have been bought a few years before, at 10/- to 20/- an acre now cost as many pounds. The first orchard was planted in 1910 17. In 1911 the first of the Companies, the Tasman Fruit Lands Limited, was founded with Mr. A. McKee as chairman of directors. It was mainly a Nelson syndicate but included the Director of the Orchards, Gardens and Apiaries Division among its members. The

17 By Messrs. Manoy, Morrissey and Allport, see p. 52.
bulk of the Tasman Estate (Mr. McKee's) was disposed of to this Company, the owner retaining to this day a large orchard in the original block. The land was cleared, planted, roaded, sub-divided and disposed of to buyers. A number of these actually took up residence in the district 18, but for those who did not, the Company undertook to carry the orchards on till the bearing stage.

Off-shoot orcharding areas were also springing up by this time. Planting was in progress at Bronte, Mapua, Ruby Bay and Flexmore, in fact all the country facing Tasman Bay showed various stages of orchard development, from scrub cutting to planting. The Tasman Fruit Land Company had gone into voluntary liquidation by this time, having been very successful in selling the sub-divisions. In 1912, a new Company, the Bronte Company, was formed to divide up the Tasman West Sub-Division.

The original Company had been very fortunate in 1910 in securing the services of Mr. F. E. Nottage then in the service of the Orchards Division of the Department of Agriculture as inspector in Hawkes Bay 19.

18 Mr. McKee remarks that it is remarkable that the great majority of people who took up land for fruitgrowing in Tasman in these early days have stayed there and it is interesting to reflect that fewer apple trees have been pulled out there than in any other part of the country.

19 Inspectors were appointed in 1908 following the Orchard and Garden Diseases Act.
to help them accomplish what they had undertaken to do. He set to work with enthusiasm and soon there was a thriving settlement and model orchard area where previously there had been waste land. Mr. McKee pays a tribute to his supervisor when he says "To his ability and enthusiasm can be attributed much of the success of the undertaking" 20.

Although for some years the enterprise simply swallowed up capital, all this expense was merely a means to an end, and in 1916 the laden lorries were beginning to roll down the valley. At about this time the "Grow Apples for Export" 21 slogan began to spread and Companies, similar to those formed in Nelson, began to appear throughout the Dominion.

The War of 1914-1918 brought difficulties and the rapid development in planting over the years 1912-1914 was halted. There was first a great shortage of labour but financiers did not abandon the industry. Evidence placed before the Board of Trade in Nelson in 1916 showed that the estimated value of the planted land was over half

20 McKee: op. cit. p. 6

21 See Chapter IV, p. 96
a million pounds. There were still many thousands of acres which could be in orchards, and the evidences of progress in the province, particularly on the Motueka side, since the industry had become established, were very convincing.

The set-back suffered during the War was serious, but not fatal. The trees were forced along by synthetic fertilisers and this had a bad effect on the fruit. Further trouble was made by the root knot in trees imported from Australia. These difficulties were augmented by the general rising costs of the War years and the finances of many orchardists were exhausted. Moreover, although the trees were now beginning to bear, there was no longer an overseas market available for the fruit. The Government came to the rescue by granting a guarantee of a penny per pound for export fruit in all districts but it was most important to Nelson. The position to-day is again aggravated by war conditions. On the authority of Mr. McKee, we can say that the present marketing scheme leaves growers with the impression that their position would have been much worse if the Government had not stepped in with its guarantee. The State assistance by no means keeps a grower in luxury, but it is generally considered to be sufficient to enable him to carry on
until the time comes again for him to command a good price for his fruit abroad.

Campbell 22, when dealing with the rapid development of the planting, says that, in 1915, the condition of affairs in Nelson was approaching an "embarrassing developmental situation" and the war brought this to an end. He continues, "Many hundreds of acres of land unsuitably situated were planted, and many individuals, who, through lack of knowledge or capital, were quite unsuitable, became involved in this development as the result of the advertising propaganda of the various development companies."

This statement requires some qualification. A pamphlet "Apples for Export" was published by Mr. A. McKee in December 1910. In 1915 he brought out a second but more elaborate pamphlet under the same title. The object of these two booklets was to popularise the export trade in apples and lay the foundations of that trade. This movement, although it received a severe blow from the War, was eventually successful, but it was not without troubles for the promoters. The 1923 and 1924 Gazette Law Reports record two very interesting cases which arose out of the

22 Belshaw, op. cit. p. 516, 1925.
publication of the second of the two pamphlets mentioned. In this, the advantages of cultivating apples, and the suitability of Tasman land for the purpose, were set forth at great length. These recommendations attracted a great number of would-be orchardists.

The two cases, Piggford v. Tasman Orchards Coy. and Thompson v. Tasman Orchards Coy., were heard in Nelson, March 9th-15th, 1922, and August 4th-5th, 1922, before Judge Hosking, in the Supreme Court. The charges were of misrepresentation, fraudulent treatment and rescission of contract. One of the main statements made by the defendants was that the orchard would come into profit five years from planting. The meaning of the phrase "come into profit" was thrashed out, the Court finally holding that "the circumstances and the nature of the representation were such that it was a representation of existing fact and not an opinion or promise merely".

There were eleven alleged misrepresentations and the giving of the evidence occupied six days. This all threw much light on the position and conditions of the industry as well as on the ethics of land jobbery. The case was adjourned to Wellington to hear further witnesses although the evidence relied on was mainly contained in
the 1915 pamphlet. In connection with two of the alleged misrepresentations information had been given in two interviews by the Company's agents in Wellington. The Judge's final decision was against the Company.

Two years later, January 25th, 1924, the case was taken to the Court of Appeal by the Company—Tasman Orchards Coy. v. Figgford, and Tasman Orchards Coy. v. Thompson. The appeal v. the decision of Judge Hosking was allowed on the grounds that the evidence did not establish that the appellant had been guilty of fraudulent misrepresentation.

Miss Figgford's further evidence showed that she had been very definitely influenced by the advertising pamphlets, especially by descriptions of soil, and climate, notably the statement that the commercial or professional man, the civil servant or the artisan, should be enabled "to pursue his ordinary vocation while a competency (was) being built up and a future home prepared" 23. The Judge's decision was "that it was clear that representation was not made that the business of an orchardist was necessarily a profitable one". It was pointed out that it was absurd to think that there was any guarantee that one could make money as orcharding is such a risky business. The planting was the very beginning only.

23 Apples for Export, II, p. 18.
After that had to come the cultivating, the manuring, and the other activities concerned with caring for an orchard.

The evidence in Thompson's case showed that there was a completely unwarranted and unbalanced optimism in the minds of would-be orchardists. It seemed that some were under the impression that whatever might befall — bad weather, frosts and low prices, disease, etc. — the sellers of the land guaranteed a profit from the apples. It was pointed out that the lack of profit in the five years immediately preceding had been brought about by five external factors:

(1) A heavy hailstorm

(2) Bitter Pit (the cause of which was not known at the time of the sale) which had affected the young orchards

(3) The War which made export impossible to South America which was regarded as Nelson's most favourable market

(4) General war conditions (lack of labour, high costs, &c.)

(5) The inefficient management of some orchards (and unfortunately both Miss Piggford's and Mr. Thompson's were under such management).

Referring to the degree to which inexperienced people could misapprehend or overlook the material of the pamphlet, the Judge noted that both the aggrieved orchardists had been in possession of Department of Agriculture documents which told of the expenses to be expected in
running an orchard. A considerable amount of literature concerning apple culture was available as apples had been grown in New Zealand for fifty years, and as near as at Riwaka, for practically as long a time. There was no need to be led blindly into the undertaking.

The question to be considered was whether the author of the pamphlet did not honestly believe the statements he made. The judgment was "that the failure of Mr. McKee's statements to be realised was due to circumstances happening after the statements were made". The fact that Mr. McKee had invested all his own resources (amounting to £14,000) on this land was sufficient proof of his honesty. Further substantiation was given by the fact that a large number of expert orchardists, T. W. Kirk, Thomas Horton and Mr. Haining, had taken up land on the same terms as Miss Piggford and Mr. Thompson. This proved they believed the land to be suitable apple-growing country. Referring to the controversial point about the meaning of "coming into profit in five years" the Court held that no doubt even this statement had been fulfilled, but not to the assumed proportion. The trees did come into bearing after the fifth year but it always takes longer for them to come into full-bearing. In addition to the causal factors
already mentioned there were others which contributed to the failure of the market for the product, viz.:

(a) Insufficient co-operation among growers to ensure a good market and keep down marketing expenses.

(b) The opening of the Panama Canal, June 12th, 1920, which diverted shipping from New Zealand to England from the South American ports of Buenos Aires and Montevideo.

(c) The general after-war slump which affected nearly all produce.

Mr. McKee was further accused in the Lower Court of giving extracts from the Journal of Agriculture extracts which might prove misleading because they were not complete. The Court decided that the statements made by the author were not intended to give a complete account of everything which had of necessity to be done for the growing of apples. Moreover, it was clear that the soil was not fertile; but was waste land, the soil of which would, as any reasonable person must have known, require judicious manuring. This was an example of a generalised statement made by Mr. McKee which had been made to appear particularised.

The decisions of the three Judges of the Appeal

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24 p. 68

Court, Stout, Sim and Stringer, showed they were unable to concur in the decision of the Lower Court. The latter considered it to be an example of general laudation and puffery and did not amount to a misrepresentation in a booklet termed a prospectus.

Mr. Justice Hosking had described it as a "fascinating and attractive production" the object of which "was to induce persons who might read it to enter into business transactions by purchasing orchards".

As it was pointed out by Stout, in the Higher Court, taking the authority of Lord Chelmsford in the House of Lords: Central Railway Coy. v. Kisch, some "high colouring and exaggeration" may be expected in such pamphlets and "some allowance must always be made for the sanguine expectations of the promoters of the adventure". "That this booklet was obviously intended to be a flamboyant advertisement of the advantages of apple growing must have been clear to any person of ordinary intelligence". Commendations in generalised statements did not "expose to liability". Only when particulars are mentioned does an advertiser become more liable for misrepresentation. A doubtful portion of this pamphlet was concerned with the appearance of
certain illustrations 26, but the meaning of the rest of the book seemed clear enough.

Certainly it was doubtful whether without these "puff pamphlets" the rapid development of the Moutere orchards would have been affected. The outside cover offered "A Place in the Sun - and an interesting occupation Yielding Health, Wealth and Happiness". To quote from the article 27 "There is no insurance policy so good and sound as our co-operative system of creating an orchard which, after the payment of five years' premiums, will enable you not only to provide for your family in the future, but to say good-bye to business cares and worries and to enjoy the remaining years of your life in comfort". No wonder it was attractive to people, especially to jaded workers deprived of the sunlight for the greater part of the day.

Thus it was that many people, unsuitable as orchardists, became involved in this great new development of orchards. Their inclusion led finally to many orchards being pulled out within a very short period by disillus-

26 "Apples for Export" II, pp. 18-20 gives evidence that apples were picked off three-and four-year old trees

27 p. 23. (Ibid.)
ioned owners. In consequence of this and the changed outlook brought about by the War of 1914-1918, a mild reaction set in. More new, but neglected, and "otherwise impossible orchard properties" as Campbell terms them, were destroyed. Circumstances had been adverse. The Companies had been at fault too and much of the Moutere Hills area showed evidence of indiscriminate planting. They maintained, also, certain areas on behalf of absentee owners who proved unable to maintain their holdings which was not a satisfactory arrangement.

The type of land which was being planted needed intensive cultivation. Synthetic fertilisers were also absolute necessities. Time and experience were necessary to show how to maintain an orchard with profit. That apple-growing is profitable in itself, not merely as complementary to another occupation has been well established. "The permanent stability of the fruit industry rests very largely on the standard of knowledge of the individual and a better understanding of the diseases against which he has to contend is essential.

28 Belshaw, op. cit. p. 516
Mr. Brunt is reported, in the "Nelson Evening Mail" in 1932, as saying that while in 1915 the pioneers in the district foresaw the possibilities for export trade they would never have dreamed that from the orchard areas surrounding the three ports, Port Nelson, Mapua and Motueka, as many as 35,000 cases of export apples would be delivered in one day as happened in the 1931 season. He commended the enterprise and the foresight of those who produced the series of prospectuses which attracted numerous buyers to the Moutere land, the district which was destined to become the largest fruitgrowing area in the Dominion.

29 Manager, Nelson Fruitgrowers' Federation.
CHAPTER IV

MAIN FACTORS INFLUENCING THE GROWTH OF

THE COMMERCIAL FRUIT INDUSTRY

Although a general description of the establishment of the apple industry has been given, it is necessary to consider in more detail three factors which completely altered the fruitgrowing situation, and changed the relative position of the industry in the agricultural organisation of New Zealand. It is probable that, unless certain features had developed, the old garden orchard, which had been a sufficient source of supply in the earliest days, would still be supplying most of the locally consumed fruit. To-day, the old time back-yard orchardist has disappeared. Instead the production of fruit is a highly technical and specialised profession which has a very important place in the agricultural occupations in New Zealand.

\[1\] et passim. Cockayne, A.H. Introduction to Fungal Diseases of Fruit Trees (Cunningham, E.H.).
It was a lengthy process in time. Quantities of fruit, far more than were needed, were produced in the domestic orchards which were prevalent in town and country alike. As long as fruit could be produced easily and cheaply in this manner, for little cultivation was given the orchards, and little care was lavished on the trees, there was no inducement to establish a commercial fruit industry. The three factors which led to the establishment of such a specialised industry were:

A. The appearance and prevalence of disease.
B. Increased local demand.
C. Export possibilities.

The study of the first of these is absolutely essential. It cannot be too often repeated that the success of the industry rests very largely with the individual orchardists. Each must keep up to date, and ever increase his knowledge concerning the diseases against which he has to contend, and keep modern his methods of control of disease. The work of scientists connected with the Department of Agriculture, the Cawthron Institute and the Department of Scientific and Industrial Research has given invaluable and incalculable aid to orchardists in disease control.
This development is specially noticeable after the war of 1914-1918, when great progress was made. A few orchardists with true pioneering spirit grappled with their difficulties. Others were apathetic and the early blights multiplied apace. Yet in these days, the number of pests was relatively small compared with the many diseases which made their appearance once orchards became established on a large scale. In the old kitchen-garden-orchard there were two bad pests only, woolly aphid and mussel scale, but the notorious codling moth was not long in appearing.

Orchard diseases from abroad were becoming prevalent. Control in the nineteenth century was not highly developed and the spread and development of these diseases proceeded at an alarming rate. This factor, together with the overproduction which resulted from the universal vogue of domestic orchards aggravated by the disorganised state of the markets where no restrictions were placed on the sale of diseased fruit, contributed to a decline in the orchard development in

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2 Peach-blight was a great trouble to stone fruit growers and the small bird menace jeopardised the small fruits industry and ruined the success of cherry growing. The pear-slug made its appearance simultaneously with the codling moth in apple.
some districts. This was particularly the case in the valley of the Waikato river and in the northern districts. The southern districts, being younger and less extensive, escaped somewhat. In the north the codling moth, which was almost uncontrollable, had not spread generally through the land. In Nelson, at about the turn of the century, the industry was still in the first stages of development. Black-spot and other diseases were not yet a source of serious worry and a lime salt and sulphur solution was the universal spray. The codling moth was, however, even then acknowledged as a "troublesome fellow". The method of control used was a system of bandaging the trees and collecting the "worms" at the end of the season. It is estimated that this pest commenced its career of destruction in New Zealand orchards, about 1887. Certainly, figures of bushels of fruit exported show a great decline in the years 1886-1891, after which date the figures gradually climbed up.

With these diseases, of fungus and insect origin

3 McKee, A. op. cit. p. 5.
4 1883 : 5547 bushels
1886 : 13676 "
1887 : 5639 "
1891 : 6191 "
ravaging the country, the production of marketable fruit became more and more difficult, and the position of the orchardist more and more precarious. The increase in acreage of domestic orchards, rather than improving the situation, aggravated it. The production of fruit from these orchards was always a side-line activity of the farmers. The care of their orchards occupied only as much, or as little, time as they could spare from their main industry. These, in their turn, became affected by the diseases rampant in the older orchards, till it could be said "the neglected, disease-permeated domestic orchard was the conspicuous feature in the history of fruit growing in the eighties of last century" 5.

