SESSION II.
1912.
NEW ZEALAND.

DEPARTMENT OF LANDS:

STATE NURSERIES AND PLANTATIONS

(REPORT ON).

Presented to both Houses of the General Assembly by Command of His Excellency.

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PLANS.

SIR,— Department of Lands, Wellington, 1st June, 1912.

I have the honour to forward herewith the usual annual report upon the operations of the Afforestation Branch of this Department, and in doing so to comment briefly upon the work of the year.

Climatic conditions were not as favourable as usual, owing to the dry weather and heavy frosts experienced in the North Island during planting operations, whilst in both Islands wet weather was general during the summer months. This resulted in a high death-rate amongst newly planted trees, though to counterbalance this to some extent the growth of established trees in the plantations was very good.

During the twelve months ended 31st March, 1912, no less than 8,563,650 trees were raised from seed in the four nurseries; 8,512,079 trees were despatched from them for planting out; and it is estimated that 16,807,400 trees remain therein at the close of the year. The expenditure for the year on the nurseries was £8,103 0s. 8d., bringing the total expenditure from the establishment of the nurseries in 1896 to £96,593 9s. 2d., of which £19,744 18s. 3d. represents the cost of permanent works. During this period a total of 71,904,234 trees have been raised and made available for the work of afforestation.

In the plantations under the control of the Afforestation Branch a fresh area of 2,566 acres was planted in the twelve months. The expenditure on the whole area of plantations was £14,587, and from their commencement in 1896, £121,840. A gross area of 18,870 acres has been planted during this period, and it is estimated that 44,568,505 trees are growing thereon.

In comparing the various costs of raising and planting trees shown against the respective nurseries and plantations, it must not be overlooked that it is comparatively cheaper to raise trees in large quantities than in small, and that to concentrate (if practicable) the raising of trees from seed in one nursery would produce cheaper results than if the same number of trees were raised in two or three nurseries. It has, however, been impossible for various reasons to restrict the raising of trees in the South Island to one central nursery, and therefore the relative cost of the southern nurseries must always be somewhat greater than the one large nursery in the North Island.

Thuja plicata (the red-cedar of California) was experimented with in the Tapanui Nursery recently; and *Pinus montezumæ* and *Pinus patula* were tried in the Rotorua Nursery. The result of the growth of these new trees will be watched with interest.

Prison labour continues to be a success, there having been a daily average of twenty-eight men employed in the North Island plantations and forty-three men in the South Island. Every assistance and willing co-operation has been rendered by the officers of the Prisons Department. The total estimated value of planting by prison labour up to date amounts to £5,254 in the South Island, and to a considerable sum for the North Island.

The interest shown by the staff in their work is very gratifying, and the keenness with which they endeavour to advance themselves in the knowledge of forestry operations is worthy of commendation. It is hoped that arrangements may be made during this year by which they may obtain information on various subjects connected with their work, such as entomology, plant-diseases, agricultural chemistry, &c., from experts in these lines, and arrangements are now being made to this end.

The Biologist to the Agricultural Department (Mr. A. H. Cockayne) again inspected the Whakarewarewa plantations with a view to seeing if any traces existed of plant-disease therein, and his report is attached thereto. He is of opinion that the condition of the plantations is excellent, and it is more than doubtful if any forestry operations in any part of the world have been so free from disease as have those undertaken in New Zealand. This is a gratifying testimony to the faithful manner in which the Afforestation Branch has performed its duties from 1896 to 1909 under the late Mr. Henry Matthews, and since that time under Messrs. R. G. Robinson (Superintending Nurseryman for the South Island) and H. A. Goudie (Superintending Nurseryman for the North Island).

In conclusion I desire to convey to the staff of the Branch my appreciation of the zealous manner in which they carry out the directions and wishes of the Government and endeavour to make afforestation in this Dominion an object-lesson for the Southern Hemisphere.

I have, &c.,

JOHN STRAUCHON,
Under-Secretary for Lands.

The Hon. Thomas Mackenzie, F.R.G.S., Commissioner of State Forests.

SUMMARIES.

Summary of Operations in Nurseries during Year ended the 31st March, 1912.

Name of Nursery.	Total Expenditure.				Trees in Nursery.			
	Supervision and Clerical.	Permanent Works.	Tree-growing.	Totals.	Estimated Trees raised during Year.	Average Cost per Thousand Seedlings.	Output of Trees.	Estimated Number in Nurseries at 31st March, 1912.
							Trees sent to Plantations during Year. / Trees sent to outside Places during Year.	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.		
Rotorua	347 10 0	254 16 2	2,890 13 11	3,493 0 1	4,615,400	..	5,293,425 / 26,805	7,049,650
Tapanui	223 0 0	479 13 5	1,533 18 4	2,236 11 9	1,585,850	0 2 8	1,488,445 / 68,019	4,387,800
Eweburn	168 10 6	157 15 6	731 15 8	1,058 1 8	992,400	0 2 1	669,155 / 1,150	2,118,250
Hanmer Springs	150 1 4	136 6 7	1,028 19 3	1,315 7 2	1,370,000	0 2 2	965,080 / ..	3,251,700
Totals	880 0 10	1,028 11 8	6,185 7 2	8,103 0 8	8,563,650	..	8,416,105 / 95,974	16,807,400

Summary of Operations in Nurseries from 1896 to 1912.

Name of Nursery.	Total Expenditure.				Estimated Number of Trees raised.	Cost per Thousand.	Output of Trees.	
	Supervision and Clerical.	Permanent Works.	Tree-growing.	Totals.			To Plantations.	To outside Places.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.		
Rotorua..	2,631 16 8	8,621 2 0	31,068 4 6	42,321 3 2	40,768,955	0 18 2	32,926,229	793,076
Ruatangata	797 2 8	1,278 19 4	6,632 6 3	8,708 8 3	2,187,732	2 15 2	2,133,520	54,212
Tapanui..	1,998 12 11	4,306 15 6	16,752 6 0	23,057 14 5	15,118,300	1 10 6	9,990,840	739,660
Eweburn	1,219 19 6	2,937 7 3	8,807 9 10	12,964 16 7	4,744,762	2 14 7	2,557,795	68,717
Hanmer Springs	895 1 4	2,600 14 2	6,045 11 3	9,541 6 9	9,084,485	1 1 0	5,750,785	82,000
Totals	7,542 13 1	19,744 18 3	69,305 17 10	96,593 9 2	71,904,234	..	53,359,169	1,737,665

Summary of Operations in Plantations during Year 1911–12.

Name of Plantation.	Trees. Number received from Nursery.	Number used to replace Losses.	Number planted on New Area.	Expenditure. Supervision and Clerical. £ s. d.	Formation, Buildings, Roads, Fencing. £ s. d.	Planting Operations. £ s. d.	General Upkeep. £ s. d.	Totals. £ s. d.	New Area planted. Acres.	Cost per Thousand Trees planted. £ s. d.	Cost per Acre planted. £ s. d.	General Upkeep per Acre planted. £ s. d.
Whakarewarewa ..	2,647,100	279,285	2,367,815	632 19 0	106 15 8	1,698 2 11	909 17 0	3,347 14 7	823	1 17 7	5 7 11	0 4 7
Waiotapu	2,646,325	251,925	2,394,400	680 0 0	1,586 5 6	743 19 8	190 15 9	3,201 0 11	841	1 9 8	4 3 8	0 2 6
Puhipuhi	..	..	..	25 0 0	..	..	139 19 10	164 19 10	..	..	..	0 2 9
Dusky Hill	13,200	13,200	..	182 0 0	12 15 1	..	185 0 6	379 15 7	..	..	..	0 4 0
Conical Hills ..	1,467,975	357,500	1,110,475	255 0 0	155 12 4	1,485 10 4	1,321 9 7	3,217 12 3	408	1 6 8	3 12 9	0 11 5
Gimmerburn ..	..	..	..	5 0 0	..	..	..	5 0 0	..	..	..	..
Naseby	667,555	52,050	615,505	99 0 0	413 12 9	954 14 6	243 6 6	1,710 13 9	226	1 11 0	4 4 6	0 10 0
Hanmer Springs ..	965,080	234,575	730,505	300 0 0	295 7 3	1,354 17 4	577 18 10	2,528 3 5	268	1 17 1	5 1 0	0 6 8
Dumgree	..	..	..	5 0 0	1 4 11	..	25 18 6	32 3 5	..	..	..	0 2 6
Totals ..	8,407,235	1,188,535	7,218,700	2,183 19 0	2,571 13 6	6,237 4 9	3,594 6 6	14,587 3 9	2,566	..	..	..

Summary of Operations in Plantations from 1896 to 1912.

Name of Plantation.	Trees. Number received from Nursery.	Number raised from Seed sown *in situ*.	Number used to replace Losses.	Total Number in Plantation.	Expenditure. Supervision and Clerical. £ s. d.	Formation, Buildings, Roads, Fencing. £ s. d.	Planting Operations. £ s. d.	General Upkeep. £ s. d.	Totals. £ s. d.	Total Area planted. Acres.	Cost per Thousand Trees planted. £ s. d.	Cost per Acre planted. £ s. d.	General Upkeep per Acre planted. £ s. d.
Whakarewarewa ..	14,073,119	109,725	2,174,393	12,008,451	3,062 18 10	3,522 15 10	17,046 1 5	6,289 8 10	29,921 4 11	5,450	2 15 3	6 1 9	1 8 2
Waiotapu	18,800,065	83,121	2,562,532	16,320,654	3,794 3 0	5,404 4 5	3,307 15 8	1,479 9 7	13,985 12 8	6,265	2 0 2	5 4 9	0 12 6
Puhipuhi	2,133,520	..	1,133,520	1,000,000	957 9 7	1,195 3 10	3,974 14 0	3,137 12 10	9,265 0 3	1,200	*	7 2 8	2 12 3
Dusky Hill ..	2,979,037	..	798,200	2,180,837	1,499 4 2	1,151 11 9	7,426 17 4	2,761 3 11	12,838 17 2	845	3 8 1	9 5 3	3 5 0
Conical Hills ..	6,962,508	..	687,171	6,275,337	1,908 9 4	2,020 19 0	11,723 1 9	5,120 6 1	20,772 16 2	2,305	1 17 1	5 1 8	2 4 5
Waitahuna ..	42,025	..	11,500	30,525	27 9 0	61 1 1	74 0 9	40 9 9	203 0 7	11	2 8 5	6 11 9	3 13 6
Gimmerburn ..	936,235	..	783,339	152,896	307 16 8	514 13 11	984 4 0	809 5 10	2,616 0 5	173	5 10 11	15 1 10	4 13 7
Naseby	1,493,785	..	196,076	1,297,709	496 19 2	985 8 0	2,528 10 3	1,344 14 3	5,355 11 8	486	1 18 2	5 4 0	2 15 4
Hanmer Springs ..	5,750,785	..	1,068,329	4,682,456	1,581 18 0	3,372 13 11	8,133 9 10	2,639 13 2	15,727 14 11	1,720	1 14 9	4 14 7	1 10 8
Dumgree	1,679,765	..	1,110,125	569,640	769 2 6	4,163 7 1	3,802 11 9	1,314 12 6	10,049 13 10	209	*	*	*
Raincliff	..	..	..	50,000	..	..	..	..	1,104 12 5	206	*	*	*
Totals ..	54,850,844	192,846	10,525,185	44,568,505	14,405 10 3	22,391 18 10	59,001 6 9	24,936 16 9	121 840 5 0	18,870	..	..	..

* Data not available.

CONDITION OF THE PLANTATIONS AT WHAKAREWAREWA AND WAIOTAPU.

[By the Biologist to the Department of Agriculture.]

In the early part of this year I paid a visit of inspection to the forest plantations in the North Island of the Forestry Branch of the Lands and Survey Department. This work was undertaken to ascertain the condition of the trees so far as any diseases were concerned. An investigation of a similar nature was undertaken the previous year, and a report submitted that was included as an appendix to the annual report of the Forestry Branch.

Whakarewarewa.

The plantations at Whakarewarewa were the first of any extent that were planted by the Department in the North Island. Some of the trees are now upwards of fourteen years old, and it is but natural to expect that these would be the first to show any signs of any serious disease that might be liable to affect mature trees.

The condition of the plantations at the present time is excellent; it is more than doubtful if any forestry operations in any part of the world have been so free from diseases as have those undertaken in New Zealand.

Acting on my suggestion in the last report, the blue-gums near the nursery which were badly affected with the Australian weevil (*Oxyops concreta*) have been cut down. A careful watch should be kept on all the eucalyptus plantations to ascertain what varieties are in the least subject to attack, and the planting of any that are liable to infestation should be discontinued in future plantings. So far the blue-gum appears to be the only one that is seriously attacked by this insect. This bears out my observations with regard to this insect in other parts of New Zealand. A careful examination was made for the larch leaf-cast fungus and larch-canker, but it is pleasing to note that no trace of these diseases is present. The pine plantations are here and there affected with the white blight (*Chermaphis laricina*). This insect (except on *Pinus sylvestris*) rarely appears to persist in any serious numbers on the trees after they have reached a certain age. It is an interesting biological fact that this insect completely prohibits the cultivation of the Scotch pine in New Zealand, while its effects on any other pines grown here is comparatively harmless. This is all the more peculiar when it is considered that the pine-white blight is a native of the same countries to which the Scotch pine belongs. In examining plantations, especially those of the Austrian pine (*Pinus Austriaca*) and Monterey pine (*Pinus radiata*) I was struck with the fact that certain trees appear to be more susceptible to the attacks of the white blight than others. Trees were seen completely free from this disease while adjoining ones, apparently quite as vigorous, were quite badly infested. It would be interesting to collect seed from quite healthy and diseased trees, and sow it to ascertain whether the immune character is hereditary. The presence of this insect, although not actually very serious, must naturally retard to a certain extent the growth of affected trees, and the use of seed producing only healthy trees would certainly be advantageous. As, in time to come, all the seed necessary for future planting will be secured from the plantations themselves, selection experiments appear to be worth undertaking. In this connection, apart from disease, I was struck with the great variation existing amongst individual trees in the larch plantations. This appears to suggest that valuable work could be done in seed-selection.

Waipa.

The Waipa plantations are almost entirely composed of larch, and are in an excellent state of health, there being no sign of disease amongst them.

Waiotapu.

These plantations were also inspected, and, with the exception of a little white blight amongst the pines, are very healthy and vigorous. In certain places trees have died, but in every case these are near hot springs or boiling mud-holes, which abound, and in all probability the roots have penetrated into the hot substratum.

Conclusion.

The general good condition of the plantations, so far as any diseases are concerned, is most satisfactory. The trees are, however, all comparatively young, and it is too soon to say with any degree of certainty that they will remain until maturity in a clean condition. I would advise the careful examination of the plantations from time to time, so that if any serious disease does make its appearance steps for its repression can be taken in hand before it has been able to obtain a serious foothold.

REPOR ON THE AFFORESTATION OPERATIONS IN THE NORTH ISLAND, 1911–12.

[By the Superintending Nurseryman, Rotorua.]

The afforestation work during the past year has not been up to the usual standard of success, owing chiefly to adverse weather-conditions occurring during the planting season and causing a higher death-rate amongst the newly planted trees. At Waiotapu the records of rainfall and temperature disclose the fact that the months of July and August were unusually dry—3·9 in. fell in fifteen days—while the number of days on which frost occurred during these two months was thirty-eight. Stormy winds, too, were prevalent. While frosts may always be expected at Waiotapu, they are not usually so frequent or so severe, nor is the rainfall in July and August

so low. Wet weather was general throughout the summer months, and where the trees have become established the growth made is remarkably good. All species seem to have benefited by the plentiful rains.

The seedlings raised during the year number 4,615,400, and are valued at £4,588 15s.; and the number raised in the North Island to date is 42,956,687. Trees planted on new area during the year number 4,762,215, and occupy an area of 1,664 acres. The plantations now contain 29,329,105 trees, which occupy an area of 12,915 acres.

The output of trees from the nursery during the year was 5,320,230, details of which will be found on Schedule V attached to the Rotorua Nursery report, and the output of trees from the North Island nurseries to date is 35,907,037. The estimated number of trees in the Rotorua Nursery is 7,049,650, of which probably 3,500,000 will be transferred to the plantations during the coming planting season.

Cost of growing Trees.

Attached to the reports on each station are statements showing the cost of raising the trees and forming the plantations, and from these figures it will be seen that the cost during the year compares favourably with last year's figures. The cost of growing trees in a nursery for a single year can only be arrived at by keeping strict account of the labour expended on each crop, and as this involves an immense amount of clerical work it is thought that the average cost to date is sufficiently comprehensive for all practical purposes. To further explain the matter it may be pointed out that Rotorua Nursery sent out 5,300,000 trees, raised 4,600,000 from seed, and grew some 2,000,000 two-year-old trees during the year, making the total of trees dealt with 12,000,000-odd. If the expenditure for the year, with a proportion of the cost of property improvements, such as buildings, &c., added, is divided over this number of trees, the average cost per thousand runs out at 6s. 1d. This average is not strictly correct, and a more reliable cost would be got by adding this year's to last year's average of 6s. 1d., making the cost 12s. 2d. per thousand, because the trees are mostly two years old when sent out from the nursery. The average cost as shown in the summaries for Rotorua Nursery has this year been worked out in this manner. The cost of growing trees in a nursery is bound to vary each year, as the results depend largely upon the germinative quality of the seed. It has frequently occurred in Rotorua Nursery that the year's seed of a certain tree germinated at the rate of, say, 15 per cent., and the following year's seed of the same tree at the rate of 30 per cent., thus resulting in 100 per cent. more trees with practically the same expenditure in sowing, weeding, and other attention.

Cost of forming Plantations.

Waiotapu Plantation.

Most of the work done at this plantation has been undertaken by prison labour, and the expenditure on this station represents supervision, purchase of tools, erection of buildings, &c., with also a comparatively small expenditure on the employment of discharged prisoners. The actual cost of forming the plantations during the year was £2 5s. 5d. per acre, or 16s. 1d. per thousand trees. The average is higher than usual, owing to the expenditure incurred in the erection of buildings and other formation-work necessary for the new prison camp. To date the actual average costs are 12s. 4d. per thousand trees and £1 12s. 2d. per acre. Although no payment is made to the Prisons Department for the labour supplied, the value of the work done by the prisoners is accurately kept, and if this value is added to the expenditure the costs work out during the year to £1 9s. 8d. per thousand trees planted and £4 3s. 8d. per acre, while the costs to date are £2 0s. 2d. per thousand and £5 4s. 9d. per acre. These costs also include the maintenance of the areas planted.

Whakarewarewa Plantation.

The plantations at this station have for the most part been formed by free labour, and the cost is necessarily higher than at Waiotapu. During the year the plantations cost £4 3s. 9d. per acre, or £1 9s. 2d. per thousand trees; and to date £5 0s. 9d. per acre and £2 5s. 9d. per thousand trees. With the value of prison labour added, the averages for the year work out at £5 7s. 11d. per acre and £1 17s. 7d. per thousand trees, while the averages to date are £6 1s. 9d. per acre and £2 15s. 3d. per thousand trees. This plantation reserve has large areas which carry a dense growth of bracken, and the cost of the work, which also includes the maintenance, has thereby been much higher than at Waiotapu, where most of the land planted has been tussocky and required comparatively little labour in clearing and in maintenance subsequent to planting.

Library of Forestry Literature.

Several new publications have this year been added to the library, which now contains 150 volumes and reports, and the officers have made good use of the books generally.

The competitive papers this year show that a decided advance has been made in the study of forestry questions. Mr. R. Glass secured first prize, and the second prize was awarded to Mr. W. Montgomery. Papers on the progress of afforestation in the Rotorua district were asked for, as it was thought that the discussion of such a subject would indicate in how far each officer had studied the general principles underlying the work. Mr. Glass's paper will be produced in the report, as it contains much information relative to tree-growth in this district, both as regards the successes and failures.

For the future it is intended that individual officers should specialize in one particular branch. One or perhaps two will take up the study of insects and plant-diseases, and while

collecting specimens of such will also record the results of their investigations. Similarly data on such questions as the rate of growth—both height and diameter increment—mixture of species, and tending of plantations will be dealt with. Other aspects of the work will in time develop, but from this small beginning it is hoped that in time the records will contain much information that will be serviceable in preparing future working-plans.

The Valuation of Plantations.

Owing to absence of data relating to the growth of exotic trees in New Zealand it is a difficult matter to place either a present or a prospective value upon a plantation. Apart from the cost of forming a plantation we have as yet no other method of arriving at its value. It is true that throughout this country there are many fine specimens of exotic trees from which the rate of both height and diameter growth could be ascertained, but these specimens are usually to be found growing in an open position and under entirely different conditions to that of trees destined to produce a supply of marketable timber, and hence are valueless for our purpose. On small areas of the plantations in this district the trees are now almost large enough to commence collecting data relative to their rate of growth, and it is hoped that in a few years sufficient information will be accumulated to place this branch of the work on a good footing.

Prison Labour.

The employment of prisoners at the tree-planting camps continues to be satisfactory. During the year an average of 11·16 men were employed at Whakarewarewa Plantation, and 17·04 at Waiotapu Plantation, making a total of 28·20 men, which is considerably below last year's average of 33·89 men. The value of work performed by prisoners is as follows:—

Station.	Value of Work performed.	Average Daily Number employed, 1910–11.	Average Daily Number employed, 1911–12.	Average Daily Number employed since Camp started.	Average Value of each Prisoner's Work, 1911–12.
	£ s. d.				£ s. d.
Whakarewarewa Plantation ..	934 19 9	10·44	11·16	12·17	83 15 7
Waiotapu Plantation.. ..	1,750 5 0	23·45	17·04	29·29	102 14 3
		33·89	28·20	41·46	

Details of the foregoing values will be found attached to the plantation reports.

At Waiotapu the average daily number of prisoners employed from the opening of the camp to the 31st March, 1911, was 30·40, but this average has been reduced this year to 29·29, owing to a shortage of prisoners suitable for sending to the tree-planting camps. This shortage necessitated considerable alterations being made in the tree-planting scheme. Comparing this year's with last year's figures a shortage of six men appears, but this does not exactly express the position, because it was during the planting season that the difficulty in getting a sufficient number of men occurred. Owing to the scarcity of free labour at Waiotapu, trees which were intended for that station had to be planted at Whakarewarewa, where more free labour is available. I have again to thank the Prisons Department's officers for their co-operation in the work, the success of which is in a large measure due to their efforts.

New Reserve.

Adjoining the plantation areas at Waiotapu on the eastern side an area of 33,000 acres (approximately) has been reserved for afforestation purposes. The land on this new reserve is in many respects similar to that which has been planted at Waiotapu, but, owing to the greater altitude of the new portion, the climatic conditions are somewhat more trying. The vast plateau known as the Kaingaroa Plains, of which the new afforestation reserve forms a part, extends from Taupo in the south to Tarawera in the north, with an altitude of about 2,000 ft. above sea-level, and an area of, roughly, 200,000 acres. The plant-life with which the greater part of the plains is at present covered consists chiefly of tussock, dwarfed scrub, danthonia-grass, and dandelion, the latter two being the chief food of the many wild horses which find a very precarious existence in this bleak district. To the eye the plains appear to have a level unbroken surface, and the deep gullies which here and there exist are not seen unless deviations are made from the public roads. For afforestation purposes the new reserve is well suited. The meagre growth on three-fourths of the area will make it possible to plant the trees with a comparatively small expenditure on clearing, and once the trees are planted very little expense will be incurred in upkeep until thinning becomes necessary. The remainder of the area, comprising the gullies and the eastern end of the block, which falls gradually towards Fort Galatea, carries a moderately heavy growth of bracken, and on this portion the work will be somewhat more expensive, although not more so than land already planted at Waiotapu.

When a meteorological station is started here it will probably be found that the rainfall on the plains will be much the same as at Waiotapu, and the average temperature lower than at that place. Strong cold winds are frequent, the prevailing ones being north-east and south-west, and the difference between the day and night temperatures is usually very marked. Very warm days are not uncommon during the summer months, but the night temperatures are almost invariably low—probably always below 40° Fahr.

That certain forest-trees do remarkably well on this land has been amply demonstrated by the experimental plantations which were formed here some years ago. About the year 1898 four areas, in all 25 acres, on different parts of the plains were planted with various forest-trees, comprising principally larch, Norway spruce, Douglas fir, Sitka spruce, Austrian pine, birch, oak, and sweet-chestnut. Of these, larch, Austrian pine, and birch were the only ones which proved suitable, and, owing to the many failures, the areas were in 1902 restocked with other species, consisting of larch, Corsican pine, Monterey pine, and Lawson's cypress, the last-named being the only one of these which failed.

The rate of growth of the species which have succeeded is, with the exception of birch, equal to that recorded at Waiotapu, and all have a remarkably healthy appearance. Douglas fir and Norway and Sitka spruces have not been included amongst the successful species, because for six years following their planting these species made little or no growth, and were badly frosted time after time. Since, however, shelter has been afforded them by the more accommodating larch and pines the Douglas fir has made rapid progress, and the spruces, although not so fast, have yet made satisfactory growth.

The preparatory work done in connection with the new reserve has consisted chiefly in laying off the roads and fire-breaks, at which work a surveyor has been employed for three months. It is intended to subdivide the land into blocks of about 1,200 acres, with fire-breaks 2 chains wide separating each block. The fire-breaks will, as far as possible, run north and south and east and west, and along the centre of each a belt of deciduous trees half a chain wide will be planted to serve as an extra means of preventing the spread of fire.

The work of erecting the buildings, and the preparation of the site to which it is intended to shift the prison camp, is well forward, and is dealt with in the report on Waiotapu Plantation attached hereto. It was expected that the camp would have been shifted about November last, but owing to the small number of prisoners available the tree-planting operations had to be curtailed at Waiotapu, thus necessitating the camp being kept in its present position for another planting season.

Principal Trees growing on Whakarewarewa Plantation.

Mr. Buchanan, Assistant Forester at Whakarewarewa Plantation, has supplied a paper giving brief descriptions of the principal trees growing at Whakarewarewa Plantation, which is attached hereto. It is thought that the information contained therein will be of value to intending planters, from whom numerous letters are received each year asking for information about the respective merits of trees generally.

Proposals for 1912–13.

The trees available for permanent planting in Rotorua Nursery number about 3,500,000, and these will be divided between Whakarewarewa and Waiotapu Plantations, where preparations are well in hand for planting them.

At Waiotapu the shifting of the prison camp will necessitate the employment of an extra number of free men to undertake the maintenance of the plantations. At both the plantations it is intended to reduce the cost of maintenance by sowing down a further area of the fire-breaks in grasses and keep them grazed with sheep.

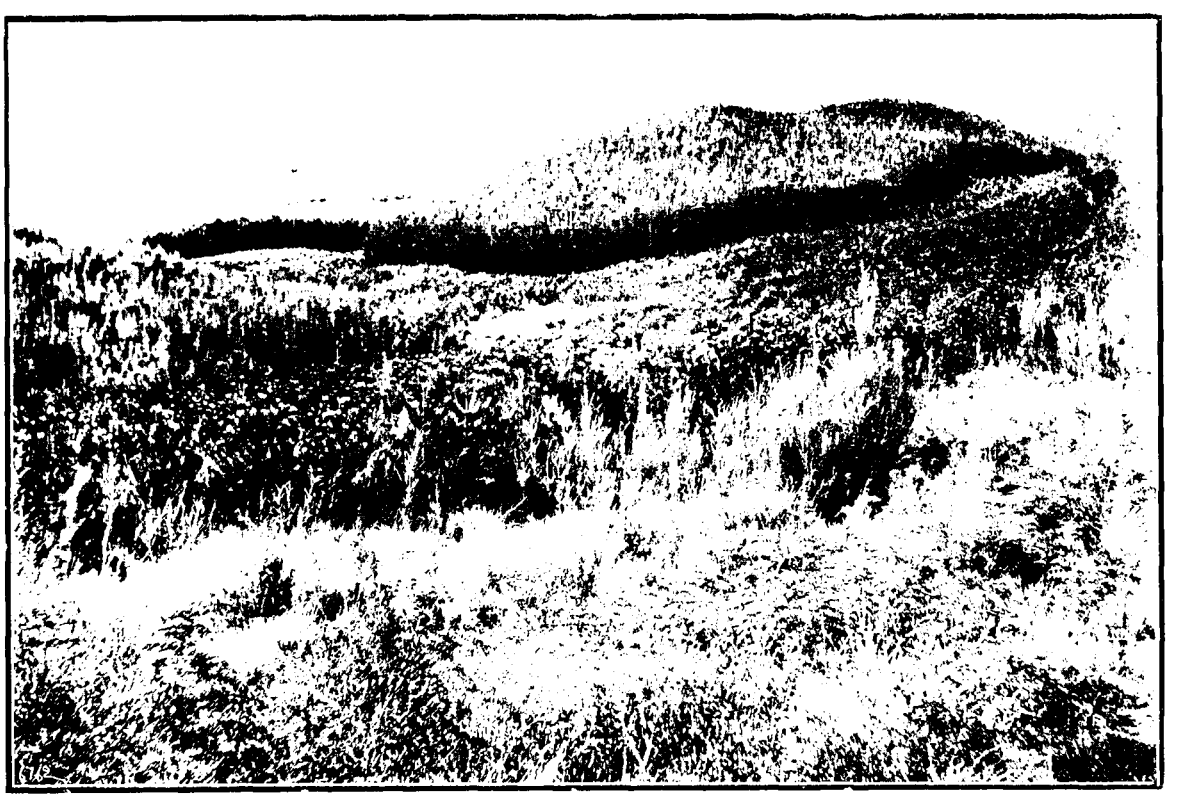
Conclusion.

In conclusion, I wish to place on record my appreciation of the assistance given me by each officer in carrying out the afforestation work.

H. A. Goudie,
Superintending Nurseryman, North Island.

Two-year-old Larch Beds at Rotorua.

One-year-old Larch Beds at Rotorua.



Birch. Ten Years. 25 Feet at Wadhurst.

Corsican Pine. Nine Years. 12 Feet at Wadhurst.

Number and Species of Trees planted in the North Island.

