LAND USE ON THE MOUTERE
GRAVELS, NELSON, AND
THE IMPORTANCE OF PHYSICAL
AND ECONOMIC FACTORS IN
DEVELOPING THE PRESENT
PATTERN.

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INTRODUCTION.

The Waimea County, Nelson, conveys to most people a picture of, an prosperous farming area, growing apples, tobacco, early vegetables, and a multitude of the profitable crops. However, this is only true of parts of the county, and few people realize that most of it is occupied by the formation known as the Moutere Gravels. Much of this area is very poor, and even marginal farming land, covered with bracken fern, gorse, and exotic plantations which stretch for miles. This problem region of the Moutere Gravels, separates the relatively fertile Waimea plains from the prosperous Motueka-Riwaka district, and presents a striking contrast to both.

The fact that this is a problem area, has at last been generally recognized, within Nelson at least, because of the effort of the Nelson Catchment Board. This body has been attempting to show that much of the land can be improved, and to encourage farmers to adopt better farming methods. The results of this investigation have been extremely interesting, and show that it would be possible to reduce the reverted area considerably. The results also show that the present land use pattern in which reverted land plays such a large part, need not have been dominated to such a large extent by the reversion.

In this paper an attempt is made to describe the present land use pattern in all its aspects, and to indicate the different factors which have influenced its development. Although physical factors much
as relief and climate have had a controlling influence, it seems probable that a study of the history of the region will reveal that other economic factors have played a far greater part. Thus it is hoped to explain how, and why, the pattern of land use as seen within the region today has developed.

TERMINOLOGY:

The term Moutere Gravels describes a geological formation, found in the Tasman Bay lowland. With the increase of local interest in the problems of farming on this formation, the term has been given rather an areal meaning. The gravel formation forms a distinctive region, extending over a large area, which contrasts clearly with the landscapes on the surrounding rock and depositional formations. As there is no local name in existence which includes only this distinctive area, the name of the geological formation has become a regional name. That most people in the Nelson district, the term the Moutere Gravels means, not a vast accumulation of gravels, but a distinctive region, recognized as a problem area, and given unity by its boundaries coinciding with the boundaries of the gravels.

LOCATION (Map 1.)

The Moutere Gravels region is located in the Waimea County, Nelson. It reaches the coast between the mouth of the Waimea River and Port Motueka, a distance of about 27 miles, and reaches some 60 miles inland to about Lake Roto-iti and Glenhope. It has an average width of about twelve miles, and covers an area of some 570 square miles.

MAPS.

The land use map of the region is on a scale of two miles to one
MAP 1

LOCATION

of places within the region, mentioned in
the text, and of the Moutere Gravels,
and the Waimea County.
inch, and it was found impracticable to cover the whole region on this scale. Consequently a line was drawn from east to west, passing just south of the point where the main road crosses Spooners Range, and the area south of this line was not mapped. The mapping of this southern portion was unnecessary, as the area covered was sufficient to indicate the land use pattern which prevails within the region i.e. more intensive farming on the valley flats, with large areas of permanent pasture, and small acreages of cultivated land. Between the valleys, reversion is widespread, and the hills are covered with fern, gorse, and other shrubby species. Large areas of the hill country, are, too, planted in exotic plantations. Although there are one or two minor exceptions to this pattern, as a whole it extends throughout the Moutere Gravels region.

In the area not mapped, the amount of cultivated land diminishes as one moves south. The pasture in the valleys, never of a very high quality, becomes progressively poorer, and the fern gradually encroaches on the valley flats, which in the extreme south show signs of slight reversion. Here too, the occasional cultivated field is devoted, not to hops or raspberries, but to turnips or other fodder crops. This change is not a sudden one, but a gradual transition, as first tobacco, then hops and raspberries disappear, and the reversion gradually spreads onto the valley flats. On the hills there is a gradual change from exotics to native bush.

Despite this gradual change in the type of farming, the general pattern of land use as established in the mapped area, with concentration on the valleys, prevails in the south of the region, and makes its mapping unnecessary.
GENERAL DESCRIPTION.

The Moutere Gravels region presents what is, at some seasons of the year, a drab landscape. Apart from the river valleys, which cover only a small proportion of the area, the region is mostly reverting land. Here gorse, ferns, heather and other types of scrub dominate the vegetation association, although south of Spooners Range, fern alone is important. This gives a landscape of dark greens and grey, except when the gorse is flowering. However the monotony of the landscape is broken by the presence of the valleys with their more prosperous appearance, and the forested areas, exotic plantations, and native bush in the south. The plantations cover large areas, especially round the Moutere Valley and Mapua, and these very dark, almost black blocks present an interesting and varied pattern. In the Golden Downs plantation, there are over 24,000 acres of exotics, and the mass of these trees is very striking.

The landscape of the region is given character by the unusual and interesting land use pattern, and in the following chapters, this is described, together with the history of its development. The physical conditions under which it has been formed are also described, and the reasons for the development of this unusual pattern analyzed.
HISTORY OF LAND USE ON THE MOUTERE GRAVELS.

The history of land use in the Moutere Gravels region will be traced to show how the present pattern has developed, and how new crops, on their introduction, have either displaced old ones, or considerably altered the balance of the land use pattern. It will be shown, that, as in other parts of New Zealand, land was cleared, and sown to pasture, or cultivated, without any thought about its suitability for farming. In their haste to occupy land, the settlers cleared, large areas that have since proved unsuitable for farming, and this has exerted a considerable influence on the present land use pattern. The region in this way has much in common with the Inland Taranaki - North Island hill country region where land that was cleared in the first flush of enthusiasm is now being allowed to revert, just as large areas of the Moutere Gravels which were cleared with hopes of obtaining good farm land, are now fully reverted to fern and scrub.

In this description of the history of land use, five dates have been taken as a basis of discussion, 1840, 1860, 1905, 1915 and 1930. The description of land use in 1860 will be fairly brief, as it shows most of the features of the 1905 pattern, on a smaller area. The years 1915 and 1930 have been selected, as by these dates, apples and tobacco respectively were becoming established as valuable crops,
Before proceeding to a consideration of the land use pattern induced by man’s occupation of the region, a short description of the situation in 1840, that is, of the natural vegetation, will be given.

NATURAL VEGETATION OF THE MOUTERE GRAVELS. 1840 (Map 2)

The reports of early explorers and surveyors provide the only information on the native vegetation of the region, but by a careful study of these, a fairly accurate picture can be obtained. These men have been particularly observant, and have noted in their reports the characteristics of the country which they passed through.

As can be seen from the map, the coastal area was one of barren clay hills, covered with fern and stunted manuka. Some of the valleys had small stands of native bush, but it was generally a desolate landscape. As the rainfall in this area is between 36 and 38 inches, it would seem sufficient to support a forest vegetation. The absence of forest vegetation is possibly due to the effect of salt spray being carried inland by northerly winds. 1

In the Lower Moutere Valley, there was a small area of scattered trees and scrub. This vegetation was transitional to that found on the stony flats of the Motueka River, where good drainage counteracted the heavy rainfall, and produced a grass and scrub vegetation. 2

The Wai-iti Valley, south of Brightwater was a natural grassland, which near the river degenerated into swampland with a flax association. 3

2. Ibid.
MAP 2.

NATURAL VEGETATION

on the Moutere Gravels, 1840, (approx.)
The Motueka Valley, above Motupiko, provided a striking area of open country, surrounded by dense bush. This expanse of tussock and Matagouri, surrounded by bush, in an area with a rainfall of 118 inches, must have come as a surprise to the first explorers. The grassland owes its existence to large quantities of serpentine transported into the valley from outside the Gravels by the Motueka River. This gives the soil too high a magnesium content for trees to grow. 1.

The greatest area of the Gravels was completely forested, the grasslands being restricted to the peripheral areas and some valleys. The forest cover was mainly composed of Nothofagus spp, though other species were important. The Moutere Valley for instance, had an exceptionally large proportion of tawai and rimu trees in the forest.

Apart from small areas of native grasses and tussock, mainly on alluviums in some valleys, and the area of scrub and fern along the coast, the Moutere Gravels carried a cover of heavy native bush in which Nothofagus spp were dominant.

LAND USE IN 1860.

Although the first settlement on the Moutere Gravels was established in 1844, by 1860, the occupied area had not increased to any great extent. In 1843 an attempt was made to establish a German colony in the Lower Moutere Valley. This failed as the lowlying croplands were flooded, but a further attempt in 1844 proved successful, and a prosperous colony was formed. 2. In the same year, the Wai-iti - Belgrove area was opened up, due to the southward spread of settlement over the Waimea Plains.

After this first spasm of settlement, little was done to open up the Moutere Gravels Region, partly because the plains were not fully settled, and partly because of difficulty of access. By 1850, a good dry

1. Ibid.
2. Ibid.
weather road connected Nelson to Waipu, but the road to Motueka was still under construction. In the early fifties settlements were established at Orinoco and Ngatimote as a result of the push up the Motueka Valley from the township.

Thus in 1860, the settled area was not great, but already the pattern of land use which was to predominate until the second decade of the twentieth century, was being established. Sheep raising, saw-milling, cropping, and a little dairying were the main occupations at this time, although their importance varied considerably from place to place.

The Moutere Valley developed early, and despite the low-lying, somewhat swampy ground, cropping became of considerable importance. However, the damp nature of the land was probably responsible for the development of dairying here, and the production of butter and cheese. It is interesting to note that dairying has persisted here until the present day, although it is now concerned with town milk supply for Motueka.

Cropping was important on the drier parts, with considerable areas under cereals, mainly wheat and oats. Hops were as yet unimportant, but some were grown.

The forest resources of the hills were being exploited by a saw-mill in the Rising Sun Valley, which sold good timber in Nelson and Motueka. Although this industry disappeared soon after the turn of the century, this area is again the site of milling operations, as *Punica radiata* plantations have been developed nearby.

The area between Brightwater and Belgrove was developing along similar lines to the Waimea Plains, with a market in Nelson. Hops were already grown here, although they were raised from a poor stock, and did not give outstanding results. This crop developed rapidly later in the century. The cereals, oats, barley, and wheat, were all important, and were marketed in Nelson, which was also the consuming centre for most of the potatoes which were grown here.

Livestock were rapidly becoming important, especially sheep, which were mainly Romneys. Turnips had been grown since 1845 as fodder for sheep, and this practice has persisted throughout the Gravels, on a small scale. Cattle were not as important, but grazed the rough areas which were being brought into production.

Orinoco and Ngatimoti had only been settled for a short time, and so were little developed. Some cropping was carried on, with oats and barley the main crop, but sheep and cattle were more important to the farmer. Cattle were relatively more numerous than in the longer settled areas, but sheep already exceeded them in importance.

In the Upper Motueka Valley, where the land was naturally clear of forest, a sheep run had been established as early as 1846. This occupied an area of some twelve square miles, and, carried about one sheep to every 4½ acres. A Southdown Merino cross was favoured here, and was claimed to give a lambing percentage of 123%, but this was probably in an exceptional year.

The land use pattern in 1860 can best be summarized through a brief, systematic, study of the main crops. Cereals were widespread, and important in all the settlements as the basis of their arable farming. The most important were wheat, oats, and barley, the first two being used in the manufacture of flour and oatmeal, although oats
were also important for horse feed.

Potatoes, turnips, and hops were of greatest significance in the Belgrove area, and reflected different aspects of the land use. Potatoes and hops had developed as commercial crops, sold in token, while turnips were used as a fodder crop. Hops were restricted to the Belgrove area, with a few acres in the Moutere Valley, and although handicapped by the use of a poor stock, they were much the most important of these three crops.

Grazing was important in all cleared parts of the region, and possibly extended some distance into the bush. Cattle were important in breaking in new ground, but only at Lower Moutere had dairying developed any significance. Sheep dominated the land use of the period, and were of greater importance in the longer settled areas, where Romneys for meat and wool were grazed by most farmers. In the Upper Motueka Valley, merinos, and merino crosses were the main breeds.