Increasing demand for fresh fruit, however, now led to the establishment of quasi-commercial orchards in certain localities. More systematic choice was made of varieties, for experience had taught that some were more liable to blight attacks than others. So orchardists began to choose blight-proof stocks, and as to apples came to rely on Northern Spy 6. Many of the old varieties were still retained in the hope that some at least might withstand disease, but without success, and this semi-

5 Cockayne, A.H. op. cit.
6 See Chapter VI, p. 1 for unfortunate results
commercial type of orchard proved as unprofitable as the domestic orchard.

The beginning of the stabilisation of the present industry dates from 1892 when the Department of Agriculture was formed and T. W. Kirk was appointed Biologist in that Department. He recognised that disease control was the essential factor in fruit production and was probably the first to stress the need for the intelligent cooperation of the grower with the scientific expert who sought to help him combat his difficulties. It was absolutely necessary to educate the grower, and to keep his knowledge up-to-date, if competent control was to be achieved. In carrying out this scheme, the Department, in 1893, appointed W. J. Palmer and J. C. Blackmore as Pomologists. Their duties were to educate orchardists in the use of sprays for the chemical treatment of disease.

There was plenty of work for these new officers to do. Scales, codling moth, and black-spot rendered the pip fruit offered for sale worthless. The three main fruits grown for market purposes, apples, pears and peaches were in a deplorable condition, but the decade

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7 Except in certain localities such as Central Otago, where the disease factor has never been so fatal owing largely to climatic conditions.
between 1893 and 1903 was a period of direct instruction with regard to the preparation and use of sprays. The history of the fight against disease is illuminated by comparing spray schedules through the years. In these days the standard sprays used were bordeaux mixture, lime-salt-and-sulphur, and paris green. Not all growers were sufficiently progressive to use even these at that date, but by 1903 the efforts of the pomologists were rewarded in that the majority of growers had been convinced that spraying was a valuable means of control.

Further evidence of the advance in education in this sphere was the general feeling which arose that some method of compelling all growers to produce clean fruit was necessary. Danger of infection came not only from disease-permeated orchards in the Dominion, but from diseased fruit and root stocks imported from abroad. In 1897, the Waikato Fruitgrowers' Association, which was one of the first of such Associations, drafted the earliest

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8 Although the story must be augmented by studying the history of biological control and other scientific methods of control.

9 See Appendix II. for general description and general historical description of these sprays.
attempt towards legislation for control of diseases of fruit and the regulation of markets. This movement was premature, and although an Orchard Pest Act was introduced at that time it was not until 1903 that the present Orchard and Garden Diseases Act was introduced. It was introduced into Parliament during the 1900 Session by the Hon. T. Y. Duncan, Minister of Agriculture.

In June 1901, the New Zealand Fruitgrowers' and Horticulturists' Conference was held at Dunedin. A Committee was set up to draw up a report on the Orchard and Garden Pests Bill. This Committee made recommendations after carefully considering every clause of the Bill which it strongly advised the Conference to approve and to urge the Government to pass into law as soon as possible in its amended form. Their report was adopted by the Conference, although the Auckland representatives refrained from voting. They considered that

10 Campbell (Belshaw, op. cit., p. 516) notes that incidentally a somewhat ironical position was created for by the enforcement of the Act which was largely based on the proposals of the Waikato Association an almost complete destruction of what were left of the Waikato orchards, which had been allowed to deteriorate, was the result.

11 This is the Committee of which Mr. R. Hursthouse (unofficial Nelson delegate) was a member. See Chapter III, p. 53.
the North Island had been subjugated to South Island interests and that the matter had not been properly thrashed out. For instance, over the codling moth menace, they considered it unwise to deal with the pest by the legislation proposed. There was as yet no known remedy for its control. Although no slur was cast upon the Government and the work done by the Department of Agriculture, it was hinted that when the Department could show by practical means that the pest could be eradicated they would fully support the adoption of the new method of control.

The Act in two schedules named eight notifiable diseases. It was of necessity an incomplete act and more names would have to be added to the lists as new diseases made their appearance. By Clause V of the original Act the Governor was empowered from time to time by Order-in-Council "to declare that any disease other than those on the first schedule to be diseases within the meaning of that schedule." Thus, from time to time Orders-in-Council have been passed and the meaning of the Act has kept pace with the progress of the Industry. In addition to notification and regulation concerning new diseases, there are now regulations regarding grade, quality, colour and other requirements for export apples as well as regulations regarding limits of size,
stickers and cases to be used. Such amendments also specify varieties acceptable for export and provide for examination at appointed stores as well as for penalties for breaches of the Act.

This legislation was of great service in the development of the fruit industry. Its promoters have been mentioned, but special credit must be given to T. W. Kirk whose name should always be associated, both with the passing, and the enforcing of the Act. It was now a penal offence to have certain specified diseases in an orchard. Inspectors were appointed under the Act to see that its clauses were obeyed, but as Cockayne 12 says, "From the commencement (this Act) has been used as a lever for educating, rather than harassing, the fruit grower". A gradually increasing number of Orchard Instructors have been employed "and the general adoption of our spraying methods, based both on foreign and local experience, can be traced to the extension work of these individuals". There was a general cleaning up of diseased trees, particularly through the destruction of such as were near the principal fruit growing centres. The enforcement of disease control in the orchards, and

12 Cockayne, A.H., op. cit. (et passim).
the prohibition of the sale of diseased fruit, led to an improvement all round, in the general stability of the industry, improved health of the orchards and trees, and improved marketing prospects. We have the authority of Campbell for saying that this legislation made possible the establishment on sound lines of a fruit industry suitable to the particular requirements and possibilities of New Zealand. Apart from providing soft fruits in season to meet local demands, it has facilitated the establishment of an export trade in pip fruits.

Some measure of the progress made in this process of education is provided by the spray schedules. As new knowledge was gained old sprays were discarded and new ones introduced, each introduction marking a new stage in development. Many changes were made in types of sprays and in the spraying methods of the nineties. In the years about 1910, when the industry was becoming well-established in Nelson, the value of oils for spraying purposes was being proved. The Stoke district was reported as being the first district in New Zealand to make a success of oil sprays. Four or five years before this Mr. McKee had read that Tasmanian orchardists

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13 Belshaw., op. cit. p. 516.
were successfully using oil sprays to combat mussel scale. He imported oil from Hobart, emulsified it himself and was rewarded with entirely successful results after two seasons' application. Neighbouring orchards followed this example and it led to the Horticultural Department's adoption of oil as a standard spray.

The time had come when primitive spraying methods were not sufficient. "Necessity created the need for knowledge and hastened the acquisition". The fruit industry was established on a commercial scale and had already secured overseas markets to which fruit was exported. This fruit had to comply with regulations not only in New Zealand but also in the countries to which it was exported. It was clear that, if old-time methods were kept, nothing but the commonest and hardiest varieties could survive. Most orchardists became enlightened and enthusiastic, and were determined to make a success of their orchards. They were interested enough to make their own experiments, to read the available literature and finally to pass on the results of their experiences to other orchardists. Assisting them all the time were the Department of Agriculture experts who did their best to help the industry to consolidate itself.
As winter spraying with oil sprays replaced the old winter lime sulphur spray, so arsenate of lead replaced paris-green. Then weak lime sulphur sprays took the place of summer bordeaux sprays which had had damaging effects on both fruit and foliage. In recent years there have been still further developments. The same causes which had led to these developments, and these developments themselves, led to a greater interest being taken by manufacturers of sprays. Scientists and individual fruitgrowers were also taking a deeper interest in this chemical control of pests and diseases. This interest was demanded if the quality of fruit for export was to be maintained.

The old strong mixtures of bordeaux lime-salt and sulphur and paris-green were in turn replaced by specifics which did not injure the trees nor blemish the fruits. Spray application has more recently reached the experiment stage. In the experimental orchards of the Department of Agriculture, the Cawthron Institute and the Department of Scientific and Industrial Research, specifics were listed. Endeavours were made to secure mixtures which would not only control the diseases but do so without

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14 See p. 76
injuring trees or fruit. The usual programme employed in orchards to-day is the application of winter oil sprays to control scale insects and destroy mite eggs. This is followed in early spring by the application of a fungicide mixture to prevent fungoid diseases from afflicting the young foliage. These mixtures are applied at varying strengths until almost the end of the season. In addition to these measures for disease control, lead arsenates are poison sprays employed to prevent injuries to foliage by chewing insects such as codling moth and leaf roller caterpillar.

In recent years the grower has been safeguarded from buying inferior spray materials by a system of certification, which was introduced by the Plant Diseases Division, and the control of which lies with that Division. Manufacturers of genuine spray products may submit their materials to the Division for analysis by their experts and certification if proved satisfactory. Subsequent tests on these certified materials are made periodically to ensure that the standard is maintained and that the protection of the growers is effective.

In the control of disease this chemical treatment had, then, a considerable amount of success. The

15 They vary according to variety of tree.
The codling moth had been brought under control by such means. But new pests were continually appearing to harass the grower as soon as older ones were under control. So, in the second decade of the twentieth century, the menace of the woolly aphid replaced that of the codling moth. Here the factor of biological control, as contrasted with chemical control, was brought to bear, and the first outstanding work of the Cawthron Institute was carried out under Dr. Tillyard, in a successful attempt to combat this pest.

The work of the scientists and practical experts, such as the Departmental officials, cannot be too highly commended. The majority of orchardists must receive great credit also for the way in which they responded to the education which was being offered them. The orchardist of to-day makes it his business to know at least sufficient of the life histories of injurious orchard pests, bacterial, fungous and insect, to enable him to control them successfully. The importance of studying, under local conditions, the life histories of these organisms has been linked up with methods of control. The grower has been well educated along lines of spraying methods and techniques as well, so that, although serious losses are still caused by disease, these are due rather
to inefficient attention and work on the part of the grower than to the methods of control themselves.

Important as has been the factor of disease in influencing the fortunes of the apple industry, the other two factors, of increased local demand and the possibilities of the export trade, have been of great though perhaps not so vital importance in moulding the course of development. The latter has rather overshadowed the force of the former in Nelson. After 1910, when development was so rapid "the growth of the fruit industry in Nelson has been mainly along the lines of successful efforts towards its consolidation: And it is upon the gradual process of consolidation that the present remarkable export trade which means so much to every member of the community has been built up." 16

The semi-commercial orchard had been established in the place of the old kitchen orchard and fruit production became centred in certain localities. This was first due to increased local demand for fresh fruit. In Nelson, when the big boom in planting came, it was a phase of development due to different causes. That aspect of the industry to which the efforts of popularisation were now directed was the possibility

of a great export trade.

The Moutere land, suitable for growing excellent fruit of export quality, was rapidly bought up for orchard sites. This illustrated a fact borne out throughout the history of the industry, that in a fruit-growing district the increase in fruit production is proportional to the increase in population. The growth of the industry was reflected in the rise in the statistics of Motueka which by the end of the century had grown from a village to a borough. In 1916, the Tasman Estate was a model orchard area with a charming settlement. Five years before it had been a wasteland of manuka. It was in the Motueka district that the influence of the industry upon the Nelson province viewed as a whole could be most clearly seen. The apple industry, it was evident, was becoming centred in certain localities.

The word "local", when applied to market, however, is used in its widest sense. It does not mean only the market in the same district or province as the fruit-growing area, but includes all the markets throughout New Zealand. The principal markets tend to be the cities and larger towns near the orchards. It has been noted

17 1880 : 5416 bushels
1900 : 32,868 bushels
that commercial fruitgrowing originated in response to increased local demand. The markets, however, lacked organisation and this along with over-production, produced a chaotic state. At the very beginning, when Mr. McKee, for instance, extended his original Riwaka orchard, the conception of the market was so narrow that his neighbours asked what would happen to them when the market became flooded with his fruit. New Zealand is, however, a large per-capita fruit-consuming country and although the export remains normally half way between one and two million cases of apples and pears per year, approximately two million cases of locally grown fruit are consumed as well 18.

The local trade was allowed to suffer at the expense of the export trade. The Fruit Marketing Report presented in Wellington, 23rd January, 1937, 19 declared that horticultural industries, as a whole, were in a

18 Over thirty million pounds weight of fresh fruit is annually imported also : See Belshaw, op. cit. p.738.

19 This was the Report of a Committee appointed by the Hon. D. G. Sullivan, Minister of Industries and Commerce, on 31st July, 1936, by a delegation to the members of the Committee of the powers of judicial enquiry and investigation conferred upon the Board of Trade by the Board of Trade Act, 1919.
chaotic state. Although good to high-quality products were being put on the market — products essential for the health of the community — producers, owing to disorganisation and low returns, were finding it increasingly difficult to carry on. Unfortunately, this chaotic state applied not only to methods of marketing, but to every phase and department of the apple industry. Plantings were unsystematic, but the worst feature of all was the feelings of suspicion and distrust which had arisen amongst all those connected with the industry — growers, processors, wholesalers and retailers.

The only phase of the apple industry which was efficiently managed was the export trade. In all other sections there was a complete lack of organisation. This disability was all the more evident because of the very success of the export trade where the markets were well beyond the reach of the individual grower. The main defect in the local system was the lack of voluntary cooperation. With the outbreak of war in 1939, and the consequent stoppage of the export trade, a new scheme of marketing under the Internal Marketing Division had to be devised. New Zealand was forced to use most of her own apple crop. The degree to which the fruit has been absorbed by the people of the Dominion is proof that even
yet New Zealand is capable of growing more apples.

The fact remains that it is upon the export trade that the industry has been built up and developed. In 1910 the coach journey from Nelson to Motueka was long, tiring and comfortless. Six years later sometimes three service cars were needed daily to take the passengers.

Just as striking has been the growth of sea-transport and the consequent development of the ports of Motueka and Mapua. Whereas in 1910 about three steamers a week called at Motueka, in 1916 the same number were frequently seen in one day. Then, too, ships entered at the risk of sticking fast on the mud-bank. Now there was a newly-opened harbour, the port of Mapua, which was "directly the offspring of the apple industry" 20.

The figures 21 showing number of cases exported from this port are the best indication of the rise of the

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20 McKee, op. cit., p. 7

21 Mapua District : Annual Production of Fruit

<table>
<thead>
<tr>
<th>Year</th>
<th>Export</th>
<th>Local</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1918</td>
<td>-</td>
<td>2,500</td>
<td>2,500</td>
</tr>
<tr>
<td>1920</td>
<td>6970</td>
<td>14,780</td>
<td>21,725</td>
</tr>
<tr>
<td>1930</td>
<td>264,571</td>
<td>82,078</td>
<td>346,649</td>
</tr>
<tr>
<td>1940</td>
<td></td>
<td>432,803</td>
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</tr>
<tr>
<td>1941 (19/7/41)</td>
<td></td>
<td>501,500</td>
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</tbody>
</table>
industry, and incidentally the growth in importance of the port. Although some indiscriminate planting had been done, and many orchards had to be pulled out so that at one time total acreage in the Province decreased from 7,000 acres to 4,649 acres, production per year remains at a figure between 1,200,000 and 1,400,000 bushels. Of this total acreage, approximately 3,276 acres are on the Moutere Hills, from which area the greatest number of cases of export fruit is produced.

During the height of production in the North Island orchard areas, when the local markets had entirely collapsed from overproduction and general disorganisation, an attempt was made to develop an export trade in apples from the North. This attempt resulted in two trial shipments of approximately 15,000 cases to London in 1892. Although the fruit arrived in reasonably good condition, and brought fair prices, no attempt was made to repeat the experiment on any large scale. The attendant difficulties were too great, and even after the trade was firmly established, years of experimenting and testing were needed to remove even a few of these difficulties.