Names of Trees.		Numbers planted.				Numbers now Existing.			
Botanical Name.	Common Name.	Whakarewarewa Plantation.	Waiotapu Plantation.	Puhipuhi Plantation.	Totals.	Whakarewarewa Plantation.	Waiotapu Plantation.	Puhipuhi Plantation.	Totals.
Acacia melanoxylon	Blackwood	125,214	1,296	5,600	132,110	123,174	1,296	..	124,470
Acer saccharum	Sugar-maple	..	50	..	50	..	..	..	..
,, pseudo-platanus	Sycamore	32,536	..	..	32,536	32,536	..	..	32,536
Aesculus hippocastanum	Horse-chestnut	232	..	..	232	..	..	..	..
Alnus glutinosa	Alder	26,393	2,000	..	28,393	26,393	..	..	26,393
Betula alba	Silver-birch	6,585	39,230	..	45,815	6,585	39,230	..	45,815
Castanea sativa	Sweet-chestnut	15,516	1,325	..	16,841	..	..	..	..
Catalpa speciosa	Hardy catalpa	222,125	50	200	222,375	..	..	..	..
Corylus avellana	Filbert	..	660	..	660	..	..	..	..
Cupressus Lawsoniana	Lawson's cypress	..	11,367	..	11,367	..	11,367	..	11,367
,, thurifera	A Mexican cypress	420	100	..	820	420	400	..	820
Eucalyptus acervula	syn. Gunnii of Mueller	48,700	..	..	48,700	40,000	..	..	40,000
,, amygdalina	Peppermint-gum	767,597	49,530	91,400	908,527	731,417	..	20,000	751,417
,, botryoides	Mahogany-gum	2	..	..	2	..	..	..	..
,, calophylla	Port Gregory gum	2	..	..	2	..	..	..	..
,, capitellata	White stringy-bark	2	..	..	2	..	..	..	..
,, coccifera	Alpine peppermint	170	8,204	..	8,374	100	5,000	..	5,100
,, cordata	Heart-shape leaved gum	2	..	..	2	..	..	..	..
,, cornuta	Yate tree	2	..	..	2	..	..	..	..
,, corymbosa	Bloodwood	1	..	18,300	18,301	..	..	..	..
,, corynocalyx	Sugar-gum	1	..	4,325	4,326	..	..	..	..
,, crebra	Red-ironbark	1	..	20,470	20,471	..	..	..	..
,, diversicolor	Karri gum	2	..	..	2	..	..	..	..
,, drepanophylla	Ironbark—Keppel Bay	2	..	..	2	..	..	..	..
,, gigantea	Giant gum	3,740	..	..	3,740	..	..	..	..
,, globulus	Blue-gum	27,000	..	..	27,000	..	..	..	..
,, gomphocephala	Tooart gum	2	..	..	2	..	..	..	..
,, goniocalyx	Mountain spotted gum	2	..	..	2	..	..	..	..
,, Gunnii—Hooker	Cider-sap gum	3,420	182,779	..	186,199	2,900	25,000	..	27,900
,, ,, Mueller	..	150	35,921	..	36,071	100	..	..	100
,, haemastoma	White-ash gum	5,190	..	..	5,190	..	..	..	..
,, hemiphloia	Forest-box	2	..	..	2	..	..	..	..
,, leucoxylon	White-bark gum	1	..	40,020	40,021	..	..	15,000	15,000
,, longifolia	Woolly butt	2	..	..	2	..	..	..	..
,, macrorrhyncha	Stringy-bark	2	..	..	2	..	..	..	..
,, maculata	Spotted gum	1	..	10,280	10,281	..	..	2,500	2,500

NUMBER AND SPECIES OF TREES PLANTED IN THE NORTH ISLAND—*continued*.

Names of Trees.		Numbers planted.				Numbers now Existing.			
Botanical Name.	Common Name.	Whakarewarewa Plantation.	Waiotapu Plantation.	Puhipuhi Plantation.	Totals.	Whakarewarewa Plantation.	Waiotapu Plantation.	Puhipuhi Plantation.	Totals.
Eucalyptus marginata	Jarrah	1	..	6,710	6,711	..	..	2,000	2,000
,, meliodora	Yellow-box	6,930	..	..	6,930	3,000	..	..	3,000
,, microcorys	Tallow-wood	2	..	..	2	..	..	..	..
,, monophylla	..	2	..	..	2	..	..	..	..
,, Muellerii	Mountain-gum	100	3,825	..	3,925	100	2,000	..	2,100
,, obliqua	Messmate-gum	68,620	30,010	19,850	118,480	50,000	..	15,000	65,000
,, occidentalis	Mallet-wood	2	..	..	2	..	..	..	..
,, paniculata	Ironbark	1	..	20,430	20,431	..	..	..	..
,, pauciflora	Drooping-gum	203,670	196,911	..	400,581	108,000	25,000	..	133,000
,, pilularis	Black-butt	2	..	..	2	..	..	..	..
,, polyanthemos	Brown-box	2	..	..	2	..	..	..	..
,, punctata	Leather-jacket	2	..	..	2	..	..	..	..
,, redunca	Wandoo	1	..	38,620	38,621	..	..	15,000	15,000
,, regnans	Giant gum	2	..	..	2	..	..	..	..
,, resinifera	Kino-gum tree	1	..	149,120	149,121	..	..	112,000	112,000
,, robusta	Brown-mahogany	2	..	..	2	..	..	..	..
,, rostrata	Red-gum	5,000	..	450,320	455,320	..	..	350,000	350,000
,, saligna	Willow-gum	2	..	..	2	..	..	..	..
,, salmonophloia	Salmon-gum	2	..	..	2	..	..	..	..
,, siderophloia	White-ironbark	1	..	27,520	27,521	..	..	..	..
,, sideroxylon	Black-ironbark	2	..	..	2	..	..	..	..
,, Sieberiana	Mountain-ash	26,750	5,650	..	32,400	3,000	..	..	3,000
,, Stuartiana	Apple-scented gum	2,018,513	40,487	520,315	2,579,315	1,096,800	10,000	450,000	1,556,800
,, tereticornis	Swamp-gum	41,220	154,209	..	195,429	10,000	..	..	10,000
,, viminalis	Manna-gum	2	..	..	2	..	..	..	..
,, virgata	Twiggy gum	2	..	..	2	..	..	..	..
,, urnigera	Urn-fruited gum	110	8,104	..	8,214	100	5,000	..	5,100
Fraxinus americana	American ash	..	..	320	320	..	..	..	..
Hikora ovata	Hickory	3,500	..	2,575	6,075	..	..	..	..
Juglans cinerea	Butter-nut	2,651	..	..	2,651	..	..	..	..
,, nigra	Black-walnut	3,402	..	6,490	9,892	..	..	..	..
,, regia	Walnut	25,110	13,084	..	38,194	13,800	..	..	13,800
Juniperus virginia	Red-cedar	670	..	2,650	3,320	670	..	..	670
Larix europaea	European larch	6,120,570	8,540,020	..	14,660,590	5,840,135	8,103,930	..	13,944,065
,, occidentalis	Western larch	50	..	..	50	50	..	..	50
Liquidambar styraciflua	Sweet-gum	1,700	..	..	1,700	1,700	..	..	1,700
Picea canadensis	White-spruce	40	..	..	40	..	..	..	..

„ excelsa	Norway spruce	197,078	2,650	..	199,728	195,025	..	..	195,025
„ grandis	Silver-fir (Cal.)	20	..	..	20	..	..	..	..
„ nobilis	Red-fir	5	..	..	5	..	..	..	..
„ pungens	Blue-spruce	20	..	..	20	..	..	..	..
„ sitchensis	Tideland spruce	97,368	15,625	42,450	155,443	91,175	..	..	91,175
Pinus austriaca	Austrian pine	286,068	1,238,243	..	1,524,311	283,655	1,084,975	..	1,368,630
„ Benthamiana	Bentham's pine	19,600	275,600	..	295,200	19,600	238,275	..	257,875
„ canariensis	Canary Island pine	6,300	375	..	6,675	6,300	..	..	6,300
„ contorta	Twisted pine	390	8,700	..	9,090	..	3,700	..	3,700
„ Coulterii	Coulter's pine	375	905	..	1,280	375	905	..	1,280
„ densiflora	Japanese red-pine	2,325	..	..	2,325	2,325	..	..	2,325
„ excelsa	Blue-pine	..	300	..	300	..	300	..	300
„ halepensis	Aleppo pine	..	63,550	..	63,550	..	..	..	..
„ Jeffreyii	Jeffrey's pine	2,200	7,053	..	9,253	2,200	6,643	..	8,843
„ Lambertiana	Sugar-pine	170	1,425	..	1,595	170	1,425	..	1,595
„ Laricio	Corsican pine	2,608,100	5,945,175	..	8,553,275	2,392,400	5,177,460	..	7,569,860
„ muricata	Bishop pine	7,445	57,050	18,500	82,995	6,320	43,800	18,500	68,620
„ Murrayana	Lodgepole pine	12,450	1,100	..	16,550	10,225	4,100	..	14,325
„ ponderosa	Heavy pine	618,425	1,284,575	..	1,903,000	505,650	1,137,825	..	1,643,475
„ „ var. scopulorum	Rock-pine	575	1,475	..	2,050	575	1,475	..	2,050
„ radiata	Remarkable pine	203,675	73,200	..	276,875	147,800	73,200	..	221,000
„ resinosa	American red-pine	50	2,150	..	2,200	50	2,150	..	2,200
„ rigida	Pitch-pine	..	12,200	..	12,200	..	12,200	..	12,200
„ Sabiniana	Nut or grey pine	25	..	..	25	25	..	..	25
„ sylvestris	Scotch fir	..	200	..	200	..	200	..	200
„ strobus	Weymouth pine	..	163,750	..	163,750	..	159,950	..	159,950
„ teocote	Mexican torch-pine	2,250	3,000	..	5,250	2,250	3,000	..	5,250
„ Thunbergii	Japanese black-pine	700	..	..	700	700	..	..	700
„ Torreyana	Torrey's pine	1,320	500	..	1,820	1,320	..	..	1,320
„ taeda	Torch-pine	1,100	..	..	1,100	1,100	..	..	1,100
Platanus orientalis	Oriental plane	3,900	..	..	3,900	1,900	..	..	1,900
Podocarpus dacryoides	White-pine (N.Z.)	..	..	4,230	4,230	..	..	..	..
„ totara	Totara	..	..	565,700	565,700	..	..	..	..
„ Hallii	„	..	..	200	200	..	..	..	..
Populus (varieties)	Poplar	600	1,825	..	2,425	600	..	..	600
Pseudo-tsuga Douglasii	Douglas fir	184,410	95,537	35,680	315,627	151,308	89,712	..	241,020
Pyrus aucuparia	Mountain ash	600	6,250	..	6,850	..	..	..	..
Quercus pedunculata	English oak	1,200	..	..	1,200	..	..	..	..
Robinia pseudo-acacia	Locust tree	100	106,225	..	106,325	..	..	..	..
Sequoia gigantea	Big tree (Cal.)	..	..	330	330	..	..	..	..
„ sempervirens	Redwood	97,641	115,875	30,915	244,431	90,673	..	..	90,673
Thuja plicta	White-cedar	3,275	15,075	..	18,350	3,275	14,200	..	17,475
Ornamental shrubs and leguminous plants		9,430	55,486	..	64,916	475	36,936	..	37,411
Totals		14,182,844	18,883,186	2,133,520	35,199,540	12,008,451	16,320,654	1,000,000	29,329,105

ROTORUA NURSERY.

(Area of enclosure, 163 acres; approximate altitude, 1,000 ft.)

The results obtained with the propagation of forest-trees at this nursery during the past year have been very satisfactory. Growth has been unusually good, and the germination of seeds, with the exception of larch, has been quite up to the average.

Rain fell on 155 days during the year, with a total fall of 59·90 in., and was somewhat heavier than usual. Last year the rainfall amounted to 39·58 in., falling on 137 days. The maximum temperature recorded during the year was 89° Fahr., occurring in February, and the minimum 22° Fahr., recorded on several occasions in July and September. Frost occurred on sixty-five nights, from May to November inclusive.

Seedling Trees.

Trees to the number of 4,615,400, and valued at £4,588 15s., were raised from seed, details of which are shown in Schedule V appended hereto.

Larch (*Larix europaea*).—This crop is thinner than usual, the trees obtained from 4 cwt. of seed being 1,250,000, and the percentage of germination was 4. The seedlings have made very satisfactory growth.

Japanese Larch (*Larix leptolepis*).—This is the first time that any appreciable quantity of this tree has been raised here, and the results so far are encouraging. From 5 lb. of seed 40,000 seedlings resulted, germination being at the rate of 8 per cent. This species of larch apparently does not possess the vigour of its European relation. The seedlings are very small and inclined to be weak. In England the Japanese larch is generally considered to be a faster grower than the European larch, but in New Zealand the opposite appears to be the case.

Corsican Pine (*Pinus Laricio*).—The crop raised from 4 cwt. of seed is estimated at 2,500,000 trees, and the rate of germination at 16 per cent. This is a splendid crop of trees: the germination was even throughout the beds, and good growth has been made by the seedlings.

Heavy Pine (*Pinus ponderosa.*)—This is an exceptionally good crop. From 90 lb. of seed 400,000 seedlings resulted, the rate of germination being 44 per cent. Good growth has been made by the young trees.

Monterey Pine (*Pinus insignis*).—From 25 lb. of seed sown 200,000 seedlings resulted, germination being at the rate of 40 per cent. These seedlings have made splendid growth, and will all be transferred to the plantation during the coming planting season.

Weymouth Pine (*Pinus strobus*).—In comparison with the results obtained with this pine for several years past the crop this year is good, although the rate of germination is only about 8 per cent. 60,000 trees were raised from 27 lb. of seed, and good growth has been made by the young trees.

Douglas Fir (*Pseudo-tsuga Douglasii.*)—The rate of germination of this species is very low this year, being 2·07 per cent. From the sowing of 12 lb. of seed 10,000 seedlings resulted, and these have made poor progress.

Apple-scented Gum (*Eucalyptus Stuartiana*).—150,000 trees were raised from 3 lb. of seed, and excellent growth has been made by the young trees, all of which will be transferred to the plantation during the coming planting season.

Experimental Lots.—Small packets, each containing 2 oz. of seed, of *Pinus Montezumae* and *Pinus patula* were presented to the Department and duly sown. Both these species are natives of Mexico, where they are found inhabiting country from 4,000 ft. to 12,000 ft. above the sea-level. They will be planted out, and their suitability for this climate tested. Neither of these pines appears to be much known in Europe, and consequently very little reference is made to their value as timber-producers.

Two-year Seedling Trees.

The growth made by the two-year-old seedlings is rather better than usual, which is no doubt due to the unusually wet summer experienced.

Larix europaea (*European Larch*).—The adoption of the proposal mentioned in last year's annual report, to allow the larch to grow without "wrenching" them, has caused the growth to be very strong. It is yet too early to make any definite statement upon the value of this treatment in combating the root-fungus (*Rosselinia radiciperda*), as this parasite is usually less troublesome during a wet season, and, although it is not so prevalent in the seed-beds this year, this may be due to the unusually wet weather experienced. A late spring frost badly nipped many of the larch, with the result that trees with double leaders and bushy specimens are very prevalent.

Very good growth has been made with most of the other trees mentioned in this schedule. *Fraxinus quadrangulata* (American ash), *Tsuga mertensiana*, and *Pinus monticola*, which were grown experimentally, do not promise to be suitable trees to grow here. They have the appearance of being in an uncongenial locality, and it is very unlikely that further trials will be made with them.

Lined-out Trees.

Severe frosts experienced in July and August accompanied by very dry weather were responsible for a death-rate of about 15 per cent. amongst the lined-out trees. This is the first occasion on which winter frosts have killed trees in the nursery. The lining out was done in July and August, which are usually very wet months, and it is probable that the newly transplanted trees succumbed more readily to the frosts, owing to the unusually dry nature of the ground. Most of the deaths occurred amongst the Douglas fir, and a small proportion of Corsican pine and heavy pine were also affected. The growth made by the lined-out trees has been uncommonly good, and a fine lot of trees will be obtained from this crop for sending to the plantations during the coming planting season. A further trial was made with lining out some 50,000 two-year-old seedling larch, but little or no growth resulted. These trees were "sized" from the two-year seed-beds, and retained in the nursery because they were either too small or too weak for sending to the plantations, and from frequent trials it has been proved that it is futile to expect such trees to grow into decent specimens.

General.

Horse-feed.—Owing to the unusually dry weather experienced during the winter months, the oaten crops grown for horse-feed were a partial failure. In all, 30 acres were sown, 14 acres being sown in

the autumn, and the balance—16 acres—in the spring. The autumn-sown crop was a very poor one, the yield being 4 tons, and this is attributed to the dry weather already referred to. From the 16 acres sown in the spring 20 tons of splendid sheaf was harvested, and this is now in stack, and will be cut as required. For winter use 6 tons of clover hay was saved and stacked. During an average year 45 tons of chaff are consumed, so that it will be necessary to purchase chaff this year in order to make up the deficiency caused by the failure of our own crop.

Manuring.—The unoccupied portions of the nursery were sown with rye, for ploughing in as a manurial crop. This is a very hardy and quick-growing plant, and, if sown early in the year, requires to be ploughed in a month after sowing. Next year it is proposed to apply ground limestone to a large portion of the nursery, and also sow down what land can be spared for two years with clover. It is only by such methods that the fertility of the soil can be maintained, as the quantity of stable manure available is sufficient only for dressing land intended for seed-beds, where heavy demands are made upon the soil by crops of seedlings.

Nursery Extension.—Work under this heading comprised chiefly the clearing and ploughing of a portion of the nursery-area adjoining the Cemetery Reserve, which has remained in its wild state, covered with a dense growth of manuka and other native plants. This work will be gone on with as time permits; and it is intended to use the land for paddocks or for cropping purposes, as it is mostly poor and irregular in shape, and unsuited for laying out into nursery beds.

The number of trees sent out during the year is 5,320,230, and their value £9,021 11s. 7d. (details in schedule appended), and the output of trees to date is 33,719,305, valued at £69,540 10s. 1d. Trees at present in the nursery number 7,049,650 (see Schedule V), and are valued at £8,476 17s. 1d., and the number of trees raised since the commencement of the nursery is 40,768,955, and their value is £78,017 7s. 2d.

The costs of the various operations during the year are as follows: Sizing, 2s. 1d. per thousand; lining out, 2s. 3d. per thousand; lifting trees for plantations, 2s. 4d. per thousand.

The average daily number of workmen employed during the year was 24·50.

Details of expenditure and other tabulated information relating to the growing of trees are attached hereto.

Following is a record of the rainfall and temperature:—

Schedule I.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1911.	In.		Deg. Fahr.	Deg. Fahr.	
April	10·72	17	78	40	..
May	7·63	12	70	28	3
June	4·25	12	62	24	10
July	1·29	7	61	22	15
August	3·21	10	63	24	17
September	5·80	12	68	22	10
October	4·21	14	69	24	7
November	6·54	20	76	30	3
December	6·55	16	78	35	..
1912.					
January	1·76	9	84	36	..
February	1·55	10	89	40	..
March	6·39	16	74	34	..
Totals	59·90	155	..	..	65

Schedule II.—Statement of Expenditure.

	For Year.			To Date.		
	£	s.	d.	£	s.	d.
Tree-planting and maintenance—						
Tree-growing	2,047	8	3	22,311	17	9
General maintenance and repairs ..	257	6	11	3,518	17	0
Tree-seeds	253	17	9	2,405	11	0
Manures	52	6	4	921	10	1
Horse-feed, purchased and grown ..	228	12	5	1,585	2	6
Miscellaneous works	51	2	3	325	6	2
Stock and material—Tools, implements ..	135	17	1	1,018	13	10
Permanent works—						
Buildings	26	12	10	2,775	12	0
Nursery-formation	86	1	9	2,294	19	11
Fencing	6	4	6	221	12	8
Water-supply	..			660	18	10
Seed-frames	..			1,649	4	9
Supervision and clerical—						
Proportion of Superintending Nurseryman's salary	100	0	0	..		
Proportion of Nurseryman's salary ..	197	10	0	2,631	16	8
Clerical assistance	50	0	0			
	£3,493	0	1	£42,321	3	2

Schedule III.—Trees Account.

	During the Year.		Since 1896 to Date.		Estimated Value, as Schedule V.
	Number.	Cost of Raising, per Thousand.	Number.	Cost of Raising and Maintenance, per Thousand.	
		£ s. d.		£ s. d.	£ s. d.
Trees grown	12,369,880	0 12 2	40,768,955	0 18 2	78,017 7 2
Trees sent out	5,320,230	..	33,719,305	..	69,540 10 1
Balance in stock			7,049,650	..	8,476 17 1
Value of land, improvements, and stock (Property Account) ..				..	6,862 8 10
Total value				..	15,339 5 11

Schedule IV.—Property Account.

	£ s. d.
Land (160 acres), Crown land not charged to Forestry Account ..	..
Buildings	1,881 12 4
Improvements	1,848 5 10
Fencing	136 5 5
Stores in hand	2,996 5 3
	£6,862 8 10

Schedule V.—Details of One-year-old Trees, sown 1911–12.

Name of Tree.	Number in Seed-beds.	Height, in Inches.	Amount of Seed sown.	Value per Thousand.	Total Value.	Remarks.
			Lb. oz.	£ s. d.	£ s. d.	
Eucalyptus Stuartiana	150,000	6	3 0	0 10 0	75 0 0	Good crop.
Larix europaea	1,250,000	1–6	448 0	1 0 0	1,250 0 0	Fair.
„ leptolepis	40,000	1–4	5 0	2 0 0	80 0 0	Good.
Pinus Laricio	2,500,000	1	448 0	1 0 0	2,500 0 0	Very good.
„ Montezumae	500	1½	0 2	1 0 0	0 10 0	Good.
„ ponderosa	400,000	1½	90 0	1 0 0	400 0 0	Very good.
„ patula	1,000	1½	0 2	1 0 0	1 0 0	Good.
„ radiata	200,000	5	25 0	1 0 0	200 0 0	Very good.
„ strobus	60,000	1½	27 0	1 0 0	60 0 0	Fair.
Pseudo-tsuga Douglasii	10,000	1½	12 0	1 5 0	12 10 0	Poor.
Native trees and shrubs	3,900	..	..	2 10 0	9 15 0	..
Totals	4,615,400	..	..	..	4,588 15 0	

Details of Two-year-old Trees, sown 1910–11.

Name of Tree.	Number in Seed-beds.	Number in Nursery-lines.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
				£ s. d.	£ s. d.	
Fraxinus quadrangulata ..	300	..	3	1 5 0	0 7 6	Poor growth.
Larix europaea	700,000	350,000	9–18	1 5 0 / 2 5 0	1,662 10 0	Very good.
Pinus austriaca	20,000	..	6	1 5 0	25 0 0	„
„ Benthamiana	10,000	..	4	1 5 0	12 10 0	„
„ densiflora	40	..	4	1 5 0	0 1 0	„
„ Lambertiana	..	1,400	3	2 10 0	3 10 0	Fair.
„ Laricio	1,000,000	..	6	1 5 0	1,250 0 0	Very good.
„ Massoniana	100	..	6	1 5 0	0 2 6	Good.
„ monticola	100	..	3	1 5 0	0 2 6	Fair.
„ ponderosa	25,000	50,000	6	1 5 0 / 2 5 0	143 15 0	Very good.
„ strobus	..	300	3	2 5 0	0 13 6	Fair.
Pseudo-tsuga Douglasii ..	20,000	30,000	6–12	1 10 0 / 2 10 0	105 0 0	Very good.
Tsuga mertensiana	300	..	1	1 5 0	0 7 6	Poor.
Totals	1,775,840	431,700	..	..	3,203 19 6	
	2,207,540					

Details of Three-year-old Trees, sown 1909–10.

Name of Tree.	Number in Nursery-lines.	Height, in Inches.	Value per Thousand. £ s. d.	Total Value. £ s. d.	Remarks.
Cupressus thurifera	200	6	3 0 0	0 12 0	Good growth.
Fraxinus americana	300	9	3 0 0	0 18 0	"
Larix europaea	16,000	12	3 0 0	48 0 0	"
" occidentalis	10	6	3 0 0	0 0 7	Very poor.
Liquidambar styraciflua	1,000	12	3 0 0	3 0 0	Good.
Picea canadensis	100	2	3 0 0	0 6 0	Poor.
Pinus Laricio	200,000	4	3 0 0	600 0 0	Very good.
" ponderosa	7,000	4	3 0 0	21 0 0	"
" resinosa	300	4	3 0 0	0 18 0	"
" strobus	100	4	3 0 0	0 6 0	Good.
Sequoia sempervirens	800	6	8 0 0	6 8 0	"
Thuja occidentalis	700	3	3 0 0	2 2 0	Fair.
Tsuga canadensis	200	2	3 0 0	0 12 0	Poor.
Totals	226,710	..	..	684 2 7	

Details of Trees transferred to Plantations, &c., 1911–12.

Where sent.	Name of Tree.	Number.	Height, in Inches.	Value per Thousand. £ s. d.	Total Value. £ s. d.	Remarks.
Whakarewarewa Plantation	Alnus glutinosa ..	400	9	3 0 0	1 4 0	Very good.
	Cupressus thurifera ..	420	9	2 5 0	0 18 10	Good.
	Eucalyptus Stuartiana ..	209,825	6	0 10 0	104 18 3	Fair.
	Larix europaea ..	272,025	12	1 5 0	340 0 7	Very good.
	" ..	495,375	12	2 5 0	1,114 11 10	"
	Larix occidentalis ..	50	9	2 5 0	0 2 3	"
	Pinus canariensis ..	6,300	6	1 0 0	6 6 0	Failure.
	" Coulterii ..	375	6	2 5 0	0 16 10	Good.
	" Jeffreyii ..	2,200	4	2 10 0	5 10 0	"
	" Laricio	569,400	4	1 5 0	711 15 0	Very good.
	" "	992,400	4	2 5 0	2,232 18 0	"
	" Lambertiana ..	170	4	2 10 0	0 8 6	Good.
	" ponderosa ..	31,200	4	2 5 0	70 4 0	"
	" ponderosa, var. scopulorum	575	4	2 10 0	1 8 9	"
	" radiata	55,875	6	1 0 0	55 17 6	Fair.
	" resinosa ..	50	4	2 10 0	0 2 6	Good.
	" teocote	2,250	6	2 5 0	5 1 3	Partial failure.
	Picea canadensis ..	40	6			
	" grandis	20	6	3 0 0	0 5 1	Underplanting as an experiment.
	" nobilis	5	6			
	" pungens ..	20	6			
	Pseudo-tsuga Douglasii ..	2,550	9	2 10 0	6 7 6	Good.
	Sequoia sempervirens ..	5,150	6	6 0 0	30 18 0	Fair.
	Thuja plicata	425	6	3 0 0	1 5 6	Good.
		2,647,100	..	..	4,691 0 2	
Waiotapu Plantation	Cupressus thurifera ..	400	9	2 5 0	0 18 0	Failure.
	Larix europaea ..	1,000,000	12	1 5 0	125 0 0	Very good.
	Pinus Coulterii ..	300	6	2 5 0	0 13 6	Good.
	" Jeffreyii ..	2,950	4	2 10 0	7 7 6	"
	" Laricio	1,445,025	4	1 5 0	1,806 5 7	Fair.
	" "	665,000	4	2 5 0	1,496 5 0	"
	" Lambertiana ..	100	4	2 10 0	0 5 0	Good.
	" ponderosa ..	114,000	4	1 5 0	142 10 0	"
	" " ..	301,625	4	2 5 0	678 13 1	"
	" ponderosa, var. scopulorum	1,475	4	2 10 0	3 13 9	"
	" radiata	2,000	6	1 0 0	2 0 0	Poor.
	" resinosa ..	50	4	2 10 0	0 2 6	Good.
	" strobus	10,100	3	2 5 0	22 14 6	Very good.
	" teocote	1,000	6	1 5 0	1 5 0	Partial failure.
	" "	2,000	6	2 5 0	4 10 0	"
	Thuja plicata	300	6	3 0 0	0 18 0	Fair.
Totals		2,646,325	..	..	4,293 1 5	

Details of Trees transferred to Plantations, &c., 1911–12.

Where sent.	Name of Tree.	Number.	Value per Thousand.	Total Value.
			£ s. d.	£ s. d.
Whakarewarewa Plantation ..	As per details above	2,647,100	..	4,691 0 2
Waiotapu Plantation	"	2,646,325	..	4,293 1 5
Mental Hospital, Porirua.. ..	*Pinus Laricio*	25,000	1 2 6	28 2 6
Vice-Regal Residence, Wellington..	Shelter and ornamental trees and shrubs	1,474	..	6 10 0
School, Mount Albert	Ditto	12	..	0 1 0
" Ongarue	"	25	..	0 1 6
" Puha	"	12	..	0 1 0
" Ohaupo	"	25	..	0 1 6
" Gisborne High	"	21	..	1 1 0
" Kaitaratahi	"	18	..	0 18 0
Borough Council, Te Aroha ..	"	200	..	0 4 6
Lands Office, Thames	"	18	..	0 9 0
Totals	..	5,320,230	..	9,021 11 7

H. A. GOUDIE,
Superintending Nurseryman, North Island.

WHAKAREWAREWA PLANTATION.

(Area, 9,547 acres; approximate altitude, 1,200 ft.)

A very successful season has been experienced, both as regards the amount of work performed and the results obtained.

Trees to the number of 2,647,100 were received from the Rotorua Nursery. Of this number, 2,367,815 were planted on new area amounting to 823 acres, and the remainder, 279,285, were used to replace failures in former years' planting. Planting was done by both free and prison labour, the former planting 1,606,900 trees on new area, and 264,285 to replace failures; while the prisoners planted 760,915 on new area, and 15,000 to replace failures. The number of trees dealt with considerably exceeds that of any previous year. The total number of trees now in the plantation is 12,007,976, occupying an area of 5,450 acres.

Prison Labour.—The average daily number of men employed was 11·16, and their work was valued at £934 19s. 9d., or an average of £83 15s. 7d. per man. Great credit is due to the Gaoler, Mr. J. Down, and his officers for the able assistance given in carrying out the various works.