The period 1840-60 saw the pattern of farming developing on the Gravels, which was to outline basically unchanged until 1910, although during this period it developed rapidly areaically, and production increased considerably. The two periods between the years 1840 and 1910, could be characterized as ones of steady development, without any startling introductions of new crops.

**LAND USE IN 1905.** (Map 3)

The period 1860 to 1905 saw the settlement of all the Moutere Gravels, and the establishment of the main farming centres which exist at present. The opening up of new land in the decade 1860-70 was particularly rapid, due to a government policy of encouraging settlement. The Dovedale area (1861), Motupiko (1869) were all settled first during this period. 1.

1. Barretton C.B: Vanguard of the South, Wellington, 1952 p. 320/
MAP 3

LAND USE IN 1905
LAND USE in 1905

- Hops.
- Cereals, wheat, oats, & barley.
- Root crops, potatoes & turnips.
- Orchards.
- Timber mills.
- Sheep.
- Cattle.
- Bush.

Note: Map is diagrammatic & location of crops approximate.

H. Bourne-Webb.
The land cost 10 shillings an acre in most areas, and development was slow at first, as clearing the bush was a fairly tedious task. By 1874, however, hops and wheat were established at Dovedale, 1 and as the other settlements probably developed at similar rates, it would be fair to say that by 1880, the Moutere farmers had attained a stable position, and had successfully established themselves.

By 1905 the Gravels were probably supporting as many families as they do today, although extensive areas were still covered with native bush, and a stable form of land use similar to that prevailing elsewhere in the Nelson Province, had been established. The pattern was very similar to that of 1860, although on a larger scale. Cropping of cereals extended throughout the Gravels and hops had developed as a commercial crop. Sheep and cattle were both important, as in 1860, well bred sheep being used in most flocks. Sawmills had also become more plentiful.

As most of the settlements were still distinct units in 1905, and the basic products had different relative importances in each a discussion of the land use in each area will serve to show how it had developed, and to what extent, since 1860.

The Moutere Valley was already showing much of its present prosperity, and land use pattern. It was one of the best developed areas of the Gravels, partly because of the relatively good soils found at Lower Moutere, and partly because of the Community spirit and hard work of the German settlers. The valley had already been proved suitable for all kinds of fruit, and a few small orchards had been established. Wheat and oats were also giving good yields throughout the valley, and hops were rapidly developing as the most important crop of the district.

1. Ibid., p. 208.
Sheep and cattle were also important, probably more so than today at Upper Moutere. Some dairying was carried on at Lower Moutere, but was not very important, most cattle being bred for meat. Throughout the valley, livestock were more important than crops, one farm of 1600 acres producing a few acres of wheat and oats, while carrying 500 sheep, and 70 cattle.

Apart from farming activities, the sawmill in the Rising Sun Valley was still in operation, although the amount of bush remaining within a reasonable distance of the mill must have been approaching exhaustion. The only other form of industrial activity in the valley was a small flour mill between Upper and Lower Moutere.¹

The Belgrave-Wai-iti area, with the Moutere, is the oldest settled area of the Moutere Gravels, and by this period had a well developed commercial agriculture, in many ways similar to that existing today.

Hops were found throughout this area, and provided the basis of commercial arable farming, a good quality stock having been imported, and replaced the early types. The importance of the crop at this time can be judged from the fact that £1,000 per annum were paid out in pickers wages in this district. Wheat was unimportant, as even potatoes and turnips, the former for domestic use and for sale, were more important than cereals.

Good quality Romney-Marsh and Leicester sheep were carried for meat and wool, at an average density of about 2½ per acre. The extensive use of winter fodder, especially turnips was the basis of this relatively high carrying capacity. Cattle and horses were not of great importance, and the numbers of the former had declined considerably from the previous period.

The land was generally well subdivided, most farms being less than 500 acres, with sheep and hops the main support of the population of about 500 in the district. In the south, and up the subsidiary valleys, farms were larger, and mostly devoted to grazing, one in Quail Valley covering 3,000 acres.

Saw milling was also carried out on a large scale, as there were several mills in the district, producing rimu, beech, and red and white pine timber. At Wai-iti the bark was also used for tanning. 1.

The Dovedale, Thorpe and Stanley Brook districts were producing wool, hides, hops, and grains, at this time. Although much of the land was bush covered, this was mostly restricted to the hills, while the valley flats were used for farming. Most of the holdings were from 200 to 500 acres, largely in the valleys, but the bush was being pushed back steadily.

Most of the cleared land was devoted to grazing sheep and cattle, although a small area was planted in crops, especially wheat and oats. As in all areas where land was still being broken in, cattle were relatively important, and were used for rough grazing. A small acreage at Dovedale was planted in hops, and although the area remained static, they continued to be grown here until about 1940. 2.

At Orinoco and Ngatimoti, sheep were mainly dominated the land use, and cropping was insignificant. The sheep were mainly Border-Leicester and Romney-Marsh stock, carried with a high proportion of cattle, about one beast to 30 sheep. 3.

1. Ibid., p112.
2. Ibid., p136.
3. Ibid., p138.
In the Motupiko and the Tadmor Valleys, holdings ranged in size from up to 500 acres at Motupiko to 1600 acres at Tadmor. Although the relative size of the farms does not suggest it, cultivated land was practically non-existent at Motupiko, while crops became more important in the Tadmor Valley.

Lincoln, Romney-Marsh, and Merino sheep were carried, at a rate varying from one to two per acre, with cattle in the proportion of one beast to 30 sheep. 1.

In the Tadmor Valley more land was devoted to crops. Hops were grown here, and were fairly important, while oats, potatoes and turnips were minor crops. The area devoted to cultivation in the Tadmor Valley has persisted to the present day, with hops still the dominant crop, as has the contrast with the lack of cultivated land at Motupiko.

**SUMMARY.**

In this period we see farming fairly evenly divided between cropping and grazing with sheep and cattle important throughout the region. The distribution of crops is fairly even, with cereals, usually wheat and oats, and hops grown in most developed areas. The cereals are the least important of these, and show a tendency to decline in the southern part of the Gravels. Hops, however, are important everywhere, and even the most southerly settlement at Tadmor has extensive gardens. Root crops are fairly extensively grown, but are of minor importance.

At this time, the land use pattern that was to be modified in varying degrees, dependent on the locality, by the introduction of apples and tobacco as cash crops had been established. Land was still being

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1. Ibid., p143.
cleared from the forest, but the amount of farming land was not increased greatly, as much of the earliest cleared land was already reverting.

LAND USE IN 1915.

In 1915 the apple orchards of the Moutere Gravels Region were being developed, and were rapidly reaching their peak as regards acreage. At this time few orchards had reached maturity, and total yields were small. However, as the pattern of distribution established at this time has remained practically unchanged, the year 1915 will be taken as a basis to discuss the development of orcharding in the Gravels Region in the period 1911-20.

Before 1911, although small orchards had been established in the Moutere Valley, large scale plantings had not developed. In 1911 a few apples were exported from Nelson, but by 1919 this trade had increased to 1,000,000 cases. 1.

In the decade before 1918 there was a boom in orcharding through most of the world. It was suggested that the Moutere area would be suitable for development, as it provided clay soils which at that time were thought to most suitable for apples. The area was opened up by large syndicates, sometimes controlled by Nelson firms such as Buxtons Ltd. These bought large blocks of land, subdivided it, and provided access, after which they put it up for sale. Due to their sales talk, not only experienced farmers, but city dwellers purchased blocks, which they often controlled as absentee landlords, through managers provided by the syndicates.

Between 1911 and 1916 about 7,000 acres were planted. The location was similar to that occupied today, between the Moutere Valley and the coast, with Tasman the main centre, and Mapua and Mariri also important.

The early plantings were on land covered with fern and manuka, and even these grew poorly on the ridges, which were often eroded down to clay. Where a thin topsoil was present in the valleys, it was infertile.

and lacking in organic matter. After cultivation the trees were planted on this country with only a handful of blood and bone fertilizer per tree as manurial treatment. The plantings were also on a square pattern, with no thought to possible erosion in the future. It is hardly to be wondered at that poor growth and slow development resulted, and this defeated many growers who lacked finance for fertilizers and seed for cover crops, and who had little knowledge of soil requirements.

After 1918, when the first flush of enthusiasm had passed away, it became obvious that the Moutere soils were not as good as had been claimed, and that the cost of development and the time required for trees to come to maturity, had been miscalculated. These difficulties forced many people, especially those who had little capital in the first place, out of production, and abandoned orchards became a common sight, until the industry stabilized at about 2500 acres.

Apple growing has persisted on the Moutere Gravels, despite the poor soils, because the climate favours it. Good growth conditions up to mid-summer, followed by dry conditions throughout the harvest, usually provide extremely favourable conditions for apple growing, and allow reasonably good yields to be obtained.

The land use pattern was very similar to that found in 1905, the addition of apple orchards on what had previously been little used land being the only major change.

By this time, most of the native bush had been cleared, only isolated patches remaining, except in the south, and the sawmilling industry had practically disappeared. The milling of exotics was still a thing of the future, as there was only one plantation of any age on the Gravels, and that was not yet mature.

In the inland valleys, the pattern of farming was still very similar to that prevailing ten years previously. The area of land available had increased as the bush was cleared, but all the valley flats were now occupied, and most of the hill country was taken up by farmers already established in the valleys.

Cropping had declined somewhat, especially where wheat and oats had been grown. Oats grown for horse fodder, had been the most important cereal, and had given good yields in the early days. However, constant cropping, with no fertilizer treatment, had exhausted what little fertility the soil had, and yields became insignificant, with complete crop failures in some cases. Thus we see the importance of arable farming declining throughout the Gravels, largely due to a rapid reduction in the area planted to cereals.

Hops were the most important crop, but apples were soon to surpass them, in monetary yield, as well as in acreage. Although apples exceeded hops in acreage in 1915, it must be noted that hops were increasing in importance, and rapidly approaching their greatest areal extent, reached about 1924.

Livestock too were important. Although cattle had declined somewhat, sheep had increased in numbers and importance, and dominated pastoral farming. The carrying capacity of the hills was still fairly good, about 1-2 sheep per acre. At this time too, the hills were much more extensively used, as much of their area had only been cleared for a few years, and reversion had not yet become a problem.

In 1915 then, the northern part of the Gravels Region was passing through a period of change, with the introduction of the apple industry. This period had not affected the greater part of the Region, and here farming was still carried on along the lines which had been established.

for fifty years. Farming practice had only been slightly modified at this time, but was shortly to be re-orientated, and the whole economy and outlook of the southern area was to be changed as effectively as that of the coastal area.

**LAND USE IN 1930.**

This period is important, because it sees the introduction of tobacco as a crop, with a complete alteration of the farming methods. It might well be stated that tobacco was the economic saviour of many Moutere farmers, as it came at a time when the reversion of the hill country was becoming difficult to control, and farming was becoming more difficult. By growing tobacco a farmer could get a reasonable living off a small area of flat land, and so neglect of the hill country became widespread.

This was in many ways unfortunate, as although much of the hill land was too poor and steep to be farmed successfully, and would have gone back to fern and scrub anyway, a larger area could have been satisfactorily maintained in fairly good pasture. However, due to this concentration on tobacco, about 50% of the Gravels Region has reverted to some extent to scrub and fern, and about half of this is fully reverted. In 1930 the possibilities of tobacco were just being realized, and the total neglect of the hill country just beginning.

