1915.

NEW ZEALAND.

DEPARTMENT OF LANDS AND SURVEY:

STATE NURSERIES AND PLANTATIONS

(REPORT ON).

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

TABLE OF CONTENTS.

SIR,— Department of Lands and Survey, Wellington, 30th May, 1915.

I have the honour to forward herewith the annual report of the Forestry Branch of this Department.

Dealing alone with the main features of the report, it may be stated that in the last year about fourteen million trees were raised at the four State nurseries, rather more than half being raised at Rotorua, and the balance at the different State nurseries in the South Island. During the same period six and a quarter million trees were sent out to the State plantations, and 265,887 to outside places; and at the 31st March last it was estimated that there were twenty-one million trees in the nurseries available for planting out in the coming and following seasons. Since the nurseries were started in 1896 about 71½ million trees have been sent to the plantations, and three and three-quarter million trees to outside places.

The total cost to date of the seven nurseries (three of which are now closed) has been £128,090; but of this, however, £25,476 has been expended on permanent works.

During the last year, in the nine plantations in which operations are now being carried on, an area of 2,165 acres was planted, making a total of 24,563 acres planted since the start of operations in 1896. The average cost per acre of planting ranged from £3 4s. 9d. to £6 1s. 6d. The total expenditure (inclusive of the estimated value of prison labour) on the plantations since 1896 amounts to £204,980, of which £31,236 was on permanent works, such as buildings, formation, roads, fencing, &c.

The abnormally long period of dry weather that was experienced in both the North and South Islands was responsible for rather severe losses in both nurseries and plantations.

No work was done by prison labour in the South Island; but the prison camps near Rotorua were kept well filled, and the average number employed there was considerably in excess of that of the previous twelve months. The total value of the work done during the last twelve months by prisoners was £2,902, bringing the total value of the work done by prisoners in the North Island to £37,865.

Thinning was started in the larch plantations in the Rotorua district, but efforts to find a market for the thinnings were not successful. Where the thinnings would be most useful is in the big mines; but these can obtain mining-timbers under such easy conditions from the adjacent native forests that there does not seem much hope that they will for some years yet take our thinnings. In the South Island thinning was started in a small *Pinus radiata* plantation at Hanmer, and, as there is there a scarcity of firewood, the thinnings were profitably sold.

Owing to the difficulty in disposing of the thinnings that must be made at an early date in plantations with an espacement of 4 ft., it has been decided to increase the planting-distance for several of the species of trees. This will reduce considerably the cost per acre of establishment.

On account of the restricted use there is in this country for larch it has been decided to give up planting any more of this tree. On the other hand, the planting of the Monterey pine will be much extended.

Owing to the extra precautions taken, there has been no serious damage this year from fires. The grazing of sheep on the firebreaks has proved very successful, and it will have the further effect of keeping down the expense of maintenance.

In connection with our afforestation operations I must here point out that our present supplies of native timber will be exhausted in about thirty years' time, and as a very small proportion of the area now planted will then be ready for conversion (as a matter of fact, the whole area planted up to the present would not keep the country supplied for two years), we shall be for some years dependent on foreign supplies. To shorten the period of such an undesirable state of affairs it will be necessary to increase very much our present operations. It is estimated that the probable annual consumption will then be about 720,000,000 ft., and to produce this amount we should plant 14,000 acres annually until a total of 700,000 acres of forest is reached. We cannot, of course (for financial reasons), at once increase our operations to this extent, but we should gradually work up to this.

It must be pointed out that there is only sufficient land at the present plantations (excepting Kaingaroa Plantation, where there is enough for some years ahead) for about another year's operations; and it is now highly important that suitable areas of Crown or other lands of poor farming value be set apart for future planting operations. This has been arranged for in connection with some pastoral runs in the neighbourhood of the Mackenzie country, the leases of which had expired; and arrangements are also being made for the setting-apart of about 24,000 acres of gum lands in the Kaipara district with navigable water-frontage. I have also submitted to you a scheme for the setting-aside of an area of about 258,000 acres on the pumice plateau between Rotorua and Taupo, comprising most of the Kaingaroa Plains, and adjoining the lands we are now operating on there. It is not quite intended that lands so set apart should be locked up, but it is advisable they be made reserves. In some instances, where suitable, those portions not likely to be required within the next

few years could, however, be leased on short terms for grazing purposes, and they could be resumed for planting as occasion required. In all instances lands it is proposed to reserve for this purpose are of very low farming value; but, in any case, the production of milling-timber is no less important than the production of farm-produce, and it is an industry which the State alone can in this country engage in to any large extent, as few farmers could be found who would be willing to plant a crop which takes from forty to sixty years to mature, and on which the profit is so small and the risk so great.

A start has been made with the proposed scheme of State assistance in tree-planting by farmers, and there are now about 150,000 trees available for this purpose in the different nurseries. This method of encouraging tree-planting has been for some years in operation in Canada, South Africa, and the different Australian States, and has proved most satisfactory.

Owing to the already increased operations of the Forestry Branch, and owing also to the large extension of planting that must occur in order to make provision against the near exhaustion of our native timbers, it is necessary to make arrangements for an increase in the staff, as was recommended in the report of the Royal Commission on Forestry. Proposals in this direction have recently been formulated and are now awaiting approval.

In January, at Wellington, Mr. Phillips Turner (representing the Head Office), Mr. R. G. Robinson (Superintending Nurseryman for the South Island), and Mr. H. A. Goudie (Superintending Nurseryman for the North Island) met in conference and discussed several matters of a technical and general nature relating to our forestry operations. Their proposals were of a valuable nature; some have already been adopted, whilst steps are being taken shortly to give effect to others. The exchange of ideas possible by conferences of the chief officers is of advantage to all participating, and it is proposed to hold them annually.

As the late Mr. H. J. Matthews's book, "Tree-culture in New Zealand," is now out of print, it has been decided that a book with a similar title be written by members of the present Forestry staff, with the assistance of two or three gentlemen outside the Department for three special subjects.

Mr. R. G. Robinson, Superintending Nurseryman for the South Island, went to Europe last year and represented this Dominion at the jubilee of the Royal Scottish Arboricultural Society. On the way there he visited the principal nurseries and plantations in Canada and the United States; and when in the United Kingdom he was shown over all the chief tree-plantations and chief nurseries. His inspection of the important European forests was unfortunately curtailed by the outbreak of war; however, the information gained will be of great value. A full report of his tour is attached as an appendix to the general report.

I personally inspected all the plantations and nurseries during the year, and I feel assured that operations are being conducted in an efficient and economical manner. The staff under Messrs. R. G. Robinson (Superintending Nurseryman for the South Island) and H. A. Goudie (Superintending Nurseryman for the North Island) have worked well and zealously, and have shown every desire to advance the interest of the State in its afforestation operations. During Mr. Robinson's absence from the Dominion his work was satisfactorily carried on by Mr. W. T. Morrison.

I wish to place on record my satisfaction with and thanks for the assistance, co-operation, and efficiency of the officers and men employed in this important branch of my Department, which reflects also great credit on the Superintending Nurserymen in charge—viz., Mr. Goudie for the North Island and Mr. Robinson for the South Island. In connection with the administration of the branch, Mr. E. Phillips Turner, F.R.G.S., Inspector of Scenic Reserves, and Mr. W. R. Jourdain, Chief Clerk, have lent me loyal and willing assistance.

The reports of the Superintending Nurserymen are attached, together with detailed reports from the officers in charge of the different nurseries and plantations. The report on the timber industry in New Zealand is also attached as an appendix, instead of being attached (as was formerly done) to the Report of the Lands Department.

On account of my having reached the retiring-age, this will be the last annual report on forestry matters that I shall have the honour of submitting to you for presentation to Parliament, and the carrying-out of these proposals will be left to my successors; at the same time I feel that I cannot too strongly impress on all concerned the importance of giving greater attention to this subject than has been the case in the past.

There is undoubtedly a very pressing demand for railways, roads, and other public works for present use, but it is also incumbent on us to provide for the requirements of the country in the near future, and that an ample supply of timber is amongst the most important of these requirements cannot but be recognized.

I have, &c.,

JAMES MACKENZIE,

Under-Secretary for Lands.

The Right Hon. W. F. Massey, P.C., Commissioner of State Forests.

SUMMARIES.

Summary of Operations in Nurseries during Year ended 31st March, 1914–15.

Name of Nursery.	Total Expenditure.				Trees in Nurseries.			
	Supervision and Clerical.	Permanent Works.	Tree-growing.	Total.	Estimated Trees raised during Year.	Output of Trees.		Estimated Number in Nurseries at 31st March, 1915.
						Trees sent to Plantations during Year.	Trees sent to outside Places during Year.	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.				
Rotorua	340 0 0	580 10 3	4,134 17 5	5,055 7 8	7,286,150	3,987,200	62,361	10,450,905
Tapanui	374 15 1	108 14 5	1,579 11 11	2,063 1 5	3,284,500	662,979	31,401	4,610,230
Ranfurly	217 0 0	49 8 6	785 11 7	1,052 0 1	913,800	708,800	115,000	1,692,600
Hanmer Springs	172 0 0	30 12 3	1,336 0 0	1,538 12 3	2,460,330	871,610	57,125	4,139,597
Totals	1,103 15 1	769 5 5	7,836 0 11	9,709 1 5	13,944,780	6,230,589	265,887	20,893,332

Summary of Operations in Nurseries from 1896 to 1915.

Name of Nursery.	Total Expenditure.				Estimated Number of Trees raised.	Output of Trees.	
	Supervision and Clerical.	Permanent Works.	Tree-growing.	Total.		To Plantations.	To outside Places.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.			
Rotorua	3,629 16 8	9,812 10 9	42,907 1 3	56,349 8 8	56,185,307	44,744,219	990,183
Tapanui	3,016 0 0	5,027 1 8	21,387 10 4	29,430 12 0	17,840,939	12,452,428	778,281
Ranfurly	1,850 19 6	3,053 1 4	11,259 17 11	16,163 18 9	6,033,687	4,020,010	321,077
Hanmer Springs	1,414 1 10	2,821 18 10	9,583 5 7	13,819 6 3	12,747,662	8,242,625	365,440
Starborough*	423 13 3	2,756 17 3	6,075 16 7	9,256 7 1	3,059,610	1,965,095	1,094,515
Kurow*	205 0 0	2,004 18 5	860 4 2	3,070 2 7	172,460	..	172,460
Totals	10,539 11 3	25,476 8 3	92,073 15 10	128,089 15 4	96,039,665	71,424,377	3,721,956

* Nursery now closed.

Summary of Operations in Plantations during Year ended 31st March, 1914-15.

Name of Plantation.	Trees.			Expenditure.				New Area planted.	Cost per Acre planted.	General Upkeep per Acre planted.
	Number received from Nursery.	Number used to replace Losses.	Number planted on New Area.	Supervision and Clerical.	Formation, Buildings, Roads, Fencing.	Planting Operations.	General Upkeep.	Total.		
North Island—				£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	Acres.	£ s. d.	£ s. d.
Whakarewarewa ..	1,199,800	127,850	1,071,950	728 4 9	672 13 0	1,739 18 8	2,513 10 11	5,654 7 4	586	4 16 7	0 7 5
Waiotapu	869,775	448,625	421,150	514 17 6	265 1 11	366 3 8	2,005 3 3	3,151 6 4	206	6 1 6	0 5 8
Kaingaroa Plains ..	1,658,675	92,500	1,566,175	500 14 6	552 11 9	1,337 12 2	305 1 2	2,695 19 7	624	3 4 9	0 5 3
Puhipuhi	260,000	260,000	..	45 0 0	1 10 5	..	770 4 10	816 15 3	..	..	..
South Island—											
Conical Hills ..	660,169	155,119	505,050	275 0 0	57 16 7	704 11 5	1,402 5 6	2,439 13 6	192	4 2 8	0 10 1
Dusky Hill ..	2,810	2,810	..	196 0 0	20 15 8	..	160 3 9	376 19 5	..	..	0 8 3
Gimmerburn ..	..	..	..	10 0 0	..	..	8 16 0	18 16 0	..	..	0 2 2
Naseby	708,800	58,150	650,650	240 0 0	151 5 5	753 10 6	318 1 0	1,462 16 11	239	3 13 0	0 10 6
Hanmer Springs ..	871,610	5,175	866,435	350 0 0	259 9 5	1,293 8 6	408 16 1	2,311 14 0	318¼	4 14 3	0 4 3
Dumgree	..	..	..	..	..	..	10 1 0	10 1 0	..	..	..
Totals ..	6,231,639	1,150,229	5,081,410	2,859 16 9	1,981 4 2	6,195 4 11	7,902 3 6	18,938 9 4	2,165¼	..	..

Summary of Operations in Plantations from 1896–1915.