Statistics for the Port of Motueka compiled by P. J. Moffatt, Harbourmaster, 22 indicated that there was

22 "Dominion", Wellington, 24/2/12.
a growing need for a new outlet for the fruit produced. The first recorded shipment, 3,923 bushels, was in 1871. By 1886 it had increased to 13,676 bushels, and but for the period from that date until 1891, when there was a rapid decline owing to the ravages of codling moth, there was a continuous increase. A decade saw the number rise to 15,472. In more recent years the phenomenal output of the "baby" port of Kapua has surpassed that of the "parent port" of Motueka and Nelson. It is the biggest port for the export of apples in all the fruit areas, handling, as it does, about half a million cases in a good season.

Mr. McKee, the pioneer in so many branches of the industry, was foremost in laying the foundations of the huge fruit export trade on the Motueka side of Tasman Bay. About 1906, moved by the success of the export trade of Tasmania, he set about collecting as much information as possible on aspects of the trade from Tasmania and America, with the view to setting on foot a similar scheme in New Zealand. His original plan was to have the Government create an orchard settlement, to be run and financed by them on community lines until the trees came into bearing. Then, the settlement was to be run on

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\[23\] See p. 78 above.
strictly cooperative lines by orchard owners. This scheme received the sympathetic hearing and support of the Right Hon. R. J. Seddon, Prime Minister at that date. He and his wife paid a visit to the promoter's orchard at Riwaka and asked that the draft of the scheme should be sent to him at Wellington. The success of the scheme which seemed so likely was not realised, owing to the sudden death of the Prime Minister in 1906.

The manuscript had been forwarded to Wellington as suggested but no Government action was taken. Mr. McKee was not to be daunted but set out to realise his ideal himself. Having found a block of land suitable for the purpose, he set to work on a propaganda campaign to popularise the export trade. During the period 1910-1915 he published his two booklets which did so much to "boost" the apple industry all round. Its primary effort was to lay the foundations of this new development in the industry. The popularity of the movement spread and it was featured in Wellington papers. Under the heading "Wealth from Apple Lands" the "Evening Post" said "This flourishing apple industry is a matter of yesterday, comparatively. The possibilities of a well-managed

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24 See Chapter III, p. 63
25 March 9th, 1915.
commercial orchard were recognised by only a limited number of growers till the demand of South America put a prospect of wealth before intelligent active men ... The fear of the local glut has passed away ... " Recognition of the growing importance of Nelson was given at the 1911 Fruitgrowers' Conference held at Motueka. Delegates from Hawke's Bay, Canterbury and Auckland all acclaimed Nelson as being the primary fruit growing district in the Dominion. 

The older fruit growing district on the eastern side of Tasman Bay, and Riwaka beyond Motueka had not remained in a static condition while all this development was taking place in the more recently planted area on the western side. Although the official export trade in apples may be said to date from 1910, in 1908 export shipments of Riwaka and Stoke fruit had been made through Messrs. Buxton and Coy., Ltd. Nelson, their agents being Messrs. Sanderson, Murray and Co., London. Prior to 1903, Mr. F. C. Hamilton of the Nelson firm had been to Australia, and, like Mr. McKee, was greatly impressed by the fruit export trade of Tasmania and Victoria from which States New Zealand herself imported fruit 26. Convinced that Nelson could produce apples as good as

26 See Appendix M.
these, he approached the Government on the matter of overseas trade in pip fruits. The Government was prepared to meet his propositions and offered their guarantee of 1d. per pound. Messrs. Buxton and Coy. employed expert packers and graders from Australia whose services were given freely to the growers. The firm was also prepared to make liberal advances to growers when necessary and they made all arrangements for the reception of the fruit in London.

A small export trade was started in 1910 when a shipment of some thousands of cases was sent to London. This was followed by small consignments to the Argentine. The figures show a conspicuous increase within the next three or four years, but during the Great War period, owing to lack of shipping, the trade was discontinued. Thus it was not till after the war that the solid foundations could be laid "and the year 1920 really marks the commencement of the business on sound co-ordinated lines based on a clearly recognised system of standard grading, packing and inspection" 27. The coming importance of the trade was recognised in 1915. South America was the biggest prospective market and was willing to absorb every case available. In that year local demand was higher also and buyers literally chased one

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27 Campbell, J.A. Belshaw, op. cit. p. 516
another through the district, each snatching every case he could.

The first agents in organising the export trade had been Messrs. E. Buxton & Co. Ltd., but as time went on, the various fruit brokers in the United Kingdom appointed agents in the orchard areas in New Zealand. Individual growers reserved shipping space on overseas vessels which were due to sail at specified dates. This meant that picking and packing had to be done to suit the sailing programmes of these vessels. Often, however, owing to adverse climatic conditions and other uncontrollable factors, delivery was not possible on the due dates.

As the years went on and the quantity of fruit available for export rapidly increased 28, some regulation of the assembly, shipment and marketing of fruit was necessary. Further this re-organisation was demanded if the Government guarantee was to be altered, as the increasing quantity of fruit exported required.

The necessary re-organisation was effected through the creation of an elaborate system of governing bodies. The first of these to be set up were the Fruitgrowers'.

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28 An increase in knowledge and steady application of the advice of scientists of Department of Agriculture officials. When the fruit from the Moutere Hills had first come on to the market it was low in texture and in general quality was not suitable for shipping.
Associations in all the orchard districts. In 1910, the next step was taken, when these combined to form the general controlling body, the New Zealand Fruitgrowers' Federation Limited 29. This is controlled by a General Manager and a Board of Directors elected by the affiliated Associations. Each of these deals with matters relevant to its own district and is the medium of exchange of ideas and literature with other such Associations. The Federation attends to the wider aspects of the industry including educational, political and trading aspects. In the early days of this society it was financed by means of an orchard tax 30 introduced by the Orchard Tax Act of 1912.

The Society, which is complementary to the Federation, is the New Zealand Fruit Control Board, which was brought into existence by the passing of the New Zealand Fruit Control Act of 1924 and which came into operation a

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29 This is an executive body

30 Campbell : Belshaw, op. cit., p. 516

1/- per acre in minimum of 2/6 on all commercial orchards. This is still being paid and the proceeds are used for such purposes as the payment of expenses of delegates to N.Z. Fruitgrowers' Conferences. The enormous growth of the trading business of the Federation has long since outgrown the need of such assistance for general purposes.
year later. Before that date, the Federation had handled all aspects of export policy but this part of the organisation was taken over by the Control Board, which also undertook to attend to arrangement for shipping space, to appoint a shipping officer in New Zealand and a representative in London to complete the scheme. The Fruitgrowers' Federation officers still attend to the actual shipping of fruit and to the supplying of all spraying and packing materials, thus acting as local agents of the Control Board.

Under this system of government, the industry has progressed with great rapidity. Neither was Government assistance lacking and in 1926 the guarantee was raised.\(^{31}\) This helped the growers to meet their obligations and made it possible to carry on the industry\(^ {32}\). The great importance of the trade in the agricultural organisation of New Zealand, and the essential value of the

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31 Until the industry was really established (1910) no Government assistance had been lent. The visit of the Right Hon. W. Massey to Nelson in the early part of 1914 resulted in a promise of £25,000 to follow the Government grant already made (same amount).

32 It left the grower very little for himself, however, for as Mr. Thorp pointed out 9/- a case had to be received before the grower realised anything for himself.
industry in Nelson Province have fully justified the assistance given to it by the Government. The place commanded by the industry is recognised to-day, but even in the season before the outbreak of the Great War, that recognition was dawning. To a great many outside New Zealand the Dominion was still one large sheep-run but now they were to think of it as one of the chief orchards of the world as well. Before the war, fruit had been exported to South America, the United Kingdom and the Continent. Between 1914 and 1918, when export to the latter two markets was not possible, Montevideo absorbed all New Zealand's export fruit. In the post-war years, when the foreign trade was resumed, New Zealand fruit held the South American market, in which it had replaced Australian fruit. The markets were continually expanding. The removal of the tariff barrier in the United States in 1913 gave promise of a new market which was not fulfilled. Canada was already a valuable customer and the opening of the Panama Canal, 1920, gave access to eastern North American ports. Although competition did arise in some markets, the demand remained satisfactory and new markets were made available until the present war made export impossible. Until 1939 the markets overseas were Great Britain and the Continent, a
large proportion going to Hamburg, Argentina, Brazil, Honolulu, British Columbia and Eastern Canada. In Great Britain, the Continent, the Argentine and Canada competition arose with cool-store fruit from the United States. There was also locally grown fruit in Canada and the Argentine with which to contend in the markets. Chile also exported fruit to the Argentine and the Commonwealth of Australia carried on a successful export trade in British and Continental markets. 33.

The greatest factor in promoting this overseas trade has been refrigeration. "One of the outstanding milestones in the development of New Zealand was the practical application of refrigeration to the transport of perishable foodstuffs" 34. The changes which refrigeration made in farm practice in New Zealand were extensive, and the development of primary production was phenomenal 35. The benefits were even more far-reaching.

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33 A startling commentary on the progress of the export trade is a list of imported apples and pears from Canada, California and Australia. See Appendix.I


35 Prior to 1882 when the historic shipment of frozen meat was made in the "Dunedin", sheep had been grown for wool only. With refrigeration and the growth of the great frozen meat industry, and other by-products, the sheep-farming industry grew considerably in importance until it ranks second in New Zealand's primary industries.
Imported butter, meat and fruit have greatly added to the comfort of life of a large proportion of the population of the British Isles. Further, by means of these exports New Zealand has been able to pay for British manufactures which she did not or could not make herself. It is not exaggeration to say "that upon refrigeration depends the whole welfare of our meat, dairy and fruit industries. It is refrigeration that puts these industries in a position in which they can market their produce overseas and can control its quality within New Zealand."

In sixty years of the history of New Zealand, 1870-1930, the outstanding development was the "elaboration of mechanical refrigeration". It originated in obscure experiments of Michael Faraday and was made of practical success in the seventies. The methods were first applied in New Zealand in 1882 in the meat industry, but were extended, first to the trade in dairy produce, and secondly to the new fruit export trade. Refrigeration was a factor, not only to be considered during the time of transport, but during any necessary period of storage. The erection of cool-stores for apples was a necessary part of the programme.

36 Callaghan, F.R.: Belshaw, op. cit., p.296 (et passim)
Mr. McKee, on his return from the Australasian Conference 37 which opened on October 21st, 1912 at Sydney and at which he had been New Zealand delegate, had impressed the fact on growers that the industry was hampered in New Zealand because of the lack of cool storage provision. His scheme for a co-operative cool-store in which shareholders held space according to shares was realised in the erection of such a store which was as successful a solution as Mr. McKee had estimated.

The apple export trade was inaugurated with the trial shipment from Nelson in 1910. Although this arrived in fairly good condition, many lessons were to be learnt from it, and cool storage trials, in stores and ships, have been a conspicuous feature in the fruit research programmes carried on in the Dominion with cooperation of investigators in England. To prolong the season and avoid market gluts successful provision

37 The fact that a Nelsonian was chosen to represent New Zealand at the Australasian Conference is an interesting commentary on the progress of the industry when it is recollected that in 1901 Nelson was not sufficiently prominent as a fruit-growing centre to have a delegate at the New Zealand Conference in Dunedin, 1901. See p. 53
for cool-storage was a necessity, which was recognised, and that recognition was fully justified by the ultimate success of the export trade. The year of triumph was 1934 when over a million cases were sent from Nelson Province to overseas markets. Indeed, in the 1932 season, there were a million cases available in the Province, but that number was not available for export as restrictions in that year were placed on very large sizes. In 1928 the whole Dominion export reached a million cases, the millionth case on that occasion being forwarded to the Prince of Wales.

During this present war, as during the Great War, the export industry has been checked, and it is entirely a matter of conjecture as to what will be the position after the conflict. Commenting on the world outlook in relation to the fruit industry, F. A. Motz expressed the opinion that the restrictions imposed on pre-war European markets were bound to continue in post-war

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38 Total Export of Dominion: 1,500,000 cases
   Total Export of Nelson: 1,008,570 cases
   (Over twice the production of the rest of the Dominion)

39 This is on the authority of Mr. H. E. Stephens, (one time Control-Board representative in London) speaking on the occasion of the shipment of the millionth case - Nelson Evening Mail, 15/5/34.

years also. Possible alleviation of the difficulties of the growers lay in the elimination of marginal produce, the setting of a very high standard for fruit, and a greater development of by-products. This observer noted that Germany hopes to have enough fruit produced in the Balkans to replace the supplies which previously were received from overseas. The state of agriculture in these Balkan states is, however, alleged by the commentator to be in a primitive state.

The apple industry, on the other hand, is a very specialised industry. Disease control, manuring, root-stocks, varieties, storage, transportation and marketing problems have all presented, and are still presenting, themselves for solution. As Belshaw 41 points out "The technique of land utilisation is conditioned by a wide variety of factors such as land tenure, transport, markets, price-movements, organisations, associations and institutions as well as by conditions of soil, climate, topography, and the stage of development of the agricultural arts."

When considering the effect of this last factor on the development of the apple industry, it is found

that it does not play such an important part as in the other agricultural activities. This is because it is so young an industry. However, in the period from 1870 onwards, the whole aspect of New Zealand agriculture was being changed through the gradual application of mechanical inventions. Then, in the seventies, wooden ploughs and single furrow iron ploughs were replaced by multiple furrow ploughs. This invention greatly accelerated the development of arable farming. In the twenties of the next century, however, horse-drawn ploughs gave way to the tractor and tractor-drawn ploughs. The small farm tractor, both wheel and caterpillar types, are to-day used in many orchards. In many areas, as orchards are usually small, the owner of a tractor will do the cultivating of his neighbour in return for other work. Ploughing, discing and all types of cultivating are done by implements drawn by the tractor.

The most modern spray outfits are also drawn by tractors, being driven by power take-offs from these machines. This task of spraying is perhaps the most important in a commercial orchard and it is the most laborious. The increased knowledge of spraying technique has already been indicated, and the efficiency of all sprays used has been increased with the use of the power-
sprayer which was in use by most growers by 1912. At first, a horse drawn outfit was used and by this means spraying was a long and wasteful process. To-day, with modern machines, three men (including the driver of the tractor) can spray thirty acres of orchard in one-and-a-half to two days. With the older methods it used to take the same number of men several days to spray the same orchard. About 1934-1936 the "stationary spraying system" seemed likely to supersede the portable power spraying machine. Although many orchards were "piped" for this purpose a great many of the pipes have since been torn up.

The important development of hydro-electricity and the increasing supply of electric power, especially since the second decade of the twentieth century, has also influenced the development of the apple industry. Prior to 1900, comparatively little development had taken place, but in even the first decade of the century, notable advances were made. The plentiful supply of electric power has greatly aided the orchardist by enabling him to instal electric water-pumps and motor-driven graders. Many thousands of gallons of water are needed each week in the spraying season and the supply was not reliable when the orchardist depended on wind-
mills. The motor-driven graders are other aids which speed up the work of grading to an incalculable extent.

In many other ways mechanical inventions have bettered the lot of the orchardist. Wiring machines, case-making machines and conveyors are efficient labour-saving devices extensively used. The whole organisation of the industry has been improved. Scientific planting, with tree planting on the square system 42 has greatly facilitated cultivation. This system also makes for efficiency and speed in picking and transporting apples in the orchard. "The whole technique in fruit tree training is aimed at the elimination of the ladder to the greatest extent possible and otherwise simplifying the labour of fruit-picking 43. The aim is to build a "low set sturdy tree" from the young tree and to do away with the ugly spreading trees which had to be bound with wire. Orchardists are continually receiving instructions as to pruning methods, in order that such well-produced trees may be the feature of modern orchards.

42 Trees are planted in rows all the same distance apart; on an average this is 18' for deciduous fruit trees.

In addition to all these "external" improvements there have been "internal" improvements also, notably in the choice of varieties necessitated by export requirements. Cool-storage trials have proved certain varieties more suitable for export purposes than others. This has led to the laying down of regulations as to which are exportable varieties, and which are not. So many eliminations have been made that the pre-war export varieties comprised a very small list compared with lists of varieties grown in the earlier days of the industry, although in 1912 planting was already done with a view to export and Cox's Orange, Jonathan, Munro's Favourite and Stormers were the prominent varieties. Deliciosa and Cleopatra, which are also important export varieties to-day, were coming to the fore. In addition there were countless varieties, some of which are still found in a few orchards but which are not plentiful, and some of which have claimed a high place in the list of export varieties. There were

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44 This term has been used to denote improvements concerned with culture methods and organisation. "Internal" then refers to improvements concerned more directly with the trees themselves.