Tobacco had been grown in Motueka in 1916, and the yields obtained there, and from a field planted in Brightwater in 1920, pointed out to the New Zealand Tobacco Coy the possibilities of the Nelson area. In 1927 the Motueka Tobacco Growers Association sold 13000 lbs., of leaf to W.D. and H.O. Wills, and after this the industry started to go ahead very rapidly. By 1930, the fullest development had not

taken place, the greatest increase being between this year and 1932 when the acreage rose from 805 to 1403. After this the acreage increased slowly, but steadily, until 1940, when it jumped suddenly from 1825 to 2875 acres. The amount of tobacco produced on the Gravels is relatively small, only about 4% of the county totals mentioned above, but it has exerted a great influence on the land use pattern.

In 1920 then, there were probably about 350 acres of tobacco planted on the Gravels, and distributed throughout all the main valleys. The amount grown was probably greatest in the Wai-iti and Dovedale areas, with slightly less in the Motupiko-Tapawera-Tadmor area, and the least in the Moutere Valley. In the Dovedale and Tapawera districts, where the area of arable land had been small since the beginning of the century, it again became important as fields of tobacco sprang up in the valleys. In other areas, although hops and raspberries continued to be grown, tobacco became more important in the land use pattern. Coincidental with the crop itself, the characteristic kilns, where drying is carried out, sprang up throughout the Region.

With the introduction of tobacco, arable farming took on a new lease of life, and the area of cultivated land became greater than it had been at any time since cereals declined. Hops and raspberries were still important in those areas where they had been grown, although the acreage had declined somewhat from the 1924 maximum. Root crops for fodder had become of little importance, while cereal production had almost completely disappeared.

The area in orchards had stabilized at about 2500 acres, and has remained around this figure ever since. Although apples were the main

1. This figure is only a rough estimate based on a comparison with the 1943 distribution, as separate figures for the Moutere Gravels are not available.
type of fruit grown, some pears were also found in the Lower Moutere Area.

Livestock were still important, and had not yet suffered the relative decline which was due to the introduction of tobacco, and the increase of reversion. Sheep were, of course, still the mainstay of pastoral production, the hills carrying about 1½ to the acre, and farmers had not yet lost interest in this more extensive farming. Dairying had developed some significance, usually supplying cream to the Brightwater butter factory, which has the largest collection mileage in New Zealand. At Lower Moutere, town milk supply was the main source of dairy farm income, and was the most profitable type of farming in the Gravels Region.

In 1930 we find that all the features of the present land use pattern had been established. Hops had been grown since the earliest settlement, and tobacco and apples are more recent developments. At this time, the reversion which is such a problem today was just beginning to develop seriously, and all the factors making for its increase are present and operating. In the following chapter, the distribution of these crops, and the extent to which they have developed will be shown, following on from the historical study of their development, and making the study complete.
Chapter III.

Present Day Land Use on the Moutere Gravels, Nelson.

The description of the present day land-use follows logically from its history, and represents the final stage of the development of farming. Crops which have been important in the past will have declined, while others have reached their greatest importance, and dominate the land use. In this way, the history of the region has affected the present day land use, through the development and decline of different crops, but it must be borne in mind that it was the operation in the past of factors which are working today, which has affected the distribution of these crops. The importance of these factors will be assessed later. The main influence of history on the present day, has been through the clearing of unsuitable land by the first settlers, and through the introduction of special crops, which brought major changes in the land use.

In discussing the present land use, the region has been divided up into three main categories, intensively farmed areas, forested areas, and reverted areas, which will be discussed separately, so their relative importance can be seen. (See map IV.) Within the first category, the different valleys will be discussed as separate regions, as the cropland and clean pasture is concentrated in the valleys, while the crops grown vary in importance from one to another. The coastal orcharding area will also be included, and it is worthwhile noting that this is the only area of intensive farming that is not restricted to the
Map 4

Land Use and Generalized Land Use Regions
LAND USE (generalised) and LAND USE REGIONS.

KEY:

A. INTENSIVE FARMING AREAS.
  I Moutere Valley
  II Waipiti and Brightwater
  III Thorpe and Downdale
  IV Stanley Brook
  V Orino Valley
  VI Motupiko-Tapawera
  VII Tadmor Valley
  VIII Valleys to South
  IX Coastal Orcharding Area

B. FORESTED AREAS.
  I Pine Plantations
  II Native Bush

C. REVERTED AREAS.
Simplified from Land Use Map.

SCALE:

0 1 2 3 4 5
0 1 2 3 4 5 MILES
valleys.

(a) THE INTENSIVE FARMING AREAS.

THE MOUTERE VALLEY.

Apple orchards are fairly extensive here, and it is possibly the presence of these which contributes most to the landscape, which has a more prosperous appearance than any other part of the region. They are concentrated, with several pear orchards, in Lower Moutere, where, unlike those in the coastal area, they are surrounded by clean pasture. At Upper Moutere there are few orchards, and these are usually on the slopes to the south of the valley.

Unlike orcharding, tobacco is most important in Upper Moutere, where, in 1943, there were 94 acres, compared with twelve at Lower Moutere. These areas have decreased slightly at the time of writing, but the distribution is still the same. Hops, too, are concentrated mainly at Upper Moutere, although the total acreage is not very large. Raspberries are grown on one farm only, and their area is negligible.

Pastures are extensive, and, as everywhere in the Moutere Gravels region, exceed the amount of cultivated land. The pasture is usually of fairly poor quality, and weeds are frequently numerous in the sward, although there are exceptions, especially at Lower Moutere, where dairy cattle are grazed. In the Rosedale and Neudorf valleys to the west, a similar type of farming to that at Upper Moutere is practised. However, here cultivated land is negligible, and the similarity is mainly in the poor quality of the pasture, and the fact that only sheep are grazed.

The best pastures are found at Lower Moutere, but this is easily explained. Apart from orchards, arable land in tobacco and hops is not extensive, for the main occupation is dairy farming for the town milk supply. Pastures still show a high proportion of weeds, but clean swards and clover are much more frequent. Also fertilizer is applied, and a better scheme of farm management followed. Apart from the established farms on the flats, some new land is being broken in on the gentle slopes to the west.

Looking over the Moutere Valley, the dominant impression is one of trees, and indeed these are an important feature in the landscape. (See Plate 1.) This is largely due to the number of pine plantations (usually Pinus radiata) in the area. On the river flats there are several plantations as well as many shelter belts. On the valley slopes they are extensive, particularly to the east, where they extend from Lower Moutere to Harakeke. Deciduous trees are also important in the landscape, especially as they are large and well developed even along the smaller streams.

Despite the relative prosperity of the area, particularly in Lower Moutere, wasteland in scrub and gorse is fairly extensive. These areas are usually along the river banks or small streams, and often cover a considerable area, as can be seen from the land use map. The plant cover is usually composed of deciduous shrubs and manuka, gorse, or blackberries. This is particularly striking at Lower Moutere, despite the fact that the area is probably greater at Upper Moutere, especially on the west bank of the river.
A. Note newly broken in land in foreground, on slopes, and the number of trees in the Valley.

B. Poor, patchy pasture in foreground. Scrub and *Pinus radiata* plantations in background along far side of valley.
On the slopes, reverted land is very extensive, and reaches down to the flats in places. The slopes to the west are usually fairly gentle, and could be farmed fairly easily, but reversion is general, except where there are plantations. It is on these slopes that some land is being cleared and laid down to pasture, but this is a costly operation, and only small areas of newly broken land are seen.

The Moutere Valley shows a distinct contrast between its Lower and Upper sections. The former is more prosperous, with extensive orchards, and the rest of the land largely in good pasture, carrying dairy cattle, and small plantations. There are also small areas covered with scrub and gorse. At Upper Moutere, hops and tobacco, unimportant at Lower Moutere, predominate, and orchards are fewer. The area is generally less prosperous, and wasteland is much more extensive on the flats. Pasture is not so good, and is devoted to supporting a few sheep. Indeed, Upper Moutere has much more affinity with the other valleys of the region, than has Lower Moutere.

THE WAI-ITI VALLEY.

By the Wai-iti Valley is meant that area south of Wakefield, before the valley opens on to the plains, and which includes the tributary valleys, the most important of which will also be discussed.

Orchards are rarely seen in this area, and the one which has developed is now very old. Indeed, the pattern of land use in the district developed very early in its history, and has been only slightly modified since.

Although a considerable amount of tobacco is grown here, in the Wai-iti valley proper, hops are the more important crop. This was one of the first areas to grow hops, and their importance was established early. Gardens are frequent, and usually about four acres, while there
is a high demand for seasonal labour for harvesting. Production is also important in some of the tributary valleys, particularly Eighty eight Valley.

Tobacco is also of considerable importance, 223 (1) acres being planted in this area in 1943, however a large percentage of this acreage is found in Pigeon Valley, and the amount in the Wai-iti Valley proper is not great.

Other crops grown here are sweet corn, potatoes, and similar crops of the market gardening type. These are not of great extent, but do provide a variety in the land use, which is usually lacking in the region.

As is usual in the Moutere Gravels region, crops do not occupy a large acreage, although they provide a large proportion of the farmers' incomes, and dominate the economy. Pastures then play a large part in the landscape. In the Wai-iti valley they are generally poor stony, with an occasional well tended sward. In summer the poor quality of much of this grassland is accentuated by the fact that it dries out, and takes on a brown and dusty appearance. This tendency for much of the pasture, even on the river flats, to be of a poor quality, is found throughout the Gravels region and provides a distinct contrast to the Lower Moutere area with its relatively good and well tended pasture.

A few sheep are carried on these fields, with occasionally, a small herd of cows, usually supplying cream to the Waimea Dairy Factory. Although dairying is relatively unimportant, on the few farms where it is carried on, it provides an important addition to the cash income.

Native bush is still found in small remnants here, and is a characteristic feature of the landscape, particularly around and south of Belgrave. Although it is found scattered throughout the valley, the greatest amount is found on the east side, along the break gradient be-

tween the slopes and the alluvial flats. Plantations are unimportant in the valley, north of Belgrove, although south of here, a large plantation covers the eastern slopes. In the tributary valleys, particularly Quail Valley they become of far greater importance.

Eighty-eight Valley is the most important of the minor valleys, partly because it is the largest, and partly because the presence of several progressive farmers makes it a prosperous area. This is probably because many of the farms have some area which is not on the gravels, and the streams running in from the east no doubt improve the alluvial soils found here. Hops and tobacco are both fairly important, but pasture definitely dominates the landscape. Although some is of a poor quality, it is generally much better than the Moutere average, and large areas, planted with good grass, and maintained by regular topdressing, are in good heart, and carry 3-4 ewes per acre. Although there is a considerable amount of cultivated land, particularly on the gently slopes to the east of the valley, most of this is reverted land which is being broken in for sowing to pasture.

The slopes to the west of the valley, are generally steep, and mostly fully reverted. This area has not been touched, as it is too steep to cultivate, and unless it is planted to conifers will continue to be unused.

Quail Valley is most important, because it is the site of one of the largest privately owned plantations on the gravels. The plantation covers the area between this valley, and the Wai-it Valley, and is owned by Nelson Pines Ltd. In the Valley itself, there is a narrow strip of fairly good pasture, with a few hops planted at its junction with the Wai-it Valley. There are two small settlements in the valley, associated with sawmills.

Pigeon Valley, to the West of Wakefield, is the main tobacco growing
area in this sector. Much of the valley floor is planted in this, with very few hops, and no other crops grown. Pasture is not very extensive, and generally poor, many of the fields having blackberries, and other weeds growing along the fence lines, while considerable areas of the flats are covered with bush, gorse, and blackberries. There is also a small pine plantation on the south side of the valley.

The Wai-iti, and its tributary valleys, are generally characterized by fairly poor pastures, with sheep, and occasional cows, scattered clumps of bush, and wasteland, the amount depending on the location, and, often surrounded by bush and blackberries, small fields of hops and tobacco, on which the farm economy is based. Within this general framework, there is considerable variety, between the better managed parts of the valley, the more open, but poorer country of the Wai-iti, and the heavily overgrown Pigeon Valley, with its many small fields of tobacco. BRIGHTWATER TO WAKEFIELD.