Free Labour.—An average daily number of 26·43 men were employed, and the average cost of the various works undertaken was as follows: Clearing for tree-planting, 19s. 4d. per acre; pitting, 6s. 2d. per thousand; planting, 6s. 11d. per thousand; and planting blanks, 18s. 6¾d. per thousand.

The natural growth on the greater part of the area cleared was comparatively light, and consequently the work was done more expeditiously and much more cheaply than in the previous year, when clearing cost £1 15s. 9d. per acre. The lightness of the growth was also advantageous to the pitting, as the ground was very clean after burning off was completed, enabling the work to be done at a considerably reduced cost per thousand. The number of pits prepared by free labour was 1,664,680.

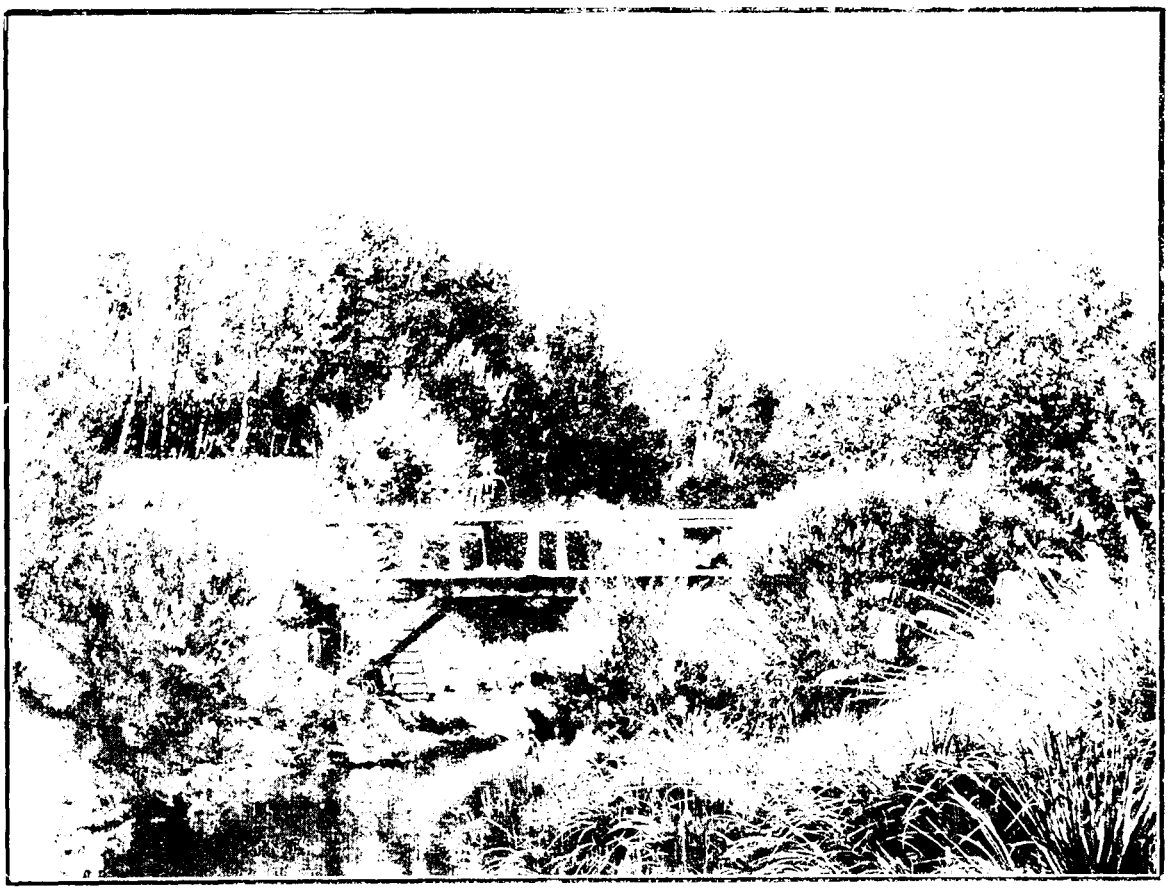
Pruning was carried on amongst the older larch and Douglas fir during the summer months, the chief object being to prevent the suppression of the latter species. In this part of the plantation the Douglas fir were planted at 8 ft. apart, amongst the larch; and although a number of them are holding their own with the larch, the majority of the Douglas fir have been outgrown, and, unless given assistance, would in time become completely smothered by the larch. By trimming up the branches of the larch immediately around them, and thus giving the Douglas fir plenty of light, the rate of height-growth will be considerably increased, and they will still have a chance of catching up to the larch. This method of planting these species together was discontinued four years ago, as it was foreseen that it would prove unsatisfactory, owing to the inequality in the rate of growth and the consequent cost of maintenance.

On the western side of the plantation a large swamp runs back some distance within the reserve, and also extends beyond the boundary. This place has always been a source of anxiety owing to the difficulty of maintaining an efficient fire-break; and as the only remedy was to clear and drain the whole area, it was decided to do so during the summer months. To obtain fall the stream running through the swamp had to be straightened, which necessitated a large drain. The opening of the smaller drains was also somewhat difficult and costly, owing to the nature of the swamp, which in many parts was simply deep black mire. The whole of the area—which was drained at a cost of £1 2s. 8d. per chain—is now rapidly drying, is safe from fire, and will later on be planted with alder.

The sum of £385 10s. 1d. was spent in keeping down the rank growth of fern amongst the young trees, and £127 5s. 2d. was required for the maintenance of fire-breaks. The fire-breaks in the older parts of the plantations, which were sown down in grass some time ago, have proved a success, and a further area will probably be sown down during the next season.

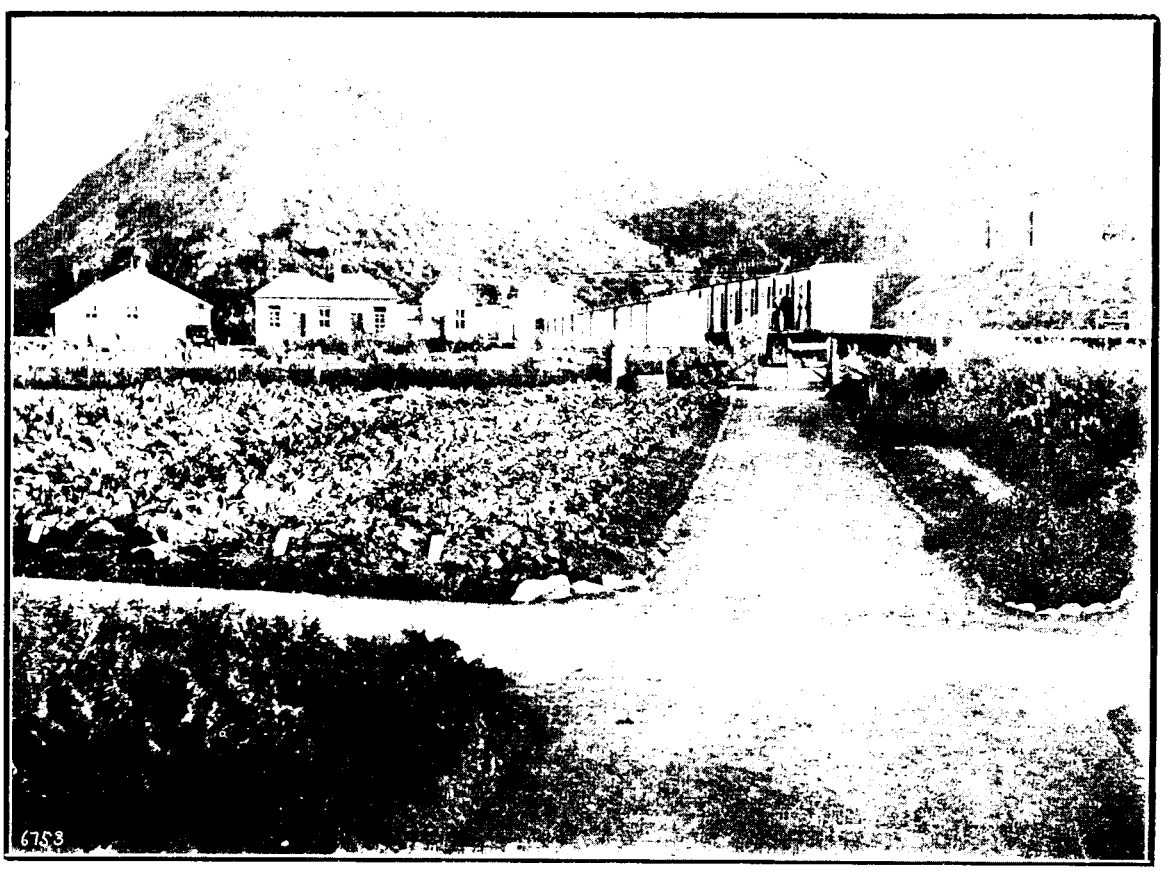
Rabbits and hares, which were on the increase, and starting to do some damage to the young trees, were kept down by trapping, shooting, and digging out the burrows.

A new area of about 540 acres adjoining the Waiotapu Road has recently been added to the plantation reserve. This is a wedge-shaped block of land jutting into the plantation, and is a decided



Fast at Whakarewarewa (Level Ball Lowered, Heavy Crowd on Bridge).

Pinus taeda, Six Years—17 Feet, at Whakarewarewa.



Person County—Woodsdale Plantation

Encroachment of Mixed Plantation at Dusky Hill, showing Large Cotton, Pine, and Ash

Japanese Laburnum, reproduced at Dusky Hill Plantation Fifteen Years Old

acquisition from several points of view, as, apart from its being very suitable for tree-planting, it requires only about 100 chains of fencing and fire-break, whereas on the old boundary 220 chains had to be maintained.

The growth made by the trees during the past season has been entirely satisfactory,t he damp weather experienced during the greater part of the growing season having favoured the young plants to a marked degree, and it can safely be said that in no previous year has the growth been more rapid. The bulk of the planting was made up of *Pinus Laricio* and European larch, and both species have done remarkably well. On the whole, the percentage of failures amongst the former is about equal to that of previous seasons, although the deaths are not evenly distributed, and are most noticeable on certain areas which were planted in the middle of winter, when the frosts were most severe. It has been found by previous experience that *Pinus Laricio,* along with other species of pines, does not do so well if planted when the ground is very cold; and, if possible, the planting should be completed before such time, but with the large number to handle this was impossible. Amongst the larch there is an almost entire absence of failures, and there will probably be little or no replanting to be done. Small plantings of Douglas fir, white-cedar, and various species of pines have all done well, with the exception of *Pinus teocote*, which were mostly killed by frost in the spring. For the same reason *Eucalyptus Stuartiana*, which were planted on bare exposed land, also suffered severely.

The planting of blanks was mostly confined to *Pinus radiata* and *E. Stuartiana* on the same block, where unfavourable conditions caused a considerable number of failures during the previous season.

Throughout the plantation the older trees have made rapid growth, quite equal to any previous year; and although several frosts occurred during the summer, beyond discolouring the foliage of the larch no damage was done.

Pits to the number of 62,000 were left available for the coming season, when it is expected that about a million and a quarter trees will be dealt with.

Statements of the expenditure, &c., for the year are attached.

Schedule II.—Statement of Expenditure.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
General utilization	..	68 17 7
Tree-planting	583 4 9	4,164 4 8
Pitting	539 6 11	5,337 18 9
Clearing	346 13 8	5,924 0 5
Cartage of trees	29 18 11	311 17 4
General upkeep of plantation	909 17 0	6,289 8 10
General repairs	55 5 3	398 3 9
Horse-feed	143 13 5	840 18 11
Permanent works—		
Fencing	..	1,078 1 10
Roadmaking	..	368 15 2
Formation	74 6 11	496 9 4
Buildings	0 6 0	863 13 7
Water-service	8 16 9	95 5 6
Stock, implements, &c.—Tools, implements	23 6 0	620 10 5
Supervision and clerical—		
Salaries—		
Supervision of free labour	282 19 0	..
,, prison labour	200 0 0	3,062 18 10
Nurseryman's proportion of clerical assistance	150 0 0	
	£3,347 14 7	£29,921 4 11

Statement of Value of Prison Labour.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
Tree-planting	285 6 10	1,558 8 3
Pitting	34 10 0	516 1 6
Clearing	270 0 0	1,557 4 8
General upkeep of plantation	336 14 6	1,386 8 9
General repairs	3 12 6	310 6 5
Miscellaneous works	4 15 11	95 19 4
Permanent works—		
Fencing	..	7 13 0
Formation	..	984 17 8
Buildings	..	205 16 0
	£934 19 9	£6,622 15 7

Average daily number of prisoners employed during year .. .. 11·16

,, ,, since camp started .. 12·17

Schedule III.—Trees Account.

	Number.
Trees received during year	2,647,100
Less, to replace blanks	279,285
Planted on new area of 823 acres	2,367,815
Previously planted	9,640,636
Total number planted on 5,450 acres (average age, 4½ years)	12,008,451

Schedule IV.—Property Account.

	£ s. d.
Land (9,547 acres): Crown land not charged to Forestry Account	
Buildings	868 10 5
Improvements	1,456 2 11
Fencing	763 3 11
Stores in hand	284 15 3
	£3,372 12 6

Balance-sheet.

	£ s. d.
Total expenditure	36,544 0 6
Less Property Account	3,372 12 6
Cost of operations	£33,171 8 0
5,450 acres planted (average age, 4½ years); cost per acre	£6 1 9
Estimated value of plantation per acre	£10 3 2

Schedule V.—Statement showing Cost of Operations.

	For Year. £ s. d.	To Date. £ s. d.
Total expenditure	3,347 14 7	29,921 4 11
Deduct cost of fencing, buildings, and road-formation, &c.	106 15 8	3,522 15 10
	3,240 18 11	26,398 9 1
Add proportion of total expenditure on fencing, buildings, road-formation, &c.	207 3 4	1,072 1 1
Cost of planting 823 acres, and maintenance of 5,450 acres	£3,448 2 3	
Cost of planting and maintaining 5,450 acres		£27,470 10 2
Average cost of planting and maintenance—		
Per acre	£4 3 9	£5 0 9
Per 1,000 trees	1 9 2	2 5 9

Statement showing Cost of Operations (with Value of Work done by Prison Labour treated as an Expenditure).

	During Year. £ s. d.	To Date. £ s. d.
Total expenditure	3,347 14 7	29,921 4 11
Prison labour	934 19 9	6,622 15 7
	4,282 14 4	36,544 0 6
Deduct cost of fencing, buildings, &c.	106 15 8	4,721 2 6
	4,175 18 8	31,822 18 0
Add proportion of fencing, buildings, &c.	267 1 7	1,348 10 0
Cost of planting 823 acres, and maintaining 5,450 acres	£4,443 0 3	
Cost of planting and maintaining 5,450 acres		£33,171 8 0
Average cost of planting and maintaining—		
Per acre	£5 7 11	£6 1 9
Per 1,000 trees	1 17 7	2 15

Return of Tree-planting Work done at Whakarewarewa Plantation, 1911-12.

Block.	Name of Tree.	Number on New Area.	Replacing Blanks.
18	Pinus Laricio	422,250	15,525
20	,, ...	725,275	..
21	,, ...	275,800	..
10	,, ...	55,000	6,400
15	,, ...	45,000	..
17	,, ...	16,550	..
21	Larix europaea	752,800	..
18	,, ...	..	7,500
19	,, ...	..	7,100
18	Pinus ponderosa	..	31,200
18	,, radiata	..	55,875
10	,, canariensis	6,300	..
10	,, Lambertiana	170	..
10	,, ponderosa, var. scopulorum ..	575	..
10	,, Coulterii	375	..
10	,, Jeffreyii	2,200	..
10	,, resinosa	50	..
21	,, teocote	2,250	..
20	Eucalyptus Stuartiana	59,375	..
6	,, ...	..	20,555
7	,, ...	..	1,400
8	,, ...	..	17,125
18	,, ...	..	111,370
10	Cupressus thurifera	420	..
17	Alnus glutinosa	400	..
21	Pseudo-tsuga Douglasii	2,550	..
20	Sequoia sempervirens	..	5,150
21	Thuja plicata	425	..
12	Larix occidentalis	50	..
3	Picea grandis	..	20
3	,, pungens	..	20
3	,, canadensis	..	40
3	,, nobilis	..	5
	Totals	2,367,815	279,285

Summary of Trees planted.

How used.	Number.
Number on plantation at present day—	
Contents of numbered blocks	12,007,976
Ornamental and shelter trees at prison camps, &c.	475
Total trees now living	12,008,451
Number planted to replace failures, &c.—	
Experimental trees not suited to district	266,305
Used to replace deaths	1,908,088
	14,182,844
Less trees raised from seed sown *in situ*	109,725
Trees received from nursery	14,073,119

Summary showing Area of Whakarewarewa Plantation (5,450 Acres in Trees).

How occupied.	Acres.
Larch	2,339·80
Pines	1,397·70
Blackwood	79·00
Eucalypti	1,489·30
Walnut	9·70
Spruce, *Picea, Pseudo-tsuga*	119·00
Birch	5·80
Alder	8·94
Poplar	1·20
Roads, tracks, and fire-breaks	406·00
Swamps and creeks	241·86
Unplanted land	2,724·30
Native land acquired during year (approximate)	524·00
Not suitable for planting	102·20
Horse-paddocks	98·50
Residence reserves	
Rotorua water-pipe reserve, &c.	
	9,547·30

Summary of Trees growing on Whakarewarewa Plantation.

	Number.
Larch (European)	5,840,135
,, (Western)	50
Pines	3,383,040
Blackwood	123,174
Eucalypti	2,045,517
Walnut	13,800
Douglas fir	151,308
Birch	6,585
Alder	26,393
Poplar	600
Redwood	90,673
Sycamore	32,536
Oriental plane	1,900
Norway spruce	195,025
Tideland spruce	91,175
Red-cedar	670
Sweet-gum	1,700
White-cedar	3,275
Cupressus thurifera	420
	12,007,976

D. J. Buchanan,
Plantation Foreman.

Waiotapu Plantation.

(Area, 41,132 acres; approximate altitude, 1,200 ft. to 2,000 ft.)

The rainfall for the twelve months ending the 31st March, 1912, amounted to 45·88 in., distributed over 137 days, and is higher than that recorded the previous year, when 31·55 in. fell on 116 days. The maximum temperature, which was recorded in February, was 88° Fahr., and the minimum 21° Fahr., recorded in August and September. Frosts occurred on seventy-six nights, being particularly frequent in July and August. Tree-planting operations, on the whole, have been successful, although the death-rate is greater than usual among the newly planted pines. The failures recorded are in a large measure due to the unusual severity and frequency of the frosts during the winter, combined with the fact that the soil was drier than is usual in the winter months. Much of the land, too, was open tussocky country, which afforded little or no shelter to the young trees from drying winds. The death-rate was not above normal where the land carried a growth of bracken.

Trees to the number of 2,646,325 were planted, 2,394,400 being planted on a new area containing 841 acres, and the remainder, 251,925, being used to replace deaths in the former years' planting.

The wet weather experienced during the summer months has been responsible for the fine growth made by the bulk of the trees throughout the plantation. In every block of trees the vigorous growth made gives evidence of the trees having responded to the plentiful rain-showers and accompanying humid conditions of the soil and atmosphere. The eucalypti, which hitherto have been most backward, seem to have taken a new lease of life, and give promise of ultimately developing into a splendid crop. It must, of course, be recognized that the climatic conditions at Waiotapu generally are now much more congenial for plant-life than they were when the land was, with the exception of dwarf scrub, devoid of any growth. Large areas of the plantation reserves are now covered with a canopy of leaves, which has the effect of reducing the evaporation of soil-moisture and of modifying the atmospheric conditions to some extent locally, and the eucalypti plantations have therefore benefited by the growth of the large blocks of conifers which surround them.

The larch and Corsican pine continue to make satisfactory progress. Heavy pine (*Pinus ponderosa*) has made especially strong growth this year, and where this species has been mixed with Austrian pine it now overtops the latter species by two or three feet. There seems little doubt but that this mixture will prove unsatisfactory. Weymouth pine, like other conifers, has made splendid growth.

Under the heading of "General Upkeep," the chief works included are attention to fire-breaks and clearing round young trees. Most of the fire-breaks which were ploughed last year have been kept in an efficient state by stirring them with the disc harrows, and very little ploughing was needed. Owing to the increasing height of the trees adjacent to the Tourist Reserve, the fire-break to protect this boundary was made wider. A heavy growth of manuka-scrub covers the greater part of the Tourist Reserve, and there will always be danger of fire from this quarter, because the reserve is much frequented by sightseers, who sometimes are careless with lighted matches. All public roads which divide the plantation-areas have been cleared of growth, and this growth burned as an extra preventive to the spread of fire.

Comparatively few portions of this plantation require much attention by way of cleaning amongst the trees, and most of this class of work during the year was confined to the areas planted with larch on the slopes of Maungakakaramea. On the low hills and flats the winter frosts usually kill off the growth which is made by the bracken during the summer, and consequently on such land very little labour is required to be expended in protecting the young trees. The growth of bracken above the frost-line, and particularly in the basins and gullies on the slopes of high hills, is sometimes very rank, and for from three to four years after such land has been planted it is necessary to go over the area two or three times a year and cut any growth that is likely to injure the trees.

Labour.—An average of 17·04 prisoners were employed daily throughout the year, performing work to the value of £1,750 5s. All the work required to be done on the plantation within three miles of the prison camp has been satisfactorily performed by prison labour, and this fact is in itself sufficient

proof of the continued utility of such labour for afforestation work. In addition to the prison labour a number of free men have been employed, principally to attend to work situated at a long distance from the prison camp, which could not be economically performed by prisoners.

Plantation-extension on Kaingaroa Plains.—The work done in connection with the formation of a prison camp on the Kaingaroa Plains is now almost completed. Plans of the buildings were prepared last winter; and in September last a start was made to erect the largest building, which comprises a large kitchen, officers' mess-room, store-room, cooks' bedroom, office, and a bedroom. A workshop was also erected, and a four-roomed cottage for the accommodation of officers is now all but completed. The water for use at the camp is being got half a mile distant, and conveyed to the camp by means of a powerful pump and oil-engine. This work is now well under way, and will be completed at an early date. An area of 2½ acres has been reserved for a kitchen-garden, and this has been well tilled and partly stocked with vegetables. For grazing purposes, 50 acres adjoining the enclosure where the camp is being formed was fenced and sown down with a mixture of cocksfoot and red-top grasses last spring. This paddock has made splendid progress, considering the soil and the climatic conditions of the locality, and should prove of great service for grazing sheep for use at the prison camp. The work has been performed partly by free and partly by prison labour. A capable carpenter was engaged to take charge of the erection of the buildings, and he has been assisted by several handy prisoners, who, besides helping with the actual carpentering-work, have done all the plumbing and painting. Most of the preparatory work in connection with the water-supply has been carried out by prisoners under the supervision of Warders McPherson and Page, who have taken a live interest in the work, which contributed in no small measure towards making it a success. Telephonic communication has been established with the new camp by erecting three miles of line, and uniting it with the line connecting Rotorua and Murupara.

Survey-work.—In November last a start was made to lay off the necessary roads and fire-breaks, and this work is proceeding in a satisfactory manner. Several angles have been done away with on the public road to Galatea, and a new road is partly formed.

Details of the expenditure for the year, &c., are attached hereto.

The following is a record of the temperature and rainfall for the year :—

Schedule I.

Month.	Rainfall.	Number of Days Rain fell.	Temperature. Maximum.	Temperature. Minimum.	Number of Days Frosts occurred.
1911.	In.		Deg. Fahr.	Deg. Fahr.	
April	7·33	13	77	35	..
May	4·67	10	72	25	6
June	3·91	11	63	22	13
July	1·12	7	62	18	21
August	2·78	8	65	21	17
September	3·86	11	68	21	10
October	3·37	11	71	26	4
November	4·75	18	76	30	2
December	5·46	17	76	32	1
1912.					
January	1·54	7	82	33	..
February	1·64	12	88	32	1
March	5·45	12	74	30	1
Totals	45·88	137	..	..	76

Schedule II.—Statement of Expenditure.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
Tree-planting	128 4 4	606 12 11
Pitting	236 19 0	602 12 3
Clearing	131 3 9	496 19 6
Cartage of trees	42 7 9	572 5 2
General upkeep of plantation	190 15 9	1,479 9 7
General repairs	52 7 7	199 12 1
Horse-feed	152 17 3	829 13 9
Permanent works—		
Fencing	52 3 10	1,746 17 3
Formation	466 14 1	950 7 11
Buildings	939 3 4	1,844 15 5
Stock, implements, &c.—Tools, implements	128 4 3	862 3 10
Supervision and clerical—		
Salaries—		
Supervision of free labour	220 0 0	3,794 3 0
,, prison labour	310 0 0	
Nurseryman's proportion of, and clerical assistance	150 0 0	
	£3,201 0 11	£13,985 12 8

Statement of Value of Prison Labour.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
Tree-planting	458 17 2	6,232 8 4
Pitting	446 7 6	6,717 7 4
Clearing	40 0 0	5,650 4 3
Miscellaneous works	4 11 0	4 11 0
General upkeep of plantation	581 15 4	3,451 16 6
General repairs	24 7 6	162 4 0
Horse-feed	7 3 0	7 3 0
Permanent works—		
Fencing	..	399 2 8
Formation	2 12 6	434 0 0
Roadmaking	50 3 6	542 3 4
Buildings	127 14 6	468 7 4
Water-supply	6 13 0	6 13 0
	£1,750 5 0	£24,076 0 9

Average daily number of prisoners employed during year .. .. 17·04
.. .. .. since camp started .. 29·29

Schedule III.—Trees Account.

	Number.
Trees received during year	2,646,325
Less, to replace blanks	251,925
Planted on new area	2,394,400
Previously planted	13,926,254
Total number planted on 6,265 acres (average age, 4¼ years	16,320,654

Schedule IV.—Property Account.

	£ s. d.
Land (41,132 acres): Crown land not charged to Forestry Account	..
Buildings	1,969 11 3
Improvements	1,520 18 11
Fencing	1,379 7 6
Stores in hand	379 9 10
	£5,249 7 6

Balance-sheet.

	£ s. d.
Total expenditure, with value of prison labour added	38,061 13 5
Less Property Account	5,249 7 6
Cost of operations	£32,812 5 11
6,265 acres planted (average age, 4¼ years); cost per acre	£5 4 9
Estimated value of plantation per acre	9 5 7

Schedule V.—Statement showing Cost of Operations.

	For Year. £ s. d.	To Date. £ s. d.
Total expenditure	3,201 0 11	13,985 12 8
Deduct cost of fencing, buildings, roads, &c.	1,586 5 6	5,404 4 5
	1,614 15 5	8,581 8 3
Add proportion total expenditure on fencing, buildings, roads, &c.	313 6 4	1,512 11 6
Cost of planting 841 acres and maintaining 6,265 acres	£1,928 1 9	
Cost of planting and maintaining 6,265 acres	..	£10,093 19 9
Average cost of planting and maintaining—		
Per acre	£2 5 5	£1 12 2
Per 1,000 trees	0 16 1	0 12 4

Statement showing Cost of Operations (with Value of Work done by Prison Labour treated as an Expenditure).

	For Year. £ s. d.	To Date. £ s. d.
Total expenditure..	3,201 0 11	13,985 12 8
Value of prison labour	1,750 5 0	24,076 0 9
	4,951 5 11	38,061 13 5
Deduct cost of fencing, roads, buildings, &c. ..	1,773 9 0	7,254 10 9
	3,177 16 11	30,807 2 8
Add proportion of cost of fencing, roads, buildings, &c.	374 16 11	2,005 3 3
Cost of planting 841 acres and maintaining 6,265 acres	£3,552 13 10	
Cost of planting and maintaining 6,265 acres ..	..	£32,812 5 11
Average cost of planting and maintaining—		
Per acre	£4 3 8	£5 4 9
Per 1,000 trees	1 9 8	2 0 2

Return of Tree-planting Work done at Waiotapu Plantation, 1911-12.

Block.	Name of Tree.	Number on New Area.	Replacing Blanks.
19	Pinus Laricio	733,475	98,250
18	,, ...	1,178,950	2,875
17	,, ...	47,025	11,575
16	,, ...	20,450	7,125
15	,, ...	10,300	..
14	Larix europaea	72,675	2,300
15	,, ...	..	3,050
16	,, ...	..	1,000
17	,, ...	20,675	300
17	Pinus strobus	9,650	450
20	,, ponderosa	282,750	125,000
12	,, ,, ...	7,875	..
15	,, ,, var. scopulorum ..	1,475	..
15	,, teocote	3,000	..
15	,, Jeffreyii	2,950	..
15	,, Coulterii*	300	..
15	,, resinosa*	50	..
15	,, Lambertiana	100	..
15	Cupressus thurifera	400	..
15	Thuja plicata	300	..
—	Pinus radiata†	2,000	..
		2,394,400	251,925
		2,646,325	

* Trial lots. † For wind-break on Kaingaroa Plains.

Summary of Trees planted.

How used.	Number.
Numbers on plantation at present day—	
Contents of numbered blocks	16,270,863
On fire-breaks	11,367
Ornamental and shelter trees at prison camps	36,936
Experimental trees..	1,488
Total trees now living	16,320,654
Number used to replace failures, &c.—	
Leguminous plants used as bait for rabbits and hares	1,425
Ornamental trees destroyed by rabbits and hares	16,000
Experimental trees not suited to district	757,214
Used to replace deaths	1,787,893
	18,883,186
Less trees raised from seed *in situ*	83,121
Trees received from nursery	18,800,065

Summary showing Area of Plantation (6,265 Acres in Trees).

How occupied.	Acres.
Larch	2,944·25
Pines	3,134·30
Eucalypti	180·50
Birch	5·95
Roads, tracks, and fire-breaks	337·30
Land unsuitable for planting, including swamps, creeks, horse-paddocks, and residence reserves	242·00
Unplanted land	933·00
" extension on Kaingaroa Plains recently reserved	33,355·00
	41,132·30

Summary showing Number of Trees growing on Waiotapu Plantation.