Name of Plantation.	Trees.				Expenditure.					Total Area planted.	Cost per Acre planted.	General Upkeep per Acre planted.
	Number received from Nursery.	Number raised from Seed sown *in situ*.	Number used to replace Losses.	Total Number in Plantations.	Supervision and Clerical.	Formation, Buildings, Roads, Fencing.	Planting Operations.	General Upkeep.	Total.			
North Island—					£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	Acres.	£ s. d.	£ s. d.
Whakarewarewa ..	18,212,014	109,725	3,304,193	15,017,546	5,158 5 1	6,380 19 0	25,329 13 1	14,944 7 7	51,813 4 9	6,808	4 16 4	0 2 6
Waiotapu ..	22,942,885	83,121	4,350,667	18,675,339	5,123 0 6	6,300 12 6	23,023 16 0	9,689 16 4	44,137 5 4	7,166	4 7 0	0 1 9
Kaingaroa Plains ..	3,277,325	..	92,750	3,184,575	1,361 2 3	3,389 1 11	2,906 2 1	575 10 4	8,231 16 7	1,166	4 2 8	0 2 5
Puhipuhi ..	2,547,042	..	1,547,042	1,000,000	1,052 9 7	1,201 16 2	3,840 11 11	4,631 10 2	10,726 7 10	1,200	4 12 9	0 7 0
South Island—												
Conical Hills ..	9,830,536	..	923,455	8,907,081	2,708 9 4	2,237 3 8	14,472 13 0	8,966 4 6	28,384 10 6	3,289½	8 12 6	2 19 11
Dusky Hill ..	3,001,597	..	820,760	2,180,837	2,061 4 2	1,239 6 4	7,426 17 4	3,202 17 8	13,930 5 6	845	16 9 8	4 8 1
Waitahuna ..	42,025	..	11,500	30,525	30 9 0	61 1 1	73 8 3	63 19 4	228 17 8	11	20 16 1	6 12 8
Gimmerburn ..	936,235	..	783,339	152,896	332 16 8	514 13 11	984 4 0	818 1 10	2,649 16 5	173	15 6 4	5 7 3
Naseby	2,956,000	..	371,126	2,584,874	1,116 3 2	1,225 16 0	4,147 15 6	2,231 0 2	8,720 14 10	958	9 2 0	2 12 5
Hanmer Springs ..	8,234,800	..	1,348,089	6,891,711	2,553 18 6	4,487 3 3	11,607 0 1	3,962 18 4	22,611 0 2	2,531½	8 18 7	1 14 6
Dumgree ..	1,679,765	..	1,110,125	569,640	931 5 0	4,198 9 3	5,762 17 2	1,548 11 2	12,441 2 7	209	*	*
Raincliff	..	..	..	50,000	..	..	..	..	1,104 12 5	206	..	..
Totals ..	73,660,224	192,846	14,663,046	59,245,024	22,429 3 3	31,236 3 1	99,574 18 5	50,634 17 5	204,979 14 7	24,563	..	..

* Data not available.

REPORT ON THE AFFORESTATION OPERATIONS IN THE NORTH ISLAND, 1914-15.

[By the Superintending Nurseryman, North Island, Rotorua.]

In presenting this report upon the afforestation-work at the North Island stations for the past year I regret that, owing to the drought which was prevalent in most parts of the Dominion during the spring and summer, the usual measure of success cannot be claimed. From August to February the rainfall was very light, and the few showers which were recorded failed to do any good owing to the rapid evaporation of the moisture from the soil. In the plantations the losses have been greatest at Kaingaroa and Waiotapu, where the soil is greatly lacking in humus; while at Whakarewarewa and Puhipuhi the losses are not greatly above normal. The losses in the nursery are principally due to the failure of many of the seeds to germinate. Those sown early in the spring have done fairly well, while the later-sown ones in most cases are very sparse. The growth has generally been very poor, but no doubt the moister conditions which commenced early in March will ensure a satisfactory autumn growth.

During the year the area of land planted was 1,416 acres, the principal species used being Corsican pine and Monterey pine (*P. radiata*). Of the last-named species, the area planted was slightly over 500 acres. The total area of plantation in the North Island formed since the commencement of operations in 1898 is 16,340 acres. In the nursery the trees raised during the year are estimated at seven and a quarter millions, the principal species raised being Corsican pine, Monterey pine, yellow-pine, Weymouth pine, Douglas fir, sweet-chestnut, *Eucalyptus Macarthuri*, and *Eucalyptus resinifera grandiflora*. Owing to the failure to secure seed of Corsican pine in 1913 there are practically no trees of this species available for planting during the coming winter. The shortage in this respect is partly compensated for by the Monterey-pine crop, but the climatic requirements of these two trees being slightly different, this shortage will directly affect the planting at Waiotapu and Kaingaroa, where the Corsican pine is the more suitable tree to plant.

Prison Labour.

Following is tabulated information regarding this class of labour. It is gratifying to be able to report that the prison camps have been well supplied with prisoners during the year, and that the average number employed is considerably greater than for the previous twelve months.

Summaries of Prison Labour.

Year.	Waiotapu Plantation.			Whakarewarewa Plantation.			Kaingaroa Plains Plantation.		
	Average employed.	Total Value of Work.	Average per Man.	Average employed.	Total Value of Work.	Average per Man.	Average employed.	Total Value of Work.	Average per Man.
		£ s. d.	£ s. d.		£ s. d.	£ s. d.		£ s. d.	£ s. d.
1900–1	20·00*	170 0 0	8 10 0	..	..	..	..	..	..
1901–2	18·00	437 18 6	24 6 7	..	..	..	..	..	..
1902–3	22·59	904 12 11	40 0 11	..	..	..	..	..	..
1903–4	30·00	902 3 0	30 1 5	..	..	..	..	..	..
1904–5	43·00	1,562 0 0	36 6 0	11·00‡	332 13 7	30 4 10	..	..	..
1905–6	42·56	2,440 8 5	57 6 9	14·19	771 8 4	54 7 3	..	..	..
1906–7	35·62	2,978 0 0	83 12 1	11·50	762 11 0	66 6 2	..	..	..
1907–8	38·64	3,878 7 6	100 7 5	15·05	1,103 5 2	73 6 1	..	..	..
1908–9	32·83	3,496 19 2	106 10 4	13·16	971 10 0	73 16 5	..	..	..
1909–10	27·81	3,164 19 2	113 16 0	10·89	789 7 6	72 10 10	..	..	..
1910–11	23·45	2,390 7 1	101 18 7	10·44	957 0 3	91 13 4	..	..	..
1911–12	17·04	1,750 5 0	102 14 3	11·16	934 19 9	83 15 7	..	..	..
1912–13	15·20	1,198 16 9	78 17 5	9·51	931 3 2	97 18 3	..	..	..
1913–14	..	..	..	11·66	1,019 17 3	87 9 4	12·36	1,113 5 0	90 1 4
1914–15	..	..	..	15·56	1,225 16 7	78 15 7	17·45	1,676 8 8	96 1 5
Totals ..	..	25,274 17 6	..	..	9,799 12 7	..	..	2,789 13 8	..
Averages	30·35†	..	68 18 9	12·47§	..	73 2 1	14·90	..	93 12 5

* One month's work. † 12·08 years. ‡ Nine months' work. § 10·75 years.

Year.	Average Number employed.	Value of Work.	Value per Man per Day.
Waiotapu Plantation.			
		£ s. d.	s. d.
1900–13	30·35	25,274 17 6	4 5
Whakarewarewa Plantation.			
1914–15	15·56	1,225 16 7	5 0
1905–15	12·47	9,799 12 7	4 8
Kaingaroa Plains Plantation.			
1914–15	17·45	1,676 8 8	6 2
1913–15	14·90	2,789 13 8	6 0

Distribution of Trees for Experimental Purposes.

The proposal outlined in the last annual report to distribute collections of *Eucalypti* plants amongst farmers for the purpose of extending our knowledge of this important class of tree was given effect to, and forty-three collections, each containing on the average twenty-five species, were sent out. Very few reports have been furnished by the persons to whom the collections were given, and in this respect the results are very disappointing. Some careful and painstaking reports have, however, been received, which give evidence of the deep interest which some of the farming community display in the question of tree-planting. Very many of the failures reported were undoubtedly due to the abnormally dry weather experienced, and it was most unfortunate that the initial effort to get the farmers to co-operate with the Department should have thus been handicapped. As far as the information goes, it would appear that *E. Macarthuri* and *E. viminalis* have generally been the most successful species tried, and that practically no newly tried species has succeeded to any extent. The stringy-barks have mostly been failures; but this can in some measure be accounted for by the difficulty usually experienced in transplanting these owing to the nature of the rooting-system, which consists of a strong taproot almost devoid of any fibrous rootlets. Eucalypts are, with a few exceptions, difficult trees to transplant; but if strong plants are used they very often come away surprisingly well, even if the tops wilt and die off immediately after transplanting. Generally, little growth is made during the summer after transplanting takes place, but immediately the autumn rains commence vigorous growth usually results. Considering this aspect of the question, it is thus possible that a great deal more information may be obtained from those who received the collections, and who may have hastily concluded that many of the species tried were failures.

At Rotorua very encouraging results were obtained with a number of species hitherto untried in this district. The red stringy-bark (*E. capitellata*), Victorian spotted gum (*E. goniocalyx*), white-ironbark (*E. leucoxylon*), tuart (*E. gomphocephala*), Sydney blue-gum (*E. saligna*), and bastard box (*E. Cambagei*) have all made very good growth, but definite information as to their hardiness cannot be given until the plants have been through a winter.

Thinning of Plantations.

The advanced state of the trees on some of the areas planted has necessitated this new phase of the afforestation-work being dealt with, and, as may be seen by referring to the portions of this report dealing with the Whakarewarewa and Waiotapu Plantations, a considerable area of larch plantations has already been thinned. As far as was possible and desirable, the methods employed have been in keeping with those adopted in Europe, but the peculiar conditions obtaining in New Zealand make it impossible to adhere strictly to European practice. These conditions may be briefly summed up under two principal headings, namely: (1) The difficulty of getting a sale for thinnings; (2) the cost of thinning. In Britain the thinnings from a plantation find a ready market, and it is generally calculated that the sales of these will cover the cost of the thinning-work done. The first thinning, therefore, entails practically no outlay whatever. In New Zealand the position is very different, because, in addition to the fact that the work costs much more than in Britain, there is at present small prospect of finding a sale for the produce. From a twelve-year-old larch plantation the thinnings taken out average about 2,000 trees to the acre. These trees, for the most part, are straight thin poles, 400 of which average in diameter about 5 in. and in length about 16 ft., while the balance of the thinnings average about 2 in. in diameter and in length about 10 ft. The larger-sized poles could be made use of for mining or fencing timbers, the demand for which is at present, and in most districts will be for some years to come, met by the product from the indigenous forests.

At the present time there is no demand for the exotic timbers, which, being quickly grown, are in most cases not very durable, and it would appear as if the State must be at some loss with the thinnings from the plantations until such time as the indigenous timbers are exhausted.

Larch planted 4 ft. apart will, at from the tenth to the twelfth year, have reached a condition when thinning becomes necessary; the side branches on about 14 ft. of the trunk are dead, and can easily be knocked off with a walking-stick, and the heads of the trees are too crowded. During the past three years experimental thinnings on a small scale have been made on larch plantations from nine to thirteen years of age, and it was found that from the tenth year onward the diameter-growth rapidly became less each year, thus indicating that the trees required a larger growing-space. The cost of thinning in the first area of twelve-year-old larch was £10 an acre, which includes £3 for hauling out the poles. On this area the bracken had been very strong, and the dead fronds were interwined with the branches of the larch, making it impossible to mark the trees without first underscrubbing. The nature of the undergrowth largely influences the cost of the work, and it has been found that underscrubbing has varied from 11s. to £2 15s. per acre. The cost has been gradually reduced as the workmen became more used to the work, and, as the poles are not now being hauled out unless required, trees of this age can be thinned at from £3 15s. to £5 10s. an acre. Owing to the fact that no market for the thinnings was available it was decided that such an expenditure would reduce the chances of the plantations being a success financially, and accordingly consideration was given to the possibility of growing timber without incurring so much expense, or, at any rate, to reducing the expenditure to a minimum consistent with the production of a marketable article. The distance apart at which the young trees were planted was the first point considered. In the past it has been deemed advisable to plant at such distances as would tend to produce timber free from knots and other defects; but as the cost of thinning, owing to the causes previously mentioned, is likely to be very high, it would seem to be better policy to aim at the production of a lower-grade timber for at least some years to come. In railway-sleepers, fence-posts, scantling and packing-case timbers knots do not detract a great deal from their utility, and consequently a large proportion of the planting could be

done so as to meet the demand for such timber. It is fairly certain that no crops can be profitably grown—except possibly *Eucalypti* and *Pinus radiata*—and bear such a heavy expenditure on thinning at the twelfth year; and consequently the trees when planted should be spaced at such a distance as will obviate the necessity for thinning early in the rotation period. The quicker rate of growth in New Zealand will permit of the spacing being much wider than is generally considered advisable in Europe, and it is therefore proposed to increase the planting-distance somewhat according to the needs of each species, and bearing in mind the nature of the locality in each case.