Most of this section consists of extensive river flats, bounded by a steep slope on the west, where the Wai-iti is still wearing away the gravels, and widening its flood plain. On the east, lower hills, more gently sloping, bound the flats, and extend to the eastern boundaries of the gravels. These flats seem to have better soils than most of the valleys in the region, probably due to the addition of material brought down by streams from the hard rock mass to the east. Because of this, the land use pattern differs from that of most of the region, and is, indeed, part of the Waimea plains economy. However the area is within the Moutere Gravels boundary, and a brief discussion of the land use will therefore be given.

Pasture is important over the whole of the area, but it is not intensively used. It is generally of a fairly good quality, though, like
the grass in the Wai-iti Valley, it suffers slightly from lack of rain in the summer. Sheep, and a few cows are grazed.

The hills to the east have large areas of reverting, and reverted land, although a considerable acreage has been broken in, and put into good pasture. There are several small plantations, and along the slopes bordering the plains, some patches of native bush.

On the Eastern border of the area there are small valleys separating these hills from the hard rock mass to the east, and generally tributary to valleys running from east to west. In these valleys fairly good pasture is found, although some is heavily weed infested, and these usually carry a fairly high number of sheep. The small areas of cultivated land are usually used for turnips and fodder crops.

On the plains themselves a much more varied form of agriculture is practised, in comparison with the gravels proper. Orcharding is fairly important, stone fruits being grown as well as apples. This is concentrated more in the west. Tobacco and hops are not grown here, the cropping being on a different basis. Some grain crops, mainly barley and wheat, are grown, while the market garden type of crop, potatoes and tomatoes for example, are fairly important. Some peas are also grown, mostly under contract for canning, although a large proportion are hand picked, and marketed fresh.

This area then is really part of the Waimea Plains, with its tomatoes, peas, grains, and apples, and shows many of the characteristics of the plains, however it must be included within the Moutere Gravels region, as its soils have many of the qualities of Moutere soils, and are composed mainly of resorted gravels.

THORPE, DOVEDALE, AND STANLEY BROOK.

Although these areas cover two separate valleys, of which the Dove valley is the larger, they have very similar characteristics, and so are
included together.

Here, tobacco dominates the land use, and fields in different stages of growth, or under cultivation for it depending on the season are a common sight at all times of the year. Most farms in the area rely on tobacco for the greater part of their income, usually planting, eight or more acres per annum. Dovedale is the third largest producing area, ranking after Riwaka and the Motueka Valley in 1943 with 296 acres. Separate figures are not available for Stanley Brook, but with Motupiko and Tapawera, it produced 239 acres, and probably at least 100 acres of this amount were grown there. 1.

Very little cultivated land is devoted to crops other than tobacco, and these are usually for fodder purposes. Turnips and occasionally oats may be planted, the latter being grazed during the winter for fodder. Clover too is sometimes planted, and used for hay.

The remainder of the valley flats are devoted to pasture, often permanent. There is very little rotation of crops, the tobacco tending to be grown on the same sites year after year. Some of the pasture is of fairly good quality, although little fertilizing is done, but much of it is infested with blackberry barberry, and other weeds. Sheep are usually carried, although the numbers are not high, most farmers regarding them as purely a side line to their main interest of tobacco growing. However at Dovedale there is one farmer, who, unlike most Moutere landholders, is purely a sheep farmer. His run is located in a tributary valley, largely on rolling slopes, on an area of clean native pasture between these two valleys. This does show that it is possible to farm the gentler sloping areas of the region successfully, but most of the areas have reverted so far that many farmers are reluctant to invest the capital required to bring them back into full use, especially as

they can make a satisfactory living by farming the valleys.

Apart from sheep, many farms carry a few dairy cows, supplying cream to the Waimea Dairy Factory. This again is regarded as a side-line, and most of the herds are small, usually less than twenty head.

There are a few small areas of native bush, and some small plantations, but trees are largely restricted to river banks, where willows are dominant, and small valleys where patches of bush remain. Hedges are common here, but instead of the untidy gorse hedge usually found in the region, Barberry hedges, often untrimmed, and growing to a considerable height, predominate. Manuka also becomes more prevalent in these valleys, especially on the slopes where there are often extensive stands.

These two valleys are more dependent on tobacco than any other area in the region, and it is here that the crop becomes an important feature in the landscape, partly because of the area devoted to it, and partly because of the characteristic kilns for drying the crop. Other factors are relatively unimportant in the farm economy, and specialization in one crop is exceptionally developed, even for the Moutere Gravels Region.

ORINOCO VALLEY.

This valley is not entirely included within the region, and that part outside of it is the richest. Within the region, the valley is mostly reverting to heath and bracken fern. There is some clear land in poor pasture carrying a few sheep. Most of the cultivated land is being reclaimed from fern, but the eradication of heath is a difficult problem. There are a few small plantations, but these are not important, while the one orchard in the area is now unproductive.

This valley, apart from the fully reverted country between the valleys, is probably the poorest area in the northern half of the region.
The landscape is dominated by the drab colour of fern and heath, with large stands of manuka, and a considerable amount of gorse. However, despite this, farmers do manage to make a living off the relatively small amount of clear ground, by placing more dependence than is usual on the few sheep which can be run on the reverted land. The present extension of cleared land may indicate that they are finding this a somewhat precarious existence.

**MOTUPIKO - TAPAWERA.**

This area can be divided into two main sections, the Motupiko to Tapawera portion of the Motueka Valley, and the Motupiko Valley proper. The area on the west bank of the Motueka River, north of Tapawera has been included with the Tadmor Valley, as it shows greater similarity to, and is contiguous with it. (Map 5)

The Motueka - Tapawera section is not typical of the usual land use in the Moutere Gravels region, as specialized cropping is relatively unimportant here. A little tobacco is grown, but most of the arable land is devoted to and occasional crop of wheat or oats, (see Plate lla.) turnips, or clover for fodder crops. Most of this cropping is confined to a river terrace which extends from Kohatu to some distance north of the boundary of the gravels. (Map 5).

Some stands of native bush remain on the flats, and a Golden Downs State Forest Nursery is located near Kohatu, but on the whole the valley north of Motupiko is not wooded. South of Motupiko however, trees become more plentiful, windbreaks of poplars or pines are common, and 2½ miles south, the boundary of the State Forest is reached, and *Pinus radiata* plantations almost cover the area.

Apart from the few crops grown, this area is devoted to grazing, mostly sheep, but a few cattle and dairy cows are carried. The pastures
MAP 5

TERRACES AND SUBREGIONS

AT MOTUPIKO
MAP SHOWING
1. MOTUPIKO - TAPAWERA SUBREGIONS.
2. MOTUEKA, TADMOR RIVER TERRACES.

KEY:
- TERRACES.
A. TAPAWERA SUBREGION.
B. MOTUPIKO VALLEY SUBREGION.

SCALE:
0 1 2 3 MILES.
are generally fairly good as the soil has a better constitution than most Moutere soils (see chapter on soils) and responds well to treatment. There is a certain amount of variety within the area itself. On the river terrace, pastures are good, but tend to dry out somewhat during the summer. Here the landscape is open, and the fields arranged in neat rectangles.

On the river flats, the fields are irregularly shaped, and although the pasture is still good, large areas of land are covered with gorse and scrub. The gorse is particularly bad along the river bed, and has spread out for a considerable distance over the banks. However some farmers have attacked it, and are pushing it back. Apart from this, many fields are separated by lines of blackberry and gorse, and poorly drained areas tend to be neglected, and covered with manuka and gorse.

South of Motupiko, the river flats do not have the same amount of reversion, although it is important along the river bank. The land here is fenced into neat rectangular paddocks, but the greeness of the fields, and the numerous trees in the shelter belts distinguish it from the terrace area.

This region is less devoted to specialized crops, and more to grazing than the rest of the valleys, and hence sheep and cattle are much more important. It has contrasts, between the areas south of Motupiko, the river flats, and the river terrace, within the same type of land use, and these all contrast with the section in the Motupiko Valley.

In the Motupiko Valley, the typical land use pattern of the region appears again. Here raspberries are the most important of the special crops, though some tobacco is grown. Turnips are grown as a fodder crop, largely to supplement the winter feed of the small dairy herds, though some are grazed out to sheep. The pasture on the river flats is fairly
Plate 11.

TAPAWERA.

A. Tapawera valley one mile below Motupiko. Terraces in foreground have had a wheat crop taken off them and are now being grazed. These were the the only beef cattle seen in the region, showing their un-importance. Note, too, the heavy growth of willows and scrub along river, and reversion and rank growth on terrace, right foreground. See long straight slope on north (right) side of valley.

B. Small valley west of Wakefield. Sheep on poor pasture, with reversion on slopes and roadside. Contrast rolling nature of region with hard rock country in background.
good, but deteriorated towards the south. However the area available is also limited as the Valley rapidly becomes fairly narrow.

Moving south up the valley, the area of crops diminishes rapidly, and the importance of pasture increases. However at the same time the area of fern and scrub in the valley also increases. On the valley slopes to the west, occasional patches of ploughed land indicate that further small areas of reverted land are being restored to grass.

In the Motupiko - Tapawera district we have a contrast between the typical land use of the region, as shown in the Motupiko Valley with its larger proportion of crops, and the more extensive, and probably better balanced type of farming found on the better soils in the Motueka Valley, north and south of Motupiko.

THE TADMOR VALLEY.

The Tadmor River joins the Motueka river near Tapawera, and its Valley runs roughly south from the Junction. It is close to the western edge of the region, and is bounded on the west by steep hills. The valley floor varies considerably in width.

Raspberries are important here, as in the Motupiko valley, in fact, apart from a garden at Upper Moutere, these are the only producing areas in the region. However, in the Tadmor Valley, both hops and tobacco are also grown, although the latter is relatively unimportant. North of the junction of the Tadmor and Motueka rivers, a considerable area has been planted in potatoes. This is a response to the present shortage, and prevailing high prices, and the crop will not be a permanent feature. South of the settlement at Tadmor, these crops gradually disappear, although about three miles south there is a concentration of raspberries.

The pasture here is usually fairly good, although the standard varies considerably. At Kaka, there is a small limeworks, which supplies
most of the valley's requirements at a cheap rate, and this helps to maintain the pastures. However, as in all parts of the Moutere Gravels region, large areas are covered with blackberry and fern, particularly along fence lines.

South of Tadmor there is, on the east side of the valley what appears to be a remnant of an old river terrace. The flat surface of this is covered with good pasture, with a little land in crops.

**SMALLER VALLEYS SOUTH OF THOSE SHOWN ON LAND USE MAP.**

These include the southern portion of the Motupiko Valley, the Rainy River, and the two valleys followed by the main West Coast road on either side of the Hope Saddle.

Here the specialized crops are not grown, and arable land is at a minimum, only an occasional crop of turnips or other fodder crops, being seen. It is difficult to decide what factors have caused this lack of arable land, but it is probably a combination of isolation, poor soils, and climate.

Pasture becomes more important here, but is a very poor quality due to the presence of weeds, and the lack of any manurial treatment whatsoever. It has a low carrying capacity of about 2 acres per sheep, only slightly above that of the reverting hill country. Most of it is in some stage of reversion, usually to fern, though large stands of Manuka and other scrub are common.

Little money is spent by the farmers in these areas to prevent reversion, and maintain the land, in fact most spend nothing on fertilizers, so the large size of farms and the drab, poor appearance of these valleys is understandable.

**SUMMARY OF LAND USE IN THE VALLEYS.**

The land - use in the valleys of the Moutere Gravels, region with
exceptions, tends to follow a characteristic pattern, although the specific crops may vary in importance from area to area. The pattern has three major elements, which are, the concentration on special crops, the large areas of pasture, and the presence of reversion and scattered areas of forest.