45 Farmer Stock and Station Journal, p. 669, 1912.
thirty-six names in an export list of 1912. The latest list contains about a dozen names. Showing that the requirements of the export trade are the real controlling factors in the trend of the development of the industry is the constant elimination in orchards of varieties which are not exportable. One orchard of sixteen acres in 1915 contained approximately sixty varieties. To-day that number has been decreased to contain the favourite export varieties Sturmer, Delicious, Granny Smith, and varieties which sell well on the local market, Washington and Black Twig. These, with a few trees of such early varieties as Gravenstein and Cox's Orange, have replaced the huge miscellany which was in vogue such a comparatively short period before. This question, of the selection of suitable varieties, is one which has taken up much time, in discussion and experiment. Many varieties which were profitable in other countries have not been successful here. In the main, it was found; however, that the first few varieties planted were suitable for export and local markets. The Government

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46 This variety has most recently increased in popularity due to a professed liking for the apple by the then Prince of Wales.

47 Cox's Orange, Jonathans, Delicious, and Sturmers.
officials on their two-acre experimental plot in Tasman carried out experiments for seven years, the results of which were most useful in solving variety problems.

These were the problems which awaited solution. Costly mistakes were made in the solving; for experience is a harsh teacher. Many of the orchardists who assisted in the development were unacquainted with the production of primary produce of any sort. A further handicap, which had to be overcome, was the lack of reliable data upon which to work. The pioneering work had therefore to be courageously faced. In this work the pioneers were ably assisted, increasingly from year to year, by the fruit researches of the Division of Horticulture of the Department of Agriculture, of the Cawthron Institute and the Department of Scientific and Industrial Research.
CHAPTER V

THE PLACE OF SCIENCE AND GENERAL SCIENTIFIC DEVELOPMENT IN NEW ZEALAND.

Although, especially in time of war, there is much controversy waged over the question as to whether science and scientific development are worth while, science has proved a valuable aid in the development of all industry. It is the sciences of physics and chemistry round which most activity is centred during years of war, but it is the science of biology, and all related pure and applied sciences which receive a stimulus after those years. The application of science to the primary industries of New Zealand has had very beneficial results. 1

1 See especially the far-reaching results of the application of refrigeration in New Zealand. The two main primary industries of the Dominion, the dairying and sheep industries, as well as the fruit industry, depend for their prosperity on this factor of refrigeration. See p. 103.
It should not be amiss to take a brief glance at the close relation of science to industry in general as a preliminary to treatment of its influence on the various phases of the apple industry. The claims of pure science are not sufficiently recognised but history has shown that its work is intimately related to industries of all kinds, including agriculture. Pure science is the foundation of all applied science for there are scarcely any advances in the one sphere which do not find application in the other. Although the experimentalist in the laboratory may not have sufficient knowledge of the particular industry to see what is the best possible use of his scientific findings, the industrialist should be so educated that he can apply the results himself. To achieve the best results a triple alliance based on the mutual interest and loyal cooperation of the investigator, the manufacturer and the artisan or farmer is required. Although there are many of the so-called evil effects of science, these arise as the result of man's failure to understand man rather than as the result of the failure of the

2 et passim. Denham: Science as an Aid to World Culture and Civilisation: Cawthron Lecture, 1937.
scientist to do his part. It must be remembered, also, that in part some of the evil effects of science may be traced to its rapid and therefore rugged growth. There are many gaps in scientific knowledge which have constantly to be filled. Consequently science is always a lopsided body of knowledge which is liable to misinterpretation, misapplication and lack of understanding. The advance in agricultural knowledge has been more advanced than in many other fields.

That progress has been feebly recognised, however, as have been the claims of pure science, and general scientific development. New Zealand was colonised by Europeans at a time when questions of scientific interest were beginning to be generally discussed. In 1841, the Chemical Society of London (now known as the Chemical Society) was established as the first society for the promotion of chemistry. Similar bodies were later formed in France, Germany, United States and Russia. While scientific development was still scarcely acknowledged in the old world, it was hardly likely that many of the colonists could have had specialised training as chemists, although doctors and druggists would have to have some knowledge of chemistry.

The attitude which was taken up in the second
decade of this century, when the Government was reluctant to recognise the claims of the Cawthron Institute 3 to regard its work as useful for the whole Dominion, is a powerful illustration of the lack of an intelligent interest and understanding in scientific development. But as early as 1867, Hooker had called attention to the fact that it was the duty of naturalists to lose no time in recording all the facts possible about imported plants and animals. Thompson 4 repeated the demand, in 1891, when he stressed the fact that although New Zealand is a young country, and we can trace back to the introduction of exotic plants and imported animals, each year it became increasingly difficult to "pick up the ravelled threads of the past". Systematic 5 and accidental naturalisation was taking place and the vegetation cover was rapidly

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3 A request was made to the Government of an annual sum of £2,000 towards the work done by the Cawthron Institute. This had been asked for as compensation for the payment of £40,000 in death duties on the Cawthron bequest. Although the petition was signed by representatives of public bodies up and down the Dominion, when presented to the Government—notwithstanding the petition was not granted.


5 In 1891 there were thirty three Acclimatisation Societies, some arose as Anglers' Associations and some as Farmers' Clubs.
being changed. With the introduction of new plants new problems were arising. Many imported plants did not thrive in New Zealand, and this was due, in Thompson's view, to the lack of suitable insects to fertilise the flowers, for with the importation of the honey bee in 1879 many plants which had not done so before now produced seeds. Recent research has fully illustrated that the important part played by bees is not honey production but pollination. It has been proved that cross pollination is essential for fruit production, and the value of bees in increasing crop production is consequently of great importance.

This question concerning successful fertilisation was but one of the problems connected with the introduction of plants from abroad. When those plants are used as sources of profits, when quantity and quality of the crops have to be of the very highest and best, then the problems connected with the culture of these crops become increasingly numerous and complex. So it was that, when the commercial orchard replaced both the

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6 The honey bee was introduced in 1839 and 1840 but in 1879 there was the first introduction of Italian bees which are the important honey bees.
semi-commercial orchard and the back-yard orchard, many problems awaited scientific solution. These can be summarised as problems, control over which was being, and is being, obtained by one of three measures:

A. Direct Control — aiming to kill the insect or plant by the application of chemical sprays.

B. Indirect Control — consisting chiefly of cultural operations.

C. Biological Control — making use of the natural enemies of diseases and pests.

It is only in recent years that this last method has come into its own. Until 1930 the advances in science had been applied in four main fields of farm practice:

A. Mechanical inventions

B. Breeding

C. Soil Knowledge

D. Plant Breeding and Selection.

In the decade 1920–1930 the real development of organised scientific investigations began; in Nelson it was through the Cawthron Institute. Soil investigations were first attempted but the possibilities of biological control were also given attention and their attention was increased in the next decade. With the

7 See Chapter IV p. 107
end of the Great War in 1918 came a period of rapid agricultural development and reconstruction, in which the spirit of scientific organisation which prevailed during the latter years of the War was much in the air, a great endeavour was made to retain, for times of peace, the scientific organisation which had been established during the War" 8. On account of the great scientific advances made during the war years and the large number of scientists available "everything seemed set for a distinct advance" and this advance was bound to affect all industries. New Zealand, being isolated, was in a somewhat unique position, because the War had called for no scientific organisation within the Dominion. In the present war, when New Zealand is losing her isolation and has been drawn into the theatre of war in the South-West Pacific, scientific organisation has become essential. Even though in the years 1914-1918 this had not been necessary, a considerable amount of thought was given to the need for some such organisation. Committees, the New Zealand Institute, and prominent scientists, from 1915 onwards, were

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8 Callaghan, F.R. - Belshaw, op. cit. p. 248.
considering how scientific advances could be made available for all industries.

Of prominent names amongst individuals working for this end the name of Professor (now Sir) Thomas Easterfield must stand out, as he was a pioneer in the cause. As Professor of Chemistry at Victoria University College and member of the Cawthron Commission, he gave the first Cawthron Lecture on the "Aims and Ideals of the Cawthron Institute." He was the first to stress at such a public meeting the need for research and said "For years I have held the view that in New Zealand there is great need of an institution, the special object of which shall be the carrying out of scientific investigations but I scarcely expected to live to see the fulfilment of this ideal". About twenty-five years later, when writing of the progress of the application of chemistry to industry, a slow progress but one in which tremendous developments were evident, Sir Thomas drew attention to the chemical investigations of the Cawthron Institute. Chemists of the Department of Agriculture had also rendered valuable assistance.

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9 July, 1917.
towards such developments and similar work of wide scope and practical value was undertaken by the Department of Scientific and Industrial Research, a Department founded subsequent to the passing of the Scientific and Industrial Research Act, May, 1926.

This was the culminating point in the clarifying of the ideas which had been formulated from 1915 onwards, and the Act was based on the report of Sir Frank Heath, Director of the Scientific and Industrial Research Department, England. He had been persuaded to extend to New Zealand a projected visit to Australia. This report drew particular attention to the need for scientific assistance for the primary industries of the Dominion. Dairying particularly need such help and he suggested that the establishment of an Institute of Dairying should first be considered. This was to be a model for similar Institutes to deal with grain and grass crops, fruit, cattle, sheep and meat industries. These were to supply all the requirements for agricultural research and the whole organisation was to serve all industries and "fall in line with the already existing institutions." 

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10 *et passim*, Callaghan, Belshaw, op. cit. p. 249.
In one wide field there has been much advance, that is in the field of fruit research. In 1930, when a grant from the Empire Marketing Board was made available, an organised Fruit Research Scheme was commenced. Co-ordination for research had been obtained through the cooperation of the Horticulture Division of the Department of Agriculture, the Plant Research Station (Palmerston North) and the Cawthron Institute. The direction of the work was under a special Fruit Research Committee set up by the Department of Scientific and Industrial Research. The Cawthron Institute already had a Research Orchard at Annesbrook. Now the Government Research Orchard was purchased at Appleby. At these orchards all manner of field experiments, manural, spraying and cultural, are conducted.

New Zealand was, from the first, hampered by her isolation. This was a drawback to efficient co-ordination in her research work with that of Great Britain and the rest of the Empire. Co-ordination was effected, however, by the development of the Imperial Agricultural Research Bureaux scheme which arose out of the proceedings of the Imperial Conference of 1926. This Conference recognised that scientific discovery was the most important
factor in promoting high quality in produce and in lowering the cost of production. The unanimous decision of the Conference was that the Empire Marketing Board should be maintained at all costs and that provision should be made for the continuation of the grant of the Board towards scientific research.

Two Bureaux dealing with the two most important economic branches of Biology, Entomology and Mycology, already existed, and New Zealand had enrolled as a member in both these.

In the twenties and thirties of this century New Zealand farmers, especially fruit farmers, were realising that the financial success of their occupations rested on efficient control of disease. The interpretation of problems was made very difficult, both on account of the comparatively short history of scientific experience in New Zealand, and also on account of its geographic isolation. The success of entomologists and mycologists in their work of control in the Dominion was dependent on assistance from these two Bureaux.

The success which attended the work of these Bureaux, then, and the assistance they thus gave, led to the suggestion that this scheme of Imperial cooperation in one sphere of science should be extended to
include other branches of scientific work, all of which affected agricultural development. Thus, New Zealand, by financial assistance, helped to establish eight new Bureaux in which she was a member. These deal with the eight subjects of:

1. Soil Science
2. Animal Nutrition
3. Animal health
4. Animal genetics
5. Agricultural parasitology
6. Plant genetics (herbage plants)
7. Plant genetics (other plants)
8. Fruit production

These clearing houses, through which information regarding the results of investigations and experiments affecting agricultural matters is exchanged, were established in 1927 after the first Imperial Agricultural Research Conference held in Westminster Hall and presided over by Lord Bledisloe. He was a foundation member of the Board of Trade as the representative of the British farmers.

Although the financial success of agricultural industries, such as fruitgrowing, is largely determined
by scientific advances, the success of the scientific application ultimately rests with individual growers. The findings of scientific workers must be put into practice by the farmers. It is imperative to find a mean between the advance of the theorising by the scientist and the practical application by the farmer. The former has to be retarded while the general education of the farmer is improved. In older countries, the gap between the scientist and farmer is known to be greatest when scientific development has received a stimulus. New Zealand is a young country but her colonists were enterprising and that spirit is illustrated to-day by the readiness and alertness with which New Zealanders adopt new methods, although in all branches of farming new methods must be taken up with caution. Although this applies to New Zealand, methods change here relatively quickly when compared with other farming communities. There has been a particular alertness in this respect with fruit farmers, especially in the controlling and checking of disease.

To improve the education of the farmer that it may keep pace with the advance of scientific knowledge, the Agricultural Instruction Service has been established
by the Department of Agriculture. The Instructors in this Service assist the farmer to apply the results of scientific experiments to his farming. In addition, they inform research workers of the practical difficulties with which the farmers are confronted. This co-ordinated scheme makes for economy of time and effort and ultimately a lower cost of production and a greater demand for the product.

The influence and effectiveness of agricultural research are lessened by the lack of co-ordination which exists between research workers in the laboratories, teachers in schools where there are agricultural courses, and field workers of the Government Departments. There is a need for adult agricultural education to become more efficient for the amount of research that is being done is very considerable. Indeed, research work in New Zealand is concerned almost exclusively with the land and the products of the land 11.

After the War of 1914–1918 there was, as has been said, an impetus to scientific development. Educational propaganda increased also and there was a movement towards organisation amongst farmers. Many returned

11 Belshaw, op. cit., p. 25.
soldiers who had never before been on the land joined the ranks of the farmers. The addition of this new element with all the easier communications which had developed and the closer contacts of men's minds with those of their fellows led to a more progressive attitude. The pressure of economic affairs when surplus stocks and falling prices made for depression hastened a need for combination among farmers to achieve political or economic ends. Of this period the chief feature was the establishment of control boards. In 1921-1922 the first of a series of Acts constituting such Boards was passed. The year 1923 saw the passing of the Dairy Control Board Act and this was followed in 1924 by the Fruit Control Board Act and the Honey Control Board Act. Further Boards were made possible by regulations issued under Section 216 of the Board of Trade Act, of 1919, on January 6th, 1933.

Although all this activity resulted from the stimuli of the War years, the actual forms of land utilisation were not influenced. It is inevitable, however, that after this present war forms of land utilisation will have to be changed in many cases. These changes will probably lead to an increase in the fruit industry, and the industries to do with such
"subsidiary products" as vegetables. Until now, New Zealand has relied on a "quadrangle of exports - butter, wool, frozen meat and cheese" 12. One of the great features in scientific development since the last war has been the degree to which experiments have been made in the substitutibility of oils. "The general effect of oil and fat technology has been to bring vegetable oils and animal fats into commercial competition and to bring various animal fats into competition among themselves" 13. The competition of fats and oils in world commerce, especially the aspect of the long fight of butter with margarine, is of great significance for New Zealand. The fact that wool is likely to be displaced by synthetic fibres is also significant. The need for the development of a new agricultural economy is thus apparent and, as Cumberland points out, one consideration is "that there is a considerable internal market still for certain fruit and vegetable products".