Larch	8,103,930
Pines	7,950,135
Blackwood	1,256
Eucalypti	72,000
Douglas fir	89,712
Birch	39,230
White-cedar	14,200
Cupressus thurifera	400
	16,270,863

R. MacRae,
Plantation Foreman.

Puhipuhi Plantation.

(Approximate area, 1,200 acres; altitude, 1,000 ft.)

The growth made by the trees at this plantation during the year is unusually good, which is probably due to the wet weather experienced through the summer months. As a rule, trees planted here are slow in making a start, owing to the soil being very porous and liable to crack during dry weather; but the growth of bracken and other weeds with which the land is now covered has assisted very largely in conserving the soil-moisture, and thereby inducing a more even growth amongst the trees. Of the trees planted, *Eucalyptus Stuartiana* still holds first place in rate of growth and general adaptability to the locality; *E. resinifera* has made very good growth, and *E. rostrata* fair growth. A number of redwood (*Sequoia sempervirens*), which have merely existed since being planted, made good growth during the past year, and give promise of ultimately developing into fine specimens.

This reserve is now in charge of a caretaker, who resides within the enclosure, and whose duties consist chiefly in keeping the boundaries free of growth in order to prevent the spread of fire, keeping the fences in good order, and generally in supervising the place in order to prevent trespass and spread of fire.

Following is a record of rainfall and temperature for the year:—

Schedule 1.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1911.	In.		Deg. Fahr.	Deg. Fahr.	
April	11·67	20	80	48	..
May	12·57	16	70	36	..
June	9·06	25	60	36	..
July	11·02	19	60	33	..
August	7·33	10	66	38	..
September	5·59	16	68	34	..
October	5·27	10	72	38	..
November	2·05	12	78	40	..
December	4·07	13	82	42	..
1912.					
January	1·35	6	89	42	..
February	4·44	8	86	43	..
March	7·12	14	80	42	..
Totals	81·54	169	..	..	..

Schedule II.—Statement of Expenditure.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
Tree-planting		1,106 1 11
Pitting		1,552 14 0
Clearing		963 17 0
Cartage of trees		179 13 3
General upkeep of plantation	139 19 10	3,137 12 10
General repairs		138 11 7
Horse-feed		33 16 3
Permanent works—		
Fencing		471 0 3
Purchase of land		10 4 3
Formation		36 13 0
Buildings		355 4 9
Stock, implements, &c.—Tools, implements		322 1 7
Supervision and clerical—		
Salaries—		
Supervision of free labour		
,, prison labour		957 9 7
Nurseryman's proportion of, and clerical assistance	25 0 0	
	£164 19 10	£9,265 0 3

H. A. Goudie.
Superintending Nurseryman.

Progress of Afforestation in Rotorua District.

[By R. Glass, Plantation Foreman, Whakarewarewa.]

To be of much value, a criticism or appreciation of any work must be based upon a clear understanding of the object of the work, and some knowledge of the difficulties to be overcome, and the problems to be solved in the endeavour to attain that object. With this knowledge and understanding one is able to judge, to some extent at least, as to the suitability of the methods employed and the possibilities of their success; but an opinion formed without due consideration of the special circumstances of the case will almost certainly prove erroneous. Hence it may be desirable to state, by way of preface, that the main object of afforestation work in Rotorua is the production in the most economical manner of such timbers as will meet the demands of the market in the near future. The difficulties to be overcome have arisen chiefly from the fact that it is necessary to grow exotic trees, from the limitations imposed by the climate, and from the severe ordeal the young trees are called upon to endure when they are planted on open country instead of growing naturally under the shelter of older trees. The slow growth of native trees prevents their being utilized for afforestation, and the selection of exotic species is rendered difficult by the fact that it is almost impossible to predict how a given species of tree will behave under new conditions. In one case it will thrive beyond expectations, and in another prove a comparative failure. The results of experiments made in other countries, though very valuable, are often modified by apparently trivial differences in local conditions. Therefore direct experiments have been required, to ascertain which are the most suitable species of trees and the most advantageous systems of management; and, whilst in agriculture one season's growth will usually determine the success or failure of an experiment, in sylviculture five to ten years, or even more, may be required—in fact, such problems as the comparative worth of various species cannot be finally solved till the timber is cut. This being so, the forester must carefully consider the qualities of the local soil and climate, the habits and requirements of the trees, and their probable value as timber-producers, and, as they develop, must watch closely for indications of success or failure, and, when necessary, alter his methods accordingly.

A consideration of the progress of the work of afforestation in Rotorua divides naturally into three sections—the past, the present, and the future.

The Past.

The work was begun in this district in 1898. Some small groups of trees had been planted previously as a test of the capabilities of the locality, but in that year the work was definitely undertaken by the establishment of the nursery at Whakarewarewa. Two areas were selected for planting, one at Whakarewarewa adjoining the nursery, and the other at Waiotapu; at the latter the experiment of employing prison labour was tried, the first gang of prisoners arriving in February, 1901. The experiment proved a complete success, providing healthy interesting work for the prisoners, and affording an opportunity of removing first offenders from gaol surroundings, whilst the value of the work done helps to reduce the cost of prison maintenance to the State.

Planting operations were begun on a small scale, the first season's output consisting of 23,000 eucalypti, the second season's of 180,000 trees of various genera, and the third of 315,000. The results showed the wisdom of making a small beginning; of five species of eucalypti first planted all but one

have failed, whilst of seventeen species of other genera only seven have proved quite suitable for the locality. Of the failures, some have been unable to bear the frosts of winter; but the great majority have been injured or killed by late frosts. In this district, given a clear night and a light southerly wind, frost may occur at any time of the year; and if it is the spring or early summer, when the trees have much tender growth, the effects on many species are disastrous. Other species, uninjured by frosts, have proved unsuitable because they make very little progress for several years after planting out, and it is necessary, to prevent their being smothered, to keep the growth of fern and tutu cut back till the trees push their heads above it: this involves considerable expense, and therefore faster-growing species are more desirable.

In 1904 Whakarewarewa Plantation was enlarged by taking in an adjoining block of land, and a second prison camp was formed. Since then the work has been carried out steadily in both plantations—at Waiotapu chiefly by prison labour, and at Whakarewarewa by prisoners and free men; and an area of 11,000 acres has been planted with about twenty-nine million trees, the annual planting being now four or five million. With the exception of some small areas, which can be more conveniently planted by free labour, the selected area at Waiotapu is now planted up, and the camp is being removed to a new site on the Kaingaroa Plains, where some 30,000 acres are available for this work.

Sylvicultural Systems.—At first it was decided to grow the trees chiefly in mixed woods, and theoretically this would seem the correct system, as such woods suffer less from the attacks of insects and disease, and also produce a greater volume of timber, than pure woods. Under the first plans for Whakarewarewa Plantation the trees were planted at 5 ft. intervals, the mixture consisting of redwoods, 108 per acre; sycamore, 327; Austrian and Corsican pines, 1,307. On a second block the intervals between the trees was reduced to 4 ft., and the mixture consisted of redwood, 680 per acre; larch, 2,042.

On paper these plans were fairly correct. A. C. Forbes, Chief Forestry Inspector for Ireland, in his "Development of British Forestry" (1910), dealing with the subject, says, "An ideal mixture might be regarded as composed of four constituents—First, the species that will develop into the profitable crop at the end of the rotation adopted; second, the species that will aid in the development of the permanent crop, and create and maintain suitable soil-conditions, and protect the crop against wind; third, a species that will act as nurses, and yield some return in the shape of thinnings before the thirtieth or fortieth year; and fourth, trees that will suppress and kill out surface vegetation during the first ten or fifteen years after planting. The two former species may be regarded as permanent and indispensable; the two latter as temporary components of a forest crop which may or may not be regarded as necessary, according to circumstances."

In the pine mixture the intervals were too great, especially in the case of the Austrian pine, which is a shade-bearing species, developing strong side branches, and which must be planted very closely to produce clean timber; and in the second mixture, larch, being highly light-demanding, would not provide sufficient protection for the soil, one of the first rules for the formation of mixed woods being, "The ruling (more numerous) species must be soil-improving" (Schlich, "Manual of Forestry"). However, as the trees grew a more serious defect developed, and the plans failed because the nurse-trees outgrew the sycamore and redwood, and, with the exception of a few trees at the outer edges of the plantations, have suppressed them completely.

Later a mixture of larch and Douglas fir was planted on a third block, and this has proved more successful. The latter species is of very variable growth: a fair proportion hold their own with the larch, whilst others make comparatively poor growth, and will probably be suppressed, but this would occur also in pure woods of the species.

In the season 1907–8 a mixture of Douglas fir, larch, and redwood was planted in a more elevated position; but, so far as can be judged by present growth, the results will be very similar to those of the former experiments—the bulk of the redwood will be suppressed, and only a portion of the Douglas fir will keep pace with the larch.

In the season 1910–11 Douglas fir and larch were planted in alternate rows, also white-cedar and larch. No indication as to how these mixtures will succeed can be expected for some years, as the trees make little height-growth for some time after transplanting.

Eucalypti have usually been planted pure at intervals of 6 ft. On some blocks various species have been mixed without apparent effect, good or bad.

Waiotapu Plantation being exposed to very severe frosts, pines have been more extensively planted than at Whakarewarewa. Mixed planting has been largely adopted, Austrian, Corsican, Weymouth, and heavy pines being the predominant species. It seems doubtful, however, if much is to be gained by planting mixtures of pines. The chief recommendation of mixed woods is their comparative immunity from attack by insects or disease; but when the species mixed are so closely allied it is probable that they will have common enemies.

Austrian pine has proved too slow-growing to form a satisfactory mixture with any of the other species; being a shade-bearer, it has not as yet suffered from being outgrown, but may be affected as the other species increase in size, and the latter, having too much space, will maintain their side branches longer than is desirable.

Heavy pine planted in mixture assumes the lead from the first, recovering from the effects of transplanting more rapidly than other species, and increases this lead about the sixth or seventh year.

Corsican and Weymouth occupy a middle place in respect to height-growth, and should form a fairly satisfactory mixture; but this combination was first tried in 1909, and therefore a decided opinion cannot be formed at present.

Douglas fir and Corsican pine were planted in mixture in the season 1903–4. Apart from the defect of the uneven growth of the former, this seems a good combination.

In both plantations the greater portion of the trees have been planted pure, and this is fortunate, since, so far as can be judged by present growth, few of the mixtures that have been tried will prove conspicuously successful. It is always possible that some of the species that now lag behind in height-growth may later on even outstrip their competitors; but, on the whole, pure planting seems the best system to follow. Even if the attacks of insects or disease make mixed woods indispensable in the future, a mixture by groups or by strips, if equally effective in minimizing these dangers, will be preferable to a mixture by trees.

The Present.

Past experience has shown that only a few species of trees, and they not always the most valuable, will thrive when planted on open country in this climate. None of the hardwoods, such as oak and ash, can withstand the effects of late frosts, whilst of over fifty species of eucalypti that have been tried, only three—*E. Stuartiana*, *E. pauciflora*, and *E. amygdalina*—have proved sufficiently hardy to justify planting to any extent; and even these are liable to injury if the winter frosts are a little more severe than usual. The conifers have proved more suitable to the prevailing conditions, but many very desirable species have failed also. Therefore the policy pursued at present is to plant the quickest-growing and most valuable of the species that thrive in the locality, so that shelter will be provided as soon as possible, under which more-valuable tender species may be successfully introduced, and yet the returns from the first crop be such as will show a profit on its cost. Experiments on a small scale are being made from time to time with promising species that have not been planted previously, as it is always possible that an untried tree may prove eminently suitable for the locality.

On the areas already planted the usual maintenance-work is carried on. The younger trees are kept clear of underscrub till they have outgrown it. Fire-breaks are kept clean, and a watch is maintained for indications of attack by insects or disease. Rabbits damage the young trees in certain areas, and are kept in check by trapping.

The plantations are not yet sufficiently advanced to require thinning or underplanting, but experiments are being carried out with various species of trees on small patches of the older areas, so that when underplanting becomes necessary some reliable data as to the most suitable species for the purpose may be available.

The following is a short account of the trees that have proved most suitable, or seem most promising for afforestation work in this district:—

Larch (*Larix europaea*).—This has proved one of the best trees for this district. It is easily raised, soon recovers after transplanting, and grows quickly, on an average about 3 ft. per annum, when the trees are properly established—say, five or six years after transplanting. Young trees suffer from late frosts on low-lying land, otherwise the species is well adapted for the climate of this locality. The timber is soft, flexible, strong, and moderately heavy, very durable in contact with the ground, and is used for sleepers, mining-props, fencing, building purposes, and shipbuilding. Since it matures early, much of the small timber that must be removed in thinning can be sold. This is a most important consideration in artificial forests, and adds materially to the value of the species for afforestation. Larch is a native of the Alps, Moravian and Carpathian Mountains, but has been successfully introduced all over Europe. Grown in Great Britain, it is very subject to disease; yet foresters persist in planting it on account of its many good qualities. The climate of Rotorua, especially in elevated situations, should approach more closely to that of its native home, and we may therefore fairly hope for comparative immunity from disease in our plantations.

Corsican Pine (*Pinus Laricio*).—This species is well adapted for planting in this locality, and grows quickly—average about 2 ft. per annum; but it requires more careful treatment in transplanting than larch, being very liable to damp off, and even with the most careful planting shows a large percentage of failures. The climate of this district seems quite suitable for the healthy development of the species; it apparently does not suffer any ill effects from late frosts, and can therefore be planted in situations not suitable for larch. It produces soft, light, durable timber, which is used for sleepers, posts, and building purposes. It is a native of southern Europe, where it is found in the mountains, and has done well where introduced in Great Britain and Germany.

Heavy Pine (*Pinus ponderosa*).—This species makes a quicker recovery after transplanting than Corsican pine, and is of quicker growth—about 2 ft. 6 in. per annum. It has done well wherever planted in this district. The timber is heavy, strong, and durable, and is used for sleepers, posts, and building purposes. It is a native of north-western America, and is there widely distributed, but does not appear to have been introduced to any great extent elsewhere. This species might hold its own if planted in mixture with larch. It would not form an ideal mixture, both species being light-demanding; but if our pure larch woods should be attacked by disease this mixture might provide some degree of immunity.

Weymouth Pine (*Pinus strobus*).—On account of a difficulty in obtaining supplies of good seed this pine has not been very largely planted. It has proved fairly suitable for the locality, but has suffered to some extent when young from the effects of late frosts. It is of fast growth—about 2 ft. 3 in. per annum. The timber is light, and has been more used for building purposes than any other in the east of the United States of America. Gifford, in his "Practical Forestry," states that timber of good quality is only obtained from centenarians; and, if this be correct, species that mature more quickly are to be preferred. Weymouth pine is a native of the eastern States of America, and has been successfully introduced in Great Britain and the Continent of Europe. According to Dr. Schlich, it is fairly suited for underplanting larch, so may prove useful later if a good supply of seed is then available.

Remarkable Pine (*Pinus radiata or insignis*).—This is one of the fastest-growing trees, and on that account is useful for planting where there is a particularly rank growth of fern. It has been used

chiefly to form wind-breaks at Waiotapu, and succeeds well in that climate. Care is required in transplanting, and the young trees may suffer from frost till they are properly established. In the past this pine has been little esteemed as a timber-tree, having been grown almost entirely for shelter; but when grown in crowded woods it will produce much cleaner timber, and, having recently been found suitable for butter-boxes, should be more cultivated in future, since on account of its rapid growth it will yield a profitable crop even if sold at low prices. It is a native of California, but experience has proved it capable of thriving in the most varied climatic conditions of this country.

Loblolly Pine (*Pinus taeda*).—A small experimental planting of this pine in Waipa Valley has been remarkably successful. Growth has been very even, and averages about 3 ft. per annum. This is one of the species producing the timber exported from the United States to Europe under the name of "pitch-pine," which is reported as a "splendid architectural wood—resembles the best larch wood in durability," and is used for railway-carriage and ship building. If a further trial on a larger scale should give equally satisfactory results, it should prove one of the best pines for this district. Its rapid growth would indicate the possibility of successful mixture with larch, but it is apparently highly light-demanding, so such a mixture will only be desirable if the occurrence of disease prevents larch being grown pure. Loblolly pine is a native of the south-east of the United States of America, and does not appear to have been used for planting in other districts to any great extent.

Norway Spruce (*Picea excelsa*).—This is classed as a fast-growing species, but grows slowly up to an age of ten or fifteen years, and therefore entails much expense in keeping clear where there is a rank growth of fern. So far as can be judged from the growth of specimen trees in Rotorua Nursery, the species will thrive well in this locality, but the surface of the soil must be kept moist by a growth of underscrub, as it has failed where planted on comparatively bare soil at Waiotapu; being shallow-rooted, it is unable to draw upon the supplies of the subsoil. The timber is soft, light, and easily worked, but not durable in contact with the soil. It is used for inside buildings, common furniture, packing-cases, and other purposes where durability is not necessary, and forms the principal source of supply of wood-pulp for papermaking in Europe. Though the slow growth of this species in early life, and the consequent expense in keeping young trees clear of fern, may preclude its use at present, it will probably prove useful for underplanting, as it bears shade well, and the possibility of utilizing for paper-pulp the small timber that must be removed in thinnings will be a strong point in its favour. Norway spruce is found growing naturally all over the Continent of Europe from the Alps to Lapland, and has been very largely used in artificial forests.

Sitka Spruce (*Picea sitchensis*).—The description of Norway spruce applies to this species, both as regards growth and quality of timber. In suitability for afforestation work there is apparently very little difference between the two. It is a native of north-west America, but is rarely found more than fifty miles inland.

Douglas Fir (*Pseudo-tsuga Douglasii*).—Owing to the variations in growth this species has only been a partial success in the plantations, but appears suitable for the climate. A circular of the United States Forest Service states, "In various parts of its range it [Douglas fir] produces forms of growth sufficiently diverse, in the opinion of some foresters, to be called varieties or even species. Whatever its botanical status, it is certain that in its sylvicultural characteristics and requirements Douglas fir presents two well-marked forms"; and instances are quoted of variations in the rate of growth in trees grown together—seventeen years old, from 26 ft. to 7 ft. 6 in.; seven years old, from 15 ft. 6 in. to 8 ft. 10 in. The variations in growth of the species on the plantations suggest the seed of the two forms must be mixed by the suppliers, and it is evident that the species cannot be grown satisfactorily till pure seed can be obtained. The fast-growing type is a most desirable and valuable species for afforestation work. Dr. Schlich considers it "the most valuable timber-tree of North America, owing to its rapid growth, great dimensions, and the excellence of its timber." The timber is imported to New Zealand as "Oregon pine"; is hard, strong, and durable, and is used for bridge-building, ship-building, and general construction. Douglas fir is a native of north-west America, the quick-growing forms being found in Washington, Oregon, and British Columbia, and the slower on the Rocky Mountains, the type changing gradually on the intervening country. This species has been introduced in Great Britain and the Continent of Europe, and is mentioned with enthusiasm by several writers. It is recommended for underplanting larch when the latter is fifteen to thirty years old. Forbes quotes an example where it has produced as good effect when so used as beech, which is generally recognized as the best species for the purpose.

Redwood (*Sequoia sempervirens*).—This species has been very disappointing; specimen trees have made better growth than any other conifer (about 4 ft. per annum), but the only successful planting has been on a small area at the Green Lake. The timber is soft and very durable, and is used for sleepers, posts, and building purposes. Redwood is a native of California and Oregon, and does not appear to have been introduced to any great extent elsewhere, probably because seed is expensive and of variable quality; but the species is peculiar among conifers in that it possesses the power of reproduction by shoots from the roots, so that regeneration will be easily effected when the tree has been established. It may be possible to introduce this species by underplanting in situations where it has failed at first.

Apple-scented Gum (*Eucalyptus Stuartiana*).—This has proved the best-adapted eucalyptus for afforestation work in Rotorua district. Its quick growth in the seed-beds rendering transplanting necessary at an early age, before a strong root-system has developed, it suffers considerably if dry or frosty weather is experienced after planting; but it possesses great recuperative powers, plants that appear quite dead often springing into fresh life under favourable climatic conditions. The rate of growth varies considerably with the situation—about 3 ft. per annum is probably an average. The timber is heavy, strong, and durable, and is used for sleepers, posts, and firewood, also in making wheels and for other purposes where strength is required. This gum is a native of Tasmania, Victoria, and

New South Wales, and has been produced in the United States of America, chiefly as a shelter-tree. Since it does not develop strong side branches, it will probably be possible to thin heavily at a comparatively early age, and introduce some of the more valuable but tender species of eucalyptus by underplanting.

The Future.

Future progress in afforestation will be along two lines—namely, extension, or the planting of new areas; and development, or the tending of the woods already planted till they attain maturity. The policy of the State with regard to the expansion of the work must depend largely upon the increased or decreased prosperity of the people, and the growth of public interest in the subject; but in view of the growing scarcity and rising prices of timber it seems tolerably certain that any change will be in the direction of increased activity.

The principal steps in the development of the plantations are pruning, thinning, and underplanting.

Pruning.—Owing to the great danger of rot arising from the germination of fungi in open wounds, pruning will be chiefly confined to the removal of dead branches from the trees. In some species the branches drop off naturally soon after they are killed by the exclusion of light; in others they remain on the stem for many years, and, if not removed artificially, will cause knots in the timber. Some authorities recommend pruning as a means of correcting defects in the development of the trees, but owing to the expense and the danger of disease it would seem preferable to dispense with such pruning, and remove malformed trees in thinning. In the case of mixed woods, when the growth of the species is uneven it is the practice in European forests to assist the slower species by pruning side branches of the quicker that threaten to interfere with its growth; but it is questionable whether such practice can be profitably adopted in New Zealand, on account of the higher wages to workmen, and it is therefore the more important that trees of an uneven height-growth shall not be planted in mixture.

Thinning.—This is probably the most important step in the development of the woods, since it governs the quality and quantity of the timber produced. In order to obtain the greatest height-growth, trees must be grown in crowded woods; and in the struggle to keep their crowns in the light they will produce straight cylindrical stems without side branches; but when they are too much crowded the stems will be deficient in thickness. On the other hand, the greatest diameter-growth is obtained when the crowns of the trees have space to spread; but if allowed too much space the timber will be of inferior quality, with very wide annual rings; knots will be formed, because the side branches obtaining light will not be killed off; and the fertility of the soil will be lessened by the action of air-currents and direct sunlight on the surface humus. In the struggle for existence in crowded woods certain trees will prove weaker than their neighbours and will be suppressed, or possibly killed outright; others, thriving better, yet outgrown by the strongest specimens, are known as "dominated" trees; and the best and strongest are termed "dominant." It is the forester's object, in thinning, to remove all the dead trees, as being breeding-grounds for insects and disease, and as many of the suppressed and dominated as may be necessary to give the dominant trees the space they require for their best development. Experiment will be necessary to determine just what this space is for each species, but it would seem probable that in our plantations it would be good policy to thin as little as possible at the earlier stages of growth, because of the difficulty of utilizing the small timber to advantage, and the fact that, whilst underthinning may mean a loss of increment, overthinning must mean the production of inferior timber. Trees grown in crowded woods provide mutual protection from wind, and do not develop such strong root-systems as when grown in more exposed situations; by heavy thinnings they are therefore in special danger of being overthrown if suddenly subjected to the pressure of high winds. Hence it will be desirable, when the development of the woods demands heavy thinning, to execute the work by repeated light thinnings, allowing sufficient time between each for the trees to root themselves more firmly. This will have the further effect of preventing the marked increase in the width of the annual rings of new wood, and consequent deterioration in the quality of the timber that ensues when the crowns of trees suddenly gain a greatly increased growing-space.

Underplanting.—Some trees will only thrive when they can keep their crowns directly in the light; others can bear a certain amount of shade. The various species differ in the degree of their light-requirement or shade-endurance, and are classified accordingly by foresters. It is characteristic of light-demanding species that they develop thin crowns, which open out, so that a pure wood of such species will fail to preserve the unbroken overhead canopy that is essential to maintain the fertility of the soil. The age at which this occurs varies with the degree of light-requirement: the most exacting species fail at an early age, and the more moderate later. Therefore, when light-demanding species are planted pure it becomes necessary to provide for the protection of the soil by underplanting. The time when this work should be undertaken is determined by the development of the trees. In larch it will probably occur at about twenty years of age; and here again experiment will be needed to show how best to thin the woods to allow sufficient light for the growth of the new species without damage to the first. This point is being kept in view in the experiments, already referred to, that are now being carried out to test the suitability of the various species for underplanting.

Utilization of Small Timber.—At present the cost of timber obtained from natural forests is the cost of felling, hauling, and milling; but when the timber comes from artificially formed forests the cost of growing the trees must be added. Therefore it would seem certain, if the plantations are to show a profit, either the price of timber must be very high or else nearly all the timber grown, whether large or small, must be used. The greater quantity of timber per acre in artificial forests will reduce the cost of felling and hauling, but the profitable utilization of the small timber will be a much more important factor. No doubt, as population increases, minor industries in which small timber can be

used will be established: but the manufacture of paper-pulp from species suitable for that purpose, and the destructive distillation of wood (by which timber of any size subjected to great heat produces acetic acid, wood-alcohol, charcoal, and in some cases tar) seem to offer the best solution of the difficulty.

Benefits of Afforestation.—Many incidental benefits accrue to the district in which the work of afforestation is carried out, such as—(*a*) The beautifying of the landscape: the plantations already afford a pleasing relief to the eye wearied by the monotony of the prevailing scrub; and year by year as the trees grow larger they will become more effective in this respect. (*b.*) The conservation of water-supplies: in this district this would seem of small moment at present, but it will assume greater importance as the natural bush is cleared. (*c.*) The moderating of the extremes of temperature: forests have a similar effect to large bodies of water in making the temperature of day and night, summer and winter, more equable. As already stated, frosts occur in this district usually with a light southerly wind, and, since Whakarewarewa Plantation lies south of Rotorua, the temperature of this wind will be slightly raised at night. To what distance and to what degree this effect will extend cannot be foretold, but it should at least reduce the number and severity of frosts in the adjacent districts. (*d.*) A more immediate and tangible benefit is derived from the employment of a large number of free men and prisoners, and the consequent circulation of money in the district. Even at present this is a matter of considerable importance; but when the woods mature the establishment of the sawmilling industry must increase the number employed, and add to the prosperity of the district. However, these benefits are but incidental; the true measure of the value of the work is the service it will render to the State in providing a supply of useful timber when the existing native forests are exhausted, and the check that this supply in the hands of the Government will impose upon the operations of speculators.

Description of the Principal Trees growing on Whakarewarewa Plantation.

[By D. J. Buchanan, Assistant Forester, Whakarewarewa.]

Larix europaea (*European Larch*).—The larch is a native of the Alps, and the Moravian and Carpathian Mountains. Height, under favourable circumstances, 120 ft. A true mountain species, it is found at an elevation of from 3,000 ft. to 6,000 ft., and even as far up as 7,000 ft. It is a very thinly foliaged, light-demanding species, with an undivided stem and thin conical crown; the branches are small, and soon die when deprived of sunlight; and, unlike other conifers, the species is deciduous. In this district the larch has proved itself one of the best species tried, and, with the exception that it is liable to be damaged by unseasonable frost when planted on low-lying country, is one of the most hardy. The young plants stand handling well, and it is without doubt the easiest of all to transplant, the percentage of failures being much lower than that of any other species. After the first two years, when it has become fully established, it grows very fast; and in the older part of the plantation the trees have since the time of planting increased in height at the rate of 3 ft. 3 in. per annum. Other species tried in mixture with it have mostly been killed out by the faster-growing larch, which is now for this reason always planted pure. Larch yields a most valuable timber, which is used for a great variety of purposes. Moderately heavy, hard, tough, and durable, it makes the best of railway-sleepers, and is excellent for fencing-material; it is used also for pit-props, for strutting and shoring tunnels, for bridge-building, for general farm purposes, and to a less extent for house-building. Venetian turpentine is also procured from the tree, and the bark is used for tanning and dyeing.

Pinus austriaca (*Austrian Pine*).—A native of Lower Austria-Hungary and the south-eastern Alps, where it ascends to an altitude of about 4,500 ft. It is rather a small, slender-stemmed tree, very rarely exceeding a height of 75 ft. The needles are placed two in a sheath, and the branches, which are numerous and strong, give the tree a compact appearance and make it very useful for shelter purposes. The Austrian pine is very hardy, and few failures have occurred in planting in this locality; it is rather slow in growth, and has averaged only 2 ft. per annum. For timber-production the trees must be planted very closely together to form a dense canopy, which will kill off the side branches; if planted widely apart the timber is full of knots and of very little commercial value. The planting of Austrian pine here has been discontinued in preference to the Corsican species, which grows much more rapidly and produces a more valuable timber. The timber of the Austrian pine is light, soft, and very durable, and is chiefly used for general building purposes. More turpentine is obtained from this tree than from any other European conifer.

Pinus Laricio (*Corsican Pine*).—The Corsican pine is a native of the south of Europe, where it is generally found growing in mountainous country. It attains a height of 150 ft. It is similar to the Austrian in the arrangement of its needles, but in appearance is a much more open tree, the branches being less numerous and not so strong, and disposed in regular, somewhat distant, whorls. It is also more light-demanding than the Austrian pine, and grows faster here, the average annual growth being about 2 ft. 6 in. Although it is perfectly hardy when established, the Corsican pine, on account of its poor non-fibrous roots, is always somewhat difficult to transplant, but nevertheless it is the most suitable forest-tree for planting in this district. Plantings of this species are now made pure; although in the past it has been mixed to a slight extent with *Pinus ponderosa*, owing to the similarity in the light-requirements of both species there is little to be gained by this method. The Corsican pine yields a light, soft, resinous, and durable timber, which is used for joists, rafters, door and window frames, pit-timber, telegraph-poles, and for scaffolding. The tree is said to produce valuable timber at forty years of age.