The crops on which farming is based are tobacco, hops, raspberries, and orcharding. Orcharding, probably the least important in the valleys proper, has remained at a fairly constant acreage, and level of production. Hops and raspberries showed a decline in acreage after reaching a maximum about 1922, which continued slowly until recently. Now, however, the acreage is showing a slight rise.

Tobacco increased steadily until the post war period, when the production rose sharply until it reached a maximum about 1945, which was maintained until 1948. Since then a considerable decline in production and acreage has taken place. This has caused considerable concern, and a Commission was set up to report on the causes of this decline. The report was published in February 1953, and although it mentions one of the main causes of the decline, the dissatisfaction of many farmers with the prices paid for leaf, it suggests that the decline can be checked by reorganizing the industry, particularly with regards to selling procedure.

This neglects the main causes of decline, for apart from the labour problems, and the very hard work demanded of the farmer, particularly in this region, tobacco growing is attended by more risks than any other form of cropping in New Zealand. Until these difficulties are overcome, or ameliorated, tobacco production will probably continue to decline.

Meantime, farmers are turning to other pursuits which they feel will bring them equal or greater returns, with easier working conditions. Dairying is increasing, and the increase in hops and raspberries is partly at the expense of tobacco.

Peas are a crop which, though negligible in the Gravels region at present, will probably expand. A plant has been established at Motueka for processing them, to extend the season of work provided by dehydration apples. Experiments have been made at several places in the region in growing them under contract, and they have proved highly profitable, so possibly another crop is due to be added to the present ones, and bring greater security to the farming.

(ii) Pasture is the most important factor areally, as the specialized crops only take up a small acreage of the total land. It is generally fairly poor, as it receives little attention or fertilizer, although there are some exceptions. The quality of most pasture is usually further reduced by the presence of weeds, especially different types of thistles. The fact that many pastures tend to dry out in summer adds to their drab appearance at time of year.

Sheep are the main livestock, and although the number carried on the valley pastures is not high, it could easily be increased by regular top-dressing, and resowing of pasture. Cattle are developing in importance within the economy not as beef animals, but rather in dairying. The number of farms with herds, and the average size of herds has tended to increase, and the cash from the sale of cream provides a useful supplement to the other sources of income. This depends on the sale of cream to the Waimea Dairy Factory at Wakefield. By most New Zealand standards this is not a large factory with an annual production of just under 1,000 tons, but it has the longest collection route in New Zealand, with trucks serving
all the Valleys in the region. This factory, by providing many farmers with a steady and reliable income, has helped stabilize Moutere farming to a considerable degree.

(iii) Reverted areas and trees provide the third main element in the valley land use and landscape. All the valleys have large areas reverting to gorse, fern, blackberry and manuka, and the growth of these in small stands, and along fence lines is a characteristic and important feature. The river beds provide the main areas of reversion, and it has often spread over a considerable area from the bed and banks. The increasing interest of the farmers in growing special crops and the consequent neglect of pastures, helps this spread.

Most valleys have a well wooded aspect, which is partly due to the survival of remnants of the native bush, and the numerous small plantations and wind-breaks. However the most important single factor in the landscape of the valley flats is the willow trees which fringe the rivers, and their tributaries. The trees are large, and often associated with tall manuka, gorse, and the winding line of willows in the fairly narrow valleys is usually a striking feature.

The valleys then, have a park like landscape, which gives them a prosperous appearance. Despite this, the land-use is dominated areally by poor pasture and reverted areas, and the only real prosperity of the valleys is found in the small acreages of specialized crops.

THE COASTAL ORCHARDING AREA.

This coastal area, as can be seen from the map, is a distinctive one, dominated by its orchards and pine plantations. Although the orchards are economically the most important, the pine plantations cover a greater area, and both are important in the landscape. The area is located north of the Moutere Valley, and the main Nelson to Motueka highway, and includes
Plate 111.

VIEW OF ORCHARDING AREA.

Note patchwork of pines, pasture, orchards and reverted areas, especially the heavy reversion on the roadside.
a high proportion of the 2,500 acres of orchards found in the region.

Apart from the orchards and plantations, large areas are fully reverted or reverting, and in some valleys, notably Gardeners Valley, pasture is fairly important. This is usually poor quality, with a large amount of bracken, and the number of sheep carried is small. In Gardeners Valley, there are too, small areas under cultivation for other crops, mainly hops.

The orchards themselves, are not restricted to any particular type of site, indeed their sites were probably selected in an arbitrary fashion by the companies that opened up the area. This is easily understood when it is remembered that at that time it was thought apples would grow well under almost any conditions. However the steepest slopes have been avoided, although in many cases little attention has been paid to the land slope.

A striking feature of this area is that the reverted land often encloses the orchards completely, or almost so. It is not unusual to see gorse growing to a height of 10 feet or more, but off along a clean line parallel to, and within 20 feet of, the apple trees.

It is interesting to note, that this is the only part of the region where intensive farming is not restricted entirely to the valleys, but is also located on the slopes and spurs. However, many of the orchards present a poor picture to the eye, with dilapidated buildings, weak looking trees, and surrounded by drab reverted areas. It is only in scattered areas around the coast and in the valleys that any views approaching the prosperity of the Riwaka district can be obtained, and these often lose much of their beauty when inspected closely, and not as a broad vista from some hill top.

The description of the pine plantations, the second significant feature in the land use, will be found in the statement on forested areas
of the region. It is sufficient to note here that although they cover a large area, the only income reading the region through them comes in the form of wages to the few workers at the tinker mills. Most of the financial returns go to Nelson, and the employees, owners of Baigents timber mill there. Any capital reinvested in the region is usually in the form of replanting of cut over plantations.

However, these forests do, to a certain degree, represent the inter-relationship of land use. The timber from them is used in the manufacture of the cases in which apples are packed. Unfortunately however, only the rough milling is done at Tasman, the finished boxes being produced in Nelson, and then shipped back to the orchardists.

**ORCHARD LAYOUT; MANAGEMENT, AND PRODUCTION.**

Most of the Moutere orchards, as has already been shown, were planted in the period between 1910 and 1920, when there was little appreciation of soil erosion problems, and the necessity for good management. Since then, the same trees have continued to maintain the production at a consistent level, which does not yet show signs of dropping. Most of these trees indeed, seem to be quite vigorous, but as they are now 30 to 40 years old, a programme of progressive replanting is urgently necessary, so yields can be maintained in the future.

The original lay out of the orchards has also created problems. They were planted, regardless of slope, on a rectangular pattern, and as a result the problem of soil wash is serious. This has been combated to some extent by improved methods of cultivation, and by retaining cover crops between the trees, for as long as possible. At present there is only one private orchard, composed of young trees, which has been planted on a contour system. Unfortunately dwarf varieties of proved types have been used, as comparison of results will be difficult. However the De-
Plate IV.

CONToured ORCHARD.

B. Contoured Orchard of dwarf varieties of proved species in Middle Background. Note area of good pasture, grazing Dairy cows. This is not common.

In both, notice how trees are planted on grid pattern, without regard to slope, and the ever present *Pinus radiata*. 
partment of Agriculture is also experimenting with contour plantings on its experimental orchard at Mariri. Although contour planting may provide a solution to the erosion problem, there are many difficulties inherent in replacing the present orchards with contoured ones, and it will probably only be important in new plantings.

Most orchardists now follow the practice recommended by the Cromthron Institute in managing their orchards. Cultivation is carried out using light equipment, and is along the slopes, in an endeavour to reduce run off, and possibly induce a terraced effect. It is stopped early enough to allow a good cover crop to establish itself for the winter season. Blue Lupins originally provided a good crop, as they established a good cover as well as having soil building qualities. Recently they have suffered from disease, except on new grounds, and now experiments with other varieties of lupins, and crops are being carried out, to find the most satisfactory substitute.

An extensive fertilizing programme is carried out using a "complete" fertilizer mixed and supplied by the New Zealand Fruitgrowers Federation, and containing Nitrogen, Phosphates, and potash. Apart from this Borax \( \frac{1}{2} \text{ lb per tree} \) and Dolomite \( 6 \text{ lb per tree} \) are applied to correct deficiencies of Boron and Magnesium which produce "internal cork" in the apples.

The prosperous apple orchards of Nelson are not found in the Moutere Gravels region, although the largest acreage is here, yields per acre are low. A few years ago the average production was 300 bushels per acre, which is slightly below the Nelson, and New Zealand average of 325 bushels per acre. Compared with the Riwaka area, where orchards are prosperous, the Moutere yield is very low, as here efficiently managed orchards may give 1200 bushels per acre, and the average is probably over
Plate V.

**REVERSION AND ORCHARDS.**

A. Typical piece of fully reverted land in coastal area, with fern and gorse. Pines in background.

B. Typical orchards with rows of trees running down slope. Pasture on left same as in Plate IV B.
700 bushels per acre.

The orchard area of the Moutere Gravels region, is not the prosperous district it is often thought to be, and reversion of much of the land is a serious problem. Although most orchardists manage to obtain a satisfactory living, they face many problems of soil deficiency and erosion, low production, fairly high costs for fertilizers, and the old age of trees which urgently need replacing. However despite these problems, orcharding is probably the only satisfactory means of extracting a living from this country, unless sufficient capital can be found to restore the reverted areas to grazing land.

**FORESTRY IN THE MOUTERE GRAVELS-REGION.**

The forests of the gravels are one of the most impressive features of the landscape, as there are few places from which it is impossible to see forests, whether they be plantations or native bush. The latter is restricted, in large areas, to the southern part of the gravels, but plantations are common everywhere, particularly on the east and north. At present, the only areas which have any economic significance, are those plantations in the north, which have been developed by private companies. The largest areas, notably those in the Golden Downs State Forest are still developing, although some hop poles and fence posts have been taken out, and recently an experimental shipment of *Pinus-radiata* timber was exported to Australia from Nelson.

The presence of these dark green, almost black, plantations which dot the area around the Moutere Valley, and seem to stretch in an unbroken dark line along its eastern slopes is one of the characteristic features of the landscape here, while in the Golden Downs the trees present a regular pattern which often stretches as far as the eye can see. The effect here is not one of unbroken dark green, but splashes of lighter
Reays Valley. Note moderate reversion in right foreground.
The exotics are Corsican pine in the foreground, and Radiata pine
in the background. The hardwoods in the valley bottom are poplars.
colour from different species break the monotony, and in Autumn the splash of brown Japanese larches provides a beautiful effect on Spooners range.

The Golden Downs State Forest, is the largest plantation in the South Island, with over 24,000 acres of a reserve of 53,000 planted. It is located along the eastern edge of the region, on an area with steep slopes, which were fully reverted. These were almost useless for farming purposes, and the development of this plantation has pointed the way to what is probably the only satisfactory way of using such areas.

The forest itself, apart from being a forestry training centre is largely experimental in nature, and sixty-two different species have been tried here. Some of these have proved successful and the plantings of these will probably be expanded to provide better varieties of timber than that obtained from the Pinus radiata. Some progress has already been made towards this goal.

Pinus radiata is the most extensive within the State Forest, and in the region as a whole, as most private plantings are of this species. The trees grow well, and at a rate as good as is obtained in the North Island. The best stands are slightly better than Rotoraia quality Class 1, and the average usually slightly better than Class 11. Poor stands are generally restricted to exposed ridges where conditions are harsh. These trees will provide the first returns from this forest, and the finance from milling these will help meet the running expenses of the plantation while other species develop.

Corsican Pinus next in importance to Pinus radiata and is expected to provide a better timber as an alternative to Pinus radiata. Although it is subject to suppression by fern and blackberries while young, once established growth is rapid, and a yield of about 60,000 fat board measure is expected
These trees are 18 years old. Thinnings have been much in demand for hop poles and fence posts.
in 50 years. (See plate VII).