Corsican pine, heavy pine, Weymouth pine, and Douglas fir will in future be planted 6 ft. apart; *Eucalypti*, *Pinus radiata*, and larch, 8 ft. apart; but these distances will be reduced in very exposed situations, or where the soil is poor or very dry. With regard to those areas of larch already planted, it is intended to make an early thinning by cutting out the trees and allowing them to lie where they are felled. If this is done before the trees have closed in too much the cost of such work will range from 7s. to £1 16s. an acre, according to the size of the trees, the nature of the undergrowth, and the aspect and gradient of the locality. Those areas of from ten to twelve years of age will require to be underscrubbed before thinning commences, but it is not proposed to haul out the thinnings unless a sale for them is assured.

When the larch were planted it was intended that they were to be underplanted with sweet-chestnuts, but, as this would necessitate the removal of the poles and a large amount of the branches, the cost of underplanting is prohibitive. If underplanting becomes necessary it can more cheaply be done from two to three years hence, by which time much of the material now lying under the trees will have decayed.

It is recognized that the proposed treatment of the larch plantations violates some of the generally accepted principles of sylviculture; and, while admitting that such is the case, it is claimed that the conditions here so far differ from those obtaining in Europe as to warrant the departure from generally recognized methods. In the past an effort has been made to proceed on lines generally found suitable in Europe, but even during the comparatively short period in which the afforestation-work has been in operation the conditions as regards the cost of the work have materially altered, and there is a need to adjust our methods to suit the altered conditions. A considerable period will require to elapse before sufficient data will have been collected to enable a definite reply to many questions being given, and it would be a safe policy to assume that labour and material will be as costly, if not more so, in twenty years' time as they are at present. On the other hand, the time is gradually coming when the indigenous forests will have become exhausted, and when the produce from the plantations will find a ready sale. When this time arrives thinning may be done with a comparatively small expenditure, and the demand for thinnings may be such as to warrant a return to closer planting-distances, but in the meantime the longer the thinning can be delayed the better will the chances be of disposing of the produce.

Owing to the light-demanding nature of the larch, and the expenses which would be incurred in giving it the proper treatment, it has been decided to discontinue planting it for a while. Larch is esteemed in Europe principally on account of the durable qualities of the timber, but in the North Island of New Zealand many species of eucalypts can be grown which will produce an equally useful, if not superior, timber.

Experimental Trees.

Several small lots of useful trees are now under trial, and, although it is too soon in many cases to look for definite results, it may be of interest to state briefly the results so far obtained.

Two lots of Scots fir—*Pinus sylvestris*—were sown, one lot being seed from Norway and the other from Finland. This pine has for years been more extensively planted in Europe than any other species, and by many authorities is still regarded as the most useful of the European conifers. It has generally been considered as a failure in this country, principally owing to the unhealthy appearance of specimen trees to be seen in several of the early settled districts. Very frequently it is badly infested with the pine aphis, the growth is slow, and a thrifty specimen is seldom seen. The reasons for the failure to acclimatize this tree seem never to have been determined, and, because it is a most valuable timber-producer, it is thought that an experiment on a small scale may probably be worth while. The principal sources from which seed may be obtained are Britain, Norway, Germany, and Finland; and, as the climatic differences are often the deciding factor in the success or non-success of a tree, the results from the two packets of seed sown this year will be closely watched. The seed in each case has germinated satisfactorily, the plants are healthy, and although the growth has been poor this may be the result of the abnormally dry weather. The Norway strain appears to be slightly the more vigorous of the two. When the seedlings reach a transplanting size it is proposed to give them a trial on the high country between Rotorua and Taupo, and also probably at Waimarino.

Two forms of *Pinus Laricio* are also under trial. They are *P. Laricio* var. *cebennensis*, and *P. Laricio* var. *taurica*. The former is the western or Pyrenees type of this species, and the latter the eastern or Taurian type. Both are reputed to be more drought-resisting than the Corsican pine. The seed of the Pyrenees form did not germinate very satisfactorily, but a good braird was obtained of the Taurian type. Both types have made vigorous growth.

Trees most suitable for the State to Plant.

Before answering this question, consideration must be given to the classes of timber required by the various industries and the proportions of each class used. It is a comparatively simple matter to state the general purposes for which timbers are required, but there appears to be no statistics bearing upon the proportions in which the various timbers are used. A reasonably accurate estimate of what the requirements of the Dominion are can, however, be made owing to the fact that some timbers can be adapted to a variety of purposes. No doubt some industries requiring a special timber may be overlooked in dealing with the question in such a broad fashion, but the necessity at present seems to be to thus decide the matter and give consideration to special cases when more definite information is acquired.

Following are some of the most important uses to which timber is put, and the names of some of the trees which will produce such timber:—

General building-construction (scantling, weatherboards, &c.	Corsican pine, heavy pine, Weymouth pine, Monterey pine, Douglas fir, *Eucalypti*.
Joinery (doors, windows, &c.)	Weymouth pine, Douglas fir.
Flooring, lining, interior finish	Any of the kinds in the two preceding groups, and in addition many of the eucalypts.
Bridge-building and similar heavy construction	Eucalypts (species), Douglas fir, Corsican pine.
Coachbuilding	Eucalypts (species), for framing; Corsican pine, heavy pine, Weymouth pine, Douglas fir for boards and panels.
Railway ties and telegraph-poles and fencing	Eucalypts (species).
Packing-cases, kegs, butter-boxes ..	Any of the pines mentioned in preceding groups, and, in addition, sweet-chestnut and poplar.
Boat-building	Eucalypts, Douglas fir, Corsican and heavy pines, larch.
Turnery	Eucalypts, ash, oak, chestnut, poplar, pines.
Furniture	Eucalypts, sweet-chestnut, Weymouth pine, Douglas fir, poplar, ash, oak.

It is not pretended that the foregoing is anything more than a rough-and-ready list of the principal uses to which timber is generally applied, and a variety of timbers which will meet these uses. The main object is to demonstrate the fact that it is not necessary to grow a great variety of timbers to provide for the principal industries. It will be noticed that Corsican pine, heavy pine, Weymouth pine, Monterey pine, and Douglas fir are capable of being used for a great variety of purposes, and are, moreover, suitable for building-construction in which large quantities of timbers are needed. The species of Australian eucalypts are not particularized, but a large variety can be grown in various parts of the North Island. From these it is possible to obtain a great variety of timbers, the principal characteristics of which are strength and durability. Many of them, too, are beautiful cabinet-woods, and, although in general they are somewhat heavy, they can nevertheless be satisfactorily used for furniture-making. For bridge-building, wharfing, railway-sleepers, fencing, and fuel some of the eucalypts have no equal. One purpose for which timber is now largely used, and for which there is urgent need to provide, is what may be described as carrying-timbers. Fruit-cases, butter-boxes, general packing-cases, casks, and crates, all of which are needed for carrying the produce of the country, absorb a large amount of timber, but generally of second-class quality. Soft light timbers are the most suitable, and almost any of the pines will produce this. For butter-boxes a better-class timber and one which has no smell is required, and for this purpose either the black Italian poplar or the Monterey pine is well suited.

For cabinetmaking, panelling, and similar purposes there are many of the indigenous trees well suited, and, as a great number of these have hitherto been but sparingly used, they would, if proper conservation regulations were applied, last for many years to come. It would appear to be a good policy to make these timbers last out as long as possible, rather than grow special timbers for the purpose. Oak, ash, maple, walnut, chestnut, *Cupressus*, and cedars are all more or less beautifully grained, and otherwise well adapted for ornamental furniture; but unfortunately most of these trees are not profitable trees to grow for general uses, and if planted especially for furniture their timbers would cost probably twice as much as the pine or eucalypts to produce. On most plantation reserves there are areas which cannot be utilized in the general scheme of planting, and which may be admirably adapted for one or more particular class of tree. When dealing with such areas the growing of special furniture-timbers could be considered, and in this way probably provided for in quite an adequate manner.

If, therefore, the State planting is done with the pines which are mentioned above, and a selection of the best of the eucalypts, the greatest part of the timber requirements of the Dominion will be well provided for, and, although the importation of some timbers for special purposes may be necessary, these in the aggregate will represent but a small proportion of the timber used, and will not seriously affect the welfare of the country.

Land for Plantations.

It is proposed at an early date to inspect a number of areas in various parts of the North Island with a view to having these set aside for future afforestation-work. This is necessary owing to the increasing cost of land, but the selection of these areas requires a considerable amount of forethought, principally concerning their accessibility. Land for plantation purposes must be low in price, and it is not desirable to select land that might even in the future be more profitably used for agricultural purposes. If, however, timber is grown by the State it will require to be distributed to the centres of industry, and the question of transit is therefore a most important one. All areas selected for afforestation should be fairly easy of access by water, by the railway, or by proposed future railway routes; or, as an alternative, a large area could be set aside on which all the timber required for the North Island could be grown, in which case it would be warrantable to build a special railway-line for the conveyance of timber when it is ready. It would appear to be a better policy to have plantations in

different localities, because various climatic conditions would be available, and thereby a greater variety of timber could be grown. Assuming that the timber requirements of the Dominion as estimated by the Royal Commission on Forestry, 1913, is correct, the State will require to provide for cutting out an area of 14,000 acres annually thirty years hence. This means the gradual planting of 560,000 acres, but owing to the slower growth of certain species, which will probably take forty years to mature, the planting for the first ten years will require to be considerably increased. Species which can probably be grown on a thirty-year rotation are *Pinus radiata* and a number of the *Eucalypti;* those requiring forty years are *Pinus Laricio*, *Pinus ponderosa*, and Douglas fir. Other trees could be mentioned, but the foregoing are sufficient to illustrate what is meant. To enable an area of 14,000 acres to be cut out annually thirty years hence, it will be necessary to plant 21,000 acres of the thirty-year rotation species and 7,000 acres of forty-year kinds annually for ten years, and thereafter at the rate of 14,000 acres annually in whatever proportion is desired. In the Rotorua district the reserve known as Whakarewarewa Plantation will probably be all planted during the coming winter, and arrangements are now in hand for securing a further area contiguous to the present enclosure. At Kaingaroa there is sufficient land reserved for some years to come; but as this locality, owing to the high altitude, is unsuitable for many classes of trees, the reserve here cannot be made to meet all the requirements of the district.

The reservation of land for the future operations of the Department is a matter which should be settled as soon as possible. With the advancement of settlement and railways the cost of land is gradually increasing, and, although it may be many years before some of the areas which would be acquired would be needed for afforestation purposes, they could in the meantime be leased on conditions which would enable them to be resumed as required.

Proposals for 1915–16.

Rotorua Nursery.—About 3,000,000 trees will be transferred to the plantations during the coming winter. Provision was made for supplying trees to farmers, but owing to the shortage of some of the crops the number available for this purpose will probably not exceed 60,000. Seeds for sowing next spring are now being procured in sufficient quantity to raise 5,000,000 trees. Further office accommodation and an addition to the implement-shed are urgently required, and will be erected during the year.

Whakarewarewa Plantation.—Preparations are now well forward for planting close on 1,000 acres, principally with Monterey pine and Douglas fir. The thinning proposals for the year as submitted in the working plans will also be carried out.

Waiotapu Plantation.—Owing to the shortage of Corsican pine no planting will be done at this station. The thinning of larch will be continued.

Kaingaroa Plains Plantation.—One thousand acres will be planted with yellow-pine (*Pinus ponderosa*).

Puhipuhi Plantation.—One hundred and fifty acres will be planted with *Eucalyptus resinifera grandiflora* and *Eucalyptus Macarthuri*.

General.

I have to express my appreciation of the zealous manner in which the officers of this branch have attended to their duties during the year.

Attached hereto are reports on the several stations under my charge.

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

Rotorua Nursery.

The rainfall for the year ending the 31st March amounted to 33·47 in., falling on 131 days. This is the lowest fall ever recorded at this station. Records have been kept for seventeen years, during which period the average annual fall has been 52·20 in. on 149 days. Previous to this year the lowest rainfall occurred in 1910–11, when rain fell on 137 days, with a total fall of 39·58 in.

Although, owing to the drought, the propagation of trees has not been as successful as usual, there has nevertheless been a fair measure of success. The estimated number of trees raised from seed during the year is 7,286,150, details of which are given in the schedule attached hereto. Plentiful crops of *Pinus Laricio* and *Pinus radiata* were obtained, but the species which were sown later in the spring failed in many cases to germinate, and in other instances germination was very sparse. Watering was almost continuously resorted to, but however carefully this is done some parts of the seed-beds get more water than others, with the result that the germination is patchy. *Eucalypti* seed in some instances remained in the ground from November till March before germination took place, and it is feared that the plants will not attain to a transplanting size before spring. There is, however, a sufficiency of plants for our requirements of *Eucalyptus Macarthuri* and *E. resinifera grandiflora*. The crops of Douglas fir, *Pinus ponderosa*, and *Pinus strobus* are very patchy and thin. Since the rainfall in March good growth has been made by most of the seedlings, but, on the whole, they are much below their normal size.

The lined-out trees and the two-year-old trees in seed-beds made very little growth up till February, but have since made splendid headway. The Douglas fir crop is a good one, but plants in the seed-beds have suffered to some extent from the larvæ of the brown beetle (*Odontria puncticollis*), which has in the past been so severe upon the larch.