Pinus ponderosa (*Yellow or Heavy Pine*).—Native of the western States of North America, where, with the exception of the Douglas fir, it has the widest distribution of any of the timber-trees of the

west, forming the greater part of the extensive forests of the Sierra and Rocky Mountains. When fully developed the yellow-pine reaches a height of from 150 ft. to 200 ft., with a stem-diameter of from 6 ft. to 10 ft.; in rare cases it has been found nearly 300 ft. high, with a diameter of 20 ft. It is a three-needle pine; the branches are comparatively few, disposed in regular whorls, horizontal, but drooping when old. It is one of the hardiest pines planted in this plantation, and appears to be quite suited to the locality. Yellow-pine is a light-demander, and in this respect is about equal to Corsican pine, but in rate of growth it is slightly faster than the latter. The timber is heavy, hard, and close-grained, and is used in general building-construction, for railway-ties, fencing, fuel, and mining-timbers.

Pinus ponderosa, var. Benthamiana (*Bentham's Pine*).—Found in the same region as the yellow-pine, but is a smaller tree of from 100 ft. to 150 ft. in height, with a diameter of from 2 ft. to 5 ft. A small number planted have proved quite as hardy as and about equal in rate of growth to yellow-pine. The timber of both varieties is similar, and is used for the same purposes. A small number of the varieties *Jeffreyii* (Jeffrey's pine) and *scopulorum* (rock-pine) were planted during the past season for experimental purposes, and from present appearances will no doubt prove quite successful.

Pinus radiata, syn. insignis (*Remarkable Pine*).—A well-known tree, native of California; height, 100 ft. It generally has three needles in a sheath, but is frequently found with four or five or even more: the branches are strong and irregularly disposed. In rate of growth it easily exceeds any of the other conifers planted here, having increased in height at the rate of 5 ft. per annum. Owing to its rapid growth it makes an excellent shelter-tree, for which purpose it has been used to a great extent throughout the country. It is found useful here for planting on land where the fern-growth is particularly heavy, as in about two years it is generally able to hold its own with anything. In the seedling stage it is often somewhat tender, but soon becomes quite hardy. *Pinus radiata* will produce a fair second-class timber, suitable for rough building, packing-cases, &c.; and as it has been proved quite suitable for butter-boxes it will no doubt become more valuable as the kahikatea becomes scarcer.

Pinus taeda (*Loblolly Pine*).—The loblolly pine is a native of Florida, Carolina, and Virginia, and is said to attain a height of 120 ft. It also is a three-needle pine, with irregular and not very numerous branches, which soon die off under a close canopy, the species being very light-demanding. Planted experimentally here, it has grown exceptionally well, and is second amongst the pines in rate of growth to *Pinus radiata*, having made 3 ft. 5 in. per year. It is perfectly hardy, and is easily transplanted. The tree yields large quantities of turpentine, which is, however, of rather inferior quality. The timber is heavy, strong, coarse-grained, and fairly durable, and is used in building-construction, chiefly for rafters, joists, &c.

Pinus densiflora (*Japanese Red-pine*).—The Akamatsou pine of Japan, of which country it is a native. It has two needles in a sheath, and numerous ascending branches. Planted experimentally here, it has proved quite hardy, but of slow growth, averaging only 17 in. per year. The timber of *Pinus densiflora* is said to be excellent for building purposes, but being a slow-growing small-sized tree it could not be called a suitable one for growing extensively.

Pinus Thunbergii (*Japanese Black-pine*).—A native of Japan, where it forms, along with *P. densiflora*, extensive forests. It also is a two-needle pine, but darker-green in colour, and not nearly so branchy as the former. The most common of all trees in Japan, where it grows to a height of 100 ft., with a stem-diameter of 6 ft. It is hardy in this locality, but too slow in growth for afforestation purposes. The timber is resinous, tough, and durable; used for building and furniture, but suitable only for indoor work. The roots are used in the production of Chinese lampblack.

Pinus Murrayana (*Lodgepole Pine*).—Native of the western States of North America, finding its greatest development in the high wet valleys of the Sierra Mountains. Grows to a height of from 80 ft. to 150 ft., with a diameter of from 2 ft. to 5 ft. A two-needle pine, with strong not very numerous side branches, which are easily pruned naturally by close planting. It is planted pure here, is hardy, and grows fairly fast, averaging about 2 ft. 8 in. per annum. The wood is soft, tough, and close-grained, and is used for dams, wharf-piles, fencing-material, railway-sleepers, and fuel.

Pinus muricata (*Bishop Pine*).—A native of California. A small bushy tree, rarely exceeding 40 ft. in height; is a good shelter-tree, for which purpose only it has been planted here. Timber of no commercial value.

Pinus Sabiniana (*Nut or Grey Pine*), *and Pinus Torreyana* (*Torrey's Pine*), are both natives of California. A few of each species have been planted experimentally, but it is not intended to plant more, as they are slow-growing, and of no value excepting as specimens of their species.

Trial plantings of *Pinus Lambertiana* (*Sugar-pine*), *P. resinosa* (*American Red-pine*), and *Pinus Coulterii* (*Coulter's Pine*) were made during the past season, but, although at present the plants are quite strong and healthy, some time must elapse before anything definite can be said as to their suitability for planting in this district. In the Sierra Mountains *P. Lambertiana*, or sugar-pine, as it is commonly called, is a magnificent tree, exceeding the yellow-pine both in height and circumference. It yields a very valuable timber, and, should it prove suitable, would undoubtedly be a useful species for planting in this country.

Pinus canariensis (*Canary Island Pine*) has been a total failure; and *Pinus teocote* (*Mexican Torch-pine*) is not sufficiently hardy to withstand the severe frost experienced here.

Pseudo-tsuga Douglasii (*Douglas Fir, or Oregon Pine of North America*).—The Douglas fir is a native of the western part of North America, and reaches its greatest perfection on the slopes and in the moist valleys of the Cascade Mountains in Oregon and Washington, and in the coast districts of British Columbia, where under favourable circumstances it grows to a height of 300 ft. and over, with a diameter up to 14 ft. The stem is straight and undivided, the branches are fairly numerous and irregularly disposed, generally spreading horizontally. As the Douglas fir is a moderate shade-bearer, a close canopy is required to kill off the side branches. In its natural state it is frequently found with its stem clear of branches for a length of 200 ft. It is hardy as regards winter frosts, but is liable to be damaged by

late spring frosts, which has proved to be the case in this district. The first plantings of this species were made in mixture with larch, the Douglas fir being 8 ft. apart. This, however, proved an unsatisfactory method, as the Douglas fir was mostly outgrown by the larch, and constant attention is required to prevent the suppression of the weaker species. In this part of the plantation Douglas fir of the same age show individually most uneven growth, some of the trees being only 2 ft. high whilst others are 20 ft. in height. This may to a great extent be accounted for by the fact that the trees, being on rather low-lying ground, were severely frosted soon after planting, and have never properly recovered; there is also some reason to believe that the seed may not have all been of the true species, but that some of it may have belonged to the Colorado variety, which is of much slower growth. According to authorities the appearance of both types is very similar, the difference in height and rate of growth being the most distinguishing characteristics. Small lots planted later on higher ground appear likely to do much better, and later on it may be found a useful species for underplanting the larch. Owing to its rapid growth, great dimensions, and the excellence of its timber the Douglas fir is considered the most valuable forest-tree of North America. The timber is fine-grained, heavy, strong, easily wrought, and capable of receiving a high finish; is not very resinous, but very durable, and does not warp or splinter. It is used in constructive building-work, bridge-building, for railway-sleepers, pit-props, masts and spars of ships, and for all interior house-decorative work, such as panelling, skirting, shelving, &c.

Sequoia sempervirens (*Redwood*).—A native of the California coast region, not widely distributed. One of the largest trees of the globe, it grows to a height of from 200 ft. to 300 ft., with a diameter of 10 ft., occasionally becoming over 20 ft. in diameter. The planting of this species has not been altogether successful, the majority of the first lot put out being destroyed by frost, and it has been found that it succeeded only in warm sheltered situations. In situations that suited it, however, very good growth has been made; and as it bears a considerable amount of shade it may perhaps be used for underplanting. When cut down the redwood reproduces by stool-shoots and root-suckers. The wood is soft, easily split, very durable, but light and brittle; also takes a high polish. It is used for building-material, shingles, fence-posts, telegraph-poles, railway-sleepers, wine-butts, water-tanks, coffins, and veneering. The timber in buildings known to be a hundred years old has been found still quite sound.

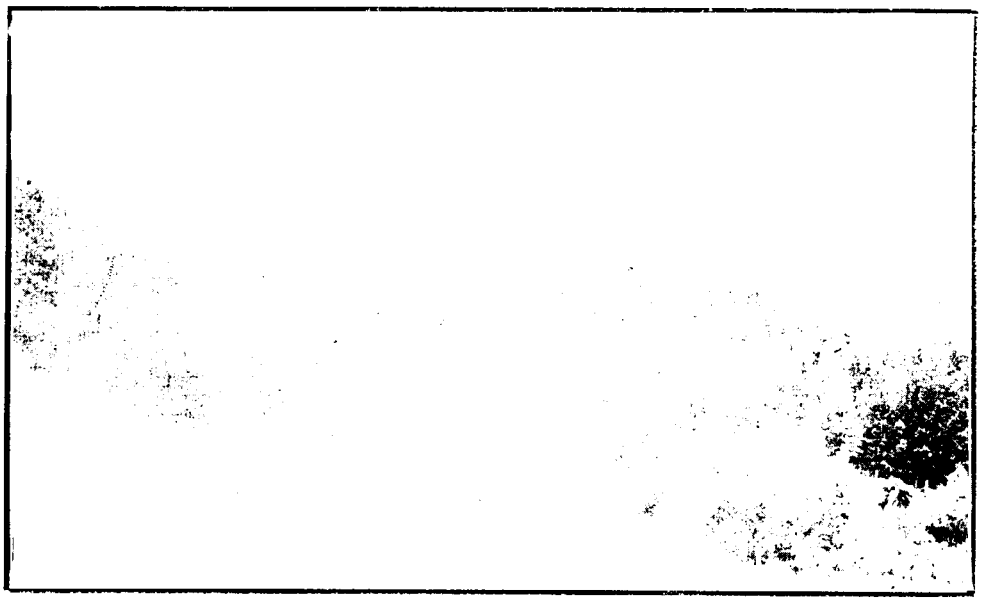
Picea excelsa (*Norway Spruce*).—Norway spruce is a native of middle and northern Europe, where it is one of the largest indigenous trees, attaining a height of 150 ft. with a diameter up to 5 ft. It thrives best in very moist climates, and is found in its natural state mostly in hilly or mountainous country. Norway spruce develops a straight undivided stem with thin branches, which become drooping with advancing age; as it bears a considerable amount of shade, a very close canopy is required when young in order to suppress the side branches. It transplants very well, but is rather susceptible to damage by late spring frosts. For several years after planting its growth is very slow, and for this reason it is not altogether suitable for planting in this district, where the fern quickly overgrows it, and considerable expense is entailed in its protection. On this account no spruce has been planted during the past five years. The Norway spruce is the principal tree of the European timber trade, the timber being commonly known as white deal or white Baltic pine. It is used for flooring-boards, planks, scantlings, mouldings, packing-cases, and scaffold-poles, and also makes excellent wood-pulp for the manufacture of paper.

Picea sitchensis (*Tideland Spruce*).—This spruce is a native of the Sitka Sound and the coast region of British Columbia. In appearance it is somewhat similar to the Norway spruce, but when mature is a much larger tree, growing to a height of 200 ft., with a diameter of 15 ft. Both spruces thrive best under similar conditions, and in rate of growth and suitability for extensive planting here there is practically no difference between them. Sitka spruce, however, is rather more shade-enduring, and in consequence may be found more useful in underplanting operations. The timber of well-grown trees is of excellent quality, and may be used for the same purposes as Norway spruce.

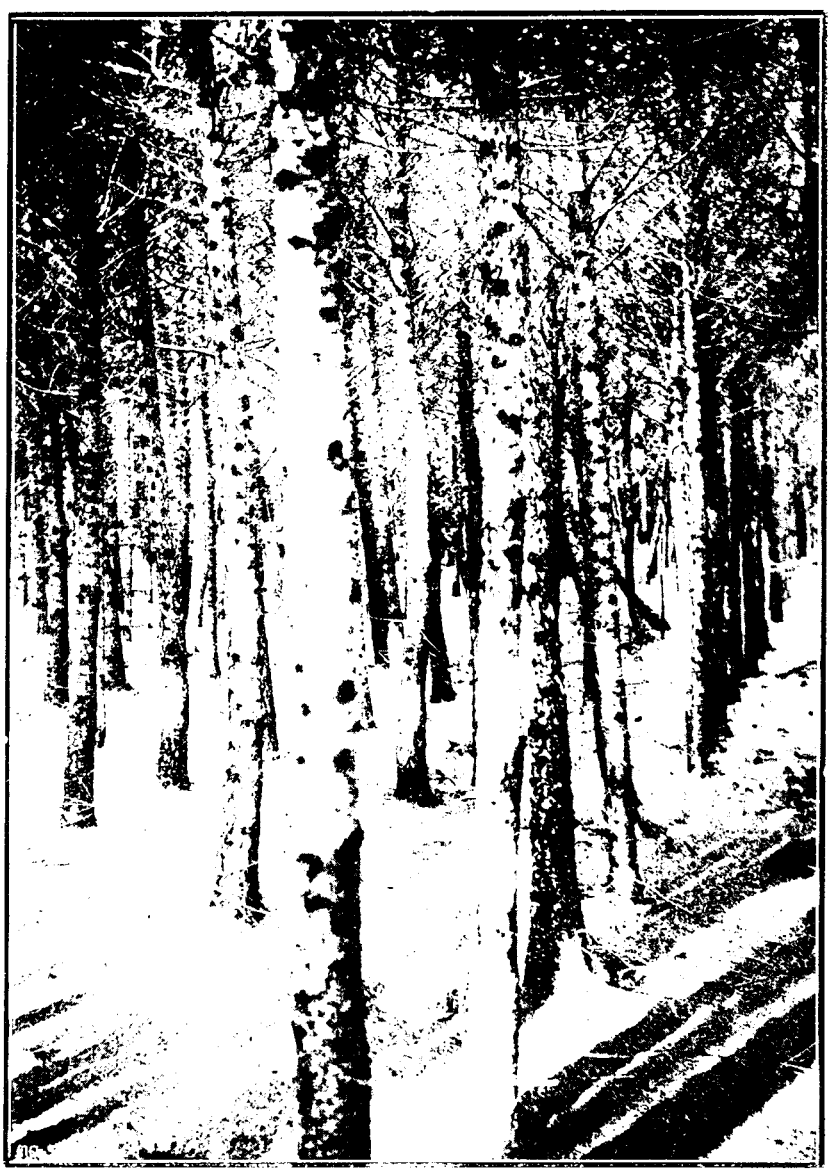
Thuja plicata (*White-cedar*).—A native of the north-western part of North America, being found from Alaska to California and Montana. Height from 150 ft. to 200 ft., with a stem-diameter of 15 ft. The white-cedar is still in the experimental stage here, small numbers having been planted during the past two seasons. It is quite hardy, is easily transplanted, and at present the young trees are looking remarkably well. As a rule it takes two or three years to become established, and for this reason is not suitable for extensive planting on heavy fern land, but, as it bears a great amount of shade, will probably be one of the most useful species for underplanting. The timber is light, soft, and very durable, and is used for fencing, weatherboarding, sashes, doors, interior house-finishing, cabinetmaking, and cooperage.

Alnus glutinosa (*Alder*).—The common alder is found throughout Europe and is also indigenous in Great Britain. It is a deciduous light-demanding tree, with a straight stem, thin foliage, and small branches, which soon die and drop off in the shade. Growing very fast, it is, however, never a large tree, rarely exceeding 75 ft. in height; and is hardy, late frosts having little or no effect upon it. Here it has been used very successfully for planting very wet land where no other species would grow, and shows an annual average growth of nearly 3 ft. The timber is soft, splits easily, and will last for a long time under water, but is not durable where subjected to the combined influences of air and water. It is used for clog-making, herring-barrel staves, cigar-boxes, and for cooperage, and also produces the best charcoal for the manufacture of gunpowder.

Acer pseudo-platanus (*Sycamore*).—Native of middle and southern Europe and western Asia. Grows to 100 ft. in height. It was planted here in mixture with the Austrian pine, but was cut down by successive unseasonable frosts, and, save for a few specimens on the outer edges of the block, never had a chance to compete with its hardy neighbour, the majority of the trees being gradually killed out. Like other broad-leaved species of deciduous trees which have proved climatically unsuitable, the

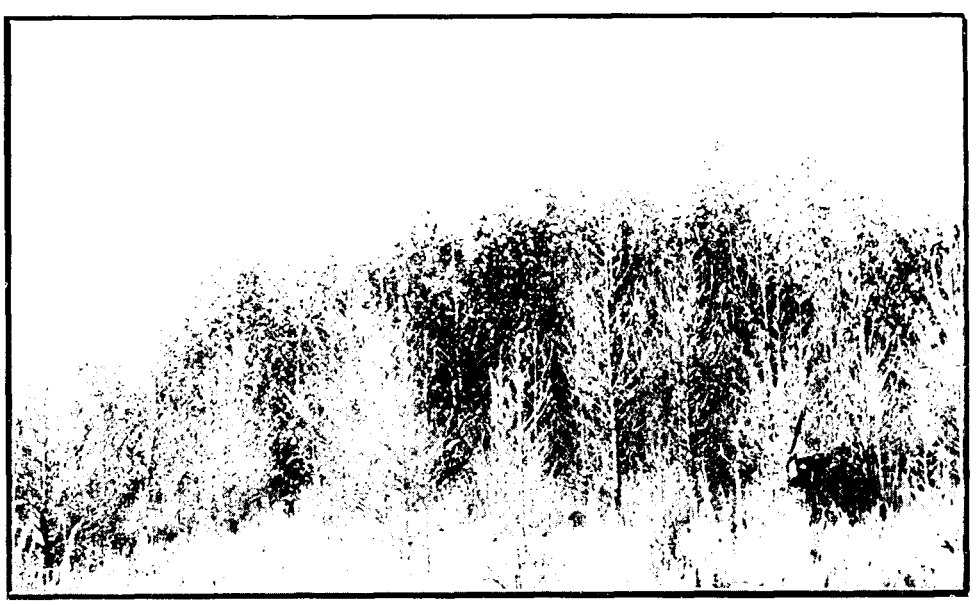


Pinus [illegible] Ponderosa Pine



Enlargement of Part Lower Portion of Preceding Plate Showing Bark and Leaves

Mature trees showing the Pinus sylvestris.



A Group of Douglas Firs at Wellington, 15 Feet. Planted Five Years.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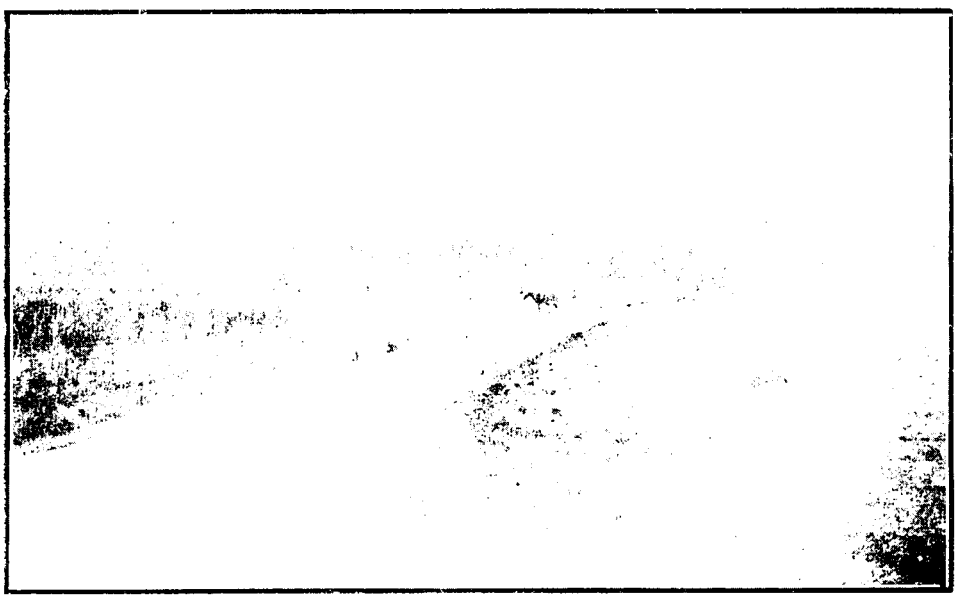


sycamore might perhaps be successfully grown in small groups amongst well-established trees. The wood of the sycamore is of considerable value, being used for cabinetmaking, pattern-making, and in the manufacture of various musical instruments.

Acacia melanoxylon (*Blackwood*).—The blackwood is an evergreen tree, native of south-eastern Australia and Tasmania, where under favourable conditions it grows to a height of 80 ft. Although hardy and easily transplanted, it has not proved a suitable tree for planting in this district. During the first year after planting it made extraordinary growth, frequently up to 6 ft., but after that the growth became slower; its stem became very much divided, and gradually assumed the appearance of a large shrub quite unsuitable for timber-production. It is thought, however, that by cutting down the trees and allowing the root-suckers to grow up a better crop will be obtained. The timber is most valuable for furniture, railway-carriages, boatbuilding, tool-handles, and for certain parts of organs, pianos, and billiard-tables. The fine-grained wood is cut into veneers; it takes a fine polish, and is considered almost equal to walnut.

Liquidambar styraciflua (*Sweet-gum*).—The sweet-gum is a native of North America, growing in the morasses and springs of forests, and having a wide geographic range. Planted experimentally here, it appears to be quite hardy, but beyond that no information is yet available as to its ultimate suitability. In its native home it is said to reach a height of 100 ft. with a stem-diameter of 10 ft. The timber is heavy, fine-grained, durable, easily worked, admitting of a high finish, very suitable for furniture.

Juniperus virginiana (Red-cedar).—Native of the eastern States of North America, growing to a height of 100 ft. The timber is valuable for a great variety of purposes, but owing to its exceedingly slow growth this species would not be a profitable one for timber-production. A small number only have been planted here amongst the experimental lots.

Eucalyptus Stuartiana (*Apple-scented Gum*).—A medium-sized tree, growing to about 100 ft. in height; found throughout the eastern and southern parts of Australia and in Tasmania. It is a fibrous-barked tree with drooping branches and copious foliage. The hardiest species of eucalpytus tried here, and the only one now being planted. It grows rapidly from the start, and on this account has been found to be the best species for growing on land where the growth of fern is particularly heavy. It is not affected by frost on the higher ground, but on low-lying land it is sometimes slightly damaged. The timber, though strong and of a handsome dark colour, is not considered a very valuable one in Australia, where it is mostly used for fencing and for fuel. The fact, however, must be taken into consideration that Australia has at the present time an abundance of the finest hardwoods, so that it is reasonable to believe that the *Stuartiana* will be comparatively a more valuable timber-tree in this country.

Eucalyptus amygdalina (*Almond-leaved Peppermint-gum*).—A native of south-eastern Australia and Tasmania. A variety of this species, *E. regnans*, is sometimes found growing to a height of 400 ft. Next to *E. Stuartiana*, *amygdalina* has succeeded best in this district. On exposed situations and on low land it is apt to be destroyed by frost, and the planting of it has for this reason been discontinued, all the suitable ground having been filled up. In sheltered situations it grows very fast, and many of the older trees are now 40 ft. in height. The timber is used for shingles, rails, fence-posts, and inner building-material; but it is not a strong timber. *E. amygdalina* is also the chief species used in the manufacture of the well-known eucalyptus-oil.

Eucalyptus pauciflora (*White-gum*).—Native of New South Wales, Victoria, and Tasmania. It is a large handsome tree, with a smooth white bark and generally drooping foliage, growing best in moist soil. Excepting *E. Stuartiana* and *E. amygdalina*, this is the only other species that has been planted to any extent; and, like the *amygdalina*, it has succeeded only in situations where it was not affected to any extent by frost. Its timber is used for ordinary building and fencing purposes.

Eucalyptus Sieberiana (*Australian Mountain-ash*).—Native of south-eastern Australia and Tasmania. A straight-stemmed tree, reaching 150 ft. in height and 5 ft. in stem-diameter. A small number only of this species was planted, and, although a few very fine specimens are to be seen, the results as a whole did not justify any further planting. *E. Sieberiana* furnishes a timber of excellent quality, which is used for shipbuilding, implement-handles, cart-shafts, swingletrees, and also for fencing and general building purposes.

Eucalyptus obliqua (*Messmate-gum*).—A large tree, attaining a height of from 200 ft. to 300 ft.; found in New South Wales, Victoria, and Tasmania. The planting of this species has been attended with results similar to those of the previous-mentioned one, only a small number in a particularly favourable situation having succeeded. The timber of this tree is used extensively for cheap fencing-rails, palings, shingles, and other rough woodwork; but is not durable underground, and does not possess great strength.

Eucalyptus acervula (*syn. Gunnii of Mueller*) has proved almost as hardy as any other species planted, but on account of its comparatively slow growth is not suitable for planting on heavy fern land.

Eucalyptus tereticornis (*Swamp-gum*) has been a failure; and the results obtained with *Eucalyptus meliodora* (*Yellow-box*), *E. urnigera* (*Urn-fruited Gum*), *E. coccifera* (*Alpine Peppermint-gum*), *E. Muelleri* (*Mountain-gum*) are also disappointing.

Although so many of the species of eucalypti tried have so far, on account of adverse climatic conditions, proved unsatisfactory, there is little doubt that many of the most valuable species may later on be introduced amongst well-established crops of the hardier species with good results.

Table showing, approximately, the Average Height of the Trees in Whakarewarewa Plantation.

Name of Tree.	Year of Planting.	Average Height.	Name of Tree.	Year of Planting.	Average Height.
		Ft.			Ft.
Larix europaea ..	1901–2	36	Picea excelsa	1906–7	4
Pinus austriaca ..	1901–2	22	,, sitchensis ..	1906–7	4
,, Laricio	1900–1	28	Alnus glutinosa ..	1904–5	23
,, ponderosa ..	1908–9	5	Acer pseudo-platanus ..	1900–1	20
,, radiata	1905–6	35	Acacia melanoxylon ..	1905–6	12
,, taeda	1906–7	17	Juniperus virginiana ..	1906–7	6
,, densiflora ..	1906–7	9	Eucalyptus Stuartiana ..	1903–4	34
,, Thunbergii ..	1906–7	8	,, pauciflora ..	1902–3	25
,, Murrayana ..	1908–9	8	,, amygdalina ..	1903–4	28
,, muricata ..	1905–6	22	,, amygdalina, var. regnans	1899–1900	35
,, Sabiniana ..	1906–7	8	,, Sieberiana ..	1899–1900	32
,, Torreyana ..	1905–6	7	,, obliqua ..	1899–1900	30
Pseudo-tsuga Douglasii ..	1905–6	10	,, Gunnii ..	1905–6	12
,, ..	1907–8	6			
Sequoia sempervirens ..	1901–2	23			

REPORT ON AFFORESTATION OPERATIONS IN SOUTH ISLAND.

[By the Superintending Nurseryman, Tapanui.]

Climatic Conditions and Tree-growth.

Considering the unfavourable conditions under which our afforestation labours had to be conducted during the past season, the result is highly satisfactory. The position of affairs at one period was decidedly unpromising, nor did it appear possible to apply any remedy that might successfully combat the ill effects of prolonged rainfalls. To some extent this bounteous moisture caused an impetus to tree-growing in Central Otago; but the more southern tree-raising station at Tapanui, where the precipitation is usually slightly in excess of requirements, appeared to suffer greatly from the sluggish rise of sap caused by the dearth of sunshine. At Hanmer Springs nearly 23 in. of rain were distributed over the four months ending December, and undoubtedly the occasional spells of warm weather intervening during this critical period for seedlings were responsible for the young plants retaining their sturdiness. As revealed in the detailed plantation reports appended hereto, vigorous growth is general amongst established trees, nor has the invasion of any dreaded disease caused uneasiness to officers concerned. The untimely shedding of larch-needles, so conspicuous at Dusky Hill Plantation last season, and which was subsequently attributed by the Biologist of the Agricultural Department to the existence to a partial drought, made its reappearance in a much milder form this year, and hopes are entertained for the almost immediate recovery of the trees. Whilst touching on the subject, perhaps it will not be out of place to lightly direct the attention of those responsible to the plantations adjoining and running parallel to the railway-line in Canterbury. Premature decay appears to be speedily overtaking *Larix europaea*, and the unhealthy tone conspicuous throughout other blocks of associated trees has, to the writer's knowledge, often been commented upon by travellers.

The development of trees growing on dredged tailings at Waitahuna is being watched with much interest, and the result of our experiments there justifies the opinion previously formed that these gorse-clad unsightly areas may be rapidly converted into valuable plantations.

Raising of Seedlings, and Expenditure incurred.

The introductory allusion to the adverse meteorological influences will be ample explanation for the decided decrease in the number of seedlings raised. Notwithstanding a greater quantity of seed being sown, only 3,984,250 plants eventuated, or an estimate of considerably over a million below last year's figures. The actual expenditure attached to the purchase of seed, and subsequent labour in raising the plants up to the yearling stage, reached 2s. 3½d. per thousand, an estimate slightly more favourable than recorded in the previous season, principally owing to better returns from Central Otago.

Some 28,947,547 trees have been grown since the initiation of afforestation work in the South Island, and it might be interesting to mention that this calculation is based solely on the actual output of trees and present stock, which entirely dispenses with any reasonable grounds for unfavourable criticism of our system of tabulating statistics. Fluctuations in the actual costs of various branches of our labour is inseparable from an undertaking so influenced by seed-quality, weather, increases in wages, &c., and the estimated average cost connected with raising two- and three-year-old trees up to the transporting stage has advanced this year to £1 15s. 4d. per thousand.

Extension of Plantations.

Contrary to expectations, the output of trees from nurseries exceeded that of the previous year by 70,000. Some 3,122,680 trees (as detailed in Schedule V) were used in extending the plantations in Canterbury and Otago, in addition to a distribution of 69,169 trees to public bodies. By increasing the total area to 5,955 acres some 15,239,400 trees have been used. From the tree-planting period onward, as the supremacy of the stronger specimens is asserted throughout our young forests, the difficulty in arriving at a reliable estimate of the number actually living becomes more intense, and in presenting any required computations of this nature approximate figures only can be given.