Douglas Fir has shown considerable promise in the northern part of the forest, where trees are vigorous, and grow faster than the Corsican Pine. In 50 years, a yield of about 100,000 feet board measure is expected, and as the timber is of fairly good quality and has been in demand much more extensive plantings are likely.

Larch also promises to grow well, even on the higher parts of the forest. Because of the excellent response of experimental plantings it is certain that the area will be extended, particularly as the timber is valuable, and the poles obtained during thinning are much sought after for hop poles and fence posts. Japanese and European larch are the main varieties grown. (See plate VI.)

If these higher quality timber trees are developed, although they take longer to mature, they will eventually prove more valuable than the P. radiata. However in the present day land use, the acreage devoted to this species far exceeds that planted in others.

The State Forest is, like all others in New Zealand, handicapped by labour shortages, and as it is impossible to carry out all the necessary maintenance work such as pruning and thinning, new plantings have been restricted.

Apart from the Golden Downs State Forest, there are some 16,500 acres of private plantings scattered throughout the Northern half of the gravels. Private plantations have been largely restricted to the area, because the timber is transported by road to Nelson, and used there, and any greater distances would tend to become less economical.

The main areas are as follows, a large block of young trees, owned by Baignets Ltd, and extending from the Dovedale Hill back to the Golden Downs forest. (See plate TX.) This area is large, and considerable ad-
Aged 12 years, these trees are growing on terrace gravels near the western boundary of the region. Gordons Knob is in the background.
joining areas have been purchased to allow further expansion. A large block of mature trees located between Quail Valley and the Wai-iti Valley adjoins the Golden Downs, and is now being milled by Baigents. In the coastal area, and the Moutere Valley especially, plantations are numerous. The area in trees here, although not continuous is probably the largest of privately owned trees. In the Coastal area, they are being milled, but the plantations in the Moutere Valley are generally fairly small, and often owned by farmers.

There is very little planting being done by private concerns, although some land has been acquired for future expansion. Their main concern is controlling the regeneration of existing forests as they are milled, and sustaining their yield.

These plantations are almost entirely of Pinus radiata, other species only covering a very small area. Most of them are of millable age, and seven mills are working the forests. Three in the Quail Valley area, one at Wakefield, and three in the coastal area. Apart from the mills in the Gravels region it is interesting to note that logs are sometimes trucked 10-15 miles, and milled by two small concerns on the Waimea Plains.

The Moutere plantations are, whether private or state controlled, efficiently managed, although labour shortages have made this difficult during recent years. They also provide the greatest area of private forest in the region, and the largest single economically productive factor in the land use.

Native bush in the region is, apart from small patches, restricted to its extreme southern portion. It is largely controlled by the State Forest Service, although little has been done in the way of management. Although of considerable areal extent in this part of the region, the native bush is economically unimportant, as it is only milled on a small
PRIVATE PLANTATIONS.

A. Baigents Ltd, plantation on Dovedale hill, looking West towards Wakefield. These trees are young *Pinus radiata*. Note fully reverted nature of country which is typical of most of the region.

B. Recent planting in the Golden Downs State Forest give herring bone pattern in the middle distance. Note firebreaks along ridge tops, and high fern along roadside.
scale. However, it is important as a factor in the control of run off and soil conservation, though, unfortunately, it does not cover all the steep slopes, and soil wash is particularly noticeable on there, in the higher rainfall area of the south.

The forests of the Moutere Gravels are of fundamental importance in the land use of the region, as they cover almost \( \frac{1}{4} \) of its area. Apart from the areal extent, the plantations, which are the most important division of the forests are rapidly increasing on commercial value, while the forests as a whole have great value in flood control, as a check to run-off. They are also of importance, as they provide a way of extracting a reasonable financial return from land which because of its steep slopes, and complete reversion was totally unsuited to agriculture.

**REVERSION IN THE MOUTERE GRAVELS REGION.**

The area which has reverted either partly or fully in the region, is, by virtue of its area of 161000 acres, the major factor in the land use pattern although it is economically a handicap. Most of this land was originally covered with native bush, and for some time carried reasonably good pastures. However, as the small amount of natural fertility was exhausted, reversion became a problem, but it was the development of small crops, which enabled the farmers to neglect the hill country to the extent that they have. If tobacco had not developed as a crop, farmers would have been forced to combat reversion by better farming techniques, and although the steeper slopes would have reverted, large areas would have been kept in pasture.

The large area of reverted land is a result of several factors, the most important of which are the development of new crops at a critical stage in the history of the region, and the natural poverty of the soils. As a result, some 46% of the region is of little, or no, economic value.
The fully reverted areas cover some 80,000 acres, and are covered with a dense growth of fern, gorse, and varieties of native scrub. (See Plate Va.) These are practically useless as feed for sheep, and most of this area is not used agriculturally. The partly reverted areas do provide some grazing, the amount depending on how heavy the fern cover is. The sheep browse on the poor grasses which grow in association with the ferns, usually dantonia, browntop, and weeds.

Another method of extracting some economic return from the reverted land, where gorse is dominant in the association, is by gorse farming. This practice, carried on by many farmers, horrified the Sheep Commission. It consists of burning the gorse, so that the sheep may graze the tender young shoots as they appear. Although not good farming practise gorse farming does give the farmer some income, without seeming to accelerate erosion greatly, and as most farmers in this area do not have the capital to restore reverted areas, it may be justifiable.

Much of this reverted land could be restored to reasonably good pasture, and the carrying capacity raised from 4-5 acres per sheep, to 3-4 sheep per acre. This is only possible on the gentler slopes, where cultivation is practicable, but these represent about 60% of the reverted areas. The main handicap to improving these areas is the high cost, which has been estimated by the Nelson Catchment Board at £20 per acre. In many areas, particularly where gorse is dominant, this figure is optimistic, and another £5-10 could probably be added to the cost. In the face of this high capital expenditure most Moutere farmers are not prepared to set out on a scheme of reclamation, indeed many do not have the required capital.

The steeper slopes of the Gravels will no doubt remain in a fully reverted condition, although many will probably be planted in exotic plantations. The success of established forests has shown that such plantations
would be financially successful, and they would also have considerable value in soil conservation.

The 161,000 acres of reverted land are scattered throughout the region, and give the countryside a drab, monotonous appearance. However, within the plant associations, different species are dominant in different areas, and change the landscape slightly.

Gorse is the dominant species on most of the northern half of the region, and when it flowers, it brings a rare beauty to the landscape. It is important in the Moutere Valley and the Coastal area, and along the eastern edge of the region, to the Wai-iti valley. In the west it is important in the Waiwhero area and to some extent in the Rosedale Valley.

In the Orinoco Valley, heather becomes the dominant species. This plant is rarely found elsewhere in the region, but in this area is a very difficult to eradicate, but it is showing a tendency to spread into the Dovedale area, and causing considerable concern to the farmers there.

South of the Wai-iti Valley, Motupiko, and Stanley Brook, fern becomes most important in the reverted areas, while gorse is rarely seen. It is also found in the Northern half of the region in association with the species mentioned above, and is the most widespread of the plants.

In the gullies and on damp shady slopes particularly, throughout the region, manuka may be found in quite considerable stands. Tutu, and other shrub-like species are often found in similar situations, although rarely in association with manuka, which usually forms pure stands.

Although these divisions can be made on the basis of the type of plant in the reversion, it should be remembered, that these species are not restricted to these areas, but are dominant within them.

A further distinction can be made on the basis of the amount of reversion. The area which are only slightly reverted are usually on gentle
slopes, or those with a northerly aspect, while the fully reverted areas tend to appear on the steeper slopes, or in damp shady sites with a southerly aspect.

In the Dovedale - Stanley Brook district there are some 13,000 acres of clean native pasture, which do not fit into any of the above categories. Native pasture in the region is generally restricted to small scattered patches, and the presence of this large area surrounded by reversion is therefore unusual. No satisfactory explanation for its existence has been found, but the soils here are less acid, and seem to have a higher, content of phosphates, magnesium, and nitrogen than most Moutere soils, and this is probably a contributing factor.

The pasture here is however showing some signs of reversion, and steps should be taken to check this. Apart from fern, the threat from heather is serious here, and if it becomes established it will prove difficult to destroy. The soil responds well to liming, and the spread of fern could probably be easily checked by topdressing and improved management. Heather is a more serious threat, and presents more problems if it is to be controlled, but a satisfactory method could probably be found.

**SUMMARY.**

The land use of the Moutere Gravels region is dominated economically by the 4200 acres of alluvial flats and gently sloping land, which are devoted to intensive farming based on tobacco, hops, raspberries, and orchards, but areally these are of minor significance. The most important features in the landscape are the exotic plantations, and the reverted areas. The latter, particularly when seen from a distance tend to produce a monotonous brown landscape, which is given interest and variety by the presence of black looking plantations and clumps of native bush.

This then is the landscape of the Moutere Gravels, dominated by fern
and forest, both of which play equally important parts in its formation, but which are outweighed economically by the comparatively minute areas devoted to certain highly profitable crops.
A NOTE ON THE GEOLOGY OF THE
REGION.

GEOLOGICAL HISTORY.

The Moutere Gravels are found in a V-shaped depression between two major converging faults, the Pikikiruna and Waimea faults, which bound the Tasman Bay lowland to west and east. Movement along these faults was responsible for the formation of the depression in which the gravels accumulated.

In Pleistocene times, the region was downfaulted, and the gravels laid down, probably to a much greater thickness than is found at present. The deposits were probably formed by a river, or rivers, flowing from the mountains to the south or southwest. Bell, and others, suggest a river flowing from north to south, at a time when a much greater land surface was exposed than at present. There are many difficulties in the face of such a theory, and the present reversal of drainage, and the formation of the Buller-Motupiko watershed would have to be explained. The theory of a north flowing river is the most satisfactory, and the difficulties which face this theory are much less formidable.

After the gravels had been laid down, uplift took place, and the present drainage system was formed, quite possibly reflecting the pattern which existed before the uplift. The main rivers have cut fairly large valleys, and laid down alluvial flats of resorted gravels. The major uplift was probably followed by several smaller ones, and there is some evidence to

support this view. At Tapawera and Motupiko there is a well developed
river terrace at about the 30 feet level, while near Tadmor, there is a
remnant of seems to be an old terrace at about 100 feet. (See Plate Xa)

There is also evidence that some of the rivers are actively widening
their valleys. This is particularly so of the Wai-iti, west of Wakefield,
the Dove River, in part of its course, and much of the Tadmor River. In all
these places, bluffs are found, some of those on the Tadmor being particularly
well developed, with small scale examples of badland topography.

Marine erosion has affected part of the coastline, as bluffs are found
at Kina. These reflect the tendency of marine erosion to level out the
coastline, and with the configuration of the coast in the Mapua and Tasman
inlets, suggest that local submergence may have taken place.

**Composition of the Gravels.**

Such structure of the gravels as can be observed in natural sections
suggests that they are of alluvial origin. This can be seen in the bluffs
at Kina, and many other places where a cross-section has been revealed.
The presence of lens shaped deposits, and layers of silt and sand in the
gravels, although on a small scale, are typical of alluvial deposits, as is
the smooth rounded shape of the gravel.

The individual boulders in the gravels vary in size, with the largest
in the south, and on the eastern boundary. The average size is generally
one to two inches in diameter, but in Quail Valley boulders up to 18 inches
across may be found. The small size and rounded nature of the gravel
suggests that it has been carried some distance, while the presence of the
largest, and most angular components in the south and east, tends to support
the theory of a northward flowing river.

The most common varieties of rock found in the gravel are greywacke,
argillite, and sandstone, but some quartz pebbles, granite and schist can be
found. 1

Plate X.

OLD RIVER TERRACE IN TADMOR VALLEY.