It is estimated that the trees in the nursery at 31st March numbered 10,450,000. Of this number, about 3,000,000 will be available for transferring to the plantations during the coming winter. The number raised since the inception of the nursery is 56,185,307, of which 45,734,402 have been transferred to the plantations or supplied to local bodies, &c.

Manuring.—The beneficial results of the systematic use of fertilizers and the growing of manurial crops is manifested in the improved growth made by the trees on land thus treated. Unfortunately,

last spring the ground was too dry to permit of the usual clover-crop being sown, but this has been remedied to some extent by making an autumn sowing of cape barley and winter tares. Much of the land, too, has been subsoiled as opportunity afforded, and this extra cultivation has made a marked difference in the vigour of the plants grown. Sorrel, which has been most plentiful in the past, is gradually becoming very scarce, but the exact reason for this cannot be stated, as no control plots were kept. The result may be attributed to a combination of circumstances, of which the most plausible reason is the use of basic slag. This manure has been found to be an excellent fertilizer for coniferous trees, and it may be said to be indispensable for a clover-crop.

During the year 4,049,561 trees were sent out to local plantations and public bodies, &c., details of which will be found by referring to the attached schedule.

The cost of various operations were as follows: Sizing and lifting lined-out trees, 3s. per thousand; lining-out seedings, 2s. 6d. per thousand.

The average daily number employed was 27·55.

Attached are schedules of rainfall and temperature and of trees grown and sent out.

Schedule I.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1914.	In.		Deg. F.	Deg. F.	
April	7·695	18	68	32	4
May	3·37	14	63	27	8
June	2·43	11	59	27	18
July	3·85	16	59	23	15
August	0·66	9	61	26	22
September	2·44	9	66	28	16
October	1·17	6	72	28	11
November	0·91	7	73	32	5
December	2·045	9	78	36	1
1915.					
January	3·095	11	80	36	..
February	0·895	5	77	41	..
March	4·91	16	76	38	..
Totals	33·470	131	..	..	100

Schedule II.—Details of One-year-old Trees, sown 1914.

Name of Tree.	Number in Seed-beds.	Height, in Inches.	Amount of Seed sown.		Remarks.
			Lb.	oz.	
Castanea sativa	70,000	7	2,466	0	Very good.
Cupressus Lawsoniana	12,000	3	4	0	Good.
Eucalyptus Andrewsii	500	5	0	1	
,, Consideniana	300	6	0	1	
,, eugenioides	1,200	6	0	4	
,, globulus	500	12	0	0½	
,, Macarthuri	250,000	10	8	0	
,, macrorrhyncha ..	100	5	0	1	Thin crop; growth good.
,, Muelleriana	300	6	0	0½	
,, piperita	200	4	0	1	
,, resinifera grandiflora ..	100,000	8	4	0	
,, tereticornis	200	6	0	0½	
,, Sieberiana	5,000	9	0	4	
,, viminalis	5,000	10	0	3	
Larix Dahurica	50	0½	0	0½	Fair.
Pinus Banksiana	1,500	1	0	1	,,
,, excelsa	200	2	10	0	Thin.
,, Laricio	5,000,000	2	500	0	Very good.
,, ,, var. cebennensis ..	100	2	1	0	Good.
,, ,, ,, taurica ..	3,000	2	1	0	Very good.
,, Massoniana	1,000	2	0	0½	Fair.
,, ponderosa	75,000	2	184	0	Poor.
,, radiata	1,400,000	7	167	0	Very good.
,, strobus	75,000	1	100	0	Thin.
,, sylvestris (Norway) ..	15,000	1	1	0	Good.
,, ,, (Finland) ..	20,000	1	1	0	Fair.
Pseudo-tsuga Douglasii	250,000	2	200	0	Thin.
	7,286,150				

Details of Two-year-old Trees, sown 1913.

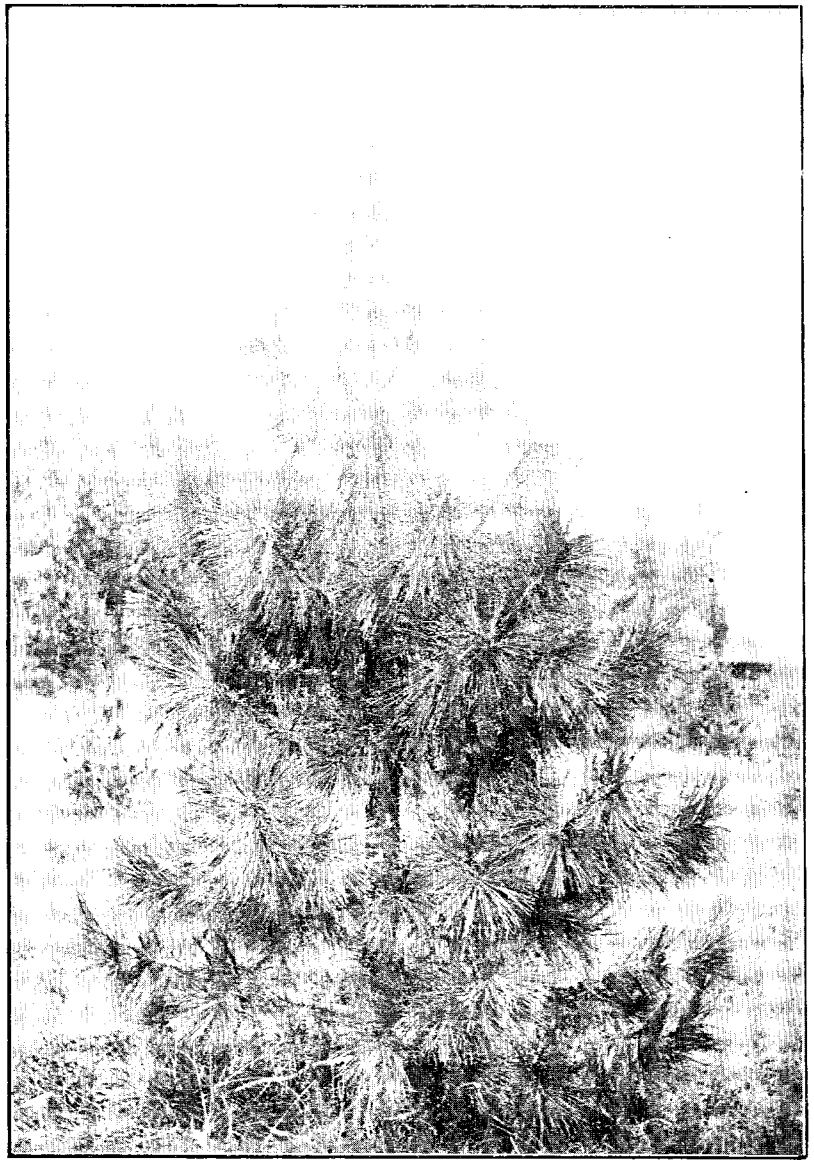
Name of Tree.	Number in Seed-beds.	Number in Nursery Rows.	Height, in Inches.	Remarks.
Abies pectinata	..	300	3	Good.
Alnus glutinosa	..	1,000	18	Very good.
Betula alba	..	400	18	,,
Callitris calcarata	..	300	10	Fair.
,, Muelleri	..	10	5	
,, rhomboidea	..	30	10	
Cryptomeria japonica	..	800	9	Very good.
Cupressus Lawsoniana	..	4,000	14	,,
Larix europaea	300,000	200,000	7 and 8	Good.
Picea excelsa	..	200	3	Fair.
,, sitchensis	..	1,000	6	,,
Pinus densiflora	..	800	8	Good.
,, luchuensis	..	20	9	,,
,, Murrayana	4,000	..	2	Poor.
,, ponderosa var. scopulorum ..	750,000	..	3	Fair.
,, radiata	..	2,000	10	Good.
,, strobus	75,000	..	4	Fair.
,, taeda	..	17,000	12	Very good.
,, Thunbergii	..	200	8	,,
Pseudo-tsuga Douglasii	500,000	300,000	10 and 8	,,
	1,629,000	528,060		
	2,157,060			

Details of Three-year-old Trees, sown 1912 (Lined out).

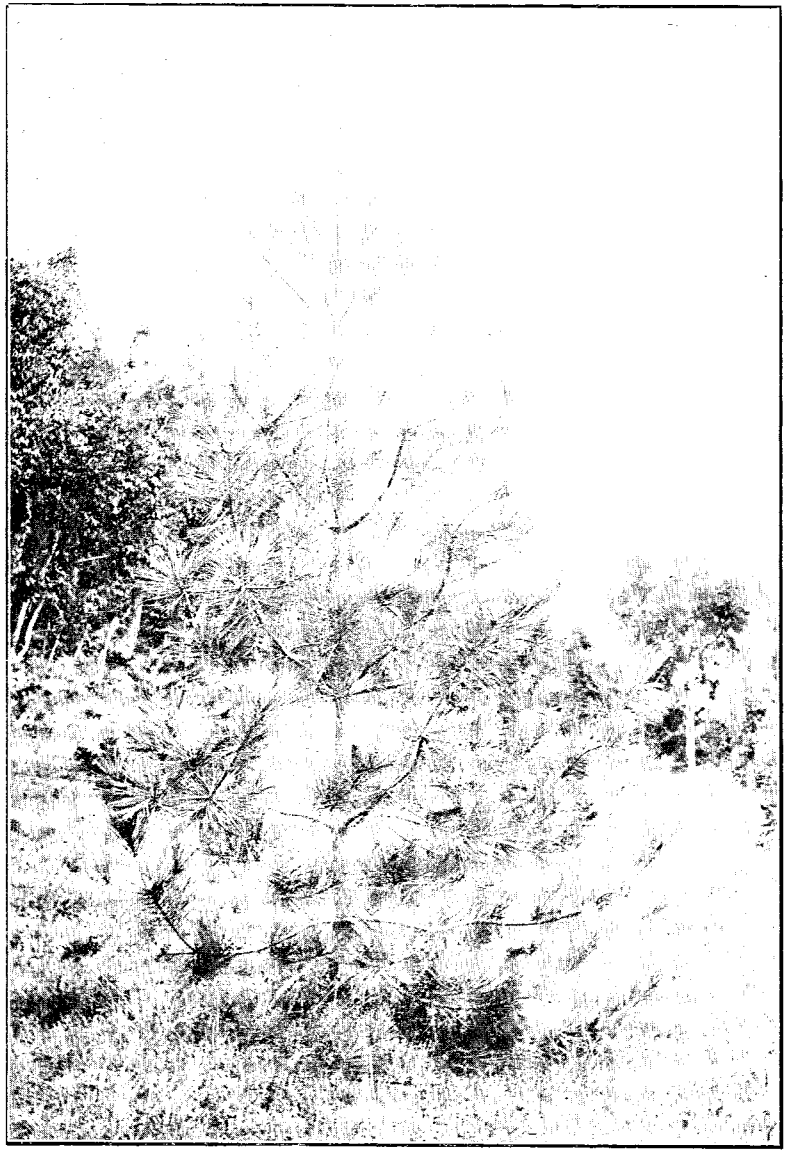
Name of Tree.	Number.	Height, in Inches.	Remarks.
Acer pseudo-platanus	4,000	14	Very good.
Alnus glutinosa	200	24	,,
Cupressus Lawsoniana	1,200	14	,,
Fraxinus americana	200	10	Poor.
,, quadrangulata	200	8	,,
Larix europaea	50,000	30	Very good.
,, leptolepis	1,000	30	,,
Picea alba	50	5	Poor.
Pinus Lambertiana	50	5	,,
,, Laricio	170,000	6	Fair.
,, Massoniana	50	5	Good.
,, Montezumae	75	4	,,
,, Monticola	20	4	Poor.
,, patula	150	26	Good.
,, ponderosa	450,000	6	,,
,, ,, var. scopulorum ..	300,000	4	Fair.
,, strobus	30,000	11	Very good.
Thuja occidentalis	500	15	Good.
	1,007,695		

ROTORUA.—PINUS STROBUS; AGE, NINE YEARS; HEIGHT, 10 FEET.