An output of about 3,250,000 trees is expected during the ensuing season, and this total at present fully taxes the resources of the contributing nurseries. The exposed nature of all planting-out ground acquired prohibits the satisfactory use of small trees direct from the seed-beds. We are thus deterred from adhering to the more economical system adopted in other favoured localities, where lining out seedlings is not indispensable, and where the almost continuous tree-cropping over the same area is not compulsory.

In conducting plantation-work some £7,873 8s. 5d. was expended. Of this amount, £2,339 4s. 6d. was allocated to the annually increasing "general upkeep" item, whilst the working-average costs connected with "planting operations" compare very favourably with past records.

Economy in maintaining efficient Fire-breaks.

The initiation of certain projected reforms in our fire-preventive measures calls for a few special remarks on the subject. Unfair comments are occasionally aimed at the designs of the Department in promoting reasonable security from the fire danger; but usually these critics, on being interrogated, are quite unable to supplement our protective work with practical suggestions, and, further, frequently utter surprise on being informed of the volume of labour already devoted to this important branch of afforestation. The yearly increasing cultivation-work attached to the fire-lines induced the Department to look about for a worthy substitute for horse-work; and during the current season a limited number of sheep will be permitted to graze over certain enclosed fire-breaks, in the hope of keeping all vegetation closely cropped. The policy of allowing sheep to wander over any youthful plantation cannot be recommended, as the excessive trampling and consequent interference with the gradually forming humus has undoubtedly a detrimental effect upon the root-system of trees, particularly in moist situations. With the development of the forest, however, and the subsequent decay of herbage caused by intense shade, sheep would not be so attracted beneath the trees, and the whole reserve could then be advantageously used for pasturage. Some thirty-eight miles of fire-breaks, averaging 50 ft. in width, were kept free from inflammable growth, although at several stations the importance of this labour was discounted by the prolonged wet weather experienced during the summer period.

Recognition of the danger arising from the general use of wax matches on plantations during warm weather urged the advisability of impressing upon employees the desire of the Department to discontinue their usage whilst on duty, and it is pleasing to refer to the ready compliance with instructions shown by all concerned.

Divisional Plans and Annual Records.

The preservation of complete divisional plans of each plantation is being steadily kept in view. Already full particulars of each area are available; but the wisdom of refraining from producing such unfinished plans in the annual report will be apparent. In the meantime each year's planting is pegged off and numbered, and when the area being afforested in each district is completed all information supported by explanatory plans will be submitted. An unexpected volume of clerical work is inseparable from the rearrangement of statistics available, but after our past records have been audited and placed on a reliable basis information and any future references required may be supplied without hesitation.

Improved Appliances.

Each year we aim at further modernizing methods by introducing appliances specially adapted for our tree-raising work. Such devices often originate from and are constructed by employees possessing an inventive turn of mind. The Department fully appreciates these individual efforts, whether wholly successful or not, and are pleased at any time not only to experiment with suggested working-contrivances, but to freely discuss any new ideas advanced.

Under this heading brief mention might also be made of the recently imported Rohrwieser hole-borer, which has been given a fair trial at Conical Hills Plantation. The machine could not advantageously displace our spade and grubber pitting systems over the argillaceous tussocky surfaces so prevalent throughout areas now being afforested. From an economical point of view, also, no advantage could be gained by the use of the borer, as in preparing 750 holes daily a sturdy employee was kept fully occupied. The merits of the machine appear to have been overestimated in certain reviews, for, whilst a measure of success is attainable over areas where the surface soil is light, and coarse vegetation does not exist, it cannot be recommended for extensive use at the present stage. The trials, however, have been by no means exhaustive, and perhaps the appliance will be more favoured where next experimented with.

Free and Prison Labour.

In connection with the casual tree-planting labour, the Department has been singularly fortunate in securing the services of reliable workers, who have taken more than the usual interest in the work this year. It has been necessary to employ an average number of 43·2 men in carrying on operations. Effective assistance was again given by prison labour at Hanmer Springs, where the camp has been of late greatly strengthened numerically. Each prisoner is credited with having performed work to the

value of £68 16s. 5d., whilst the combined efforts of the gang were equal to an expenditure of £992 14s. 1d. (details of which appear in the associated report). The total value of tree-planting work done by prison labour in the South Island to date now reaches £5,254 3s. 10d., and the flourishing state of the plantation generally surely proves the excellence of the methods and labour applied.

One of the chief drawbacks in the successful utilization of prison labour in tree-planting over small areas, where extension-work is uncertain, is the impossibility of selecting a central camp from which speedy access to all points of the reserve can be given. The camp at Hanmer Springs has, up to the present, occupied a fairly convenient site; but with the gradual acquirement of ground the workers are compelled to walk almost unreasonable distances, which necessarily interferes with the average costs in pitting and tree-planting.

Educational.

Correspondence Class.

An attempt was made to resume the correspondence class conducted last season; but frequent absence from headquarters, together with increased duties, insisted upon at least a temporary cessation of this useful work. During each visit to the various stations, however, officers are invited to openly debate any question affecting the management generally of their nursery or plantation; and, needless to state, the benefits arising from such interchange of ideas is oft-times considerable.

Specimens of Seeds and Timbers.

Interrogations regarding the appearances and characteristics of seeds and timbers of the various trees have opened up a further field for study, and spare time has been partly devoted to the creation of a miniature museum of timber and seed specimens, which will be at all times at the service of those in need of associated information. A well-represented collection can only be gathered after years of perseverance, but the possession of even the more widely known kinds gives greater scope for practical and otherwise intelligent replies.

Library.

The reference library of forestry literature is availed of repeatedly by officers, who recognize the importance of studying the afforestation problem from its many aspects. Several excellent publications were added to the already lengthy list, but the large amount of outside work involved upon nurserymen and foremen in charge frequently forbids their studying to the extent desired by them.

Sand-planting in Central Otago.

A series of applications from landowners to the Government for assistance in checking the spread of sand over their affected properties led to a subsequent inspection of Sandy Point, Tarras, by Dr. L. Cockayne and myself. Indications pointed almost conclusively to the natural clearance of sand-particles from the locality through the agency of strong north-westerly winds; but by the concentration of efforts upon the fixation of sand along the terraces, and creating live barriers near the original source and also at intervals along the course of the drift, it was anticipated that the period of direct injury to tenants of adjacent holdings would be shortened. From the outset the presence of rabbits made tree-planting somewhat speculative, notwithstanding provision being made by the formation of wire-netted enclosures. On the other hand, no concern was felt for the safety of unprotected marram-grass; and exceedingly fine results attained in the latter planting demonstrates the needlessness of attempting the extermination of the pest when undertaking this phase of dune-reclamation.

Two employees were occupied for six weeks in carrying out the following works, the total cost of which amounted to £66 9s. 6d.: Lifting and planting 36,850 marram-grass sets; planting 2,200 *Pinus muricata;* planting 750 *Populus fastigiata;* planting 750 *Salix viminalis;* planting 70 various experimental trees; lining out 5,000 *Pinus radiata* seedlings; erecting 90 chains of wire-netting fencing. The marram-grass was planted about 3 ft. 6 in. apart each way, in straight lines along the terrace-faces, each man separating 1,200 sets from the parent plants, and duly planting this number daily.

Promises were extracted from local interested persons to keep the wire-netted enclosure free from rabbits; but a recent inspection revealed the presence of the pest in such strength that many of the trees had been destroyed after success seemed assured. The isolation of the planted area, and consequent inconvenience of officially attending to requirements of such semi-experimental works, make a repetition of expenditure of a similar nature undesirable, unless the services of a reliable honorary caretaker is available.

Selwyn Plantation Reserves.

In accordance with the wishes of the Selwyn Plantation Board, and as directed by the Under-Secretary of Lands, advice was tendered relative to the plantation-extension work throughout Selwyn County; and, although unavoidable circumstances necessitated a somewhat lengthy delay in commencing the season's operations, the anticipated measure of success in planting has been obtained.

With a view to becoming conversant with the Board's requirements, a complete inspection of the reserves was undertaken in December, and a general illustrated report, embodying a policy for future guidance, duly presented. The Board realizes the increased initial expenditure essential in the conversion of the smaller reserves into forests; but the possession of this knowledge has not hindered members from drafting a thoroughly practical programme, which will be carried into effect during the coming season. Another function of the Board is to protect certain reserves from becoming inundated with sand; and in this connection a reclamation scheme of dune-planting, embracing the fixation and final afforestation of the dunes, has been outlined, and every effort will be made to also include this useful work in the year's operations.

Distribution of Surplus Trees, and Advice to Public Bodies.

Rarely is it possible to estimate with perfect accuracy the number of trees available in nurseries for transportation to our State plantations, and occasionally surplus plants remain after requirements are fulfilled. Requests from public bodies for a limited number of any such stock are usually complied

with, and during the year under review some 69,169 trees, valued at £212 15s. 6d., were apportioned as per Schedule V. A consignment of somewhat large proportions was allotted to the Mackenzie County Council, who have been actively engaged for years past in fostering a steady tree-planting policy among the district settlers. The Engineer, Mr. R. L. Banks, under whose able supervision the season's planting was conducted, alludes to the striking success achieved, and the immense future benefit to the district that should emanate from the creation of these State-assisted plantations.

A small area of the Waimakariri Territorial Training-grounds near Christchurch was enclosed by a rabbit-proof fence, and some 4,780 trees planted therein for shelter purposes on behalf of the Defence Department. Much need of further boundary, shelter, and internal clumps of trees for aiding military manœuvres was also obvious, and the carrying into effect of these suggestions was deferred for another year. A fair growing-percentage in *Pinus muricata* and *P. insignis* has resulted; but some few hundred specimens of *Cupressus macrocarpa* have failed to succeed on the sandy surface.

Much information on matters relating to tree-growing was imparted to public bodies, when the transmission of such advice did not interfere with departmental duties.

General.

In conclusion, I have to heartily thank all officers for their liberal support in terminating the season's operations under perhaps the most trying conditions yet experienced.

The Justice Department, ably represented by Warder-in-charge Ayling and assistants, must also be highly commended for the excellence of administration of their co-operative labours.

R. G. Robinson,
Superintending Nurseryman, South Island.

Tapanui Nursery, Otago.

(Area, 120 acres; altitude, 500 ft.)

Adverse climatic conditions have been instrumental in curtailing the usual amount of success attained in tree-raising at this station. The annual rainfall (38·53 in. on 201 days) exceeded the registered amount of the previous year by over 10 in.; but perhaps the almost incessant cold rains and entire absence of warmth during November were the chief factors in hastening the decay of a large number of apparently healthy plants. Frosts were recorded on fifty-five occasions, which is more than double the number registered during the last yearly period. A brief spell of warm weather was welcomed in January, when the highest shade temperature reached 90°; and 10° of frost occurred during the night of the 26th June.

Raising of Seedlings.—The excellent state of the ground, together with a desired calmness during the seed-sowing period (commenced on the 3rd October), augured well for success in this branch of labour; but simultaneously with the covering of frames heavy rain fell, causing a battering effect on the surface. Seed-germination was consequently sluggish; but eventually a fair number of seedlings broke through the earthy crust formed, only to succumb in large numbers through the persistent coldness, and consequent attacks of our most dreaded forms of diseases—"damping-off" and *Odontria zealandica*. To minimize this partial failure a second sowing of *Pinus Laricio* was conducted on the 12th February; and the result has exceeded expectations, and increased the number of Corsican pines to 1,100,000. The total number of seedlings raised reaches 1,585,850, the details of which are shown in Schedule V. From 20 lb. of *Larix leptolepis* seed some 125,000 plants resulted; but the European-larch crop is a decided failure, owing to the previously explained causes. The combined total of our shelter-pines (*Pinus muricata* and *P. radiata*) reaches 110,000, which number will be ample to meet requirements. In addition to very satisfactory returns in the *Pinus ponderosa* beds, much useful experimental work was undertaken with the following species of the pine family—*Pinus alba*, *P. Banksiana*, *P. patula*, *P. Montezumae*, *P. picea*, *P. Murrayana;* but until they have passed through the winter test their suitability or otherwise for the locality cannot be determined. An interesting sowing of the native *Myrtus bullata* was attended with a very fair measure of success, some 2,000 plants eventuating from ½ lb. of seed. Small amounts of various tree-seeds were also used in the trial plots, and valuable knowledge has thus been acquired. As outlined in the previous year's report, at Conical Hills Plantation an effort will be made to create a small block of *Cupressus macrocarpa*, for which purpose the 30,000 sturdy seedlings raised will be used.

Transplanting young Trees.—No difficulty was experienced in transferring some 2,805,080 seedlings from beds to nursery-lines during the spring-time. This lining-out labour was commenced on the 24th August, and completed, with an occasional intermission, about two months later. Besides an increased death-rate, tree-growth has not equalled that of ordinary seasons here; but there is every likelihood of the required number of trees being advanced enough for permanent removal to our associated plantations, without having to supplement our sturdy stock by the inclusion of undesirable two-year-old seedlings, as is oft-times done here, with more or less unsatisfactory issues.

Several exceedingly fine breaks of larch and Corsican pine may be seen where the young trees suffered from no interruptions from the grass-grubs. Each succeeding year the impossibility of growing two successive crops of trees over the same area becomes more apparent; and to escape the ill effects of the pest, besides conducting our periodical soil-restoration methods, a limited area in an adjacent semi-sheltered horse-paddock will probably be utilized for the coming season's transplantation-work.

Horse-feed.—Much success has attended our horse-breeding ventures since the idea of profitably using two old mares originated, and, of the ten horses bred, misfortune has overtaken only one so far.

The expense attached to the upkeep of fourteen horses is necessarily somewhat large, particularly when the pasture available is neither extensive nor rich; but we generally manage to grow sufficient produce, unless handicapped by an unfavourable spring. The current season's yield of an approximate 33 tons of oaten sheaves is somewhat above the average, and, in company with the similar experiences of Otago farmers generally, the harvesting problem was decidedly perplexing owing to the later ripening of grain and overabundance of moisture. About 6 tons of rye and clover hay were also stacked after

repeated delays, and probably the few tons of carrots required for winter feed will be lifted from this late-maturing crop.

Buildings, Improvements.—Several inexpensive improvements were effected to buildings and surroundings; and in this connection it might be mentioned that wet and otherwise unfavourable weather for agricultural work is usually availed of when undertaking fencing, building, or other progressive schemes. The neat serviceable cottage for the resident horseman was completed, and much credit is due to the nursery foreman and assistants for the bulk of the labour directed upon the building. A much-needed reform was undertaken in the shifting of several smaller buildings from the main stable and workshop to more convenient sites. This new arrangement permits of the expeditious harnessing of horses to the various implements, and entirely dispenses with the necessity heretofore practised of having to resort to manual labour in drawing to the open, and subsequently replacing, heavy machinery when required.

During lifting operations the need of more tree-storage accommodation was felt; and this want has been relieved by constructing an iron lean-to on the sizing-shed, at the end of which the cycling staff are permitted to keep their bicycles.

A combined experimental and shelter plantation was formed to take the place of a piece of fast-decaying native bush; and smaller improvements in the form of painting buildings and implements, construction of roads, fencing, &c., were also carried into effect.

The annual expenditure amounts to £2,236 11s. 9d., providing employment for 11·13 men, and the total expenditure to date reaches £23,057 14s. 5d.

The year's output to plantations, public bodies, &c., is 1,556,464 trees, which are valued at £4,674 15s. 6d., as per Schedule V, and there is every prospect of at least an equal number being similarly dealt with during the ensuing season.

Some 4,387,800 trees are now in stock in various stages, the two-year-olds being represented by the largest number.

Statement of expenditure, Property Account, Trees Account, and meteorological records are appended.

Schedule I.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1911.	In.		Deg. Fahr.	Deg. Fahr.	
April	3·36	12	78	32	1
May	1·09	12	68	27	7
June	3·02	19	62	22	6
July	2·02	12	53	25	22
August	1·32	12	65	25	4
September	2·82	16	66	28	10
October	2·71	19	72	30	3
November	6·36	26	70	28	1
December	3·33	20	74	32	1
1912.					
January	3·40	19	90	35	..
February	3·87	16	86	33	..
March	5·23	18	78	33	..
Totals	38·53	201	..	..	55

Schedule II.—Statement of Expenditure.

	For Year.			To Date.		
	£	s.	d.	£	s.	d.
Tree-planting and maintenance—						
Tree-growing	886	2	0	11,779	15	11
General maintenance and repairs ..	317	7	1	2,277	6	0
Tree-seeds	110	14	3	1,066	18	8
Manures	32	3	11	221	8	4
Horse-feed, purchased and grown ..	105	13	0	1,185	17	9
Miscellaneous works	81	18	1	220	19	4
Stock and material.—Tools, implements ..	46	8	9	982	0	0
Permanent works—						
Buildings	375	10	5	1,999	3	4
Nursery-formation	1	3	9	497	4	9
Fencing	55	16	3	604	1	11
Water-supply	0	14	3	224	5	6
Supervision and clerical—						
Proportion of Superintending Nurseryman's salary	122	0	0	1,760	14	11
Clerical assistance	101	0	0	237	18	0
	£2,236	11	9	£23,057	14	5

Schedule III.—Trees Account.

	During the Year.		Since 1896 to Date.		Estimated Value, as Schedule V.
	Number.	Cost of Raising.	Number.	Cost of Raising and Maintenance.	
		£ s. d.		£ s. d.	£ s. d.
Trees raised	1,585,850	211 6 4	15,118,300	23,057 14 5	..
Trees sent out	1,556,464	..	10,730,500	..	..
Balance in stock			4,387,800	..	7,514 12 0
Value of land, improvements, and stock (Property Account)				..	4,278 8 5
Total value				..	11,793 0 5

Schedule IV.—Property Account.

	£ s. d.
Land (120 acres); Crown lands not charged to Forestry Account ..	..
Buildings	1,999 3 4
Stock	263 0 0
Improvements	721 10 3
Fencing	604 1 11
Stores in hand	690 12 11
	£4,278 8 5

Schedule V.—Details of One-year-old Trees, sown 1911–12.

Name of Tree.	Number in Seed-beds.	Height, in Inches.	Seed sown.	Value per Thousand.	Total Value.	Remarks.
			Lb.	£ s. d.	£ s. d.	
Larix europaea	40,000	2	202	1 0 0	40 0 0	Failure.
„ leptolepis	125,000	1½	20	1 5 0	156 5 0	Fair crop.
Pinus Laricio	1,100,000	1½	149	1 0 0	1,100 0 0	Sturdy plants.
„ ponderosa	130,000	1¾	63	1 0 0	130 0 0	„
„ Benthamiana	5,000	1¾	12	1 5 0	6 5 0	„
„ muricata	50,000	2	7	1 0 0	50 0 0	Fine even crop.
„ radiata	60,000	4	8	1 0 0	60 0 0	„
„ strobus	4,000	1	4	1 0 0	4 0 0	Experimental.
			Oz.			
„ alba	4,750	1	2	1 0 0	4 15 0	„
„ Banksiana	2,300	1	1	1 0 0	2 6 0	„
„ patula	1,000	1	1	1 0 0	1 0 0	„
„ picea	700	1	2	1 5 0	0 17 6	„
„ Montezumae	600	1½	1	1 0 0	0 12 0	„
„ Murrayana	300	1½	1	1 0 0	0 6 0	„
„ sylvestris	250	1½	1	1 0 0	0 5 0	„
Picea sitchensis	500	1½	2	1 0 0	0 10 0	„
„ excelsa	800	1½	8	1 5 0	1 0 0	„
			Lb.			
Pseudo-tsuga taxifolia	24,000	3	9	1 5 0	30 0 0	Thin crop.
Cupressus macrocarpa	30,000	4	5	1 0 0	30 0 0	Excellent plants.
Myrtus bullata	2,000	1½	½	1 10 0	3 0 0	„
Pittosporum Ralphii	400	1½	3	1 0 0	0 8 0	Fair germination.
Berberis Darwinii	250	1	¼	1 0 0	0 5 0	„
Various trees	4,000	..	..	1 0 0	4 0 0	..
Totals	1,585,850	..	..	..	1,625 14 6	

Two-year-old Trees, sown 1910–11.

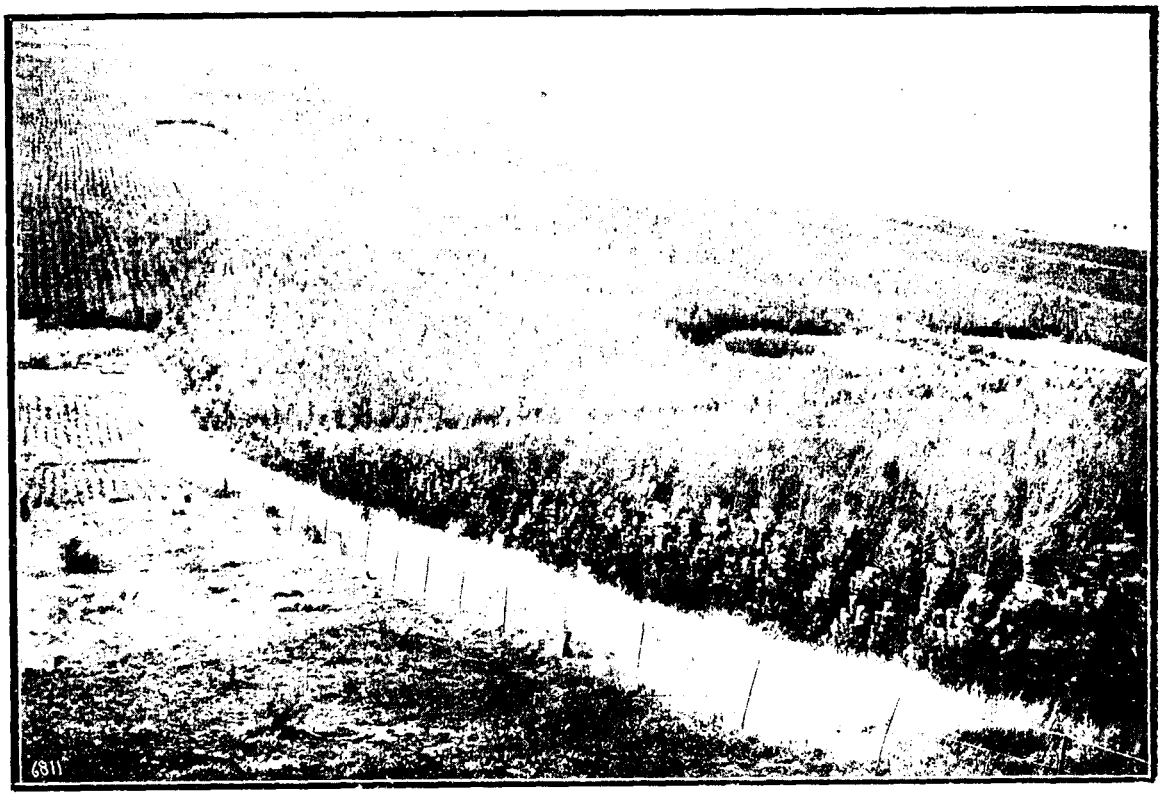
Name of Tree.	Number in Seed-beds.	Number in Nursery-lines.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
				£ s. d.	£ s. d.	
Larix europaea	433,000	465,000	15	1 5 0 / 2 5 0	1,587 10 0	Well-grown trees.
Pinus austriaca	4,700	..	3	1 5 0	5 17 6	Growth much affected by excessive moisture.
„ Laricio	257,000	55,000	4	1 5 0 / 2 5 0	445 0 0	Ditto.
„ ponderosa	183,000	8,500	4	1 5 0 / 2 5 0	247 17 6	„
„ Benthamiana	26,000	..	4	1 5 0	32 10 0	„
„ maritima	..	2,500	7	2 5 0	5 12 6	Strong fibrous-rooted trees.
„ muricata	..	2,600	8	2 5 0	5 17 0	„
„ radiata	..	22,500	10	2 5 0	50 12 6	„
„ strobus	..	1,000	3	2 5 0	2 5 0	Fair results.
„ scopulorum	..	1,500	5	2 5 0	3 7 6	„
Pseudo-tsuga taxifolia	24,000	30,000	4	1 5 0 / 2 5 0	97 10 0	Healthy trees.
Picea sitchensis	242,000	11,800	2½	1 5 0 / 2 5 0	329 1 0	Fair crop.
Betula alba	..	4,100	13	2 5 0	9 4 6	Strong growth.
Cupressus macrocarpa	..	300	15	2 5 0	0 13 6	„
„ Lawsoniana	3,500	..	3	1 5 0	4 7 6	„
Alnus glutinosa	..	1,700	18	2 5 0	3 16 6	„
Thuja plicata	..	15,400	6	2 5 0	34 13 0	„
Cytisus proliferus	..	1,000	15	2 0 0	2 0 0	Satisfactory results.
Various trees	..	1,000	..	2 5 0	2 5 0	„
Totals	1,173,200	623,900	..	..	2,870 0 6	
	1,797,100					

Three-year-old Trees, sown 1909–10.

Name of Tree.	Number in Nursery-lines.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
			£ s. d.	£ s. d.	
Larix europaea	5,000	18	3 0 0	15 0 0	These trees have developed well, considering adverse weather-conditions.
Pinus Laricio	781,600	4	3 0 0	2,344 16 0	
„ ponderosa	194,700	4	3 0 0	584 2 0	
Pseudo-tsuga taxifolia	1,400	6	3 5 0	4 11 0	
Picea excelsa	350	6	3 0 0	1 1 0	
Fraxinus excelsior	11,600	6	3 0 0	34 16 0	
„ americana	3,000	10	3 5 0	9 15 0	
Betula alba	200	40	3 0 0	0 12 0	
Alnus glutinosa	3,800	15	3 0 0	11 8 0	
Various trees and shrubs	3,200	10-40	4 0 0	12 16 0	
Totals	1,004,850	..	..	3,018 17 0	

Trees transferred from Nursery to Plantations, &c., 1911–12.

Where sent.	Name of Tree.	Number.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
				£ s. d.	£ s. d.	
Conical Hills Plantation	Larix europaea	775,950	16	3 0 0	2,327 17 0	An excellent growing-percentage resulted in each variety enumerated.
	Pinus Laricio	354,850	10	3 0 0	1,064 11 0	
	„ ponderosa	218,350	8	3 0 0	655 1 0	
	„ austriaca	23,375	9	3 0 0	70 2 6	
	„ Benthamiana ..	200	10	3 5 0	0 13 0	
	„ muricata	575	12	3 0 0	1 14 6	
	„ Jeffreyii	25	8	3 5 0	0 1 7	
	Picea excelsa	40,250	7	3 0 0	120 15 0	
	„ sitchensis	11,550	8	3 5 0	37 10 9	
	Fraxinus excelsior ..	21,500	10	3 0 0	64 10 0	
	Betula alba	8,200	15	3 0 0	24 12 0	
	Thuja gigantea	10,450	12	3 10 0	36 11 6	
	Alnus glutinosa	2,700	15	3 0 0	8 2 0	
		1,467,975	..	..	4,412 1 10	
Dusky Hill Plantation	Pinus Laricio	13,000	10	3 0 0	39 0 0	Used to replace failures, mostly in sycamore blocks.
	Fraxinus excelsior .	200	10	3 0 0	0 12 0	
		13,200	..	..	39 12 0	



THE SIDE OF HAY AT SEED [illegible] AND [illegible] PLANTS

PUTTING AND BUILDING LARGE CAP OF HAY AT SEEDING NURSERY

Sizing Seedling Pines for Lining out at Tapanui Nursery.

"Break" of Labour, Tapanui, also showing Extension Nursery in the distance.

Trees transferred from Nursery to Plantations, &c., 1911–12—continued.

Where sent.	Name of Tree.	Number.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
				£ s. d.	£ s. d.	
Tarras Plantation	Pinus muricata	2,200	12	3 0 0	6 12 0	These were used create barriers drifting sand.
	" insignis	5,000	6	1 5 0	6 5 0	
	Assorted trees (experimental)	70	10	3 0 0	0 4 2	
		7,270	..	..	13 1 2	
Mackenzie County	Larix europaea	25,000	15	3 0 0	75 0 0	Distributed to settlers.
	Pinus Laricio	10,000	10	3 0 0	30 0 0	
	" ponderosa	15,000	10	3 0 0	45 0 0	
		50,000	..	..	150 0 0	
Conical Hills Plantation	As per details above ..	1,467,975	..	..	4,412 1 10	
Dusky Hill Plantation	" ..	13,200	..	..	39 12 0	
Tarras Plantation ..	" ..	7,270	..	..	13 1 2	
Mackenzie County ..	" ..	50,000	..	..	150 0 0	
Selwyn Plantation ..	Pinus Laricio	5,000	..	..	12 10 0	
Waimakariri Plantation	" muricata	2,900	..	..	8 14 0	
Hawea Domain Board	Assorted trees	579	..	..	2 4 9	
Palmerston Sanatorium	"	650	..	..	2 12 0	
Cave Domain Board	"	400	..	..	1 12 0	
Tourists Department, Queenstown	Larix europaea	50	..	..	0 3 0	
Anderson's Bay Orphanage	Assorted trees	3,200	..	..	12 16 0	
Lawrence Borough Council	"	100	..	..	0 8 0	
Ocean Beach Domain Board	Pinus muricata	1,000	..	..	3 0 0	
Acclimatization Society, Clinton	Assorted trees	1,700	..	..	6 16 0	
Waiau Domain Board	Pinus muricata	200	..	..	0 12 0	
Roxburgh Borough Council	Assorted trees	250	..	..	1 0 0	
Cromwell Borough Council	"	750	..	..	3 0 0	
Balclutha Borough Council	"	290	..	..	1 3 3	
Rawhiti Domain Board	Pinus muricata	650	..	..	2 5 6	
Brighton Improvement Society	Assorted trees	300	..	..	1 4 0	
Totals ..	..	1,556,464	..	..	4,674 15 6	

W. T. Morrison,
Nursery Foreman.
R. G. Robinson,
Superintending Nurseryman.

Dusky Hill Plantation, Otago.

(Area, 845 acres; altitude, 400 ft. to 800 ft.)