A. Striking remnant of old terrace on east side of Tadmor Valley. Note reversion in foreground.

B. Junction of gravels with underlying mudstones along western boundary, west of Tadmor.
The gravel is usually in a clay matrix, which gives a yellow colour to the subsoil, and is relatively unconsolidated.

**STRUCTURE AND SURFACE FORM.**

The uniformity of summit levels in the region, best seen when viewed from the hills outside its eastern boundary, is, perhaps, its most striking feature. There is a gentle slope from south to north, from an altitude of 2700 feet in the south, through 1640 feet at Spooners Range, and 1090 feet on the Wakefield-Dovedale road to 190 feet at Kina bluffs, where the gravels are cliffed by the sea. This gradient can probably be regarded as similar to that of the initial surface, and if so it gives a gradient of about 50 feet to the mile. This is very similar to that found on the Canterbury Plains, which are made of a similar type of deposit.

The Motueka and Wai-iti rivers drain most of the region, although the Wai-iti, close to the eastern boundary, affects only a small area. The Motueka River dominates the drainage pattern of the region, and drains about 60% of its area, despite the fact that for a large part of its course it lies off the west boundary of the region. From its source in the hills to the east, the river flows north north-west across it for 18 miles. Just below Tapawera, and after it has left the region, the river swings round, and flows north-east, parallel to the western boundary of the gravels, for the lower 25 miles of its course. To the south of the main stream, the tributaries flow in a south-north direction, and the main grain of the country follows this line. North of the river, its smaller tributaries, and those of the Wai-iti river, tend to flow in a roughly east-west direction.

The drainage pattern is generally dendritic, and the surface is fairly finely dissected. It may be possible, as will be mentioned later, that some of the rivers are, at least partly, fault guided, but as there is no proof of this, the pattern may be regarded as dendritic.
The river valleys generally have very flat flood plains, of varying width. They are at their widest at Lower Moutere, and below Tapawera, in the Motueka Valley, but even here they narrow rapidly. No generalization is possible about the slope of the valley sides, as this varies considerably, and one side of the valley is often much steeper than the other. However, the interfluves are generally smoothly rounded, with much gentler slopes.

A noticeable feature is that many of the east-west trending valleys have a very steep slope to the north, and gentler slopes to the south. See fig. This may be true of only part of the valley as at Dovedale, or extend through most of its length, as in the Rising Sun Valley. This formation is found at Tapawera, where the steep slope is well developed, and rises about 400 feet above the valley floor, and in the Dove, Eves, Rising Sun, and Moutere Valleys. In the latter two, the steep slope is small, but still noticeable. Thus the usual V-shaped profile becomes asymmetrical, as shown in the sketches.

An investigation of the causes of this feature does not come within the scope of this paper, but it may be caused by erosion, fault-lines, or by the major to east and west tilting the whole block. However,

whatever the cause may be, the repetition of this landform in so many valleys is a striking feature.

SLOPE: (See map attached at back of book, Fold Map C.)

Figure 1 shows that most of the region has moderately steep to steep slopes, greater than 15°. The largest proportion of these steep slopes is found south of the Motueka River, with a large area between the river, and the Dovedale-Wakefield road to the north. The only considerable single area of land not in this category is found around, and north of the Moutere Valley, and even here much is strongly rolling land, with slopes between 12° and 15°. The next largest categories are in rolling country, with slopes between 5° and 12°, and flat land.

The flat land is restricted almost entirely to the river valleys, and comprises the flood plains. It is usually in narrow strips, and the occasional wider bands are not extensive. The Moutere Valley, with a width of two miles at Lower Moutere is the largest of these.

Rolling land is important in the northern part of the region, and along the eastern boundary. Small areas are also found in the Dovedale, Tadmor, and Motupiko Valleys. Easy rolling land is very restricted. Small patches are found in most valleys, with the largest areas in the Motueka and Tadmor Valleys. Here they are confined to the river terraces mentioned above, and show the extent of these very well.

About 65% of the region is steeply sloping land, a fact which severely limits its use for farming. The 35% of gentler sloping and agriculturally more useful land is restricted to the northern section of the region, and small areas in, and bordering, the main valleys.

EFFECT ON LAND USE.

Geological factors have their greatest effect on the land use of the region through slope, but even where this is effective, it is not always
the dominating factors. Cultivation is usually restricted to slopes less than 15°, and to the valley flats which provide the areas most suited to arable farming, because of their flatness. However much of the land use has developed without regard to slope, particularly in the orcharding area.

In the reverted areas, and some of the forested country, slope has played a part in shaping the land use, and will probably become much more important in the future. Reversion is found on all slopes, but the steeper ones represent areas where it would be difficult or impossible to prevent reversion, and where it would probably have developed, even under different economic circumstances. These steep slopes tend to be more heavily reverted, and have been favoured for recently developed plantations, as they are entirely unsuited to agriculture.

An indirect effect on the land use has been through the nature of the soils as the materials from which they developed are responsible for their paucity. However a discussion of the effect of soils on the land use will follow later, and it is sufficient to mention here the part which geology has played in their formation.

Geological elements have usually worked in association with other factors in their effect on land use. This effect has been restricted, but some relationship between land use and land slope can be found. For instance, flat land has become more valuable, while sloping land has been neglected by the farmer, and allowed to revert, the degree of reversion often depending on the slope of the land. On the other hand, the slope cannot be regarded as the main cause of reversion, as a large proportion of this land could have been maintained in good pasture. Only on slopes greater than 15°, where cultivation is impracticable, can slope be regarded as an important factor; but there can be no doubt that where slope makes cultivation difficult, reversion would almost certainly have occurred in any
Geological factors have not been important controls of the land use of the region, but the most effective of these have been slope, and soils. Even the effect of these has been obscured, as the type of land use that could be expected to develop on the steeper slopes, has spread over all categories of slope, because of the effect of various other factors.
CLIMATE OF THE REGION.

Although only a few statistics regarding the climate of the Moutere Gravels region are available, rainfall records have been kept for several places, and some temperature figures are available.\(^1\) From these a description of the climate, and its possible effect on land use, can be given.

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<td>Motueka</td>
<td></td>
<td></td>
<td></td>
<td>47.9</td>
</tr>
<tr>
<td>Wakefield</td>
<td></td>
<td></td>
<td></td>
<td>47.4</td>
</tr>
<tr>
<td>Stanley Brook</td>
<td></td>
<td></td>
<td></td>
<td>46.3</td>
</tr>
<tr>
<td>Golden Downs</td>
<td>60.6°F</td>
<td>39.2°F</td>
<td>12-13°F</td>
<td>48.0</td>
</tr>
<tr>
<td>Hope Saddle</td>
<td></td>
<td></td>
<td></td>
<td>70.0</td>
</tr>
<tr>
<td>L. Roto-iti</td>
<td></td>
<td></td>
<td></td>
<td>63.0</td>
</tr>
<tr>
<td>Roding R.</td>
<td></td>
<td></td>
<td></td>
<td>61.9</td>
</tr>
</tbody>
</table>

By plotting the rainfall statistics on a map (Figure VII) it is possible to get some idea of its distribution, and to insert the probable position of the isohyets. These bend to the south, and reach furthest inland along the eastern border of the region, swinging back to the coast to east and west of the region. This distribution is caused by the direction of the rain bearing winds in relation to relief. The Tasman Bay depression, of which the region is a part, forms a rough triangle, with its base facing the

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1. (No Author). N.Z. Air Department, Meteorological Observers for 1945, Wellington, 1950, pp24-26, 67-68.
MAP 7

RAINFALL DISTRIBUTION
DISTRIBUTION OF RAINFALL
ON
MOUTERE GRAVELS.

KEY:

- Approximate Location of Isohyet.
- Exact Site of Recording Station.
- Site of Recorder only approximately known.

Scale: 0.5" = 12 Miles.
main rain bearing winds, and surrounded by high ranges. Thus precipitation is lowest along the coast, increasing rapidly to east and west, where the ranges rise sharply. Moving south, the increase is more gradual, as the air is forced to rise more slowly.

A further study of the rainfall map shows that most of the Region has less than 60 inches, but a large area has between 40 and 60 inches. In the Coastal area, rainfall is between 35 and 40 inches, and sunshine hours are high. At Nelson the average is 2486 hours of bright sunshine per year, with a low number of rainfall days, (118) Along the coast of the Gravels, the situation is very similar, with a slight decrease in sunshine to the west. Moving inland, the number of rain days increases, and the number of sunshine hours decreases.

Temperature distribution is probably very similar to that of rainfall, only the temperature decreases to the south. The coastal area of the region has mild temperatures, and light frosts. Moving south we find that at the Golden Downs Plantation at Kohatu, the mean maximum temperature has dropped considerably. Frosts too, are much heavier here, usually between \(10^\circ\) and \(13^\circ\), but often greater than this, rising at times to \(16^\circ\) or more. As this is largely caused by increasing distance from the sea it is obvious that further south in the regions, temperatures will be even lower, and frosts more severe.

The region is sheltered by the surrounding ranges from Westerlies, and to some extent from southerlies, so gales are infrequent. Hail and thunderstorms are also rare, and on the few occasions that they do occur, usually affect only a small area. The low frequency of these destructive climatic phenomena makes the area suitable for the growing of fruit, and other crops susceptible to damage.
EFFECT ON LAND USE.

Climate has not been a dominant controlling factor in the land use of the Moutere Gravels region. It has been important, through the crops which it has favoured, rather than through any definite restrictions it placed on agriculture. For instance, the high number of sunshine hours, the low rainfall in the ripening and harvesting periods, and the rarity of gales, have produced a very favourable climate for fruit growing, and this overcame the handicap of poor soils to some extent.

The same factors favour tobacco and hop growing, although dry spells in the early summer growing period may retard the crops, especially tobacco.

The decline of arable land and the tendency of reversion to spread onto the flats in the southern part of the Motupiko and other Valleys, maybe partly due to climate. The shorter growing season, and the much higher rainfall, about 60 inches, do not favour the specialized crops, but the high rainfall is undoubtedly important in the increase of reversion on the flats.

SUMMARY.

The effect of climate on the land use pattern has been more through the types of farming it favours, rather than through definite restriction. Only in the south does climate tend to become a restrictive factor, and although it is probably one of the most important factors in the decline of arable land, and the increase of reversion here, other factors are also working.

Climate has been of greater importance than geological factors in shaping the land use, but its importance has varied with its location, and, as with geology, it must be remembered that other factors are also at work. In most parts of the region, climate must be regarded as being a positive rather than a negative influence on the land use pattern, and as having had
a considerable influence on it.
SOILS ON THE MOUTERE GRAVELS.

The character of the soil is one of the fundamental factors affecting the land use throughout the Moutere Gravels region. Although six different types of soils have been recognized, not counting the alluvial soils of the valleys, they are all characterized by infertility. The poverty of the soils, their acidity, and the difficulty of getting them to respond to treatment are factors which have contributed to the reluctance of farmers to maintain the greater part of the region in good pasture. As soils have been one of the important factors in shaping man's attitude to farming in the region, a brief discussion of the various types, and their characteristics, will be given.

MOTUPIKO LOAMS.

These occur on the valleys throughout the region, except in the Upper Motueka Valley. They exhibit most of the characteristics of the hill soils from which they have developed through resorting, but fertilizer treatment has modified them slightly. These are the soils on which the specialized crops have developed, and are, therefore, the only ones to receive any considerable amount of fertilizer. Soils which receive less care. They usually have a better supply of potash, phosphoric acid, and lime available to plants than most of the soils, and hence their base saturation is higher. The better condition of the soils is usually due to fertilizer treatment by the farmers, rather than any inherent advantages.

GORDON AND TAPA'ETRA.

These soils are found in the Upper Motueka Valley, and although they are basically composed of resorted gravels, they have a very high magnesium
MAP 8

SOILS.
SOIL MAP
OF
MOUTERE GRAVELS

SOIL TYPES.