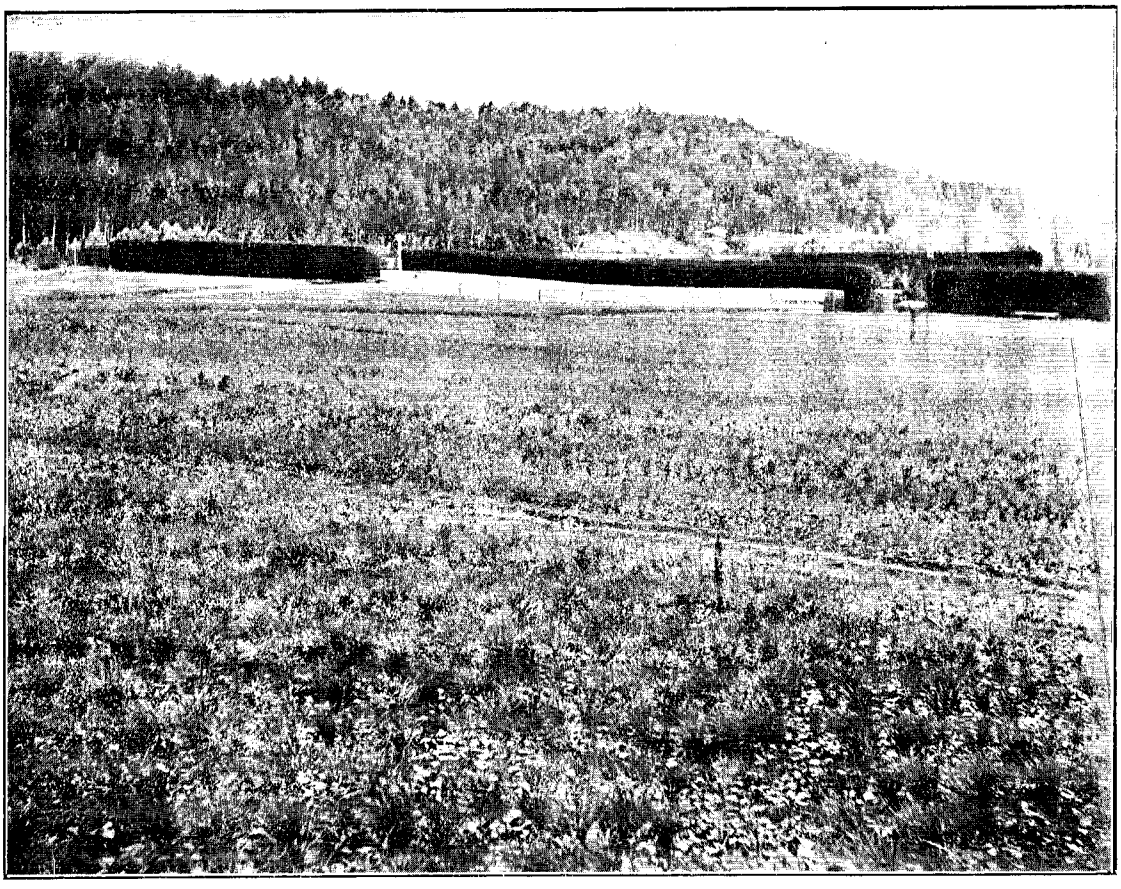
ROTORUA.—LARCH PLANTATION, FOURTEEN YEARS OLD, AFTER THINNING.



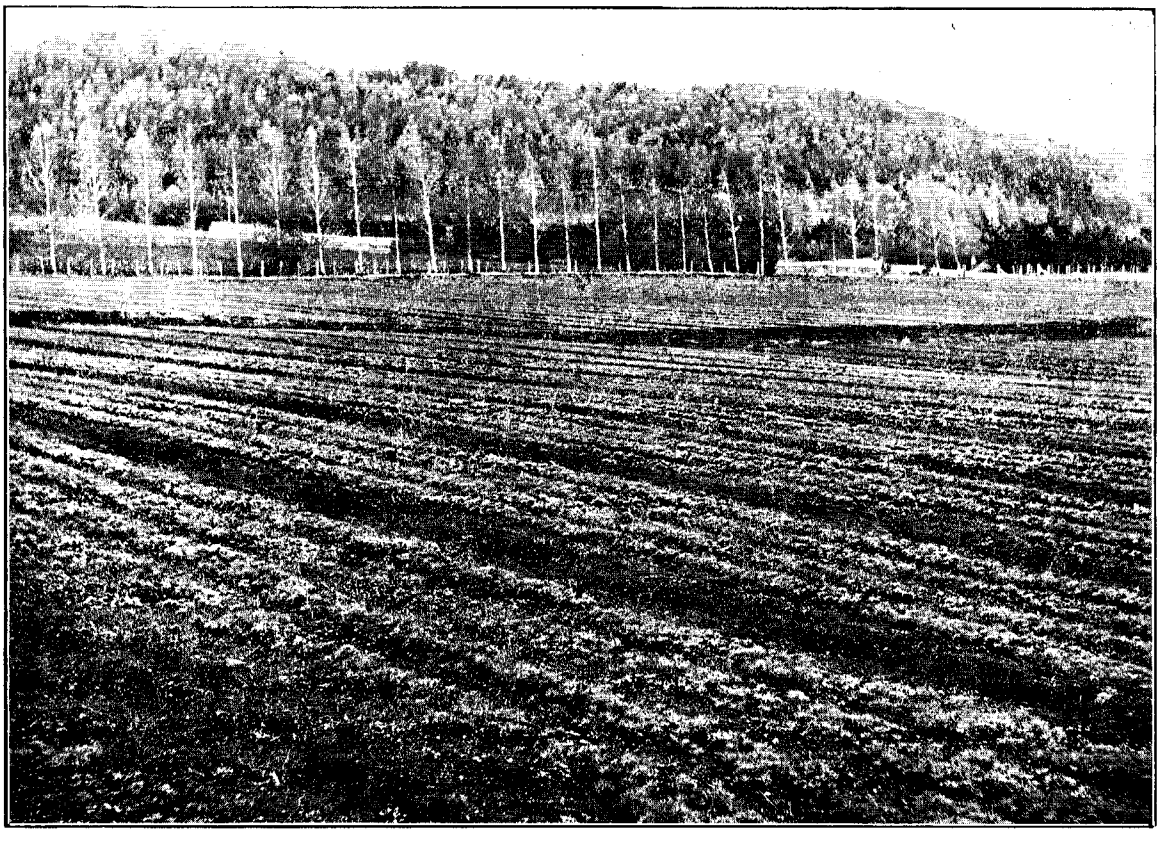
ROTORUA.—PINUS PONDEROSA: AGE, EIGHT YEARS: HEIGHT, 10 FEET.



ROTORUA.—PINUS TORREYANA: AGE, NINE YEARS: HEIGHT, 16 FEET.



ROTORUA. LINED OUT TREES.



ROTORUA. SEEDLINGS OF CORSICAN PINE. PART OF A CROP OF FIVE MILLION TREES.

KAINGAROA PLAINS. DOUGLAS FIR: AGE, FOURTEEN YEARS.

ROTORUA. SEEDLING MONTEREY PINE (PINUS RADIATA), PART OF A CROP OF 1,400,000 TREES.

Details of Trees transferred to Plantations, &c., 1914–15.

Where sent.	Name of Tree.	Number.
Whakarewarewa Plantation	Acer pseudo-platanus	600
	Castanea sativa	16,000
	Cryptomeria japonica	350
	Eucalyptus eugenioides	450
	,, globulus	400
	,, corynocalyx	1,850
	,, Macarthuri	14,600
	,, Muelleriana	200
	,, regnans	1,450
	,, saligna	1,050
	,, Sieberiana	10,400
	,, viminalis	10,000
	Larix europaea	35,000
	Picea alba	175
	,, excelsa	50
	,, sitchensis	200
	Pinus Lambertiana	325
	,, Laricio	37,000
	,, ponderosa	15,000
	,, ,, var. scopulorum	200
	,, radiata	1,050,000
	,, strobus	2,000
	Populus monolifera	2,250
	Thuja occidentalis	200
	Tsuga canadensis	50
		1,199,800
Waiotapu Plantation	Larix europaea	60,000
	Pinus Laricio	749,875
	,, ponderosa	59,900
		869,775
Kaingaroa Plains Plantation	Eucalypti (10 species)	8,500
	Pinus Laricio	1,646,150
	,, radiata	2,975
		1,657,625
Puhipuhi Plantation	Eucalyptus resinifera	221,500
	,, ,, grandiflora	38,000
	,, (25 species for trial)	350
	Pinus (14 species for trial)	150
		260,000

Summary.

Whakarewarewa Plantation	As per details above	1,199,800
Waiotapu Plantation	,,	869,775
Kaingaroa Plains Plantation	,,	1,657,625
Puhipuhi Plantation	,,	260,000
Prisons Department, Point Halswell	Pinus Laricio	40,000
,, Waikeria	,, and Eucalypti	2,000
Agricultural Department, Mamaku	,, radiata	350
Railway Department, Marton	,, radiata and Eucalypti	2,000
Public school, Johnsonville	,, radiata	100
,, Waikiekie	Shelter-trees	255
,, Kaitieke	,,	951
,, Port Albert	,,	300
Settlers' Association, Waihi	,,	5,900
Borough Council, Te Aroha	,,	1,000
Domain Board, Brightwater	Assorted trees	25
,, One-Tree Hill	Eucalypts	80
,, Kawakawa	,,	108
Boys' Home, Eltham	Shelter-trees	140
Inebriates' Home, Rotoroa	,,	525
Racecourse, Hokitika	Assorted trees	227
Public Hospital, Opotiki	,, and shrubs	228
Farmers and landowners	Collections of Eucalypti for experimental purposes	8,172
		4,049,561

Whakarewarewa Plantation.

The measure of success obtained during an average year could not be expected here during the past year, but it is pleasing to record that the result of the season's operations is far from being a failure.

With the exception of about 21,000 *Eucalypti*, all the planting on new area was done with *Pinus radiata*. This species when sent out from the nursery is generally fast grown and rather tender, and consequently cannot be planted out on recently cleared country until the severe winter frosts are over. Planting thus commenced after the drought had set in, the work being very slow on account of the difficulty of firming the soil and the necessity of careful handling in order to keep the plants in a moist condition.

Dry weather continued throughout the planting, and finally the pitting and planting of a further area which it was proposed to fill up had to be abandoned. The loss through drought will probably amount to about 20 per cent., and, although for a time the majority of the plants had a very sickly appearance, they have now quite recovered, and during the past three months have made excellent growth.

The area on which the bulk of the planting was done is high country with steep rough faces, on which the natural growth was exceptionally heavy. The average cost per acre of preparing and planting the ground was consequently a good deal more than the average for the same work during the previous season, when the land was fairly easy to work. For the distribution of trees a sledge-track had to be formed through the block, the nature of the country making this also a somewhat expensive undertaking.

The *Eucalypti* planted on new area were confined to three species—viz., *E. Macarthuri*, *E. viminalis*, and *E. goniocalyx*. Of the three, *E. Macarthuri* has shown the best results, and although there are a considerable number of failures many of the plants have made splendid growth, and this species promises to be a suitable one for more extensive planting. More failures are to be found amongst *E. viminalis*, and *E. goniocalyx* has been practically a complete failure. The aspect of the area planted was most suitable, and the plants had the advantage of being protected by a growth of young bracken.

Some 3,000 *Eucalypti*, comprising seven species, were also planted for experimental purposes, but were subjected to several frosts immediately after planting, which, together with the dry weather, caused the almost complete failure of the lot. Of the few trees surviving, the greater percentages are of *E. Macarthuri*, *E. regnans*, and *E. Muelleriana*. Of those planted to replace failures the best results have been obtained with *E. Sieberiana*.

On the oldest block of larch an area of slightly over 14 acres was underplanted, Spanish chestnut sown *in situ* being chiefly used for the purpose. But for the depredations of quail, which pulled up quite half of the seed as the sprouts broke through the surface, the crop would probably have been an excellent one.

Eleven other species of more or less shade-enduring trees were also tried, and in almost all cases remarkably few deaths have occurred, although the growth made by several species cannot be regarded as satisfactory. Those making the best growth were sycamore, Weymouth pine, *Thuja occidentalis*, *Eucalyptus globulus*, and *Cryptomeria japonica*. A number of years, however, must elapse before the suitability of any particular species for this class of work can be finally determined.

Although the growth made by the older trees has not, on the whole, been so vigorous as usual the effects of the drought have not been particularly noticeable excepting on the flats, where the larch and pines have a somewhat unhealthy appearance. On some of the low land *Pinus Laricio*, planted in 1907, was badly affected by early frosts, and the drought in the spring being against recovery many of them have since died, and others are in a very bad state.

In general maintenance-work the sum of £1,712 6s. 6d. was spent, the chief items being clearing of growth amongst trees, maintenance of fire-breaks, planting blanks, and underscrubbing and thinning larch. A total area of 150 acres of larch was thinned, 58 acres being part of the oldest block, and the other 92 acres part of a block planted in 1907. The cost per acre for the former area was £2 14s., and for the latter £1 16s. 9d. In addition, the older block had to be underscrubbed, which added an extra £2 per acre to the cost of the work. As there is at present no market for larch thinnings, and small likelihood of any in future, it is advisable that all the younger blocks be thinned as soon as possible, in order to avoid extra expenditure for which there is little probability of receiving any adequate return.

Trees to the number of 1,199,800 were received from Rotorua Nursery during the season. Of this number, 1,071,950 were planted on new area, amounting to 586 acres; 107,500 were used to replace failures; and the remainder (20,350) were used for underplanting a portion of the oldest block of larch. The greater part of the planting was done by free labour, the prisoners being responsible for 340,000 trees only, which are planted on new area. The total planted area now amounts to 6,808 acres, containing 15,017,546 trees.