It is indeed gratifying to be able to report on the improved appearance generally of trees planted throughout this reserve. The beneficial effect of evenly distributed moisture is most strongly apparent in the larch blocks, where a much more healthy tone prevails than in the previous season. It cannot be contended, however, that a complete restoration from premature leaf-shedding of *Larix europaea* has yet eventuated; and the present vigilance for any outbreak of disease will be persevered with. Some little damage to walnuts and chestnuts was occasioned by the advent of an unseasonable frost in November, but a good recovery was effected, and these trees have since progressed without further interruptions. The hardwoods, particularly *Fraxinus* and *Quercus pedunculata*, have shown their distinct partiality for a wet season, and in many instances their vertical development has exceeded 3 ft. In the earlier stages we were under the impression that *Pinus austriaca* grew with greater vigour and was otherwise hardier than *Pinus Laricio;* but of recent years the latter species has quite outshone the Austrian pine, both in average annual growth (20 in.) and its freedom from the white aphis—*Chremes laricio.*

Strong winds have again been responsible for slight damage being done to the delicate leaders of *Pseudo-tsuga taxifolia.* Where occupying sheltered positions over 3 ft. of growth was made, whilst in the more elevated situations the rate of development is reduced to about one-third. Of all varieties operated with here, none from a forester's point of view are so discouraging as the spruces, which, when placed on partially exposed hillsides, rarely increase their height annually by more than 6 in.

Red Deer.—So persistent have been the attacks upon our young ash and oak by the red deer that it has been necessary to devote a fair amount of time in stalking the destructive animals, two of which were recently shot. The difficulty experienced in locating the whereabouts of the intruders in the dense plantation may be easily imagined; and as our boundary-fences offer no effective barrier against the deer, it is only by keeping a rifle constantly within reach that one is able to get within an effective shooting-range.

General Maintenance.—In addition to the usual amount of general maintenance-work performed by the two employees engaged, a start was made at removing the lower decayed branches of larch. This labour is expeditiously carried out with the aid of a stout stick; and, when trees are sufficiently advanced for the operation, three or four brisk blows will easily dislodge the brittle branches without creating any injury to the supporting bole. The clearance-work has not progressed far enough to permit of an accurate calculation being made for conducting the operations over an extended area.

Some 13,200 trees, as enumerated in Schedule III, were utilized for replanting throughout, and an excellent growing-percentage resulted.

Two teams of horses were occupied for nearly three weeks in cultivating fire-breaks; but at no period of the past season has surface vegetation been inflammable enough to cause any anxiety to those responsible.

Minor works, in the form of removal of coarse growth from around young trees, tree-pruning, formation of tracks, and rabbiting, were also carried on.

An expenditure of £379 15s. 7d. was incurred during the year, which advances the total expenditure to £12,838 17s. 2d.

Details of expenditure, Trees Account, Property Account, and balance-sheet are appended.

Schedule II.—Statement of Expenditure.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
Tree-planting	..	3,094 16 2
Pitting	..	3,619 2 7
Clearing	..	496 5 11
Cartage of trees	..	216 12 8
General upkeep of plantation	162 10 1	2,573 4 8
General repairs	8 1 0	61 0 11
Horse-feed	14 9 5	126 18 4
Permanent works—		
Fencing	..	258 2 3
Formation	..	366 7 2
Buildings	4 11 4	373 9 10
Stock, implements, &c.—Tools, implements	8 3 9	153 12 6
Supervision and clerical—		
Salaries—		
Supervision of free labour	155 0 0	1,110 10 0
Superintending Nurseryman's proportion and clerical assistance	27 0 0	388 14 2
	£379 15 7	£12,838 17 2

Schedule III.—Trees Account.

	Number.
Trees received during year	13,200
Less, to replace blanks	13,200
Previously planted	2,180,837
Total number planted on 845 acres (average age, 8 years)	2,180,837

Schedule IV.—Property Account.

	£ s. d.
Land (845 acres); Crown lands not charged to Forestry Account	..
Buildings	373 9 10
Stock	..
Improvements	366 7 2
Fencing	258 2 3
Stores in hand	24 18 5
	£1,022 17 8

Balance-sheet.

	£ s. d.
Total expenditure	12,838 17 2
Less Property Account	1,022 17 8
Cost of operations	£11,815 19 6
845 acres planted (average age, 8 years)	..
Estimated value of plantation per acre	£11 7 6

F. BENFELL,
Plantation Foreman.

R. G. ROBINSON,
Superintending Nurseryman.

CONICAL HILLS PLANTATION, OTAGO.

(Area, 3,672 acres; altitude, 400 ft. to 1,050 ft.)

Weather-conditions have not favoured afforestation operations in this locality during the past season, and the usual measure of success attained is due principally to the excellent work performed by employees, who on rare occasions require to be reprimanded for careless application of labour.

Tree-growth generally is perhaps slightly below that of the previous year, excepting in sheltered gullies and flats, where annual development of such trees as sycamore, ash, and the spruces is unprecedented. All varieties responded to what appeared to be an early spring; but an unexpected frost not only proved fatal to a number of the more tender Oregon-pine leaders, but seriously interfered with the season's progress of all trees. The uniformity of growth in the *Pinus Laricio* and *Pinus austriaca* blocks is conspicuous, and the former species has again proved its superiority over any other trees operated with here, for succeeding under adverse conditions. An interesting trial planting last season of 10,000 *Thuja plicata* discloses the possibility of raising the tall-growing Pacific red-cedar at this station on the more favoured sites. Since the inception of the Forestry Branch much experimental work has been conducted; and we are now aware that many useful timbers at present neglected could be successfully grown, but only in the most fertile spots, which at the present time, however, are being allocated to the more valuable *Fraxinus excelsior* and *Fraxinus americana*. The larches have made fair headway, although their increased rate of progress at the base of hillsides is becoming more conspicuous with each succeeding year. Over a fair-sized area rocky outcrops have quickly been covered with the sturdy bull and heavy pines, which are undoubtedly the hardiest of the *Pinus* family grown here. Where shelter-belts of *Pinus insignis* and *Pinus muricata* have been formed the beneficial effects on the more delicate trees on the leeward side is apparent, and shows the wisdom of making provision for shelter at the earliest moment.

Pitting and Tree-planting.—Some 1,467,875 trees were planted out during the year, but of this number 357,500 had to be utilized in replacing failures in the previous year's planting. This labour was undertaken by contract at 11s. 6d. per thousand, and employees were thus able to earn between 7s. 6d. and 8s. 6d. per day. An excellent growing-percentage was obtained throughout, and the most minute inspection reveals but few deaths in any of the varieties dealt with. The custom of using at least a small number of trees direct from the seed-beds was not repeated this year, and perhaps this restriction was the chief factor in reducing the losses in transplantation. It was possible to get a sufficient number of pits prepared by contract at 12s. 6d. per thousand, and it is doubtful if the Department could carry on similar work by day-labour at a cheaper rate.

Fire-breaks.—The early possibility of grazing all the unplanted area with sheep was fully discussed, and every effort will be made during the current season to erect light divisional fences fringing the external lines of trees. Opinions are often expressed by farmers to the effect that sheep should be given free access within the planted reserves; but the amount of injury created to the floor of the young forest by excessive tramping makes the fulfilment of the idea undesirable. Some 90 acres of fire-breaks were put into an effective state by either ploughing, disking, or harrowing, as the state of the ground demanded. The surface vegetation has remained in such a moist condition throughout the season that it has not even been possible to conduct the burning-off of tussocks, fern, &c., so essential prior to pitting. This immunity from fires, however, is not enjoyed annually, and special precautions against any outbreak are usually in force during the summer and autumn months.

Divisional Plans.—The revision of records and compilation of reliable plans occupied more time than was expected, but the labour so directed will in future greatly simplify management.

Buildings, Fencing.—A small expenditure was devoted to the erection of two huts for employees connected with our lower plantation, and the extra comfort thus provided is appreciated by the occupants. It was evident from the outset that successful planting could only be accomplished by adhering to the system of divisional fencing, and effecting a clearance of rabbits on the season's planting-ground, before seriously attending to that area not immediately required. This method is still in force; and the dismantling and re-erection of some two miles of wire-netting fencing was carried out by contract, at 3s. 6d. per chain for each operation. The remaining area of some 800 acres will not require subdividing, and ere the ground available has been afforested it will be possible to permanently remove the internal fencing-material for enclosing any newly acquired property.

General Maintenance.—In the supporting statement of expenditure appended hereto it will be noticed that by far the largest sum is written against "general upkeep" of plantation; but it must be remembered that included in this item is such labour as tree-pruning, clearance of coarse vegetation around young trees, attention to roads and fire-breaks, replanting of failures, horse-shoeing, rabbiting, supplying fuel to employees, cutting of noxious weeds, and other minor works.

Economy is introduced wherever practicable; but as the area planted becomes more extensive it is only reasonable to anticipate a correspondingly increased expenditure in the general upkeep. This rabbiting-work has been made all the more difficult through our inability to burn badly infested gullies, as amongst the rank fern and tutu the presence of burrows is often overlooked by rabbiters, and dogs and ferrets hunt reluctantly under such conditions. More labour was incurred in securing fuel for employees this year, as our stock of partially decayed fencing-posts was exhausted, and it became necessary to cut and deliver firewood from Dalvey Bush, a distance of about seven miles from our central camp, over rough roads. The expenditure for the year was £3,217 12s. (an increase of £2 on the previous year), which provided employment for 22·5 men. Since the initiation of the afforestation-work at this station £20,772 16s. 2d. has been expended, the details of which may be seen on reference to the following table:—

Schedule II.—Statement of Expenditure.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
Tree-planting	673 15 1	4,536 17 7
Pitting	744 10 9	6,198 5 7
Clearing	17 19 6	666 3 2
Cartage of trees	49 5 0	321 15 5
General upkeep of plantation	1,273 18 8	4,651 6 0
General repairs	28 12 8	371 9 5
Horse-feed	18 18 3	97 10 8
Permanent works—		
Fencing	58 11 9	1,164 10 9
Formation	..	259 11 10
Buildings	69 15 7	314 0 11
Stock, implements, &c.—Tools, implements	27 5 0	282 15 8
Supervision and clerical—		
Salaries—		
Supervision of free labour	180 0 0	1,380 0 0
Superintending Nurseryman's proportion and clerical assistance	75 0 0	528 9 4
	£3,217 12 3	£20,772 16 2

Schedule III.—Trees Account.

	Number.
Trees received during the year	1,467,975
Less, to replace blanks	357,500
Planted on new area	1,110,475
Previously planted	5,164,862
Total number planted on 2,305 acres (average age, 4¾ years)	6,275,337

Schedule IV.—Property Account.

	£ s. d.
Land (3,672 acres); Crown land not charged to Forestry Account	..
Buildings	314 0 11
Stock	..
Improvements	259 11 10
Fencing	1,164 10 9
Stores in hand	131 7 0
	£1,869 10 6

Balance-sheet.

	£ s. d.
Total expenditure	20,772 16 2
Less Property Account	1,869 10 6
Cost of operations	£18,903 5 8
2,305 acres planted (average age, 4¾ years)	..
Estimated value of plantation per acre	£9 15 0

H. Howe,
Plantation Foreman.
R. G. Robinson,
Superintending Nurseryman.

Waitahuna Plantation.

(Dredged area, 11 acres; altitude, 331 ft.)

The educational benefit derived from such an experimental plantation becomes more pronounced each year, as the various trees demonstrate their relative suitability to the existing conditions. It may be confidently asserted that tree-growth generally is equal to that noticed throughout any of the most progressive South Island stations. To the casual observer the absence of uniformity is conspicuous, and discloses faulty methods; but the utter impossibility of creating over a few acres an evenly grown forest wherein about fifteen varieties are used is patent to those experienced in tree-culture.

Although only four years have elapsed since planting was first carried on, the European larch have reached a height of about 15 ft., and no signs of any disease are visible. Equally satisfactory are the *Pinus Laricio, P. ponderosa,* which are both progressing at the rate of 18 in. annually. The merits of the *Pinus radiata* were well known; but, in making about 3 ft. of heavy growth each year,

perhaps preference as a shelter-tree on dredged tailings should be given to the *P. muricata*. For the first two years Oregon pine and Norway spruce were somewhat backward. These varieties are now amongst the most rapid growers, probably owing to their roots having reached the desired moisture, attainable about 2 ft. below the surface. Of the less valuable timbers, birch, alder, and poplars are thriving; but in any future extension-work under similar conditions the inclusion of these trees is not desirable.

No labour was directed upon the plantation during the year, although at an early date the suppression of the rank gorse-plants that threaten to interrupt the progress of the smaller trees will require to be undertaken.

Details of expenditure, &c., are appended.

Schedule II.—Statement of Expenditure.

	To Date. £ s. d.
Planting operations and maintenance—	
Tree-planting	20 2 0
Pitting	27 6 0
Clearing	23 0 3
Cartage of trees	3 0 0
General upkeep of plantation	37 2 3
General repairs	4 0 0
Horse-feed	..
Permanent works—	
Fencing	57 11 1
Formation	3 10 0
Buildings	..
Stock, implements, &c.—Tools, implements	..
Supervision and clerical—	
Salaries—	
Supervision of free labour	9 0 0
,, prison labour	..
Superintending Nurseryman's proportion and clerical assistance	18 9 0
	£203 0 7

Schedule III.—Trees Account.

	Number.
Trees received during year	..
Less, to replace blanks	..
Planted on new area	..
Previously planted	30,525
Total number planted on 11 acres (average age, 4 years)	30,525

Schedule IV.—Property Account.

	£ s. d.
Land (11 acres); Crown land not charged to Forestry Account	..
Buildings	..
Stock	..
Improvements	3 10 0
Fencing	57 11 1
Stores in hand	..
	£61 1 1

Balance-sheet.

	£ s. d.
Total expenditure	203 0 7
Less Property Account	61 1 1
Cost of operations	£141 19 6
11 acres planted (average age, 4 years)	..
Estimated value of plantation per acre	£9 17 6

R. G. ROBINSON,
Superintending Nurseryman.

DUMGREE PLANTATION, SEDDON.

(Area, 881 acres; altitude, 100 ft.)

In expending the small sum of £32 3s. 5d. in resuscitating, clearing, and disbudding works, much benefit has been derived by the plantation generally. It was not possible to state accurately in last year's report to what extent the damage by fire had attained, as in certain places the undergrowth had been of insufficient density to create enough heat to permanently injure the trees; and in such cases, although the smaller lateral branches were completely destroyed, the trunks and leaders gave indication of life. Expectations have been borne out by quite a large number of apparently dead trees recovering from their semi-dormant state, and these specimens are progressing with renewed

vigour. The destruction was mostly confined to the early planted blocks of *Larix europaea*, *Pinus Laricio*, *P. ponderosa*, *P. Benthamiana*, *Betula alba*, and *Robinia pseudo-acacia*, covering an area of about 80 acres, over which about 160,000 were burnt. Perhaps half of this number will be a reasonable estimate of trees permanently injured; but it cannot rightly be asserted that the plantation, even prior to the conflagration, was a success, as the prevalence of large unplanted spaces throughout permitted the formation of coarse lateral branches, and so defeated the object originally aimed at. Some 450 acres of treeless area have been fenced off and leased for grazing purposes, whilst greater security from any future outbreak of fire has been gained by securing the services of the enthusiastic local officer of the Justice Department, who exercises a vigilance over the planted reserve, and is fully empowered to run a limited number of sheep to keep cocksfoot and other rank vegetation in check. It is needless to emphasize the excellence of this substitute for fire-breaks.

Exceedingly fine progress is being made by all varieties planted, and this can only be attributed to the abundance of moisture found in the substrata by the gradually extending root-system.

Appended are statements of expenditure, Trees Account, &c., which include liberal allowance for losses enumerated.

Schedule II.—Statement of Expenditure.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
Tree-planting	..	1,777 10 7
Pitting	..	3,898 11 1
Clearing	..	13 5 0
Cartage of trees	..	73 10 6
General upkeep of plantation	25 18 6	1,505 17 4
General repairs	..	23 17 8
Horse-feed	..	..
Permanent works—		
Fencing	..	122 17 10
Formation	..	158 5 7
Buildings	..	41 2 8
Stock, implements, &c.—Tools, implements	1 4 11	276 3 2
Supervision and clerical—		
Salaries—		
Supervision of free labour	..	347 14 9
,, prison labour	..	467 16 3
Nurseryman's proportion and clerical assistance	5 0 0	108 14 0
	£32 3 5	£8,815 8 5
Estimated value of prison labour (apportioned in above items)	..	2,365 14 7
Actual expenditure	..	£6,449 13 10

Schedule III.—Trees Account.

	Number.
Trees received during year	..
Less, to replace blanks	..
Planted on new area	..
Previously planted	569,640
Total number planted on 209 acres (average age, 6 years)	569,640

Schedule IV.—Property Account.

	£ s. d.
Land (857½ acres)	3,600 0 0
Buildings	..
Stock	..
Improvements	158 7 7
Fencing	122 17 10
Stores in hand	1 4 11
	£3,882 10 4

Balance-sheet.

	£ s. d.
Total expenditure (prison labour included)	8,815 8 5
Less Property Account	3,882 10 4
Cost of operations	£4,932 18 1
209 acres planted; (average age, 6 years)	..
Estimated value of plantation per acre	£10 5 0

R. G. ROBINSON,
Superintending Nurseryman.

Eweburn Nursery, near Naseby, Otago.

(Area, 49 acres; altitude, 1,400 ft.)

The rainfall at this station for the year was 16·26 in., which fell on twenty-two days, being 0·65 in. in excess of last year. The highest reading of the thermometer (in shade) was 93° on the 5th February, 1912, and the lowest 15° on the 18th July, 1911. The lowest reading on the ground was 12° on the 26th June, 1911. Frost occurred on 150 nights in the screen and 203 on the ground. The weather on the whole has been much better than in the previous year for tree-growth generally, and, although a backward season, it has been very favourable for the lined-out trees.

The seedling larch have done much better than usual, there being almost an entire absence of insects, which greatly destroyed last season's crop. The crop of seedlings as a whole is very satisfactory, the estimated number raised being 992,400, and valued at £992 8s. The latter part of the season has been wetter and cooler than usual, and in consequence there has not been so much watering to do. A larger pipe was laid at the intake of the dam, which also gave a more plentiful supply.

The work of lining out was commenced on the 3rd September, and finished on the 5th October, and 731,320 trees were lined out at an average cost of 1s. 9d. per thousand. The strike of lined-out trees has been very good, and there will be approximately 800,000 trees sufficiently advanced for removal to the plantation for the coming season.

The number of trees sent to the Naseby Plantation was 637,655, and 2,750 to other stations and public bodies, their value being £1,960 15s. 8d. The number of trees on the nursery at the 31st March, 1912, is 2,118,250, and their value is £3,769 1s. 9d.

During the year a new wagon has been purchased for the removal of trees, and is found very convenient, and greatly facilitates the work of transport.

The shelter-breaks, &c., have been kept in order, and the buildings have received two coats of paint. The nurseryman's residence has also been enlarged, which is very much appreciated.

The work as a whole for the year has been satisfactory. The expenditure for the year amounts to £1,058 1s. 8d., and the total to date £12,964 16s. 7d.

The average number of men employed for the year was 5·34. Appended are statements of accounts, &c.

Schedule I.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1911.	In.		Deg. Fahr.	Deg. Fahr.	
April	1·63	12	76	30	2
May	0·41	4	63	20	20
June	1·34	12	60	18	25
July	1·35	8	48	15	29
August	0·49	4	62	22	25
September	0·75	8	65	26	16
October	0·83	8	73	29	9
November	2·30	12	73	26	6
December	1·39	17	72	29	4
1912.					
January	1·17	12	84	29	4
February	1·43	12	93	29	2
March	3·17	13	76	27	8
Totals	16·26	122	..	..	150

Schedule II.—Statement of Expenditure.

	For Year.			To Date.		
	£	s.	d.	£	s.	d.
Tree-planting and maintenance—						
Tree-growing	356	4	5	5,173	15	0
General maintenance and repairs	265	17	5	2,535	17	0
Tree-seeds	51	10	5	497	19	8
Manures	..			40	15	3
Horse-feed, purchased and grown ..	58	3	5	514	4	4
Miscellaneous works	..			44	18	7
Stock and material—Tools, implements ..	44	8	3	831	15	11
Permanent works—						
Buildings	71	13	0	830	11	2
Nursery-formation	..			624	18	4
Fencing	..			340	1	0
Water-supply	41	14	3	310	0	10
Supervision and clerical—						
Proportion of Superintending Nurseryman's salary	26	0	0	447	7	4
Proportion of nurseryman's salary ..	140	0	0	740	1	8
Clerical assistance	2	10	6	32	10	6
	£1,058	1	8	£12,964	16	7

Schedule III.—Trees Account.

—	During the Year.		Since 1896 to Date.		Estimated Value, as Schedule V.
	Number.	Cost of Raising.	Number.	Cost of Raising and Maintenance.	
		£ s. d.		£ s. d.	£ s. d.
Trees raised	992,400	103 7 0	4,744,762	12,964 16 7	..
Trees sent out	640,405	..	2,626,512	..	..
Balance in stock			2,118,250	..	3,769 1 9
Value of land, improvements, and stock (Property Account)				..	2,583 5 0
Total value					6,352 6 9

Schedule IV.—Property Account.

	£ s. d.
Land (50 acres); Crown land not charged to Forestry Account ..	..
Buildings	830 11 2
Stock	109 7 5
Improvements	934 19 2
Fencing	340 1 0
Stores in hand	368 6 3
	£2,583 5 0

Schedule V.—Details of One-year-old Trees, sown 1911–12.

Name of Tree.	Number in Seed-beds.	Height, in Inches.	Amount of Seed sown.	Value per Thousand.	Total Value.	Remarks.
			Lb.	£ s. d.	£ s. d.	
Pinus Laricio	667,100	1½	84	1 0 0	667 2 0	Fair crop.
„ ponderosa	103,000	1½	30	1 0 0	103 0 0	Even crop.
„ Benthamiana	8,300	1½	8	1 0 0	8 6 0	„
Larix europaea	214,000	1½	84	1 0 0	214 0 0	„
Totals	992,400	..	..	..	992 8 0	

Two-year-old Trees, sown 1910–11.

Name of Tree.	Number in Seed-beds.	Number in Nursery-lines.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
				£ s. d.	£ s. d.	
Pinus Laricio	150,600	..	3	1 5 0	188 5 0	Sturdy plants.
„ ponderosa	62,750	..	3	1 5 0	78 8 9	„
Larix europaea	130,000	..	12	1 5 0	162 10 0	Strong plants.
Totals	343,350	..	..	..	429 3 9	

Three-year-old Trees, sown 1909–10.

Name of Tree.	Number in Nursery-lines.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
			£ s. d.	£ s. d.	
Pinus Laricio	678,100	10	3 0 0	2,034 6 0	Strong plants.
„ ponderosa	65,700	6	3 0 0	197 2 0	Healthy plants.
„ austriaca	38,700	8	3 0 0	116 2 0	„
Totals	782,500	..	..	2,347 10 0	

Trees transferred from Nursery to Plantations, &c., 1911–12.

Where sent.	Name of Tree.	Number.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
				£ s. d.	£ s. d.	
Naseby Plantation ..	Pinus Laricio ..	441,950	8	3 0 0	1,388 19 7	These trees have made satisfactory progress.
	„ ponderosa ..	103,950	8	3 0 0	311 17 0	
	„ Benthamiana ..	54,925	8	3 0 0	164 15 6	
	Larix europaea ..	27,050	12	3 0 0	81 3 0	
	Poplar cuttings ..	3,430	..	1 0 0	3 8 7	
	Willow cuttings ..	6,350	..	1 0 0	6 7 0	
	Pinus Laricio ..	350	..	..	..	Removed from old site.
	„ ponderosa ..	15,775	..	..	..	
	Larix europaea ..	13,775	..	..	..	
		667,555	..	..	1,956 10 8	
Tarras Plantation ..	Poplar cuttings ..	750	..	1 0 0	0 15 0	
Gimmerburn Cemetery	Willow cuttings ..	750	..	1 0 0	0 15 0	
	Pinus Laricio ..	250	..	3 0 0	0 15 0	
	„ ponderosa ..	250	..	3 0 0	0 15 0	
Stationmaster, Ranfurly	Pinus Laricio ..	25	..	3 0 0	0 1 6	
	Pyrus aucuparia ..	25	..	3 0 0	0 1 6	
Eweburn School ..	Pinus ponderosa ..	50	..	3 0 0	0 3 0	
	„ Laricio ..	50	..	3 0 0	0 3 0	
	Pyrus aucuparia ..	50	..	3 0 0	0 3 0	
	Cytisus vulgaris ..	50	..	3 0 0	0 3 0	
Tapanui Nursery ..	Poplar cuttings ..	250	..	1 0 0	0 5 0	
	Willow cuttings ..	250	..	1 0 0	0 5 0	
Totals.. ..	..	670,305	..	..	1,960 15 8	

A. W. Roberts,
Nurseryman in Charge.

Naseby Plantation.

(Area, 1,350 acres; altitude, 2,300 ft.)

The total rainfall at this station for the eleven months on which records were taken was 24·03 in. on 119 days. The highest reading of the thermometer (in shade) was 90° in February, 1912, and the lowest 11° in the month of July, 1911. Frost occurred on 191 nights for the eleven months. The weather as a whole has been very favourable for the work carried on, and the trees planted during the first season have made very satisfactory growth.

The trees planted this season have also done well, and the percentage of deaths will be very few. As the adjoining land is very bad with rabbits, we have had a great deal of bother in dealing with the pest; but, as the area is fenced off from the portion taken in the first season, little or no damage has been done. On the upper portion the men have been digging-in the burrows and trapping regularly, and at intervals poison has been laid.

On investigation at the Survey Paddock plantation, the trees thriving best are *Pinus ponderosa* and *Pinus Laricio*. A large number of *Pinus austriaca* were planted alternately with the *Pinus ponderosa;* but as the former are too slow, and badly attacked with aphis, the selection has not been a wise one. Although the *Pinus ponderosa* are completely surrounded by trees infested with the aphis, not one shows any sign of infection. The trees best suited for mixing are *Pinus ponderosa* and *Pinus Laricio*, as these grow very much about the same rate per year; but I believe they would be even better planted pure. A number of larch has also been planted, and these have made fair growth, and seem to be perfectly healthy.

The County Council has been good enough to form the worst parts of the road leading to the plantation, which has made the work of carting much easier and safer. In order to make a good job of the same on the hillside, plantation labour was employed to gravel the road. The fire-breaks were ploughed on the new area, the whole block being now complete.

A toolhouse and shed for fuel has been erected on skids, and this has been found very convenient. Owing to the scarcity of scrub of any kind it is a difficult matter to supply the men with firewood, but a cheap lignite is put on the ground for them.

Pitting by contract was commenced during the latter part of the year, and preparations are being made for the reception of 800,000 trees.

During the year 667,555 trees were delivered at the plantation, and of these, 52,050 were used to replace blanks in the previous year's planting. The area planted for the season is 226 acres, making a total on the new area of 336 acres, and the total to date, with the old site, is 486 acres. The number of trees on the plantation to date is 1,297,709.

Planting was commenced in the latter part of August and finished in November, the weather being very changeable during operations.

The expenditure for the year is £1,710 13s. 9d., and the total to date £5,355 11s. 8d.

The average number of men employed on day-labour was 6·71, and 3·50 on contract.

Appended are statements of expenditure, &c.

Schedule II.—Statement of Expenditure.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
Tree-planting	372 17 6	1,069 3 5
Pitting	571 1 0	1,335 11 3
Clearing	..	20 17 10
Cartage of trees	10 16 0	102 17 9
General upkeep of plantation	238 18 7	1,167 17 10
General repairs	4 7 11	12 6 5
Horse-feed	..	164 10 0
Permanent works—		
Fencing	288 8 2	768 10 11
Formation	72 6 0	77 6 0
Buildings	31 11 1	116 11 1
Stock, implements, &c.—Tools, implements	21 7 6	23 0 0
Supervision and clerical—		
Salaries—		
Supervision of free labour	65 0 0	313 10 11
Nurseryman's proportion of clerical assistance	34 0 0	183 8 3
	£1,710 13 9	£5,355 11 8

Schedule III.—Trees Account.

	Number.
Trees received during year	667,555
Less, to replace blanks	52,050
Planted on new area	615,505
Previously planted	682,204
Total number planted on 486 acres (average age, 6 years)	1,297,709

Schedule IV.—Property Account.

	£ s. d.
Land (1,350 acres); Crown land not charged to Forestry Account	..
Buildings	116 11 1
Stock	..
Improvements	77 6 0
Fencing	768 10 11
Stores in hand	23 13 3
	£986 1 3

Balance-sheet.

	£ s. d.
Total expenditure	5,355 11 8
Less Property Account	986 1 3
Cost of operations	£4,369 10 5
486 acres planted (average age, 6 years)	..
Estimated value of plantation per acre	£10 2 6

T. SCREEN,
Plantation Foreman.
A. W. ROBERTS,
Nurseryman in Charge.

GIMMERBURN PLANTATION RESERVE.

(Area, 425 acres; altitude, 1,200 ft.)

There has been no work done at this station this season, except that of ploughing land for oats, and this has been charged against Eweburn Nursery.

The trees on the plantation seem to be making better headway, especially the larch, which are more suitable for this part of the country.

The expenditure for the year is £5, and the total to date is £2,616 0s. 5d.

Appended are statements of expenditure.

Schedule II.—Statement of Expenditure.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
Tree-planting		857 4 3
Pitting		29 9 0
Clearing		..
Cartage of trees		97 10 9
General upkeep of plantation		379 8 5
General repairs		9 13 5
Horse-feed		420 4 0
Permanent works—		
Fencing		387 11 2
Formation		50 0 0
Buildings		57 3 9
Stock, implements, &c.—Tools, implements		19 19 0
Supervision and clerical—		
Salaries—		
Supervision of free labour	5 0 0	228 0 0
Nurseryman's proportion of clerical assistance		79 16 8
	£5 0 0	£2,616 0 5

Schedule III.—Trees Account.