There were and always will be new aspects of old industries and entirely new industries requiring the

12 Cumberland, K.B., op. cit., p. 553 (et passim)
13 Jobberns, G.
application of scientific research. In the apple industry problems to do with production, processing of by-products and marketing have presented themselves for solution. The biologist, the chemist, the geologist, the mycologist, the botanist, the bacteriologist and the economist have all rendered valuable service in solving those difficulties. Particularly after 1919 was there phenomenal progress. In the past, disease control methods and other scientific techniques were adaptations of practices used in other countries. Since the foundation of Research Institutes in New Zealand in this period after the Great War, work has been actually done under local conditions. The cooperation of the research activities of the Department of Agriculture, the Cawthron Institute and the Department of Scientific and Industrial Research has made possible the continual improvement of the agricultural activities of New Zealand. Of these, the fruit industry probably owes the greatest debt to science.
CHAPTER VI

THE ESTABLISHMENT OF THE CAWTHRON
INSTITUTE AND ITS WORK IN RELATION TO
THE APPLE INDUSTRY

The year 1833 was an important landmark in
the history of science in New Zealand, for it was
the date of the birth of Thomas Cawthron, founder
of the Cawthron Institute. Cawthron, a shrewd
business man, of frugal habits himself, was generous
in promoting public welfare. His gifts to the city
of Nelson included the Cawthron Park of 7,000 acres,
the Nelson Institute and Library Building, the School
of Music, and the organ, and the flight of Cathedral
steps. The most lasting monument to his name,
however, is the Cawthron Institute, the work of which
is known not only throughout the whole Dominion but
also throughout the scientific world.

Under the terms of Cawthron's will, the greater
part of his estate, £240,000, was left for the
"material and intellectual development of the city and district he so dearly loved" \(^{1}\), by the foundation of a Technical Institute and Museum to be called the Cawthron Institute. As the Trustees had no idea of the exact nature of the Institute which the testator wished to establish, a private scientific advisory commission was set up under the chairmanship of Sir James G. Wilson, President of the Board of Agriculture. \(^{2}\) This Commission met in Nelson from December 14th to December 19th, 1916. It then withdrew to Wellington where a small sub-Committee consisting of three members was appointed to draw up a report.

The Commissioners agreed with the Trustees that Cawthron must have had in mind a research institution. They all realised that applied research rests on pure research and that progress is conditioned by the application of scientific discoveries. "Consideration therefore should be confined to research work which was

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2 The other commissioners were Professor Benham, Dr. Cockayne, Professor Easterfield, Professor Marshall, Sir James G. Wilson and Professor Worley.
likely to be of the most value to Nelson and the
Dominion as a whole, to agriculture, horticulture
and possibly geology with the emphasis on horticulture
in view of the position the apple industry already
occupied". Mr. Cawthron had, during his life time,
shown a great interest in the work of research
institutions throughout the world, especially after
1914. Although naturally reticent, he had often
spoken of the need for relating scientific research
to practical matters. There were neither the avail­
able funds nor the large population to justify the
erection and provide for the maintenance of a Technical
School similar to the higher Technical Colleges of
America and Europe. An ordinary Technical School
already existed in the city.

These facts, combined with the obvious need for
research in Nelson's primary industries, confirmed
the decision of the Commissioners that the Institute
should exist for research in primary industries. Such
an institution would have a very important bearing not
only on the material welfare but also in the educational
progress of Nelson as a province, and New Zealand as a
whole. An elaborate educational scheme was formulated
for the benefit of students and research workers. The Nelson public was also to be educated through lectures and publications of the Institute 3.

The Constitution provided for a Board of Trustees; an Advisory Board; a Director; a Staff of scientific officers and their assistants.

It was hoped that the Institute would be complementary to the scientific divisions of the Government Departments already existing, but it was the first institution in New Zealand in which properly organised research was to be the main function. The recommendations made by the Commission were approved by the Supreme Court and in 1921 the Institute was opened officially by His Excellency, Viscount Jellicoe, Governor-General of New Zealand 4.

Professor Masterfield had accepted the invitation of the Trustees to be Director. This was a particularly happy choice. When in July, 1917, he gave the first

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3 Results of experimental work were to be published and distributed. This has taken place through the medium (a) animal reports (since 1935) (b) bulletins (c) publications in scientific journals and local papers and reprints of these articles, and (d) monographs

4 The date of the establishment of the Institute can be taken as 1920.
Cawthron Lecture, he said, "for years I have held the view that in New Zealand there is great need of an institution, the special object of which shall be the carrying out of scientific investigations, but I scarcely expected to live to see the fulfilment of this ideal". He predicted a great future for the Institute, and his prophecy has been fulfilled. About fifteen years later a leading orchardist said "If it had not been for the (Cawthron) Institute, not to-day nor at any other time in the future of the district would Nelson have exported a million cases in a season."

In 1917, two years before the foundation of the Cawthron Institute, when all available land was being rapidly bought up, there were 2,000,000 acres only in cultivation out of Nelson's total area of 4,500,000 acres. Of this area, all but 500,000 acres was uncultivated land capable of improvement for pastoral purposes only at great cost. 6

5 Mr. D. Haining, speaking on the occasion of the shipment of the millioneth case, made this assertion. Nelson "Evening Mail", 15/5/34.

6 The carrying capacity of the occupied land was 38 sheep per acre. The corresponding figure for Taranaki was 2.1 sheep. But the best land was devoted to dairying and the proportion of dairy cows to population was higher in Waimea county than the average for the whole of New Zealand.
The county with the largest proportion of cultivated land was the Waimea county. It seemed likely in 1917 that this district would become one of the most prosperous regions in New Zealand because of the great increase which had taken place in the apple industry. The most significant feature of this development from a financial and ecological point of view was the inclusion of the manuka-clad Moutere Hills in the largest orchard area. It was indicative of the possibilities of the industry in Nelson. Obviously the help of science should be enlisted to realise these. There was no doubt that Nelson offered unique opportunity for apple research, especially of a biochemical nature. Problems to do with spraying, manuring, pruning and choice of root stocks also demanded instant attention. The apple industry claimed the first attention of the Institute which has ever since been unremitting in its efforts to improve it as well as other industries of the soil - tomato, hop, tobacco and small fruits.  

7 The manurial programme for raspberries of the Institute was widely adopted and led to such a great increase in yield that in 1926 Sir Henry Jones, the recognised Australian authority on commercial fruitgrowing, stated it to be the greatest in the history of the trade. It is of further interest to note that a pamphlet prepared by Mr. Rigg on lucerne in Nelson brought a request for copies from the Department of Agriculture in Tasmania, where the authorities expressed the desire to issue a pamphlet to every farmer in the State.
A. The Work of the Soil and Chemistry Department

The first essential work to be done, as the success of agriculture depends to a large extent on the quality of the land, was to conduct a soil survey, and soil analyses. The fruit from the Hills area had come on to the market but it was not at first satisfactory, in appearance or keeping quality. The trees producing this fruit were not yet established, the texture of the apples was poor and they bruised easily. It was obvious that the land needed toning up and that attention was needed before the trees could be firmly established. Expert advice was necessary to find out the cheapest and most effective method of manuring this land which, although it was too poor for grazing, had been planted in orchards. This question of fertilising was of great importance as it is very easy to overmanure fruit trees and stimulate them to over-vigorous growth to the detriment of the quantity and quality of the fruit.

In 1919 there were now experts available who could give the advice that was necessary. The Cawthron Institute scientists realised that they could not make any recommendations on this question until
they had ascertained the constituents of the soil.
The first person whom Professor Easterfield approached in his search for a competent staff was Mr. T. Rigg 8. He had been connected with the Rothamsted Agricultural Station in England and had continued his researches in Russia. The essential features of the classification of soil types throughout the Empire are based on pioneer investigations in this country where there has been a tremendous increase in production owing to the increase of the application of science to agriculture. Simultaneously with a rise in the output of heavy and defence industries the production of foodstuffs and general goods had to be increased. The collectivization of agriculture was completed under the second Five-Year Plan, 1933-1937. The gradual process of the application of science to the fertile and infertile soils of Russia enabled those regions to support their vastly increased populations. Agriculture in the days of Tsarist Russia was ill-planned and unscientific. Artificial fertilizers were rarely used and poor harvests were the inevitable result of poor seed and

8 Now Sir Theodore Rigg, Director of Cawthron Institute, and head of the Soils and Agriculture Department.
poor soil. The Soviet Union, using science as the instrument in developing its resources, has completely changed the agricultural map so that parched deserts in the south, swamps and marshes in the north, have been made to carry heavy crops.

In a small way, the agricultural map of Nelson was changed by the aid of such men as Professor Easterfield and Mr. Rigg. As the fruitgrowers and market-gardeners were already asking for manurial programmes, the first task they set themselves was to conduct a preliminary soil survey. In 1920 a bulletin was issued dealing with the meaning of soil surveys, the result of this particular survey and a description of the Moutere soils. Recommendations for the improvement of these soils were given and the functions of various plant foods were described.

9 The Cawthron Institute did the initial soil survey work in New Zealand. In the new programme of soil and land utilisation surveys and no less than four Government Departments are cooperating with the Institute and the Director (Sir Theodore Rigg) is chairman of the Committee nominated by the New Zealand Research Council to control this work.

10 Rigg, T. "Soil Survey in its relationship to the Nelson District with particular reference to the Moutere Hill soil".
Although this advice regarding liming and the use of fertilizers generally was the information that the orchardists needed, the position was very difficult for many growers. The expenses of establishing their orchards had been so heavy that many had not the capital with which to carry out the suggested manurial programmes of the Institute. The Government came to their aid with a special Fertilizer Loan of £5,000. This enabled the first systematic work for the improvement of the land to be undertaken under the supervision of the Orhards Division of the Department of Agriculture, Mr. Thorp being in charge of the work. Orchardists were to apply the amounts and types of manures recommended by the Institute. There was at once a marked increase in the amount and quality of the fruit.

The soil survey was continued in the field and more facilities for analyses were provided in the laboratory to supplement this work. It was a fixed policy of the Institute that conclusions arrived at in the field should be further substantiated by pot and

11 Many declared that without Mr. Rigg's advice, 1920-1921 they would have abandoned their orchards.
laboratory experiments on the different types of soil. Experimental plots on the Moutere Hills were maintained and bulletins continued to be published to convey to the public the results of all experiments. By 1926 investigation into the soil types of Stoke, Hope, Motupiko, Motueka, the Waimeas generally and the tomato-growing area in the Wood, Nelson city had been carried out. The results of these investigations, as each was completed, had already been made known, through lectures to orchardists, farmers and market-gardeners but they were now made available in pamphlets 12.

A soil map 13 was prepared and the chemical and physical characteristics of each soil type were duly explained. The knowledge obtained was of great service in determining the reasons for the failure or low production of crops and facilitated the making of different manural programmes for the various soil types. Cover crops were also recommended for some soils. Wherever these soil treatments have been

12 Rigg, T. "Soil Treatment and Crop Production in Nelson District, 1924-1925".

13 See Appendix Plate III.
followed the improvement of the trees and the fruit has been significant.\textsuperscript{14} By 1932 the exhaustive soil survey work had been completed and a systematic programme of manurial treatment had been set forth.

There are three types of soils used for apple culture in Nelson and these vary immensely in natural fertility.

1. Riwaka Soils: These promote deep rooting of trees and are well supplied with plant food, especially phosphates.

2. Moutere Hill Soils: These are texturally suitable for apple culture but the fertility is very low.

3. Stoke Soils: These are intermediate in fertility between the other two types.

Although survey work was done on all these soils and manures were suggested for them it was the Moutere Hills type which naturally received most attention\textsuperscript{15}, and the results obtained from fertilizers on this the poorest soil were most striking. Manurial treatment

\textsuperscript{14} The yield of Jonathan apples in orchards on the Moutere Hills, under the well-balanced Institute treatment, increased greatly.

Average for manured blocks (per acre) = 300 bushels
Average " unmanured " " " = 187 bushels

\textsuperscript{15} Experiments were also carried out on Stoke soils but not on the Riwaka types. Although little manurial treatment was needed there, growers were urged to cultivate well to maintain the excellent quality of the soil.
based on the supply of deficient plant foods — first by lime treatment, followed by the use of phosphatic fertilizers, and the growth of cover crops to improve the supply of organic matter and the nitrogen content of the soil, have had remarkable results. The further use of nitrogenous manures in the Spring has made success even more striking.

These long term manural experiments are still being continued. The results have emphasised the importance of complete manures of nitrogen, potash and phosphate, for many Nelson soils. The greatest hope for general improvement in the apple industry lies in the increased judicious use of fertilizers. Indeed, the successful utilisation of much of the pastoral land of New Zealand is dependent upon their application. After the researches of such institutions as the Cawthron Institute have established this thesis, it remained for the fertilizer chemist to devise ways and means of manufacturing the material on a large scale.

The most important development in scientific agriculture during the last few years has been the recognition of the importance to animals and plants of the so-called minor elements of the soil. Need for
calcium, potassium, potash and nitrogen was stressed in all plans for manurial treatment. Other important elements such as magnesium and iron, though not so frequently required in chemical treatment of crops, were known to be vital to the normal functioning of plants. The older methods of analysis were insufficiently refined to detect and estimate the value of very small quantities of other elements. By the use of modern laboratory methods light has been thrown on the importance of these trace elements. Small quantities of such elements as bornn, zinc, copper, manganese, and cobalt have been proved in many instances to be necessary to plant and animal health.

The soil survey work of the Institute expanded in the initiation of a detailed study of the mineral contents of Nelson pastures in relation to both crop production and health of stock. The most notable development in this work was the perfecting of a technique of analysis for traces of cobalt. This mineral deficiency work was continued in the field of

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16 Magnesium is more abundant in seeds and leaves than in other parts of the plant. This element forms an integral part of the molecules of chlorophyll (a) and (b). Although iron does not enter into the composition of the chlorophyll pigments green plants are unable to develop chlorophyll in its absence.

Wright, Barton, E. "General Plant Physiology" pp. 317-318.
biochemistry where a knowledge of the functions of these minor elements in biochemical processes became better understood. During the 1935 season the disease of internal cork in apples was shown to be due to a boron deficiency 17. This recognition was not only important in itself, but also because the association of this disease with a deficiency in an element suggested that in many instances diseases might be due to lack of such minor elements. Copper deficiencies had been proved the causes of diseases in citrus and pear trees in Florida. Sufficiency of manganese had also been shown necessary for good yields of many cereals, vegetables and sugar-cane. Cobalt investigations were commenced at the same time as those on boron and the success which attended all these researches was most gratifying.

The work on this boron deficiency was continued under Dr. Askew. The discovery of the definite relationship between the occurrence of "internal cork"

17 At the same time it was established that "brown heart" of swedes and turnips was due to the same cause. Boron is an element which is found widely distributed in all parts of plants, and all types of plants. Its absence causes deficiency diseases and in particular abnormal fruiting.
and the boron content of the soil was supplementary to the discovery of Mr. J. D. Atkinson, of the Department of Scientific and Industrial Research, which indicated that this disease could be controlled by the injection of boric acid into trees with affected fruit. A cooperative scheme of work was carried out by these two institutions of research with the result that from field experiments with borax spray and clinical studies regarding the intake of boron and its distribution in the leaves and fruit of the trees, much valuable information was obtained.

Although experiments with borax sprays were carried out to see if they had any beneficial effect on bitter pit, and other apparently physiological diseases of apples, in each case no positive result was obtained. One interesting fact revealed by the borax experiments was that the keeping quality of Jonathan apples was adversely affected by the intake of boron in too great quantity. Experiments had to be made with sprays of varying strengths to overcome this difficulty.

18 During 1936 the investigations were extended to other crops and a survey was made of the boron status of typical Nelson soils.
Although these boron investigations were and still are being continued, since 1938 more stress has been laid on the deficiency of magnesium. During the 1936-1938 seasons early defoliation of Jonathan trees, on certain manorial blocks at Upper Moutere, increased to an alarming extent. This loss of leaves started to occur about the end of December and had an adverse effect on the size, colour and time of maturity of the current season's fruit as well as hindering the formation of the next season's fruit buds.

At first the trouble was associated with heavy potassic manuring but it was found later that it was not strictly confined to such areas. Doubtless, however, potassic manures increased the incidence and degree of defoliation. Again, the results of injection experiments and the chemical analyses of leaves showed that the cause of the trouble was a lack of magnesium. The fact that high figures for potash were associated with low figures of magnesium showed that there was a problem there, too, which needed further explanation.