An average daily number of 27·32 men were employed. The average costs of the various works undertaken were as follows: Clearing for tree-planting, £1 11s. 8d. per acre; pitting, 7s. 3d. per thousand; planting new area, 9s. 6d. per thousand; underplanting, £1 0s. 6d. per thousand; planting blanks, £1 8s. 1d. per thousand. The formation of 151 chains of sledge-track cost, on an average, 16s. 6d. per chain; and 127 chains of fencing were erected at a cost of 7s. 6d. per chain, including cartage of material and clearing of line.

Prison Labour.—The strength of the camp has been fairly well maintained throughout the year, the daily average number of men employed being 15·56, as against 11·66 for the previous year.

The work performed has consisted of clearing new area, planting, road-formation, and general maintenance, of a total value of £1,225 16s. 7d., the satisfactory manner in which it has been carried out being in a great measure due to able assistance rendered by the Prison Department officers. The clearing is now well in hand of a new area of approximately 500 acres, the pitting and planting of which

will probably keep the prisoners fully occupied during the coming season. To provide access to this area, and also to that planted during the past season, four and a half miles of road sufficiently wide to carry a buggy and pair, and two miles of bridle-track were formed. The roads have been well graded, and will later on, as time permits, be widened for heavier traffic.

Proposals for 1915.—If sufficient labour can be obtained the remainder of the unplanted land within the present enclosure will be completed. All this land consists of steep faces covered with a dense growth of bracken, tutu, and other native shrubs, and consequently the cost of clearing and planting will be about the same as that incurred on the area planted in 1914. The trees available for planting number a million and a half, and are composed chiefly of *Pinus radiata*, Douglas fir, and *Eucalyptus Macarthuri*.

Summary showing Area of Whakarewarewa Plantation (6,808·74 Acres in Trees).

How occupied.	Acres.
Larch	2,557·80
Pines	2,458·80
Blackwood	79·00
Eucalypti	1,553·50
Walnut	9·70
Spruce, *Picea*, *Pseudo-tsuga*	134·00
Birch	5·80
Alder	8·94
Poplar	1·20
Roads, tracks, and fire-breaks	391·93
Land unsuitable for planting, including swamps, creeks, horse-paddocks, residence reserves, water-main reserve	735·16
Unplanted land	1,807·97
	9,743·80

Waiotapu Plantation.

The season ending the 31st March has probably been the most trying of any in the history of the plantation. Rain was recorded on 121 days, the total fall being only 29·36 in., while the average rainfall for the past six years is 47·08 in. The heaviest monthly rainfall was 6·60 in., falling in April. The highest shade temperature was 88° F. on the 28th January, 1915, and the lowest—15°—recorded on the 18th July and the 15th August. Frosts occurred on 137 nights, this being far more frequent than in past years, due no doubt to the dry weather experienced.

In consequence of the dry weather and frequent frosts, large numbers of failures are noticeable in the season's planting. The area planted consisted mainly of tussock land, this being the most difficult class to deal with in transplanting young trees, as very few species are found to be suitable even under the most favourable weather-conditions. *Pinus ponderosa* is undoubtedly the hardiest tree grown at Waiotapu, and even with this species the death-rate is 20 per cent. In *Pinus Laricio* the failures are at the rate of from 50 to 70 per cent., according to the situation of the different blocks. In this case the frosts were as destructive as the want of sufficient moisture. Larch is considered one of the surest trees to strike, and until the advent of the grass-grub it was rarely necessary to replace failures, the percentage being so small, but this season fully half will require replacing. *Pinus radiata* resulted in a complete failure, 8 to 10 per cent. being the estimate of living trees. This species is always difficult to transplant unless showery weather prevails at the time of planting.

Trees to the number of 869,775 were received from the nursery, these being supplemented by 13,900 *Pinus radiata* lifted from a block planted two seasons ago at 4 ft. apart. In planting an area of about 206 acres 432,750 trees were used. All the suitable land in the enclosed area at Waiotapu has now been planted. *Pinus Laricio* and *Pinus ponderosa* were planted at 4 ft. apart, and *Pinus radiata* and larch at 8 ft. In replacing failures in former plantings 450,925 trees were used. The average cost of planting trees at 4 ft. apart was 6s. 8d. per thousand; larch at 8 ft. cost 11s. 6d. per thousand. The cost of this work was increased by the fact that the pits, being dug four years ago, were difficult to find.

In the older portions of the plantation the trees have not been materially affected by the abnormal season. In a few instances the height-growth is hardly up to former years; but this is most noticeable in *Pinus Laricio*, with trees from 4 ft. to 5 ft. high growing on low-lying country, the growth being about half that of the previous seasons. On the 20th November 14° of frost cut back a great many Douglas fir and large larch, which up till then were considered to be out of the late-frost area. On a block of tall *Pinus radiata* (ten years old) several fine trees have died at the tops, due principally to the drought, and in a few instances to frost. Of the pines planted at different periods for experimental purposes *Pinus Massoniana* has made rapid growth, and will probably shake off the pine aphis in another year or two. The growth of this species, with *Pinus patula* and *Pinus teocote*, exceeds that of *Pinus radiata* at this early stage, and may prove useful for planting up heavy fern country. All other species continue to make good growth, with the exception of *Pinus Lambertiana*, which is not frost-hardy.

A working plan was prepared in connection with thinning larch, and a start made at this important work. Larch even when grown to perfection does not produce a first-class all-round timber, its uses being limited to railway-sleepers, scaffolding-poles, piles, &c., where strength rather than clean timber is required. This being the case, the thinning is made heavy, the number being

reduced to about 700 trees to the acre. Where the height-growth does not exceed 10 ft. the trees are usually of an even growth, and a party of experienced workmen each take an alternate row, felling those trees that are not required, and, where necessary, marking the trees to be left on the adjoining row. Another party follows and deals with the rows left, cutting all trees but those marked. With the trees over 18 ft. high the procedure is different; the dominating trees are beginning to assert themselves, and the lower branches are brittle. Underscrubbing becomes necessary at this stage. Each man has a stout stick about 5 ft. long, with which he clears a way through the underscrub, taking care not to injure the trees, alternate rows being thus treated. Before cutting commences a competent officer with a short slasher marks all trees to be taken out. Underscrubbing costs from 11s. 6d. to £1 1s. per acre, according to the amount of undergrowth and the condition of the branches. Thinning out trees up to 10 ft. high costs from 7s. to £1 14s. per acre, and those from 18 ft. to 35 ft. cost from £2 to £2 16s. per acre, plus the cost of underscrubbing. Altogether 258 acres have been thinned for the season.

To enable a correct estimate of the areas in different species to be arrived at, the blocks are being subdivided into compartments, and when surveyed should prove useful in compiling a working plan for the pines and *Eucalypti*.

Alterations and an addition of one room and veranda were made to the officers' quarters, the whole providing very comfortable quarters. Huts for workmen are urgently required. At present the majority of the men reside in tents, and these are quite unsuitable for forming a permanent camp. The plantation has been worked by free labour for over two years, and the difficulty of getting suitable labour is increased by the want of proper accommodation.

Fire-breaks were kept free of all inflammable growth by ploughing, cutting, and burning. Tracks were made to provide quicker access to the different parts of the plantation in case of fire, and the number of these tracks will be increased as time permits. On two occasions during the year it was necessary to have the men out at night to combat fires close to the plantation. In order to reduce this to a minimum, it is proposed to burn off all scrub to at least 5 chains from the boundary-fences during the coming season.

The swamp from the horse-paddock to the creek on Blocks 4 and 5 was drained; this provided an outlet for surplus water, and also made it possible to form a convenient foot-track. A ditch was opened to provide a permanent water-supply for the No. 1 camp.

The horse-paddock at No. 2 camp has been down in grass for six years, and it is now necessary to have it renewed. Half the paddock will be ploughed ready for sowing in the spring. Paddocking for the horses belonging to workmen is necessary, as at times the men are required to work five miles from camp, making it necessary to have a horse to get about with. It is proposed to sow down the 16½-acre paddock on Block 4 for their use.

The average daily number of men employed during the year was 18·85. A record of rainfall and temperature is attached.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1914.	In.		Deg. F.	Deg. F.	
April	6·60	16	72	22	7
May	3·33	15	68	18	13
June	2·76	11	60	17	19
July	3·13	17	59	15	21
August	0·26	5	60	15	25
September	1·65	9	66	16	18
October	0·95	5	79	21	10
November	1·56	9	74	18	7
December	1·52	7	82	26	8
1915.					
January	1·90	7	88	28	3
February	0·30	4	79	31	2
March	5·40	16	77	27	4
Totals	29·36	121	..	..	137

Summary showing Area of Waiotapu Plantation (7,166·80 Acres in Trees).

How occupied.	Acres.
Larch	3,310·85
Pines	3,663·50
Eucalypti	180·50
Birch	11·95
Roads, tracks, and fire-breaks	312·30
Land unsuitable for planting, including swamps, creeks, horse-paddocks, and residence reserves	298·20
Unplanted land	Nil.
	7,777·30

Kaingaroa Plains Plantation.

During the past year the area of this plantation has been increased by 624 acres, making a total of 1,166 acres planted to date. Trees to the number of 1,658,675 were planted—1,566,175 on a new area, and the balance (92,500) used to replace failures in the former year's work. The drought has been keenly felt here, there being about 30 per cent. of failures amongst the trees planted during the year. The principal species planted was *Pinus Laricio*, which generally has been most successful here, but owing to the very dry conditions prevailing from August to February the young trees never really had a chance to pick up after transplanting. An experimental planting of eucalypts, consisting of 8,500 trees, in ten species, was made, but these failed absolutely, possibly owing to the drought; but it is probable that only the hardiest kinds will succeed here. The small nursery which was started last spring has proved to be an excellent idea. Between 800,000 and 900,000 small seedling *Pinus ponderosa* were lined out, and have made very satisfactory growth. The weeding of these has been done by a few of the prisoners during broken weather, when the plantation-work could not be undertaken, and consequently it has been unnecessary to employ extra men for the purpose. A further considerable saving has been effected in the carting of these trees, for whereas the whole of the seedlings were carted from Rotorua in two loads, with the extra growth made they would now make from eight to ten wagon-loads. It is proposed to extend this system very considerably, and for this purpose an area of 20 acres is now in course of preparation. Provision will thus be made for lining out all the trees required here a season ahead of the actual planting, the seedlings being supplied from the nursery at Rotorua.

The subdividing of the land set apart for afforestation into blocks of about 300 acres has progressed very well, and there is now sufficient land dealt with to enable the planting to proceed for the next two years. The survey-work will be continued until the whole reserve of 33,355 acres is completed, and a detailed plan of the whole prepared. At the present time the fire-breaks are being left 4 chains wide. It is proposed to leave a permanent fire-break 2 chains in width, and plant up the remaining 2 chains with a deciduous tree which will not readily carry fire. A tree to fulfil these conditions is difficult to select, owing to the prevalence of frosts during the spring and summer months. Poplars, which would be excellent for the purpose, are most susceptible to these unseasonable frosts, and most other deciduous trees are equally so. It is thought that this difficulty might be overcome by planting a mixture, or by underplanting, and an experiment in this direction will be made on a small scale next winter by planting one of the fire-breaks with a mixture of larch and sweet-chestnut. If the chestnut proves suitable the larch can be cut out as soon as the chestnut becomes thoroughly established.

The prison labour performed work to the value of £1,676 8s. 8d. during the year.

The number of pits available for tree-planting during the coming winter is 2,000,000. The principal species to be planted are *Pinus ponderosa*, *Pinus radiata*, and Douglas fir.

About 100 acres of land surrounding the prison camp has been reserved for paddocks and for nursery purposes, and it is proposed to gradually increase the fertility of this by a rotation of crops. With this in view, a portion of the area now under grass will be ploughed and sown with oats, which crop will be followed with a sowing of grass and clovers. It is hoped that by this method the land will gradually be brought into good condition for nursery purposes, and at the same time supply the wants of the station as regards grazing, &c.

The average number of men employed was as follows: Free men, 3·77; prisoners, 17·45.

A record of rainfall and temperature for the year is attached.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1914.	In.		Deg. F.	Deg. F.	
April	6·02	18	68	30	4
May	3·17	15	63	27	9
June	2·40	11	58	24	17
July	3·67	17	58	19	21
August	0·56	7	59	23	16
September	2·17	11	67	24	13
October	1·16	5	76	28	9
November	1·35	10	75	25	2
December	1·96	10	81	31	3
1915.					
January	2·00	9	88	35	..
February	0·60	6	80	31	1
March	4·58	11	78	31	1
Totals	29·64	130	..	..	96

Summary showing Area of Kaingaroa Plains Plantation (1,166·48 Acres in Trees).

How occupied.	Acres.
Pines	1,153·34
Eucalypti	13·14
Fire-breaks (not yet calculated)	..
Unplanted land	32,188·52
	33,355·00

PUHIPUHI PLANTATION.