Mapua clay loam.
Rosedale silt loam.
Stanley silt loam.
Spooner stoney silt loam.
Korere silt loam.
Hope silt loam.
Resorted alluvial soils.

After a map by E. Ballenden and J. Fox.
content. This is caused by tributaries of the Motueka bringing down quantities of serpentine from the Ultra-basic rocks around Gordons Knob. Gordon loams are found south east of Motupiko, and are very rich in magnesium, and poor in phosphates. The early settlers found difficulty in cropping the land, and today these soils are included in the Golden Downs State Forest.

The Tapawera Loams below Motupiko, have less magnesium in proportion to other materials, and more available phosphates. Lucerne, clovers, and grasses do well, especially if treated with phosphatic manures, but the amount of magnesium affects the quality of tobacco leaf. The better condition of the soil probably helps explain the growing of some wheat here.

**MAPUA CLAY LOAMS.**

This type of soil is deeply weathered, and restricted to the coastal area. The soil is deeply leached, and highly acidic, and requires extensive manurial treatment to produce good crops. It is very poor in magnesium, lime, nitrogen, and phosphates, and it is difficult to understand how apples can be grown with as much success as they have been. However farm management and fertilizers have overcome most of these deficiencies to some extent.

**ROSEDALE SILT LOAM.**

This soil, which adjoins the Mapua clay loam shows more variation in composition, and is not so strongly leached. It is markedly acid throughout, though more so in the northwest, and low in phosphate, lime, and magnesium.

**STANLEY SILT LOAMS.**

This type shows remarkable variations in base saturation and acidity, between locations which are close together. T. Rigg and others have suggested that this is due to the density and nature of the original forest cover. The presence of broadleaf species in the flora and a more dense forest
cover would tend to preserve supplies of phosphate and bases in upper soil profile. If this is the reason, the presence of this type of vegetation, on only a small part of the Moutere Gravels would have to be explained as similar conditions of climate and aspect are found over large areas of the region. However, whatever the cause, the soils have a higher base saturation, and more available phosphate, lime magnesium, and nitrogen than other soils in the region. It is probably because of the better condition of the soil that the largest area of clean native pasture in the region has been maintained here.


Also J. Holloway "Marginal Problems of Nothofagus Forest Soils" 7th New Zealand science Congress "Papers on Forestry and Marginal Lands.

This paper tends to support this theory, as it suggests that Nothofagus spp. directly effect the soil, and produce poor soils, where similar conditions, under a different vegetation cover have developed good soils. If this is so, then the presence of broadleaf species in the vegetation association may have been effective in producing slightly better soils.
SPOONER STONY SILT LOAM

Located to the east and south of the Stanley silt loam, this soil is found in an area of generally steep slopes. Although deficient in lime and phosphate, the soils have a fairly good base saturation percentage, and are not too acidic. Much of the area is fully reverted, but this is probably due as much to the steepness of the slope as to any deficiencies of the soil. All large part of the Golden Downs State Forest Reserve is on this soil type, and pines do well on it, although, again, this is not due to any distinctive properties of the soil.

KOREKE SILT LOAM

This type soil is found south of the Spooner Stony silt loam, in a region of higher rainfall. Consequently the soil profile is strongly leached and poor in lime and phosphates. Where the land has been more recently cleared, leaching has not proceeded to the same extent as elsewhere.

HOPE SILT LOAM.

In the extreme south of the region, with a rainfall of 60-70 inches, these soils are strongly leached. An iron pan layer has formed in some parts, and the soils are highly deficient in lime, magnesium and phosphate. The high acidity and deficiencies of the soil make it very similar in these respects to the Mapua clay loam.

MECHANICAL COMPOSITION.

All the soils of the Moutere Gravels Region have developed from a parent material of gravels and clay. The depth to which the Gravels have been weathered varies considerably, reaching 48 inches in the Mapua clay loams, but is usually between 20 and 30 inches. The soils generally have a very low proportion of fine gravel, the rest being made up of sands, clays and silts. The proportions of these vary throughout the profile, and the soil rests on a parent material of coarse gravels set in a clay matrix.
The Upper few inches of the soil may be stained brown and black by humus, but on the slopes this layer is very thin, and the lower horizons, coloured yellow, are often exposed.

**EFFECT OF SOILS ON LAND USE.**

Unlike the climate of the region, the soils have been a handicap to the development of land use, rather than a favourable influence. However soils and climate have been the most important of the physical factors affecting land use. All the soils are poor and acidic so their effect has probably been general rather than specific, although slight changes in composition have been significant in some area.

The poverty of the soils has been an important factor encouraging the general spread of reversion within the region. The reversion of large areas could have been controlled by the use of fertilizers, cultivation and resowing of pasture, and improved techniques of farm management. Because of the poor soils, this would have been a difficult and costly task, but farmers would have had to carry out some such policy to stay on the land, had tobacco not developed as a satisfactory and profitable crop when it did. Thus although soils are largely to blame for the spread of reversion, the economic aspect of the problem was probably of greater importance.

The concentration of tobacco and other specialized crops on the valley flats was not due to the presence of better soils there. It has been shown that the Motupiko loams show very similar characteristics to the hill soils, though the Tapawera loams are a better soil. This points to the fact that the location of arable land here was due to other factors: the flatness of the land, and ease of cultivation and access.

The influence of specific soil types on the land use is seen in the degree to which reversion has proceeded, though soil is not the only cause of this. On the Spooner Stony silt loam, most of the land is fully reverted,
but it would be incorrect to ascribe this completely to the poor soils. No doubt the soils have played their part, but the steep slopes which prevail in this area have also affected the degrees of reversion.

The Stanley silt loams with their better supply of the basic plant foods provide what is probably the only example of soil as the main control of its area having retained a cover of clean native pasture. Even in this area however, reversion is spreading slowly, but would prove much easier to control.

Soils have probably been the most important of the physical factors in shaping the land use pattern of the Moutere Gravels region. The general poverty of the soils in the important plant foods has, throughout the history of the area, been a handicap to cropping, and the production of good pastures. At first their influence was not so important, but when the low initial fertility was exhausted, crops became poor and pasture deteriorated rapidly. The failure of oat crops in the early years of this century was a result of the declining fertility fo the soils.

The extensive areas of reverted land are largely due to the poverty of the soils, though other factors combine with this in different areas. For instance, the high rainfall in the South encourages reversion, as do steep slopes where they are found. However, soils need not have attained the importance they have in controlling land use, as by the investment of capital, and the use of fertilizers, much of this reversion could have been checked, and probably would have been, had not other factors developed during the 1920's. Even now much of this land could be reclaimed for pasture with the investment of a large amount of capital, but these same economic factors are still operating.

The soils, through the interplay, of economic factors especially, have had a broad general effect on the land use of the region, supplemented
in some areas by climate and geological factors. The poverty of the soils is today reflected to a large extent by the large proportion of reverted land, and will no doubt continue to be so reflected in the future.

The technical information on the soils found in the region was obtained from

CHAPTER VII.

ECONOMIC FACTORS WHICH HAVE INFLUENCED THE LAND USE PATTERN.

The present day land use pattern, of concentration within the valleys on specialized crops, and the consequent neglect and reversion of the hill country, has been shown to have been partly shaped by soils, climate, and geology, especially the first two. The most important factor in developing the present pattern, is found in the history of the area; the introduction of tobacco in the 1920's, and the effect of this new crop on the farming economy of the region.

The importance of this new crop to the land use pattern cannot be overestimated. Other factors are important; climate because it favoured tobacco growing, and soils and steep and slopes because they tended to produce reversion. However, without the impact of tobacco on the economy reversion would not have been allowed to develop to the extent which it has.

As tobacco is a high value crop, it is possible to get a comfortable living from eight to ten acres, and above this area, profits increased rapidly. As only a small area was planted, the farmer was often able to cultivate, tend, and harvest, the crop using labour available within the family, or obtained through co-operation with his neighbours. Thus although the crop demanded very hard work, especially in this region, for some eight months of the year, little capital was needed, apart from the initial amounts to purchase fertilizers and plants, and to build drying kilns. This initial capital could usually be obtained from the Tobacco Companies on fairly easy terms, and paid off over a period of years.
At this time too, reversion was becoming a problem on the hill country, as most of the fertility reserve of the soils had gone. Much of the land which was reverting could have been retained in pasture but this would have required a large amount of capital. The amount of capital needed to maintain the hill country would have been greater than that required to start tobacco farming, and was more difficult to obtain, as there was no organization like the Tobacco Companies to help the sheep farmer. The end of the 1920's was, too, a time of low wool prices, and there was always the possibility that if money could be raised to develop pastures, the farmer would either be unable to repay the loan, or to maintain the pasture.

The impact of tobacco was, therefore, considerable. Farmers turned from the hill country with its high capital needs, and the problem of combating reversion, to the valleys and tobacco. Although it demanded hard work, the capital needed could be obtained fairly easily, and high returns could be got off a small area.

The concentration on producing tobacco on the valley flats, and the neglect of the hill country was the main factor contributing to the increase in reversion, although physical factors favoured it. The concentration of farming on the valleys would not have developed because of the influence of physical factors alone. It must be obvious then than the growing of tobacco, and the change in the economic structure has produced a vast change in the land use pattern.

Although tobacco was the crop which precipitated the change in land use, the importance of longer established crops must not be underestimated. It was during the 1930's that they reached their greatest acreage, and although subordinate to tobacco, the importance of hops and raspberries is great. The increase in acreage of these crops during this period was probably due to the increasing problem of reversion, but together, or singly they were not
of sufficient importance to produce the change that tobacco brought. Although, like tobacco they give a high financial return off a small area, the demand for them is not sufficient to allow them to expand to the same extent.

These then are the three specialized crops of the Region. Favoured by climate, their development, especially tobacco, during the 1920's produced a profound change in the economic structure of the Region, and allowed the influence of soils and geology to increase in the areas outside the valleys.

Apart from the abrupt contrast between hill land and valleys induced by the change in crops, changes appeared on a smaller scale within the valleys. Among them can be included the increase of blackberries and weeds along fence lines, and the general neglect of pastures. Today some pastures are being improved for dairying but this is on a small scale and almost insignificant in total acreage, except in Lower Moutere.

The development of specialized crops was associated with other minor economic factors, in the move to concentrate on the valleys. The land was flat or gently rolling, and easy to cultivate, while transport facilities were good. This latter factor was important, as the crops often have to be carried a considerable distance, often up to half a mile, and sometimes more, from the fields to the drying kilns and grading sheds. Also the homesteads were usually on the flats, and there was a tendency to crop the land which was closest to the house. Thus the factors of convenience, and ease of transport have played a subordinate part in the rise of the valleys as the dominating areas in the land use pattern of the Moutere Gravels region.

The Nelson Catchment Board is at present investigating the possibility of developing the region, and reclaiming the more gently sloping reverted areas to pasture. They have conducted a thorough investigation, and have no doubt that it would be possible to develop large areas to carry 3-4 sheep per
acre. However, despite the high prices at present being paid for wool, it seems improbable that most farmers would be interested in re-establishing pasture unless some form of subsidy was available. The cost would be high, £20-30 per acre, and a considerable amount of capital in the form of heavy tractors, ploughs, and other machinery would also be needed. As similar economic factors to those which operated in the past are still operating, most farmers are content to continue as they are, and neglect the hill country still further.

Wool prices today are high, but this does not provide sufficient incentive to reclaim land, as there is no guarantee that prices will continue at the present level. Also tobacco is now a well established crop, and although the industry is facing a period of difficulty and slightly decline, there is little doubt that it will remain the dominant crop of the Moutere Gravels region.

Thus from a consideration of the importance of economic factors in the 1920's, and of the present situation, it becomes obvious that economic factors, as produced by the concentration on specialized crops, have played a dominant part in shaping the present day land use pattern.
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