19 They were extended to grapes over 1941-1942 season.
It was obvious that the best method of controlling the disease would be by increasing the amount of magnesium in the soil but how that could be best effected was not known. Tests were made with several magnesium compounds in the different manurial programmes and by 1940 valuable results had been obtained by the use of magnesium carbonate, magnesium sulphate and ground dolomite (a mixture of magnesium and calcium carbonates) \(^{20}\). An interesting feature of the experimental programme was the successful use of magnesium sulphate sprays. The results suggested that spray treatments of deficient trees might be employed as a valuable temporary measure until the value of the soil top-dressing of magnesium compounds were fully tested. By the 1941-1942 season the application of these compounds, especially magnesium carbonate, was producing valuable results. Laboratory experiments had been extended, also, and much study had been made on the distribution of magnesium in the leaves and young wood of apple trees. Modern methods and new laboratory techniques made advance more rapid.

\(^{20}\) This applies to the Braeburn district. Results in other localities were not entirely satisfactory.
The long term manurial experiments and deficiency investigations have been of great importance to the Nelson apple industry. They have demonstrated the importance of the different plant foods in apple production and have provided much valuable material for nutritional studies and investigations. The importance of these last has always been stressed throughout the history of the Institute. Early in that history it was emphasised that cool storage tests of fruit quality must be undertaken in all manurial experiments and results must be correlated with experiments on the chemical composition of apples. It was recognised that, with more knowledge of the role of individual plant foods in connection with the quantity and quality of fruit, much smaller losses would be sustained. Not only would a higher quality of fruit be obtained but much money which had been spent on fertilizers could now be saved.

Cooperative work in the Cawthron Institute and Government Departments was called for to deal with certain ailments of apples. These included cracking of fruit, russetting of fruit, and the incidence of drought spot, cork, and bitter pit. The first
Cawthron Institute Bulletin dealt with three ailments called "water deficiency diseases" of apples. These were internal cork, crinkle, and drought spot and they had caused considerable loss all through the decade from 1920-1930 without any effective control being exercised.

During this period, the growth of the industry, especially by the development of the export trade, was phenomenal. Research work was begun and developed on problems relating to cool-storage. Observations concerning these physiological diseases were able to be made as a result of storage trials over the 1925-1926 season. Shortly afterwards information became available which showed that widespread damage was caused in British Columbia and Australia by similar ailments. All this information showed that fruit, which grew on certain types of soil, and under particular climatic conditions, was susceptible. All investigators agreed that the

21 Soil with bad textural quality — liable to caking.

22 In Nelson there is a particularly low rainfall in November and December, the months in which the fruit is in an early stage of development. In addition low humidity, strong drying winds and bright sunshine are factors increasing liability to the diseases.
diseases were physiological and resulted from water deficiencies in the fruit.

In New Zealand the investigation of these deficiencies was just beginning and much experimental work had to be carried out before the factors causing them were discovered. The fact that soil and climatic conditions had a determining influence was already known. After a few years of investigation it was found that poor cultivation and bad management of orchard soils considerably affected the severity of the ailment. Investigations abroad showed that heavy nitrogenous manuring, which made for rank growth, was accompanied by most of the symptoms of water deficiency diseases. Although no actual experiments were carried on in Nelson on this aspect, it had been noted that trees with luxuriant foliage produced more affected fruit than those with poor foliage. This confirmed the opinion given several years before that nitrogenous manures should be reduced or eliminated in areas when severe losses were experienced. In view of the fact that these water deficiency diseases

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23 A good tilth obtained early in the season was necessary as well as careful cultivation so that no roots should be cut.

24 In British Columbia, by McLarty.
occurred from the failure of the roots to supply the full amount of moisture to fruit and foliage, the solution which suggested itself was a drastic thinning out of affected trees. The result would be a greatly reduced leaf area in relation to the root system. This should have beneficial results as the amount of drainage would be less.

This experimental work concerned with the control of physiological diseases and the improving of the quality of apples under cool storage conditions, was therefore, closely connected with nutritional problems.

With the growth of the export trade it was necessary to define the best conditions under which fruit could be stored on land and at sea. Physiological diseases such as apple scald, bitter pit (or crinkle), flesh collapse and spot in Jonathan variety demanded investigation. Although a trial shipment had been sent in 1910, and the fruit had landed in England in a fairly sound condition many lessons had been learnt and the need for better storage conditions
had been emphasised. Provision would have to be made for more efficient packing so as to avoid slackness in the cases at the end of the journey. The best samples in the shipment was a consignment of Sturmers which were a little wet but otherwise sound. Most of the other fruit was very wet and unsound, owing to the fact that the temperature in the cool chambers had been too low. The various shipping firms stated the temperature which they believed would be the best, the average being about from 38° to 40°.

It was obvious that there was a wide field here for research. In New Zealand the problem was to keep the fruit in sound condition from April

25 A consignment sent by the author's father received the following report:

Jonathan: fair quality: mixed sizes: very soft 6/9 - 7/-
Jonathan (Belfast): fair quality: bold: very soft 6/7 - 7/-
Cleopatra: fair quality: medium size: very green 7/9 - 8/-
Munroe's Favourite: fair quality: large: green & ripe 8/-

26 The fact that the fruit arrived in London during the week of the funeral of Edward VII combined with the fact that a heavy consignment of Australian fruit, which had made its reputation, was already on the market, militated against the success of this local shipment.
till December. Consequently, in 1920, the New Zealand Fruitgrowers' Federation approached the Cawthron Institute with the request that these problems should be investigated. A few preliminary experiments were made and the results were sufficient to justify the appointment of two officers to make a full-time study of this cool storage work.

Mr. M. McLelland was first appointed and a little later Mr. L. W. Tiller. Over the years 1921-1922 preliminary experiments had been carried out by the Director of the Institute, Professor Easterfield, and the Orchard Instructor, Mr. J. K. Thorpe, in the Mapua Cool Store. Their work was continued by the two new assistants who published the results of their experiments in a number of bulletins.

Although by 1923 they had gained information about certain physiological diseases, the work was greatly hampered by the lack of an experimental chamber. In 1925 the Directors of the Nelson Freezing Company made it possible to have a small experimental store erected within a chamber of their works at Stoke. They were soon able to complete their work on the disease of flesh collapse.²⁷

²⁷ It was found that the descriptions of internal breakdown of the English workers, Kidd and West, agreed with their own observation of flesh collapse.
The work of 1925-1926 concerned the finding of suitable storage temperatures. It was very evident that for satisfactory storage a large number of factors required consideration. In order to eliminate internal breakdown results so far showed that a temperature which was not practicable from the commercial point of view was necessary. Although this particular disease was due primarily to too low a storage temperature and was greatly increased by excessive humidity in the air of the cool store, it was also shown to be definitely associated with soil of good texture, adequate plant-food reserves and good drainage.

In 1927, the equipment was accidentally damaged by fire and the accounts of investigations over that season were lost. The experiments of the following year confirmed the results obtained and experiments on internal breakdown were continued. These mostly concerned the still debatable influence of the relative humidity on the occurrence of the disease but an initial inquiry was made into the value of oiled wrapping paper. Further studies were made as to the influence of soil type and the value of manuring and preliminary notes were taken on the influence of root
stocks on the keeping qualities of some varieties.

Within the next few years special work on storage temperatures and humidity conditions was undertaken at the Cawthron Institute at the request of the Department of Scientific and Industrial Research. The results of experiments revealed much as to the behaviour of the six main export varieties of apples.

As an indication of the recognition the work of the Cawthron Institute was gaining abroad, we may cite the request of the Canadian Cool Store Commissioner for an edition of a bulletin to be distributed through Canada as a special Cool Storage news-letter.

The fertiliser trials which were being continued all this time showed that although the yield of fruit and the growth of the trees was improved by top-dressing, when ammonium sulphate was used there was a relatively large increase in the incidence of internal breakdown. The treatment of boron deficiency also increased the severity of this disease. It was evident that care must be exercised in the use of borax in Nelson orchards.

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28 Sturmers and Jonathans

29 Sturmers, Jonathans, Delicious, Dunn's Favourite, Cox's Orange,
The effect of manurial treatments on the storage quality of fruit was an essential factor to be considered when assessing the merits of any specific manurial programme.

The present war has created many difficulties in the marketing of New Zealand apple crops. With the view of assisting the Internal Marketing Division, the Cawthron Institute and the Department of Scientific and Industrial Research have co-operated in a series of storage experiments. It was hoped that recommendations could be made concerning the storage of certain varieties of apples in suitable orchard sheds. The Institute carried out experiments in their Annesbrook store with nine varieties. These were picked at different times and packed in different wrappers, with different case linings. Further successful results were obtained over the 1941-1942 season but experiments were overshadowed by the new and somewhat

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30 Success was obtained in the control of superficial scald with the use of oil wraps on Granny Smith apples. This can be compared with the successful use of copper sulphate wraps in controlling fungal rot of pears. Results of work of Tiller: "Orchardist," July 1st, 1934.
more important development of the series of experiments on the determination of the optimum conditions of gas storage.

The fact became more and more evident that the storage life of fruit is affected by many orchard factors such as time of picking, type of soil, manurial practice and root stocks. The question of stocks is one to which the Cawthron Institute has extended its investigations. Years of experience have proved that different soils are suited to different root stocks. The stock which was used in the early days of the industry was Northern Spy. It owed its wide use to the fact that it was immune from blight infection by woolly aphids. This stock was successful on the rich, deep soils of Tasmania but the shallow Moutere soil proved an unsuitable medium for it. The roots of Northern Spy stock were liable to spread near the surface whereas deep roots were needed to allow for periods of drought. This Moutere Hill soil was easily ploughed but there was great danger of root cutting in this shallow soil which also did not allow for erosion. From trees of this spreading-root system only light crops per acre could be expected.
Official experiments on root stocks were begun in 1932. It had been recognised as one of the results of the experimental work in physiological diseases that the influence of root stocks on the incidence of these ailments was an important one. On their Annesbrook orchard the Cawthron Institute conducted tests with different root stocks, in the 1935 season select East Malling and Northern Spy stocks being planted. Double Vigour stock was another used and by 1937 experiments suggested that while the old Northern Spy remained the best stock for Cox's Orange, the other two gave higher yields for Sturmer and Jonathan varieties. The data obtained by 1942 showed that the tendency was for Double Vigour stock to provide more fruit than Northern Spy. All the records kept over the last decade have provided valuable information regarding the yield and growth of individual trees in the control blocks.

These field and laboratory experiments conducted by the Soil and Agriculture Department of the Cawthron Institute, carefully planned and developed vigorous trees produced fruit more susceptible to these diseases.
cultural investigations have been useful and valuable
guides to experimental work by other research
institutions. The chief feature of the work to-day
is the healthy cooperation which exists between the
Institute and the Government Departments which conduct
research.

B. The Work of the Mycological Department

Although in 1900 black spot and other diseases
and pests, except the codling-moth, did not seriously
worry the average orchardist, by 1912 it was becoming
increasingly difficult to enumerate the ever-
increasing number of blights. As is usually the case,
as the industry expanded so did the number of different
pests which assailed it. 32

There is a considerable number of fungous
diseases which are of more or less economic importance
to the orchardist. Practically all of these have been

32 The author has heard old Riwaka farmers speak of the
days when strawberries flourished in that area.
Gradually the blights assailed this small fruit
until there is hardly a strawberry garden left.
imported from abroad. They are usually common in all lands where apples are grown. The two most important of these diseases are black spot (Venturia inaequalis) and powdery mildew (Podosphaera leucotricha).

This latter is confined to the apple in New Zealand and no varieties are immune although some are more susceptible than others. The disease probably originated in Western North America and from there has spread to almost every country where apples are grown. The conidial stage was first recorded for New Zealand by J. Blackmore, the Government Pomologist, in 1901. Cunningham, in 1923, was the first to observe the perithecial stage. The Cawthron Institute has conducted no experimental work on this disease.

Black spot, the other fungous pest mentioned, is a very common blight throughout all the apple-growing districts in New Zealand, except in such places as

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33 Cunningham: "Fungal Diseases of N.Z. Fruit Trees"

34 It is reported also in Europe, North America, South Africa and Australia.
have low humidity during the growing season, e.g. Central Otago and some localities in Marlborough and North Auckland. Its occurrence in New Zealand was first reported by Kirk in 1894 and the ascigerous stage in 1921 by Miss Curtis and Cunningham.

Over the period 1896-1900 much literature on this disease was made available through the work of R. Aderhod, a German scientist. Again, in 1913 and 1917, the subject of the control of black spot came into prominence.

In New Zealand the real investigations began in the second decade of this century with the work of Cunningham and Curtis. Dr. Curtis was, and is, the chief of the mycological department of the Cawthron Institute. With the initiation of the work of the Institute, when Mr. Rigg was attacking the problem of the poverty of the Moutere soil, Dr. Curtis took up the special study of black spot which was the main fungous trouble affecting pip fruits in Nelson.

35 Dr. Curtis studied the conditions for black spot development in the other main fruit districts of New Zealand as well as Nelson.

36 Not only does this disease weaken the tree by damaging the leaves but it reduces the market value of the fruit by disfiguring the epidermis.
Over the period 1921-1924 investigations proved that the main spring infection was due to ejections of ascospores from the fallen leaves of previous years. Growers were recommended to destroy these leaves by burying, or more effectively by burning. This unfortunately took too much time to be a practical method of prevention. In an endeavour to find a means of control which would be more suitable, experiments were made to test the value of spraying the dead leaves. All that would be required in normal seasons, when unusually wet weather had not been experienced, was that during the course of ordinary sprays a little more should be sprayed on the dead leaf carpet. Sprays should be applied during Spring, the critical time of the year, and maximum effectiveness was to be secured only when those sprays were applied immediately after rain.

As it was pointed out by Cunningham, it was an impracticable method because of the difficulty of destroying all infected leaves, as some lay under hedges, etc. and infected shoots still remained. To eradicate these would take much time and a modification of the pruning system. Nevertheless, he admitted that by the destruction of infected leaves, danger would be minimised. He claimed that sprays according to schedule had given complete control and this with deep autumn ploughing should be sufficient.
Although no further experimental work was carried out directly on this disease the mycologists have the fungus constantly under their observation. This is necessary because the life history shows variations in different years according to humidity, and temperature conditions. Thus, following observations made in the Spring, when the spores are ready for dispersal, a notice is published in the local paper warning growers when to spray. This notification service has been most helpful to the orchardists.

Mycological research for a considerable number of years was devoted to fungal diseases of small fruits, stone fruit, tomatoes, hops and tobacco. During the first decade of the Institute's history, however, other fungal diseases of pip fruits were made the subjects of investigation. One such disease was silver leaf or silver blight, a disease principally affecting plums but universal wherever stone fruits or pip fruits are grown in any quantity.

This disease is caused by a fungus (Strepptom purpureum Pers.) and its control presents a problem in all parts of the temperate world. It is common
in New Zealand on apples, pears, quinces, and numerous other fruit-trees as well as on many ornamental shrubs. It was first recorded in New Zealand in 1894 by Blackmore. It was probably known as early as 1836-1838. Only in 1901 was it demonstrated that the disease was due to a parasitic fungus and even then the recognition of the fungal action was only slowly achieved. Most of the modern data was contributed by the Englishmen, F. T. Brooks and J. Percival, and a Luxemburger, J. Bintner.

Cawthron Institute mycologists studied the disease under local conditions. In 1924, as the result of their observations, they advised the removal and burning of all infected parts of trees. All wounded surfaces, where branches had been removed, had then to be painted to prevent spores entering crevices. Coal tar had proved a suitable dressing in New Zealand. English experimenters rather preferred soft grafting wax or a home-made white lead paint for the purpose of treating wounds.

38 It is associated with an over-supply of sap and is most likely to occur on all grafts, Granny Smith being the main variety affected.

39 Cunningham, op. cit.
Other preventative measures were advised. As spraying was of no avail in combatting this disease all old stumps and infected tree parts must be destroyed by fire. In young trees, if the disease had not taken a firm hold, if the good health of the trees was maintained by well-balanced manuring, especially in phosphate, and potash, and if there was adequate drainage, control could be maintained. To help maintain that control growers were warned not to plant hedges of tree lucerne near orchards as these plants were highly susceptible to the disease of silver blight. The pest was a source of serious loss and although the Institute continued its observations over many years the greatest hope for control lay with the conscientious and intelligent orchardist.