As may be seen by the record of rainfall and temperatures attached hereto, the past year has been a very dry one. In spite of this fact, however, the results obtained with the trees planted during last winter have been very satisfactory. An area of 250 acres (approximately) upon which totara had been planted some years ago was cleaned and burned, and replanted with *Eucalyptus resinifera* (red-mahogany) and its variety *E. resinifera grandiflora* (mountain-mahogany). The death-rate is estimated at 12 per cent. During the early summer the progress made by the newly planted trees was somewhat slow, but in the early autumn they began to freshen up, and since have made splendid headway. The mountain-mahogany is simply a large-fruited form of the red-mahogany, and it appears to be the better tree of the two for this district. From the seedling state it is ever so much more vigorous, and there is every indication that it will be a faster-growing tree than its congener. The seedlings used for planting were supplied from Rotorua Nursery, and were sent by rail and steamer packed in cases. Generally the time occupied on the journey was four days, but on several occasions the trees were in the cases five or six days, with the result that many were lost owing to them becoming heated. The losses due to delay in transportation amounted to 38 per cent. of the total trees sent, so that it will readily be understood that if planting was to be carried on on an extensive scale in this district it would be more profitable to open a small nursery at Puhipuhi to raise the trees. Fortunately the crop of eucalypts largely exceeded the estimate, owing to the especially good quality of the seed, so that the loss did not at all interfere with the planting proposals for the year.

It is proposed to plant another 150 acres during the coming year with mountain-mahogany and *Eucalyptus Macarthuri*.

The average daily number of men employed during the year was 5·21. Following is a record of the rainfall and temperature:—

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1914.	In.		Deg. F.	Deg. F.	
April	3·14	13	68	40	..
May	3·00	14	60	32	3
June	2·00	18	60	32	4
July	3·02	22	60	32	4
August	3·38	17	60	32	4
September	2·33	10	66	32	1
October	1·19	8	70	32	2
November	0·77	6	70	34	..
December	0·42	4	82	40	..
1915.					
January	0·99	6	90	46	..
February	0·51	6	92	40	..
March	7·42	12	76	40	..
Totals	28·17	136	..	..	18

REPORT ON AFFORESTATION OPERATIONS IN THE SOUTH ISLAND.

[By the Superintending Nurseryman, Tapanui.]

A general review of the year's afforestation operations reveals the attainment of very similar results to those specially commented upon in earlier reports. New experiences gained each year, however, enable the Department to put into practice methods having an economic bearing and improvement upon those superseded. Under separate headings are disclosed some of the leading features connected with the year's undertakings, and district reports contain information that will doubtless be valuable to persons interested in the progress of any particular tree-planting station. Certain abbreviations have been made in the compilation of returns this year, and as circumstances arise efforts will be made to still further curtail statistical matter. Several valuable ideas for giving publicity to our operations were discussed at a recent forestry conference in Wellington, but could not be judiciously introduced this year, as sufficient data were not available for accurate tabulation. Adverse climatic conditions have been instrumental in causing unusually severe losses in seedlings raised, particularly in the Otago nurseries, and perhaps the prevalence of constantly recurring high winds may be singled out as being the paramount cause of the minimized success. The intensely dry weather experienced at Ranfurly can be gauged from the fact that only 7·34 in. of rain fell for the six months ended December—a period over which a fair amount of moisture is essential if even moderately successful issues are to be the outcome of our tree-planting work. On perusal of Otago Central meteorological records it is possible to understand the disadvantages under which the Department has to labour there, although on our more recently acquired plantation area adjacent to the Naseby reservoir the rainfall not only greatly exceeds that registered on the plains, but precipitations are of a more frequent occurrence. It is indeed fortu-

nate that our young forests were not called upon to withstand the terrific gales experienced in parts of Canterbury during October, otherwise deplorable losses might have ensued. Irreparable injury was created to several of the large Selwyn plantations of *Pinus radiata* and *Eucalypti*, and wholesale removal of trees and subsequent replanting is now being resorted to in the endeavour to restore the useful purpose of the almost indispensable shelter-breaks. It is indeed surprising that such havoc should so suddenly be played with trees that have thriven for thirty years or more. We are thus opposed to a greater adversary in the wind-factor than was supposed, and must make still greater provision for the inclusion of pioneer wind-resisting trees on the northern and western quarters of exposed plantations.

Brief Allusions to Unsuitable Practices.

With the development of plantations the effects arising from the injudicious selection of trees for certain positions becomes more pronounced, and as knowledge regarding local conditions and behaviour of certain trees, when confined to uncongenial situations, is acquired, areas planted with unsuitable varieties are again being dealt with. Previous references have been made to the experimental nature of much of our tree-planting work. Although the results achieved by New Zealand's pioneer tree-planters demonstrated clearly what might be accomplished under a variety of conditions, the fact cannot be overlooked that the State in its earlier operations was confronted with sylvicultural problems the solving of which could only be determined by well-directed and sustained experiments. Although the necessity for somewhat extensive replanting-work is regrettable, New Zealand's experience in this direction is not unique, as personal observation during my recent tour disclosed the introduction of equally drastic measures, even where scientific forestry practices have been in evidence for generations. At each of our stations instances of what not to do are conspicuous, and it is only by the strict observance of the conduct of trees under varied influences that we can ever hope to make afforestation on second- or third-class lands a remunerative proposition. In the southern plantations the hardwoods—*Fraxinus excelsior*, *Quercus pedunculata*, and *Acer pseudo-platanus*—were not only originally used in admixture, but were allotted some of the most exposed positions, with the result that after about twelve years the trees would not average an annual vertical development of 4 in.; and, further, in nearly every case the shelter afforded by pines in the vicinity has had no appreciable effect upon the apparent barkbound hardwoods. Then, again, both Douglas fir and Sitka spruce have been intensely disappointing, owing to the susceptibility of their tender leaders to injury from high winds. Although a fair proportion of these trees are making good headway in the highly sheltered valleys, the progress of those placed at more elevated situations gives indication of their being in a constant state of interruption, and consequently even partial success cannot reasonably be anticipated from these varieties under the conditions outlined. In Central Otago larch and pines (both light-demanding trees, but of entirely different progressive habits) have been planted together, and after about the fifteenth year the former variety has completely outstripped and promises to quickly suppress its more valuable neighbour. At Hanmer Springs a fairly large area of ground is covered with *Picea excelsa*. We have shared the optimistic opinions entertained by sylviculturists generally regarding the probability of rapid headway on the spruces becoming quite established; but after some ten or twelve years' watchfulness there appears to be no other alternative than to replant the area with fast-growing pines, and assist any of the shade-bearers that may find the eventuating conditions congenial. Our operations with the sensitive larch have also not been completely successful, and over a very large area the probable results cannot yet be forecasted with any degree of certainty. It is certain, however, that where this variety of tree is subjected to such almost incessant boisterous winds as have been experienced in portions of South Otago during the past four seasons the production of straight boles for milling purposes is an impossibility; nor is the creation of efficient protective shelter-belts across fairly abrupt hill-faces with a westerly aspect practicable. Contrary to expectations, the larch are somewhat easily affected by winds, and the trees are assuming that decided leaning tendency which seriously interferes with the future conversion of such timber. There can be no doubt, then, that a very large proportion of ground earmarked for future operations in the South is only suitable for the production of pinewood, whilst hard woods should be lightly represented by the more sturdy species of *Eucalypti* in place of the overplanted English ash and oak.

Promoting Economy by increasing Planting-distances.

Although allusions to the above matter have been made in the special report appended, further explanatory references in support of the proposition will doubtless not be out of place here, particularly as our planting policy has already been affected by the adoption of the measures advocated. What must be considered as one of the most important alterations in the afforestation scheme originally devised is the decision to increase spacing-distances between trees. This idea has only matured after careful investigation into, and comparison with, methods adopted in other countries. In Europe the combined agencies of cheap labour and ready sale for even such waste as pine-needles (which are utilized for bedding stock) make close planting justifiable; but generally in New Zealand we are faced with reversed circumstances, and therefore aim at creating district forests that will meet the requirements of the locality. The increasing of our spacing for, say, *Pinus Laricio* from 4 ft. up to 4 ft. 6 in. and 5 ft., and *P. radiata* to even 8 ft. (according to circumstances), in the South Island will during the coming year effect a saving of at least £800 in actual planting-work alone, whilst the future maintenance and thinning operations will have an appreciable effect upon the economic issue. It will be readily understood that under the new spacing-scale afforestation areas will be more readily exhausted should the present output be continued, for in place of 1,000,000 trees occupying 368 acres as formerly, this number in equal division of *Pinus Laricio* and *P. radiata* will require an area of 600 acres.

Experimental Work in connection with recent Reservations.

During the year an inspection of several large areas was made with a view to their resumption or acquisition for afforestation purposes, and the authority given to conduct experimental work at Galloway and Omarama, Otago—both extremely arid localities, where much data relative to the sylvical characteristics of several commercially valuable trees has not been secured—promises to simplify any future operations that may be undertaken. An early start will be made on each reservation by enclosing 2 or 3 acres, and a sufficient number of well-selected trees planted as will provide the necessary knowledge to permit of the adoption of a general planting-scheme that will meet local requirements, and entail a minimum outlay in establishment and subsequent management. It is gratifying to know that at each experimental area little danger from exterior fires is anticipated, as no vegetation of an inflammable nature clothes the surrounding surface. All work will be carried on precisely after the manner adopted in the more favoured localities, and the artificial application of water to young trees will not be general. The result, then, should furnish ample statistics for the compilation next year of an interesting report on the proposition, and also provide data of a valuable nature to adjacent settlers should they be desirous of undertaking tree-planting work under abnormal conditions.

Tree-raising Work.

In raising 6,658,630 seedlings the germinating-percentage must be regarded with much satisfaction. As seed of our principal tree—*Pinus Laricio*—was unprocurable for the previous year's sowing, the purchase of 398 lb. of seed and raising of some 4,600,000 pines of this species is perhaps the most interesting phase of the season's operations. Another excellent result has been attained in the production of over 750,000 sturdy *Pinus radiata* from 118 lb. of colonial seed. Also included amongst the year's total are the seedlings that have been specially grown for distribution to farmers, although a further year's development in these plants is essential ere the scheme can be launched in its entirety. Equally favourable returns have accrued from comparatively small sowings of the hardier species of gum—*Eucalyptus viminalis, E. Macarthuri, E. Muellerii,* and others—and in each district where afforestation-work is being conducted experiments with these trees will be made this season on a fairly extensive scale. The drying influence of high winds experienced during springtime caused tremendous losses in lined-out stock at both the Otago stations, but particularly at Tapanui Nursery, where over 30 per cent. of failures in transplantation eventuated. Immediately succeeding the transference to lines strong winds swept across the partially sheltered "breaks," and practically withered up thousands of the tender plants, even before the sap became active. Even those that survived remained in almost a dormant state until very late in the summer, when the prevalence of greater humidity caused extraordinarily vigorous growth. A trial sowing in unprotected drills of *Pinus radiata* seed, which had been immersed in a batter of red-lead and water, has been attended with such encouraging results that the future extension of the practice is justified. It is evident that the treatment is sufficiently effective for some time, as until germination begins the birds show no inclination to break the shell covering. Notwithstanding the complete inattention to the trial lines after sowing, a very fair growing-percentage resulted, and an unquestionably better class of fibrous rooted seedling for permanent planting remains. An attempt will be made in subsequent sowings to render the seed still less enticing to birds, by adding to the batter a more highly poisonous fluid. It is estimated that over 2,500,000 trees will be sufficiently advanced for permanent planting this winter, and, having sown a much larger quantity of seed this year than formerly, the operating nurseries should be in a position to greatly increase the subsequent output. Since the initiation of afforestation-work in the South Island some 26,680,158 trees of various ages have been utilized in extending State plantations, whilst an additional 2,731,773 have benefited domains and public institutions.

Plantation-work and General Comments.

The total expenditure allocated to the general maintenance of the established plantations and extension work reached £6,420 0s. 10d. Some 749¼ acres were afforested with 2,022,135 trees, in addition to a further 221,254 for replanting purposes. On a statement preceding the report will be seen details supporting an expenditure of £90,051 1s. 1d. since initiation, and, although 21,367,564 trees were originally used in the planting of 8,223 acres at the various stations, probably 30 per cent. of this number have, since attaining the desired object, been naturally suppressed. The usual measures were adopted in carrying on the various works, although the slightly increased cost in pitting and planting must be attributed to the existence of much less regular conditions. Solely free labour has been directed upon tree-planting work this year. The effect of the war is now being felt, as the gradual exodus for the front of the right type of plantation worker makes it a difficult matter to replace him. Already nine employees have been accepted for active service by the Defence Department, and others are contemplating a similar move. The progress of trees, which is detailed in each of the district stations, may be regarded as equally satisfactory as in previous years, and specially pleasing is the upright development of trees growing at our Canterbury plantation. Thinning operations have begun on a small scale at Hanmer Springs, where it has become necessary to give more growing-space to the ten-year-old *Pinus radiata*. It was my intention of referring to this matter at some length; sufficient data, through the incompletion of the undertaking, not being available, a special tabulated review will be included in a subsequent return. So far the actual expenditure attached to the cutting down, removal, and stacking of a cord of timber for firewood purposes amounts to 10s., and as the disposal of the pinewood at £1 per cord, delivered locally, promises to be an easy matter, the future financial success associated with our preliminary timber-cutting is promising.