	Number.
Trees received during year	..
Less, to replace blanks	..
Planted on new area	..
Previously planted	152,896
Total number planted on 173 acres (average age, 6 years)	152,896

Schedule IV.—Property Account.

	£ s. d.
Land (420 acres); Crown land not charged to Forestry Account	..
Buildings	57 3 9
Stock	..
Improvements	50 0 0
Fencing	387 11 2
Stores in hand	19 19 0
	£514 13 11

Balance-sheet.

	£ s. d.
Total expenditure	2,616 0 5
Less Property Account	514 13 11
Cost of operations	£2,101 6 6
173 acres planted (average age, 6 years)	..
Estimated value of plantation per acre	£10 0 0

A. W. ROBERTS,
Nurseryman in Charge.

HANMER SPRINGS NURSERY, CANTERBURY.

(Area, 40 acres; approximate altitude, 1,225 ft.)

The rainfall during the year reached a total of 51·38 in., an increase of 6·70 in. on the previous year. The maximum monthly precipitation took place during July, being 10·45 in. for ten days, or an average of a little over an inch a day. Rain fell on 131 days during the year, an increase of twenty-one days as compared with last year. The highest shade temperature (94°) was registered on the 6th February, and the lowest (20°) on the 16th and 19th July; frosts being recorded on twenty-three nights during July, and sixty-one nights during the year. The rainfall throughout the year was fairly evenly distributed with the exception of the months of July and August, when 10·56 in. and 0·40 in. respectively were recorded.

Seedling Trees.

Seed-sowing was completed on the 30th October, the operation having been taken in hand a week previous and conducted under favourable conditions. The results were highly satisfactory, with the exception of larch and Oregon pine, the seed of the former being of very poor quality, which would account to a great extent for the thinness of the crop. The total number of seedlings raised was 1,370,000, valued at £1,322 10s.

Larix europaea.—The results were extremely poor as regards germination, as out of 168 lb. of seed sown only about 130,000 trees resulted; the plants are, however, exceptionally sturdy, and the percentage of loss through the grass-grub is not appreciable.

Pinus Laricio.—A very fine crop was produced from the 122 lb. of seed sown, the number of trees raised being 850,000. The young plants are very well grown and sturdy.

Pinus ponderosa.—120,000 seedlings were raised from 30 lb. of seed, the young trees making very good growth.

Pinus Benthamiana.—The sowing of 10 lb. of seed of this species resulted in a sturdy crop of 10,000 plants.

Pinus insignis.—A very good crop resulted, the amount of seed sown being 4 lb. Of the 20,000 seedlings raised the majority are strong and healthy.

Pinus muricata.—Not so sturdy a crop as the *insignis*, but a greater number of plants to the amount of seed sown (4 lb.), the total of trees produced being 30,000.

Pseudo-tsuga taxifolia.—The seedlings of this species made but poor growth compared with last year's crop; about 10,000 plants were raised from 2 lb. of seed.

Alnus glutinosa.—The seed of this tree was collected in the plantation adjoining the nursery, from eight-year-old trees. The results were highly satisfactory, the total number of seedlings raised from 6 lb. of seed being 200,000.

Two-year-old Seedlings.

Pinus Laricio.—This was the only variety allowed to remain in the seed-beds for two years, and the young plants have made fine growth. This plan does not recommend itself at this station, however, as after lining out the growth is not so vigorous as that obtained among trees lined out at one year old, and the development of root-fibre is much inferior and the whole plant less sturdy, the previous close confinement in the seed-beds tending to spindly growth.

Two-year-old Lined-out Trees.

Larix europaea.—This is a very fine crop, the young plants being exceptionally healthy-looking and sturdy. The percentage of loss after lining out was very small; but the grass-grub made its appearance in patches later in the season, and accounted for a slight percentage of deaths. The whole of this crop will be transferred to plantations during the coming season.

Pinus Laricio.—The percentage of loss in this variety on a portion of the lined-out area was very severe. This area was rather heavily limed some months previous to the commencement of lining-out operations, and this alone would account for the loss sustained, as conifers naturally dislike lime. Had it been possible to fallow the area for a further twelve months the loss would not have occurred; but no other ground was available at the time. A distinct contrast is noticeable on the unlimed area under this variety of tree, the percentage of deaths not being appreciable, and the growth throughout being much more vigorous. The liming should, however, prove most beneficial after the second year.

Pinus insignis.—This species has made good growth, and it is anticipated that the whole crop will be available for transfer to plantations this season, to be utilized for shelter purposes.

Pinus muricata.—This crop has not done well, although planted under exactly the same conditions as the above-mentioned variety. The majority are, however, sufficiently developed for permanent transfer, and will be used for the same purpose as the *insignis*.

Pinus ponderosa.—The growth of this variety is above the average, and the crop is a very fine one, the percentage of deaths after lining out being very small.

Pinus Benthamiana.—This species has not done so well as the foregoing, the poor development of root-fibre in the seedling stage being against successful transplanting. The percentage of deaths is above the average.

Pinus austriaca.—The loss through transplanting among this variety is below 1 per cent., and the growth for the season is good. Only a little over 2,000 of these trees were raised, however, as it was not deemed advisable to cultivate the species to any great extent, owing to its susceptibility to blight.

Pseudo-tsuga taxifolia.—Few deaths have occurred among this variety, the growth throughout being well above the average; fully three-quarters of this crop will be fit for permanent planting this season. The remainder will be lined out for another year.

Picea sitchensis.—These trees, though slower-growing than the aforementioned species, have done remarkably well. The young plants, however, are not sufficiently well forward for transference this winter, and will therefore remain in their present position for another year. The raising of the variety at this station is not recommended, owing to the prevalence of "spruce red-spider" in the adjoining Spa plantations, and the peculiar susceptibility of this species of Abies to attack from the pest.

From a perusal of the above summary it will be gathered that lining-out operations were productive of very fair results: the percentage of loss over all was not great. The work was commenced on the 11th August and completed on the 6th October, the whole operation being conducted under favourable conditions. The number of trees dealt with was 1,836,200, at an average cost per thousand of 1s. 7d.

Three-year-old Trees.

Pinus Laricio.—Of this variety about 400,000 were transplanted from the two-year-old seed-beds during the spring; but the results could not be considered as an unqualified success, the percentage of loss being above the average, and the growth being considerably inferior to that of trees lined out at one year old during the previous spring. The breaks being side by side, the contrast between the two is most noticeable; the trees transferred from the seed-beds at one year old, although exactly the same age as those transferred at two years, have put on twice the growth of the latter, and are very sturdy and well-rooted plants, whereas those transferred at two years have made but little headway, and have not the healthy appearance of the former. Another trial, however, will be made this season in order to give the experiment a fair test at this station.

Pinus ponderosa.—These trees were lined out two seasons ago at one year old, and are now a fine sturdy crop, and should stand the test of transplantation well. It is estimated that there are approximately about 1,000,000 trees available for permanent transfer to plantations. The total number in stock at the nursery on the 31st March was 3,251,700, valued at £5,964 9s. 6d.; the number of seedlings raised during the year was 1,370,000, valued at £1,322 10s.; making a total of 9,084,485 seedlings raised on this nursery from initiation to date. Trees to the number of 965,080, valued at £2,896 7s. 6d., were transferred to the plantation during the year.

Tree-growth throughout the nursery was not quite up to the average of former years, partly owing to the general coldness of the summer and partly to the constant cropping of the areas, which has taxed the fertility of the soil severely. The hoeing and weeding of seed-beds and the lined-out areas was a large item of expenditure during the past year, owing to the moist season tending to rapid weed-growth, and consequently necessitating employment of additional labour.

General.

General Maintenance and Repairs.—This work also required a good deal of attention, much labour being utilized in repainting buildings and vehicles, upkeep of harness and implements, and general repair-work. The usual attention was given to the upkeep of ornamental borders and the maintenance of general neatness about workshop, stables, and implement-shed.

Horse-feed.—About 12 tons of oaten chaff were grown and harvested in fine condition, the previous year's stock being chaffed early in the season, and lasting up to the present date; this was, however, augmented by the purchase of a quantity of feed-oats. The carrot-crop turned out a satisfactory one, and should last well through the winter. For the ensuing season's horse-feed an area of about 23 acres was put down in dun oats during the autumn, with a sowing of 1 cwt. per acre of fertilizer. The operation was conducted under favourable conditions, and a good crop should eventuate. A quantity of hay was harvested, and should provide ample fodder for the horses during the winter months.

Buildings.—A convenient bathroom was added to the nurseryman's house, and a wood-shed, breakwind, and trellis were also erected; the additions are much appreciated. A substantial oat-bin was built in the stable-loft to prevent the ravages of mice, and existing feed-bins were also lined with zinc.

Nursery-formation.—This work consisted of the formation of ornamental borders and the tile-draining of low-lying areas.

Fencing.—To prevent hares gaining access to the new nursery-area and doing damage to the trees the area was enclosed by a substantial netting-fence.

Water-supply.—About 300 ft. of 1 in. piping was purchased for the extension of the water-supply to seed-beds. The supply at the nursery is very satisfactory, the pressure being all that could be desired. At the dwelling and stables, however, the supply is not satisfactory, the water being pumped by ram from adjoining creek into a tank, from which it is laid on to the house and stables, the pressure being totally inadequate. The erection of an additional tank would meet present requirements.

Pests.—The grass-grub has not been greatly in evidence, and compared with past years very little damage was done. Rabbits and hares were conspicuous by their absence. The nursery is evidently quite free from disease of any kind.

The daily average of men employed throughout the year was 7·17.

Statement of expenditure and values, together with records of rainfall for the year, are appended.

Schedule I.

Month.	Rainfall.	Number of Days' Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1911.	In.		Deg. Fahr.	Deg. Fahr.	
April	3·36	13	78	31	3
May	1·10	2	67	23	11
June	4·74	14	63	17	16
July	10·56	10	54	20	14
August	0·40	3	62	23	8
September	5·59	15	67	25	5
October	3·69	10	70	32	2
November	5·29	13	74	31	1
December	8·08	16	73	34	..
1912.					
January	1·81	12	83	34	..
February	3·23	13	94	34	..
March	3·53	10	88	32	1
Totals	51·38	131	..	..	61

Schedule II.—Statement of Expenditure.

	For Year. £ s. d.	To Date. £ s. d.
Tree-planting and maintenance—		
Tree-growing	700 9 8	4,199 17 0
General maintenance and repairs	127 3 5	564 9 9
Tree-seeds	75 0 2	552 0 5
Manures	15 0 11	64 0 7
Horse-feed, purchased and grown	80 19 1	490 5 2
Miscellaneous works	30 6 0	174 18 4
Stock and material—Tools, implements	8 12 6	540 10 7
Permanent works—		
Buildings	72 12 9	1,056 19 3
Nursery-formation	19 18 6	472 2 3
Fencing	26 11 4	82 9 9
Water-supply	8 11 6	448 12 4
Supervision and clerical—		
Proportion of Superintending Nurseryman's salary	36 0 0	151 0 0
Proportion of Nurseryman's salary	104 1 4	694 1 4
Clerical assistance	10 0 0	50 0 0
	£1,315 7 2	£9,541 6 9

Schedule III.—Trees Account.

	During the Year. Number.	During the Year. Cost of Raising.	Since 1896 to Date. Number.	Since 1896 to Date. Cost of Raising and Maintenance.	Estimated Value, as Schedule V.
		£ s. d.		£ s. d.	£ s. d.
Trees raised	1,370,000	149 5 9	9,084,485	9,541 6 9	..
Trees sent out	965,080	..	5,832,785	..	..
Balance in stock			3,251,700	..	5,964 9 6
Value of land, improvements, and stock (Property Account)			..	..	3,048 18 1
Total value			..	..	9,013 7 7

Schedule IV.—Property Account.

	£ s. d.
Land (40 acres); Crown land not charged to Forestry Account	..
Buildings	1,056 19 3
Stock	115 0 0
Improvements	912 3 1
Fencing	82 9 9
Stores in hand	882 6 0
	£3,048 18 1

Schedule V.—Details of One-year-old Trees, sown 1911–12.

Name of Tree.	Number in Seed-beds.	Height, in Inches.	Seed sown.	Value per Thousand.	Total Value.	Remarks.
			Lb.	£ s. d.	£ s. d.	
Larix europaea	130,000	6	168	1 0 0	130 0 0	Poor germination.
Pinus Laricio	850,000	3	122	1 0 0	850 0 0	Good crop.
„ ponderosa	120,000	3	30	1 0 0	120 0 0	„
„ Benthamiana	10,000	4	10	1 0 0	10 0 0	Poor germination.
„ insignis	20,000	5	4	1 0 0	20 0 0	Fair growth.
„ muricata	30,000	4	4	1 0 0	30 0 0	„
Pseudo-tsuga taxifolia	10,000	2	3	1 5 0	12 10 0	Thin crop.
Alnus glutinosa	200,000	7	6	0 15 0	150 0 0	Very good crop.
Totals	1,370,000	..	..	..	1,322 10 0	

Two-year-old Trees, sown 1910–11.

Name of Tree.	Number in Seed-beds.	Number in Nursery-lines.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
				£ s. d.	£ s. d.	
Larix europaea	..	700,000	15	2 5 0 / 1 5 0	1,575 0 0	Fine crop.
Pinus Laricio	170,000	80,000	3½	2 5 0	392 10 0	Sturdy plants.
„ insignis	..	15,000	12	2 5 0	33 15 0	Good growth.
„ muricata	..	2,000	8	2 5 0	4 10 0	Poor growth.
„ ponderosa	..	100,000	4	2 5 0	225 0 0	Good growth.
„ Benthamiana	..	18,000	4	2 10 0	45 0 0	„
„ austriaca	..	2,500	4	2 5 0	5 12 6	„
Pseudo-tsuga taxifolia ..	..	24,000	8	2 10 0	60 0 0	„
Picea sitchensis	..	20,000	6	2 10 0	50 0 0	„
Biota orientalis	..	200	3	3 0 0	0 12 0	Poor growth.
Totals	170,000	961,700	..	..	2,391 19 6	

Three-year-old Trees, sown 1909–10.

Name of Tree.	Number in Nursery-lines.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
			£ s. d.	£ s. d.	
Pinus Laricio	650,000	7	3 0 0	1,950 0 0	Poor growth.
„ ponderosa	100,000	7	3 0 0	300 0 0	Good growth.
Totals	750,000	..	..	2,250 0 0	

Trees transferred from Nursery to Plantations, &c., 1910–11.

Where sent.	Name of Tree.	Number.	Height, in Inches.	Value per Thousand.	Total Value.	Remarks.
				£ s. d.	£ s. d.	
Hanmer Springs Plantation	Larix europaea	325,750	18	3 0 0	977 5 0	Sturdy plants.
	Pinus Laricio	16,000	9	3 0 0	48 0 0	
	„ ponderosa	185,600	9	3 0 0	556 16 0	
	„ austriaca	380,440	12	3 0 0	1,141 6 4	
	„ Benthamiana ..	46,000	9	3 0 0	138 0 0	
	„ muricata	6,375	9	3 0 0	19 2 6	
	Pseudo-tsuga taxifolia ..	3,375	12	3 5 0	10 19 4	
	Cupressus Lawsoniana ..	400	10	3 15 0	1 10 0	
	Thuja gigantea	500	9	3 0 0	1 10 0	
	Alnus glutinosa	640	10	3 0 0	1 18 4	
Totals ..	..	965,080	..	..	2,896 7 6	

W. G Morrison,
Nurseryman in Charge.

Hanmer Springs Plantation, Canterbury.

(Area, 2,668 acres; altitude, 1,225 ft.)

Afforestation operations at this station were most successful during the past twelve months, despite the abnormal weather-conditions prevailing, which were far from conducive to good results. The winter was extremely rough; and sharp frosts were experienced right through the spring, and on several occasions during the summer months. The unseasonable frosts had rather a detrimental effect on the young and tender growth of larch, Douglas fir, and tideland spruce: the trees have, however, recovered their usual healthy appearance. Pines were not affected.

The growth of trees throughout the plantation has been good, larch again showing the best results. During the early summer, however, signs of "needle-cast" were noticeable in established larch-plantations; but these trees have since regained their usual health, and have apparently shaken off the

disease. Larch planted during the past season have put on a vertical growth of 10 in., and established trees from 1½ ft. to 4½ ft. The newly planted pines have also done well, a vertical growth of from 4 in. to 6 in. being common. In the established plantations *Pinus Laricio* has outclassed all others, and is eminently suited to this district, the average growth for the year being 10 in. to 18 in. Other varieties have also done extremely well; but such cannot be said of Douglas fir and Menzies spruce, these two species having made poor headway.

The percentage of deaths in the past year's planting is very small, and very little filling-in will be required. A large area of the previous season's planting will, however, require attention in this matter, as the deaths have not yet been replaced.

Tree-planting was commenced on the 9th May and completed on the 8th September. A total of 965,080 trees was dealt with. The replanting of failures in former years' planting absorbed 234,575 trees, and the remainder—730,505—were planted on new area. Of the latter, a total of 299,900 was planted by contract at a cost of 7s. 6d. per 1,000, and the remainder by prison labour. The method of planting by contract proved most successful, being cheaper and more expeditious than by day-labour, thus enabling planting to be completed earlier in the season, and allowing the trees to establish themselves before the drying winds of spring set in. An area of 268 acres was planted during the year, containing 730,505 trees; making a total area of 1,720¼ acres now under forest, containing 4,682,456 trees.

A length of 168 chains of old fencing was dismantled and re-erected around the remainder of the newly acquired area, and about 30 chains of new fence was also erected, making a total length of 194 chains completed. This work was done partly by free and partly by prison labour.

Free Labour.—An average of five men were employed on contract work, and 4·58 on day-labour.

Pitting.—This was purely contract work, the number opened for the year being 449,191, costing 15s. per thousand.

Tree-planting.—This work was also done by contract, the operation being performed in a very satisfactory manner at a cost of 7s. 6d. per thousand; 299,900 trees were dealt with in this manner.

Clearing.—All clearing was carried on by prison labour only.

Cartage of Trees.—A total of 965,080 trees were carted to the plantation trenches, at a total cost of £18 17s. 7d.

General Upkeep of Plantation.—The total labour-cost of this work was £412 2s. 4d., of which the greater part was expended in the replanting of failures, and pruning and cutting-out of double leaders among larch and pines. The areas dealt with will not again require attention in the matter of replanting; but pruning will probably be necessary again in a few years' time.

The destruction of noxious weeds, such as gorse and briar, entailed considerable labour; a good deal of attention was also necessary in clearing foreign growth from around young trees. All culverts and roads were kept in proper repair. About six miles of fire-breaks were kept clear of all inflammable growth by ploughing and disking. Pests in the form of rabbits and hares were kept well in check by gun and dogs.

Horse-feed.—This work consisted in the preparation of the ground for sowing crop, sowing of oats, and harvesting operations.

Fencing.—The chief item under this heading was the erection of 194 chains of new fencing enclosing the remainder of the area set aside for plantation purposes. Material from the old boundary-fence was used, but was not quite sufficient to complete the enclosure, a quantity of new material being purchased for this purpose. The work was carried out in a satisfactory manner.

Formation.—The construction of culverts was responsible for the greater part of the expenditure under this heading, some very substantial structures being built. The approaches to these culverts entailed considerable labour; but the proper formation of the crossings was absolutely necessary to allow of the distribution of trees to the plantations.

The drainage of swamp-areas was also taken in hand, a total length of about 138 chains of ditch being opened. The formation of about 30 chains of new road was necessary. One mile of new fire-break was ploughed for the first time.

Buildings.—A substantial hut for the storage of tools was erected at the prison camp, at a labour-cost of £5 14s. 3d. This structure meets all requirements.

The presence of red deer in the plantation was discovered recently, a few trees being barked by them.

The birch green-fly (*Aphis betuli*), which did so much damage to the foliage of *Betula alba* last summer, has not made its appearance this year; this may be accounted for by the moist summer experienced, as compared with last year.

The pine white-aphis (*Chermes laricio*) is still in evidence, but is chiefly confined to Austrian pine. No damage of any consequence appears to have been done, as the trees appear to shake off the disease in a few years, except in the case of very badly infected trees; but these latter are very few in number.

Prison Labour.—The number of prisoners available for forestry-work during the past year was double that of the previous year, the daily average employed being 14·3. The usual excellent standard of work was maintained.

Each prisoner's work for the year is valued at £68 16s. 5d., and the total value of all works performed for the year is £992 14s. 1d., details of which are as follows: Tree-planting (430,605 trees), £212 4s. 7d.; pitting (564,863 pits), £434 0s. 1d.; clearing (190 acres), £234 5s. 11d.; general upkeep, £77 12s. 9d.; horse-feed, harvesting, £3 9s. 3d.; fencing (dismantling 58 chains and erecting 64¼ chains), £25; formation (forming culverts, roads, &c.), £6 1s. 6d.

Statements of values and expenditure are appended.

Schedule II.—Statement of Expenditure.

	For Year. £ s. d.	To Date. £ s. d.
Planting operations and maintenance—		
Tree-planting	326 2 6	2,714 18 0
Pitting	775 11 4	4,027 6 11
Clearing	234 5 11	1,312 7 10
Cartage of trees	18 17 7	78 17 1
General upkeep of plantation	543 18 7	2,470 12 10
General repairs	3 9 6	14 12 4
Horse-feed	30 10 9	154 8 0
Permanent works—		
Fencing	102 1 4	1,123 15 3
Formation	112 9 11	1,085 8 6
Buildings	26 18 11	748 19 8
Stock, implements, &c.—Tools, implements	53 17 1	414 10 6
Supervision and clerical—		
Salaries—		
Supervision of free labour	165 0 0	776 14 4
,, prison labour	90 0 0	432 16 8
Superintending Nurseryman's proportion and clerical assistance	45 0 0	372 7 0
	2,528 3 5	15,727 14 11
Estimated value of prison labour (apportioned in above items)	992 14 1	5,254 3 10
Actual expenditure	£1,835 9 4	£10,773 11 1

Schedule III.—Trees Account.

	Number.
Trees received during year	965,080
Less, to replace blanks	234,575
Planted on new area	730,505
Previously planted	3,951,951
Total number planted on 1,720¼ acres (average age, 7 years)	4,682,456

Schedule IV.—Property Account.

	£ s. d.
Land (2,668 acres); Crown land not charged to Forestry Account	..
Buildings	748 19 8
Improvements	2,707 9 0
Fencing	1,123 15 3
Stores in hand	123 3 1
	£4,703 7 0

Balance-sheet.

	£ s. d.
Total expenditure (prison labour included)	15,727 14 11
Less Property Account	4,703 7 0
Cost of operations	£11,024 7 11
1,720¼ acres planted (average age, 7 years)	..
Estimated value of plantation per acre	£10 15 0

A. J. Boydell,
Plantation Foreman.
W. G. Morrison,
Nurseryman in Charge.

Tarras Plantation.

Statement of Expenditure.

	£ s. d.
Marram-grass and tree planting	22 0 3
Pitting	1 17 7
Cartage of trees	1 6 0
Fencing	39 5 8
Superintending Nurseryman and clerical assistance	2 0 0
Total	£66 9 6

WAIMAKARIRI PLANTATION.

Statement of Expenditure.

	£	s.	d.
Tree-planting and purchase of trees	10	16	0
Pitting	3	10	0
Freight on trees	2	2	8
Fencing	118	3	5
Superintending Nurseryman and clerical assistance	2	0	0
Total	£136	12	1

R. G. ROBINSON,
Superintending Nurseryman.

Approximate Cost of Paper.—**Preparation, not given; printing (1,600 copies, including plans and illustrations), £100.**

By Authority: JOHN MACKAY, Government Printer, Wellington.—1912.

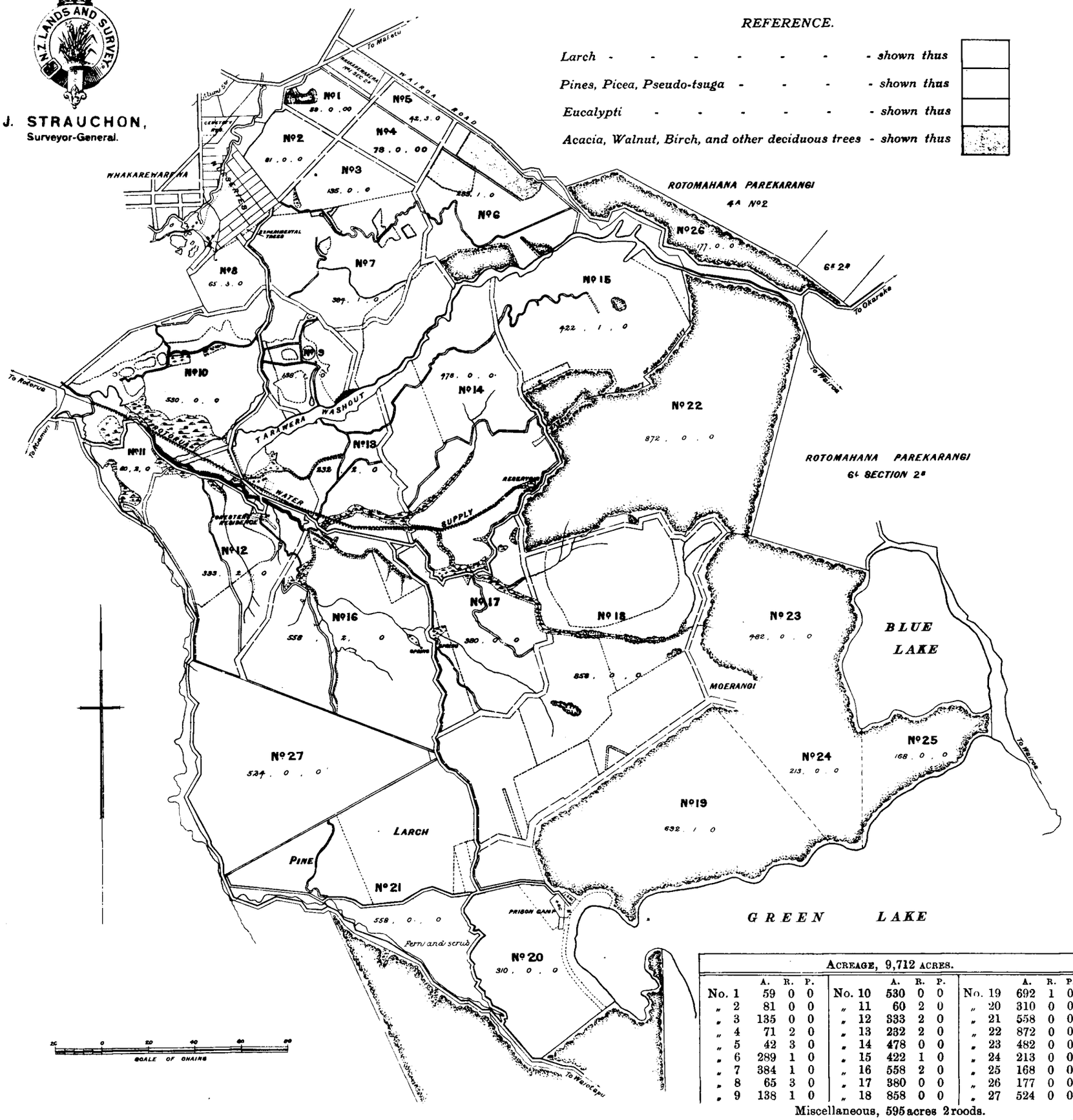
Price 2s.

ROTORUA NURSERY AND WHAKAREWAREWA PLANTATION.

J. STRAUCHON,
Surveyor-General.

REFERENCE.

Larch - - - - - - - -	*shown thus*
Pines, Picea, Pseudo-tsuga - - - -	*shown thus*
Eucalypti - - - - - - -	*shown thus*
Acacia, Walnut, Birch, and other deciduous trees -	*shown thus*



ACREAGE, 9,712 ACRES.

	A.	R.	P.		A.	R.	P.		A.	R.	P.
No. 1	59	0	0	No. 10	530	0	0	No. 19	692	1	0
" 2	81	0	0	" 11	60	2	0	" 20	310	0	0
" 3	135	0	0	" 12	333	2	0	" 21	558	0	0
" 4	71	2	0	" 13	232	2	0	" 22	872	0	0
" 5	42	3	0	" 14	478	0	0	" 23	482	0	0
" 6	289	1	0	" 15	422	1	0	" 24	213	0	0
" 7	384	1	0	" 16	558	2	0	" 25	168	0	0
" 8	65	3	0	" 17	380	0	0	" 26	177	0	0
" 9	138	1	0	" 18	858	0	0	" 27	524	0	0

Miscellaneous, 595 acres 2 roods.

E.S.Wood, Delt. 1911

By Authority: John Mackay, Government Printer

H. T. McCARDELL, CHIEF DRAUGHTSMAN, HEAD OFFICE, WELLINGTON.

J. STRAUCHON,
Surveyor-General

PLAN OF
WAI-O-TAPU STATE PLANTATION.

REFERENCE.

Larch,	- - -	*shown thus*
Pines,	- - -	"
Eucalypti,	- -	"
Birch,	- - -	"

40 30 20 10 0 20 40 60 80
SCALE OF CHAINS

N.Z. LANDS AND SURVEY

Nº 1 88 · 2 · 0
Nº 2 36 · 1 · 0
Nº 3 37 · 3 · 0
Nº 4 22 · 2 · 0
Nº 5 71 · 2 · 0
Nº 6 257 · 2 · 0
Nº 7 24 · 2 · 0
Nº 8 27 · 2 · 0
Nº 9 285 · 1 · 0
Nº 10 172 · 0 · 0
Nº 11 191 · 2 · 0
Nº 12 37 · 1 · 0
Nº 13 298 · 0 · 0
Nº 14 324 · 2 · 0
Nº 15 203 · 2 · 0
Nº 16 168 · 1 · 0
Nº 17 73 · 2 · 0
Nº 18 160 , 0 , 0
Nº 19 248 , 0 , 0
Nº 20 119 · 2 · 0

GALATEA ROAD
OLD CAMP
PRISON CAMP
MAIRE ROAD

E.S.W. 1911.

1910 5/7 464

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H. T. McCARDELL, Chief Draughtsman Head Office, Wellington.