Other diseases were studied from the twenties, and over a long period. The two chief fungal troubles after black spot and silver leaf were eye rot (Botrytis rot) and mouldy core. As a result of increased financial assistance from the Primary

\[40\] Due to general depression and the reduction in the income of the Institute, the maintenance of the full scope of the work was very difficult.
Producers and the Department of Scientific and Industrial Research, the work of the mycological department was extended during the 1934-1935 season.

Investigations over a number of years had already provided material for the tracing of the relative frequency of the numerous secondary fungi causing eye rot. It had become obvious that the same fungi did not necessarily predominate in successive seasons for weather conditions and location of orchards and apple variety were all determining factors. During the investigations of 1936 at least twenty fungi associated with eye rot had been identified. The predominating fungus was determined as Botrytis cinerea and the relative percentage of the other fungi in comparison with this species had been assessed. Although war conditions modified the scope of the mycological department's contribution to fruit research, this work of identification was continued over the 1939-1940 season.

The causes of mouldy core and possible methods of control were also investigated. This disease was found to be due to defective variety, for infected varieties (Cleopatra, Delicious) possessed a large open passage between calyx and core. This, when open,
allowed the passage of wind- or water-borne spores of many fungi which under suitable conditions germinated, produced hyphae which penetrated the tissues, and set up the decay identified as mouldy core.

Cunningham, in a series of experiments, had isolated a great number of different genera. In 1934 and 1935 this investigator conducted the first experiments in a long series concerning this disease as it affected Delicious apples in Nelson. A large number of fungi was identified and species of *Fusarium* proved to be of the greatest significance as causing the disease. By 1936 thirty fungi had been identified and their relationships with each other worked out, and over the next few seasons all the data obtained was re-assembled and arranged systematically. The work of investigation was continued with the *Fusarium* species.

This work on the study of fungal diseases in apples has been very important in the development of the apple industry. It must, however, be considered in conjunction with the work of the other departments. The causes and conditions of problems in the apple industry are so complex that their solution involves the work of more than one science department. An
important feature of the Cawthron Institute has been the cooperation which has existed amongst all the departments.

C. The Work of the Entomological Department

When the Institute was first established, the Chief of the Entomological Department was Dr. R. T. Tillyard. An important development on the history of this department occurred in 1936 when the Government Plant Research Bureau Committee decided to locate the Entomological Division of its work at Nelson, in association with the Cawthron Institute. Dr. David Miller, Chief Entomologist at the Institute, was made Director of the newly co-ordinated entomological researches. Nelson is thus the main centre for entomological research in New Zealand.

It was also the scene of some of the earliest investigations into the problems connected with insect pests. The branches of work which the department covers are:

1. Control of insects attacking farm crops, fruit and forest trees and
2. The biological control of noxious weeds.
In the progress of economic entomology one of the most interesting developments has been that of the factor of biological control. This has come into its own only within the last two decades.

The first introduction of a natural enemy for an insect pest was made in 1874, when a ladybird beetle which preyed on aphids was introduced from England. This was, incidentally, one of the first recorded attempts to utilize biological methods in any country. Since that time, attempts have been made to introduce thirty seven insect parasites to control about twelve pests. Twenty-four of these were liberated in New Zealand and eleven are known to have become established.

Of these two *Aphelinus* and *Vedalia* keep their hosts under adequate control. The introduction of *Aphelinus* to control woolly aphid (*Schizoneura lamigera*) was the first outstanding success of the Cawthron Institute. In 1920, this major insect pest

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2. Most of the earlier introductions were made by the Department of Agriculture while of later years both the Department of Agriculture and the Cawthron Institute have attempted this means of control. *Vedalia cardinaria* was a beetle first introduced in 1894 to control cottony-cushion scale which is now only a minor pest of apple, pear and citrus.
was causing untold losses to orchardists. In America, on the other hand, the original home of the pest, the disease had not reached the degree of severity which it had attained to in New Zealand. The problem presented to Dr. Tillyard was one in which man had destroyed the original association of plants and animals in a particular area. He had introduced 1. the apple tree; 2. the woolly aphis (unwittingly), without 3. the natural enemies of the insect.

Following enquiries made at the 1920 Conference with regard to woolly aphis, Dr. Tillyard visited the United States. There he found three kinds of insects which successfully attacked the insect pest. Supplied (through the courtesy of Dr. Howard, of the United States Bureau of Entomology) with shipments of two of these, he returned to New Zealand to attack the problem. One insect failed to establish itself but the other, *Aphelinus mali*, gave results of outstanding value, for woolly aphis has been reduced to the status of a minor pest.

In February, 1921, parasitized twigs from America were received in New Zealand and three strains
of the parasitic *Aphelini* were crossed, producing a vigorous strain. The insects were raised at the Institute and were distributed in large numbers to orchardists all over New Zealand. Applications for supplies were received from state officers of the United Provinces of India and arrangements were entered into with steamship companies to enable supplies to be carried in cool storage to Bombay. By this time, 1925-1926, it was pointed out that the general distribution of the insect in New Zealand would not be continued in the future as it was considered that there were sufficient supplies in the Dominion.

The control exercised by *Aphelinus mali* on woolly aphid is complete. Unfortunately a belief has arisen amongst orchardists that the parasite is becoming less effective. This is due to the fact that a basic principle in biological control has been overlooked. This is the fact that in the case the interaction of two organisms, both influenced by climatic and cultural conditions, fluctuations in the extent of control in different seasons and localities is most probable. Thus, in certain seasons, the parasite is unable in early and mid-summer to prevent
the insect pest it is there to control from increasing. The life cycles of both *Schizomus laingera* and *Aphelinus mali* as they occur under local conditions are still studied so that knowledge may be kept absolutely up-to-date.

This question had taken up most of the attention of the entomologists up till 1926. But other problems were pressing for solution, chiefly the problems regarding the control of mealy bug, apple leaf hopper and codling moth. This latter is probably the most important pest of apples and was the first real menace to the Nelson fruit industry. Control was attempted as early as 1906 by the introduction of a parasite of the larva of the pest. Two other parasites were later imported, the first in 1931 and 1932, and the second in 1933 and 1934. By 1935, it was not known whether the first of these was established and the fact never seems to have been settled. The second parasite was not reared in sufficient numbers for liberation.

In these years of the early thirties, bait trap indicators were used as a method for testing codling-moth sprays. The control of the pest depends on the

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43 As well as the pear leaf curling midge, the pear slug and the earwig which attacked stone fruit.
maintenance of an adequate covering of arsenate of lead on the fruit during the flight period of the moth. It is an unfortunate feature of this programme that the application of such poisonous sprays adversely affects the parasites. The latest report of the Institute, however, tells of the arrival of a consignment of parasites from the United States. Arrangements have been made to test these, under laboratory conditions, this spring.

Control of another insect which infests apples, mealy bugs, have been the objects of study at the Institute. These are particularly inimical because not only as sap-sucking insects do they drain the sap away but they also destroy the chlorophyll, interfere with the normal functioning of the stomata and have a toxic influence upon the plant tissues. In addition they may spread spores of fungal diseases.

Although there are about a dozen species indigenous to New Zealand, the apple mealy bugs belong to two species, one American and one Japanese. They are noted for their resistance to sprays and so reliance has been placed on biological methods of control. The first introduction of a parasite occurred in 1897 by the Department of Agriculture. Since 1920, several
other parasites have been introduced, without success, by this Department and the Cawthron Institute. Finally in 1933 a successful result was obtained with the introduction of a parasitic Australian insect. Two years later large supplies had been reared and distributed all over New Zealand, Samoa and the Cook Islands.

Urgent measures were also called for to deal with the apple leaf hopper (Typhlocyba australis) which first came into prominence as an apple pest in New Zealand about 1918. By 1935, accumulated data was sufficient to provide a fairly full knowledge of the biology, identity and distribution of this insect. Methods of control had also been carefully studied and the important discovery was made that under local conditions the eggs are attacked by a parasite. The fact that the leaf hoppers were not important pests to apples in Europe seemed to indicate good prospects from biological control by an introduced parasite.

At the same time it was recorded as an apple pest in Australia, although it had been actually present for some years. It probably originated in Europe and most likely that it entered New Zealand in the egg stage under bark of imported apple trees, root stocks or cuttings.
During the thirties, careful studies were carried out on a Dryinid parasite of the leaf hopper. The Imperial Institute of Entomology agreed to look for suitable insects to send to New Zealand as opportunity offered. Although the insect was controlled to a considerable extent by an egg parasite, it was hoped that a newly introduced natural enemy would supplement that work.

Apple leaf roller \( (Tortrix posttittana) \), another introduced pest, is a source of loss to apple growers. It was introduced into New Zealand about the last decade of the nineteenth century. Effective control depends on the maintenance of an adequate cover of arsenate of lead until picking time. The ordinary codling moth sprays serve to control leaf roller but they must be continued longer as the pests are present after the flight period of the codling moth.

In addition to chemical means of control, biological methods have been applied. In 1922 an Australian parasite of the larva was introduced. It was possibly present before this, intentional introduction. The biology of the dominant species in Nelson \( (Tortrix posttittana) \) was closely studied during the
second decade of the Institute's history and ten species of parasites were found attacking the larval and egg stages of the insect. The most important of these was identified as *Apanteles tasmanica* which infested the larval stage. Much preliminary work was required before the selection of an efficient parasite could be made. Mr. L. J. Dumbleton conducted the studies and, during the course of these, visited Australia and Tasmania. During these visits he collected much important data. This investigator also studied the problem as it presented itself in Central Otago where the leaf roller caterpillar was causing serious loss to stone fruitgrowers.

Until very recently, no parasite could be regarded as an important factor in the control of leaf roller. It was a problem which could not be properly approached owing to the absence of information regarding parasities of the species in Australia, its country of origin. Until all that information was available Mr. Dumbleton, in 1940, advised that the principal criterion for suitability of introduction was the relative abundance of the different species of parasites in Tasmania. Such a criterion was not
entirely reliable, however, as the parasite which had assumed greatest importance in New Zealand was relatively unimportant in Tasmania.

A native insect which attacks apples and blemishes the skin is the bronze beetle (*Eucoleaspis brunnea*). Prospects for the biological control of this pest are not promising. No true parasites of the pest are known although the larvae of black beetles and robber flies are known to prey to some extent on the grubs of the beetle.

The genus has been known for over a century and a half for in 1769 Sir Joseph Banks collected New Zealand species. In 1781 Fabricus published a concise description of this insect giving the habitat as Nuova Hollandia. This confusion arose from the rediscovery of Australia on the journey home. The first volume of the Transactions of the New Zealand Institute, 1868, gave a summary of a paper 45 in which was given a description of the damage done by "a small brown beetle" to young apples. Numerous other investigations were made of the insect until in the late twenties Averil M. Lysaght, working at the

45 Huntley.
Cawthron Institute, conducted intensive studies. The possibilities of biological control, cultural control and chemical control were explored.

As already said, the prospects of the first method were not promising. By the second means serious infestations could be checked by careful and constant cultivation \( ^46 \), especially from November to January, when the beetles were in flight. The insect breeds in rough uncultivated places, in grass, blackberry, manuka, &c., so that orchardists were advised to destroy such infection areas.

Dr. Miller carried out control experiments \( ^47 \) with chemical sprays in the two years after 1926 in conjunction with the biological studies. Paris green, lead arsenate, calcium arsenate, sodium fluosilicate, sodium arsenate and geraniol were the insecticides used. Experiments confirmed that calcium arsenate (arsenite of lead) was most effective. This had been the experience in other countries and from the

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\( ^46 \) Working of the soil disturbs beetles which are laying eggs as well as destroying many of the early stages of the pest. The ground is also kept free from vegetation on the roots of which the grubs may feed.
data available an extensive and detailed series of experiments, to ascertain the most effective concentration of the sprays, could be carried out. Two other insect pests, San José scale (*Aspidiotus perniciosus*) and red mite (*Byrodea protensis*), have been considered but these are best controlled by chemical methods also. Biological control over them has not been successful.

These were the actual insect pests of apples which have received the attention of the Cawthron Institute experts. There was one other disease which was investigated very early, but it was of plant not insect origin. This was the bacterial disease of fireblight (*Erwinia amylovora* Burr). Fireblight is the most destructive disease of apple trees in North America and in New Zealand it has shown possibilities of becoming equally destructive.

Its introduction into New Zealand was mysterious. Late in 1919 it was reported for the first time and was found to be present in the Bay of Plenty, Thames and North Auckland areas. The Wanganui area was also affected and a slight outbreak occurred in Wairarapa. While Cunningham was hard at work investigating the disease early in 1920, Dr. Tillyard at the Cawthron
Institute started a propaganda campaign in Nelson. If this menacing blight spread to the Nelson orchard area the position would be extremely serious, probably the ruin of the apple industry would result.

It was pointed out that although Cook's Strait as a natural barrier would afford some protection it could be nothing more than temporary. The orchardists must help themselves by destroying all hawthorn hedges. Hawthorn was a plant closely related to the apple family and the fireblight organism lived on this as its first host plant. Further justification for the destruction of hawthorn, blackberry and sweet briar came from the fact that such trees and shrubs harboured other pests which included leaf rollers, codling moth, oyster shell scale and San Jose scale. Further, the leaf hopper was known to frequent hawthorn hedges and striking work in America had established the fact of a relationship between the prevalence of leaf hoppers and fireblight. Tests had shown that the insect pests were active agents in spreading the bacterial disease.

Dr. Tillyard conducted a lengthy lecturing tour through the Nelson district. He had studied the disease in Hamilton although the main work in connection
with the disease was done by Mr. R. Waters, Plant
Pathologist and later officer-in-charge of the
Biological Laboratory of the Department of Agriculture.
On behalf of the Cawthron Institute Trust Board, the
Director of the Institute had asked the Department of
Agriculture in Canada and the United States for any
literature on fireblight and for suggestions for
methods of control. In the valuable reports
obtained, the comforting factor was acknowledged that
with the cooperation of all concerned the disease
could be stamped out. Thanks to their efforts the
disease did not reach alarming proportions in Nelson.

This valuable work of the Entomological
Department is being continued under the capable leader-
ship of Dr. Miller, Assistant Director of the Institute,
and a worthy successor to Dr. Tillyard. It is hoped
that equally successful remedies for insect pests, with
those already found, will be discovered. Although
some of the work has not given promising results so
far it must be stressed that there is no reliable
criterion for determining in advance the results of
the introduction of any parasite. Local conditions
are the determining factors on behaviour. In spite
of the knowledge which has been accumulated on this subject in the twentieth century "The method of biological control is in practice empirical" 48.

48 Dumbleton, op. cit. p. 590.
CHAPTER VII

GENERAL RESULTS

The valuable work carried out by the Cawthron Institute has become recognised throughout not only New Zealand but also the whole scientific world. The honour of a Knighthood conferred by His Majesty the King on Professor Easterfield, and on Mr. Rigg, the present Director, was in recognition of the importance of the scientific research which has been carried on under their direction. A further indication of the esteem in which the Institute is held in New Zealand was afforded in 1937 when local bodies in Nelson were empowered to exempt the Institute from rates and taxes in the case of all land and buildings used for scientific research. ¹

¹ Compare this with the attitude of the Government in the early days of the Institute's history. See above p. 96.
The work undertaken by the Institute was fully justified by the position which the apple industry occupies in Nelson. From an economic point of view, the town is dependent on the produce and wealth derived from the land. The importance of the industry is indicated by the value of the apples marketed overseas from the Moutere Hills and surrounding districts.

We must not forget that there are a number of industries which are directly dependent on the apple industry. These subsidiary industries include cider-making, the manufacture of fruit-juices, fruit canning and jam-making. By creating a market of fruit by the establishment of the "K" jam and canning factory in 1881\(^2\), Samuel Kirkpatrick was responsible to a considerable degree for the establishment of the fruit-growing industry in Nelson\(^3\). A canning factory was also established at Stoke, in the first decade of the present century, but this did not have a lengthy career.

The cider industry has developed as a separate branch of the trade in the last few years. Once, even a

\(^2\) The present factory was erected about 1900 (Information received from Mr. C. Milner, Director of "K" factory).

\(^3\) This applies particularly to the small-fruits-industry.
decade ago, most orchardists brewed their own cider. To-day, there are one or two who devote themselves to this activity. The 1937 Fruit Marketing Committee obtained much useful information regarding the manufacture of cider, and unfermented apple-juice drinks from Mr. R. J. Marshall, of Stoke, who, appalled by the wastage of fruit on most orchards, had erected buildings and a plant for their manufacture. This was a small venture but the Nelson growers asked for the establishment of a modern cooperative factory. This may follow but, although a committee of experts was set up to decide ways in which any war-created surplus of apples might be disposed of, not much progress has been made as the need was not as urgent as was expected. Fruit has been absorbed in New Zealand without leaving the expected surplus. This year, however, an interest has been taken, in Britain, in the possibilities of a trade in dehydrated apples from New Zealand.

In addition to giving rise to such new industries connected with by-products, the apple industry, through the application of science, has made possible the rise of new chemical industries. Two
chemical works have been established in Nelson to manufacture the specific spray materials which are required for the chemical control of pests. These are Mr. Lawry's lime sulphur works at Stoke and McKee and Sons chemical works at Tasman.

The apple industry thus now holds an important place in the economy of Nelson. In saving the industry from ruin when it was beset by the difficulties of its inception, the Cawthron Institute performed a service not only for Nelson but for the whole of New Zealand. Lord Rutherford, recognised as New Zealand's greatest scientist, paid a tribute to the work of the Institute when he said:

"I do not think we could get a better illustration of the application of science to agriculture than in this province of Nelson. I remember in my boyhood looking at the yellow soil, thousands of acres of it, worth only a few shillings and I remember that some venturesome people tried to see if they could grow apples on it. But the trees did not flourish, and the fruit was weakly. It was at this stage that the turning point really came with the establishment of the Cawthron Institute".

\[4\] Lord Rutherford was referring to the Moutere Hills soil. The millionth case of apples which he received actually came from an orchard planted on this soil type.
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Also:

(a) Collection of New Zealand and Australian papers of Mr. McKee.

(b) Files of the "Motueka Star".

(c) Files of the "Nelson Examiner".

(d) Files of "The Colonist".

(e) Files of the "Nelson Evening Mail".

(f) The "New Zealand Farmer: Stock and Station Journal", 1911, 1912, 1916 (Fruit Numbers).

(g) New Zealand News, 24/7/34.

(h) Orchardist, 1930 et seq.

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APPENDIX A.

TOTAL ORCHARD AREA IN NEW ZEALAND

1939-40 figures
1941 Year Book, p.384.

Figures refer to orchards of \( \frac{1}{2} \) acre or over on holdings of one acre or more situated outside borough boundaries.

<table>
<thead>
<tr>
<th>Land district (excluding boroughs)</th>
<th>Number of Orchards</th>
<th>Area of Orchards</th>
<th>Average Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Acres</td>
<td>Acres</td>
</tr>
<tr>
<td>Nelson</td>
<td>553</td>
<td>4,601</td>
<td>8.32</td>
</tr>
<tr>
<td>North Auckland</td>
<td>1,747</td>
<td>4,278</td>
<td>2.45</td>
</tr>
<tr>
<td>Otago</td>
<td>671</td>
<td>3,236</td>
<td>4.82</td>
</tr>
<tr>
<td>Hawke's Bay</td>
<td>613</td>
<td>3,140</td>
<td>5.12</td>
</tr>
<tr>
<td>Canterbury</td>
<td>1,120</td>
<td>2,060</td>
<td>1.84</td>
</tr>
<tr>
<td>Auckland</td>
<td>1,311</td>
<td>1,558</td>
<td>1.19</td>
</tr>
<tr>
<td>Remainder of Land Districts (six)</td>
<td>1,606</td>
<td>2,026</td>
<td>1.26</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>7,621</strong></td>
<td><strong>20,899</strong></td>
<td><strong>2.74</strong></td>
</tr>
</tbody>
</table>
**APPENDIX B.**

Summary of probable amount of comparatively level land within the supposed boundaries of the Nelson Settlement.

1848 Handbook, p.239.

<table>
<thead>
<tr>
<th>District</th>
<th>Gross amount of land surveyed or supposed to be comparatively level. Acres.</th>
<th>Estimated amount of land of fair average quality, immediately available for cultivation. Acres.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Massacre Bay:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Aorere</td>
<td>15,000</td>
<td>10,000</td>
</tr>
<tr>
<td>(b) Takaka and Motupipi</td>
<td>30,000</td>
<td>15,000</td>
</tr>
<tr>
<td><strong>Blind Bay:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Motueka</td>
<td>10,000</td>
<td>5,000</td>
</tr>
<tr>
<td>(d) Moutere Cliffs</td>
<td>15,000</td>
<td>-</td>
</tr>
<tr>
<td>(e) Moutere Wood</td>
<td>5,000</td>
<td>-</td>
</tr>
<tr>
<td>(f) Upper Motueka and Motupeko</td>
<td>18,000</td>
<td>5,000</td>
</tr>
<tr>
<td>(g) Wai-iti and tributaries</td>
<td>6,000</td>
<td>5,000</td>
</tr>
<tr>
<td>(h) Nelson Suburbs, Waimea West and Waimea Islands</td>
<td>7,000</td>
<td>2,000</td>
</tr>
<tr>
<td>(i) Pelorus, including Kaituna Pass and tributaries</td>
<td>15,000</td>
<td>15,000</td>
</tr>
<tr>
<td>(j) Queen Charlotte Sound</td>
<td>15,000</td>
<td>15,000</td>
</tr>
<tr>
<td>(k) Wairau</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kaiparati-ao</td>
<td>20,000</td>
<td></td>
</tr>
<tr>
<td>Wairau Plain</td>
<td>100,000</td>
<td>60,000</td>
</tr>
<tr>
<td>Wairau Valley</td>
<td>50,000</td>
<td></td>
</tr>
</tbody>
</table>

|                                   |                                                                               |                                                                                           |
|                                   | **306,000**                                                                    | **132,000**                                                                               |
### APPENDIX C.

**Population Distribution of Nelson**

*New Zealand Statistics of Population and Buildings, 1940-1.*

**Estimated population (including Maoris)**

<table>
<thead>
<tr>
<th>Urban Areas:</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nelson City</td>
<td>11,400</td>
</tr>
<tr>
<td>Tahunanui Town District</td>
<td>890</td>
</tr>
<tr>
<td>Other urban area</td>
<td>1,510</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13,800</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boroughs:</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richmond</td>
<td>1,130</td>
</tr>
<tr>
<td>Motueska</td>
<td>1,730</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Counties:</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waimea</td>
<td>11,950</td>
</tr>
<tr>
<td>Takaka</td>
<td>1,990</td>
</tr>
<tr>
<td>Collingwood</td>
<td>1,480</td>
</tr>
<tr>
<td>Buller</td>
<td>6,260</td>
</tr>
<tr>
<td>Murchison</td>
<td>1,760</td>
</tr>
<tr>
<td>Inangahua</td>
<td>3,840</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27,280</strong></td>
</tr>
</tbody>
</table>
APPENDIX D.

Meteorological Register for 1846-7 kept by J.W. Barnicoat on Waimea Plain.


<table>
<thead>
<tr>
<th>WIND</th>
<th>WEATHER</th>
<th>THERMOMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.E. S.W. Other Calm Fine qtrs.</td>
<td>Sunny</td>
<td>Cloudy but</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fair</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept. 1846</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>Oct.</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Nov.</td>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>Dec.</td>
<td>23</td>
<td>8</td>
</tr>
<tr>
<td>Jan. 1847</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>Feb.</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>March</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>April</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>May</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>June</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>July</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td>August</td>
<td>20</td>
<td>7</td>
</tr>
</tbody>
</table>

Totals 219 71 13 62 239 65 19 42 28.73 34 45 66 29 88
### APPENDIX E.

**TABLE XXV.**

(Belshaw, p. 112)

**Bright Sunshine (hours)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Auckland</td>
<td>219.4</td>
<td>191.9</td>
<td>179.5</td>
<td>143.9</td>
<td>131.8</td>
<td>114.1</td>
<td>120.9</td>
<td>150.4</td>
<td>149.7</td>
<td>169.2</td>
<td>191.9</td>
<td>209.8</td>
<td>1912.5</td>
</tr>
<tr>
<td>Napier</td>
<td>211.2</td>
<td>212.0</td>
<td>211.6</td>
<td>189.0</td>
<td>156.7</td>
<td>149.4</td>
<td>144.9</td>
<td>180.6</td>
<td>212.3</td>
<td>228.8</td>
<td>242.4</td>
<td>262.5</td>
<td>2451.4</td>
</tr>
<tr>
<td>Wellington</td>
<td>227.4</td>
<td>211.3</td>
<td>188.5</td>
<td>154.4</td>
<td>130.8</td>
<td>106.9</td>
<td>107.8</td>
<td>140.4</td>
<td>163.0</td>
<td>177.4</td>
<td>203.2</td>
<td>221.2</td>
<td>2036.3</td>
</tr>
<tr>
<td>Nelson</td>
<td>267.6</td>
<td>237.1</td>
<td>212.4</td>
<td>187.7</td>
<td>172.3</td>
<td>151.7</td>
<td>156.5</td>
<td>193.7</td>
<td>203.3</td>
<td>218.3</td>
<td>250.8</td>
<td>252.7</td>
<td>2504.1</td>
</tr>
<tr>
<td>Lincoln College</td>
<td>213.0</td>
<td>197.0</td>
<td>176.9</td>
<td>149.1</td>
<td>136.9</td>
<td>114.8</td>
<td>115.3</td>
<td>148.9</td>
<td>174.6</td>
<td>197.1</td>
<td>211.8</td>
<td>205.3</td>
<td>2040.7</td>
</tr>
<tr>
<td>(Christchurch)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alexandra</td>
<td>203.8</td>
<td>223.9</td>
<td>217.9</td>
<td>172.0</td>
<td>130.7</td>
<td>108.2</td>
<td>118.0</td>
<td>149.0</td>
<td>174.3</td>
<td>219.0</td>
<td>198.8</td>
<td>223.8</td>
<td>2166.4</td>
</tr>
</tbody>
</table>
## APPENDIX F.

### AREAS OF LAND IN OCCUPATION: UNDER CULTIVATION

**Agricultural and Pastoral Production: 1939-40**

<table>
<thead>
<tr>
<th>County</th>
<th>Land Occupied</th>
<th>Land Cultivated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waimea</td>
<td>603,454</td>
<td>177,378</td>
</tr>
<tr>
<td>Takaka</td>
<td>89,333</td>
<td>35,314</td>
</tr>
<tr>
<td>Collingwood</td>
<td>146,439</td>
<td>30,793</td>
</tr>
<tr>
<td>Buller</td>
<td>98,654</td>
<td>26,795</td>
</tr>
<tr>
<td>Murchison</td>
<td>180,663</td>
<td>55,893</td>
</tr>
<tr>
<td>Inangahua</td>
<td>86,313</td>
<td>20,104</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>1,205,356 acres</strong></td>
<td><strong>346,277 acres</strong></td>
</tr>
</tbody>
</table>
APPENDIX G.

DEPARTMENT OF AGRICULTURE REPORT:
Orchards, Gardens and Apiaries Division


Estimated Area in Acres under Orchards in Dominion.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Auckland</td>
<td>10,960</td>
<td>11,506</td>
<td>600</td>
<td>318</td>
<td>12,424</td>
</tr>
<tr>
<td>Hawkes Bay</td>
<td>2,569</td>
<td>2,305</td>
<td>120</td>
<td>130</td>
<td>2,555</td>
</tr>
<tr>
<td>Taranaki</td>
<td>742</td>
<td>948</td>
<td>50</td>
<td>60</td>
<td>1,058</td>
</tr>
<tr>
<td>Wellington</td>
<td>3,415</td>
<td>3,613</td>
<td>150</td>
<td>75</td>
<td>3,838</td>
</tr>
<tr>
<td>Marlborough</td>
<td>550</td>
<td>463</td>
<td>100</td>
<td>40</td>
<td>603</td>
</tr>
<tr>
<td>Nelson</td>
<td>3,961</td>
<td>4,874</td>
<td>600</td>
<td>750</td>
<td>6,224</td>
</tr>
<tr>
<td>Canterbury</td>
<td>3,554</td>
<td>4,113</td>
<td>200</td>
<td>280</td>
<td>4,593</td>
</tr>
<tr>
<td>Westland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Otago</td>
<td>2,793</td>
<td>4,012</td>
<td>300</td>
<td>360</td>
<td>4,672</td>
</tr>
<tr>
<td>Southland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>28,534</td>
<td>31,834</td>
<td>2,120</td>
<td>2,013</td>
<td>38,967</td>
</tr>
</tbody>
</table>

The increase in acres was 7,413 in four years - from 28,554 acres in 1908 to 35,967 acres in 1912. Nelson's increase in that period from 3,961 acres to 6,224 was of particular significance.
APPENDIX H.

HISTORICAL SUMMARY OF THE CHIEF SERIES OF SPRAYS AND THEIR USE IN NEW ZEALAND.

(From Plant Protection by the aid of Therapeutants, G.H.Cunningham, pp.1-25).

Group I: Sulphur Series:

In New Zealand ground and sublimed sulphurs have been used since 1892, but were not employed in the field until 1916 when they were applied to apple trees (with indifferent results) to combat powdery mildew. Colloidal sulphur was tested experimentally in 1930 with such satisfactory results that it has displaced the coarser sulphurs from the spray programmes of the Dominion.

Group II: Polysulphide Series:

Lime sulphur is a spray of general use in the apple industry in this Dominion. In New Zealand lime sulphur and salt was first recommended by Hanlon in 1892, and was used subsequently as a winter spray until about 1912 when it was replaced by commercial lime sulphur.

Group III: Copper Series:

The common Bordeaux spray has been used in New Zealand since spraying has been commonly practised.

Group IV: Arsenate Series:

Paris Green or aceto-arsenite of copper was one of the first sprays to be used in the Dominion. Lead arsenate was introduced a little later, and the value of these arsenical sprays having been recognised, they were used widely in the fight against codling moth, while the industry was in the relatively early stages of establishing itself.

Group V: The Oil Series:

Kerosene sprays were the first oil sprays but after 1905 the use of winter applications of lubricating oils superseded kerosene sprays. Little additional progress was made in the development of oil sprays until
the introduction of commercial emulsified oils in 1912. Since then lubricating oils have been used almost continuously as winter sprays.

Group VI: Plant Extracts:

In commercial orchards in New Zealand the only sprays used, which are derived from this series, are nicotine sprays but these are mainly used to combat "curly-leaf" of peaches.
APPENDIX I.

Summary of Apples and Pears imported into the Dominion at Different Ports of Inspection for year ended 31st December, 1912, from following countries.

<table>
<thead>
<tr>
<th></th>
<th>CANADA</th>
<th>CALIFORNIA</th>
<th>TASMANIA</th>
<th>VICTORIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Apples</td>
<td>Pears</td>
<td>Apples</td>
<td>Pears</td>
</tr>
<tr>
<td>Auckland</td>
<td>8,797</td>
<td>182</td>
<td>7,475</td>
<td>504</td>
</tr>
<tr>
<td>Wellington</td>
<td>1,392</td>
<td>250</td>
<td>11,140</td>
<td>3,062</td>
</tr>
<tr>
<td>Christchurch</td>
<td>1,083</td>
<td>2,265</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Dunedin</td>
<td>2,042</td>
<td>100</td>
<td>4,410</td>
<td>2,779</td>
</tr>
<tr>
<td>Bluff</td>
<td>50</td>
<td></td>
<td></td>
<td>2,712</td>
</tr>
</tbody>
</table>

**Total**  

|          | 13,314 | 532 | 25,340 | - | 9,057 | 1,126 | 52 | 1,257 |

Grand Totals = 47,763 cases apples.  
2,915 cases pears.

This list was compiled by T.W. Kirk from official returns for year ending 31st December, 1912, and appeared in Nelson "Colonist", September 12th, 1913.