Volume of Timber ascertained by Sample-plot Methods.

The collecting and tabulating of records bearing on the annual increment and timber volume of growing trees in our youthful plantations has now been instituted, as it is chiefly in the possession of such data that the correction of close planting can be determined, and thinning resorted to. Some eight sample plots have been permanently pegged off at Dusky Hill Plantation and one at Tapanui Nursery by Mr. W. A. Fraser, B.Sc. (Forestry), and the statistics relating thereto are appended. Most encouraging returns are revealed in the tables, and it is evident that trees planted in New Zealand develop with greater rapidity than in either Great Britain or Germany. For instance, at Dusky Hill the volume of timber per acre over a fifteen-year-old larch area in Serial No. 1 amounts to 2,565 cubic feet, whilst only 1,890 cubic feet is calculated in the yield tables over a twenty-year-old similar block in Saxony. Perhaps the plot of pure *Pinus radiata* (which has been planted at slightly over 8 ft. apart, and has developed rather heavy branching habits) discloses the most satisfactory returns, as after nine years planting 3,009 cubic feet of timber has been produced, whereas in North Germany less than 800 cubic feet of the comparatively fast-growing *Pinus sylvestris* is expected over a similar growing-period. A minute examination of specimen larch shows the annually reducing rate of girth-expansion, and a light thinning in the more advanced blocks might be undertaken at any time now with improving prospects. Arrangements are now complete for the subdivision of blocks in the South Island plantations by a competent surveyor, and efforts will be made to place the earlier plantings on a more satisfactory basis for recording purposes.

Details of Sample Plots, Tapanui District.

Serial Number of Sample Plot.	Area of Sample Plot, in Acres.	Species.	Age, in Years.	Number of Trees planted per Acre.	Number of Trees now Dead per Acre.	Number of Trees per Acre under 3 in. Diameter at B.H.	Number of Trees per Acre over 3 in. Diameter at B.H.	Average Diameter at B.H., in Inches, of Trees over 3 in.	Average Height, in Feet.	Volume per Acre, in Cubic Feet.		
										Timber over 3 in. Diameter at Small End.	Tree-tops and Trees under 3 in. Diameter.	Total.
I	0·30	European larch ..	15	2,032	596	110	1,326	4·70	37·0	2,380	185	2,565
		Douglas fir ..	15	196	0	140	56	4·75	15·0	70	15	85
		Norway spruce ..	9	120	26	94	0	..	2·5	..	..	..
		Ash	15	330	0	330	0	..	20·0	..	..	..
				2,678	632	674	1,382	..	..	2,450	200	2,650
II	0·20	European larch ..	14	2,230	345	165	1,720	4·45	34·0	2,124	374	2,498
		Douglas fir ..	14	225	0	225	0	..	10·0	..	..	..
		Norway spruce ..	9	180	15	145	0	..	2·5	..	..	..
		Ash	14	385	10	375	0	..	20·0	..	..	..
				3,020	390	910	1,720	..	..	2,124	374	2,498
III	0·20	Maritime pine ..	14	2,240	250	170	1,820	4·70	30·5	3,171	398	3,569
		Oak, ash, sycamore	14	746	0	746	0	..	18·0	..	..	..
				2,986	250	916	1,820	..	..	3,171	398	3,569
IV	0·20	European larch ..	13	2,652	277	375	2,000	3·85	29·0	1,800	662	2,462
		Walnut	13	108	107	1	0	..	..	..	..	..
				2,760	384	376	2,000	..	..	1,800	662	2,462
V	0·20	Japanese larch ..	14	2,560	360	400	1,800	4·00	25·5	1,776	486	2,262
VI	0·20	Austrian pine ..	14	2,160	35	170	1,955	4·20	20·5	2,335	305	2,640
		Oak, ash, sycamore	14	750	0	746	0	..	15·0	..	..	..
				2,910	35	916	1,955	..	..	2,335	305	2,640
VII	0·40	*Populus deltoides*	11	795	17	110	668	4·00	27·5	545	303	848
VIII	0·20	European larch ..	12	2,425	165	585	1,675	3·70	26·5	1,148	312	1,460
		Walnut	12	108	73	35	0	..	..	..	..	..
				2,533	238	620	1,675	..	..	1,148	312	1,460
IX	0·24	*Pinus radiata* ..	9	538	0	5	533	7·35	42·5	2,869	140	3,009

Fire-breaks.—Substituting Grazing for Cultivation.

For the past three years the increasing amount of labour devoted to the keeping of fire-lines in an efficient state emphasized the importance attached to the substitution of some means that might be advantageously employed in attaining the same purpose with a reduced expenditure, and successful trials extending over that period have been made with a small flock of sheep. The animals were liberated on the Conical Hills Plantation, where trees have attained a height ranging between 5 ft. and 25 ft. The optimistic opinions harboured have been borne out by direct results, as the sheep have remained well on the fire-lines, and kept the herbage closely cropped. No damage to trees has

eventuated, and by the sale of wool and lambs it has been possible to enlarge the original flock until the venture now shows a 30-per-cent. profit on the original outlay. In furtherance of the projected extension in our grazing-scheme, £200 was authorized for the purchase of full-mouthed ewes, 220 of which have been secured for three of the plantations. It can be confidently expected that less cultivation-work will be essential next season, when a full report on the whole matter will be submitted. Fire-lines aggregating 290 acres have been ploughed or cultivated on the four plantations for protective purposes, an expenditure of about £155 having been incurred in this direction. Recognizing the importance of providing the means for speedy communication between two or three centres on large plantations, the installation of a private service at Conical Hills was carried out, and, apart from the simpler measure thus provided for assembling employees in the event of an outbreak of fire, the telephone has proved its extreme usefulness as a time-saver in management generally.

Trees for Farmers.

In pursuance of the decision to supply farmers with shelter and timber trees at cost price the following varieties and quantity of seed were sown during the latter part of the season:—

Pinus Laricio	6 lb.
,, ponderosa	40 lb.
,, radiata	30 lb.
,, maritima	10 lb.
Pseudo-tsuga taxifolia	15 lb.
Picea sitchensis	1 lb.
Populus deltoides	2,000 cuttings.

With the exception of *Pseudo-tsuga taxifolia* and *Picea sitchensis* the results are distinctly good, as nearly 250,000 sturdy plants have thus supplemented our main sowings. Whilst a limited number of *Pinus radiata* could already be drawn from this source for distribution to the most favourable localities with fair prospects of success, past experience in operating over the greater portion of the South Island emphasizes the necessity of using two-year-old ordinarily grown pines to ensure the best returns. Both poplars and gums, however, may be permanently planted about a year after the commencement of propagation. A circular indicating the terms upon which trees may be secured, and disclosing details relative to the varieties available, is being printed by the Department; and in dealing with *bona fide* applications every effort will be made to establish shelter-belts or wood-lots economically and expeditiously, although absolute smoothness in promulgating the scheme cannot reasonably be expected until an idea of the farmer's requirements are ascertained.

Proposals for 1915–16.

State Plantations.—During the coming year slightly over 2,500,000 trees will be utilized in extending the various South Island State plantations by 1,450 acres.

Trees for Farmers.—It is anticipated that approximately 50,000 trees will be requisitioned for by farmers wishing to take advantage of the scheme initiated this season.

Domains and Public Bodies.—Every effort is being directed upon supplying the needs of the Mackenzie County Council and Selwyn Plantation Board, and probably 150,000 trees will be distributed to these bodies at cost price.

Acquirement of Land and Experimental Work.—At both Tapanui and Hanmer Springs districts the resumption or acquirement of land for extension purposes is necessary. Beyond the establishment of experimental plantations at Omarama and Galloway, several important trials associated with tree-raising will be undertaken.

General.

During my five and a half months absence in Europe and America Mr. W. T. Morrison, Nursery Foreman, Tapanui, carried out the Superintending Nurseryman's duties with much ability, and was ably supported by Mr. J. Hetherton, clerical assistant.

A report covering experiences in America and the Continent appears as an appendix, and the educational value to me from the comparatively short tour may be gathered by a perusal of the matter.

The gradually increasing amount of inspection-work inseparable from the expansion of operations made it necessary to purchase a motor-car, and more time is now available for attending to clerical duties and personal supervision.

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

Tapanui Nursery, Otago.

(Area, 173 acres; altitude, 500 ft.; established, 1897.)

In common with most parts of Otago, the past season here has in a way been a severe one, owing to the prevalence of persistent and heavy winds and an almost total absence of those conditions of humidity so necessary at a certain period of the season for the successful raising and growth of trees. Although the weather-records show no exceptional extremes of either heat or cold, with the exception of a few weeks at the beginning of January, the weather throughout the season has been consistently cold and unconducive to the development of young nursery stock. In the spring and early summer months quite abnormal gales for this district were experienced day after day, and to this must be attributed in a great measure a partial failure in the transplanting of *Pinus radiata* seedlings from seed-beds to nursery-lines.

Raising of Seedlings.—Fortunately we were able to avail ourselves of a week of fine weather in October for seed-sowing operations, and the bulk of the seed was sown under ideal conditions both as regards soil and weather. The resultant crop shows good germinative qualities in most of the seed dealt with; but it cannot be claimed that the seedlings, excepting perhaps *Pinus radiata*, have since made as much growth as might have been desired in order to ensure successful transplanting the following season. About three weeks prior to the main sowing, which commenced on the 14th October, a small sowing of *Pinus radiata* was made in order to test the effect of a longer growing-period; but the result does not show any considerable difference in the development of the seedlings as compared with those sown later, although if done early enough, and with a good season following, there is no doubt that sturdier trees would be the result. With one or two exceptions almost all seeds germinated well, the exceptions being *Pinus Lambertiana* and part of *P. ponderosa*, the failures being due to poor seed. A feature of the seed-beds this season is the absence of any apparent damage to seedlings by the grass-grub, due probably to the fallowing of the ground for two seasons and subsequent frequent ploughing and cultivation. About the middle of December a sowing of various *Eucalypti* was made, with in most cases very good results, the varieties which gave the best results being *Euc. Macarthurii*, *E. viminalis*, and *E. Sieberiana*. A trial sowing was made late in the season of a few drills of *Pinus radiata*, in order to test the advisability of adopting this method of dealing with this species. The seed was first coated with a mixture of red-lead and water to protect them from birds; but this does not seem to be entirely effective, although the idea merits a further trial. The total estimated number of seedlings in stock is 3,284,500.

Transplanted Trees.—With the exception of the *Pinus radiata* seedlings previously mentioned, and also *Cupressus macrocarpa*, most of the trees lined out this season have struck fairly well, especially a break of about 75,000 *P. austriaca*, in which there is hardly a death; but the growth made subsequently has not been up to the usual standard, owing to the adverse climatic conditions experienced. About 5,000 *Populus deltoides* cuttings were prepared and put in, and these have done well, almost 100 per cent. "striking." It is satisfactory to be able to state that the grass-grub is not in evidence to any extent amongst the lined-out trees this season, and no material damage has been done by this pest.

Preparation of Ground.—Although there has been an absence of good growing-conditions throughout the season, the ground has seldom been too wet to carry on systematic tillage of all nursery "breaks" not at present occupied by trees. These breaks have been continuously ridged and cultivated throughout the season, and it is anticipated that it will not only help to sweeten and generally benefit the soil, but will to a great extent tend to exterminate the grass-grub, which has caused so much damage in previous years. It will become necessary, however, to again utilize next season some of the breaks which are at present in crop; and this shortage of suitable nursery-ground constitutes one of our main difficulties in dealing with the grass-grub pest, and also in instituting a proper rotation of cropping.

Horse-feed.—About 18 acres of land was prepared and sown down in oats, and an excellent yield of about 36 tons of oaten sheaves was the result. This should be sufficient to keep the horses in chaff and oats well on into the following season, and, according to the trend of prices for horse-feed, should prove a very good asset. A considerable quantity of hay (about 20 tons) was also harvested, and about 1 acre of swede turnips has given good results.

Miscellaneous Works.—Several minor improvements have been effected during the year, and all buildings and gates have received a coat of paint. Several of the roads were regravelled, and everything is now in order to proceed with the usual winter work of lifting and transfer of trees.

The expenditure amounted to £2,063 1s. 5d., providing employment for an average of ten men; and the anticipated output for the coming season may be put down at 900,000 trees.

Rainfall, Temperature, &c.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1914.	In.		Deg. F.	Deg. F.	
April	7·12	16	67	29	4
May	2·83	13	62	25	16
June	5·02	20	55	28	10
July	2·56	17	58	21	12
August	2·48	16	65	26	18
September	2·75	19	71	27	7
October	2·25	12	78	29	3
November	3·65	19	77	31	2
December	3·22	17	87	32	1
1915.					
January	3·95	17	86	34	..
February	3·58	16	78	33	..
March	2·97	13	81	30	3
Totals	42·38	195	..	..	76

Details of One-year-old Trees, sown 1914–15.

Name of Tree.	Number in Seed-beds.	Height, in Inches.	Amount of Seed sown.	Remarks.
			Lb.	
Pinus Laricio	2,450,000	1½	178	Medium crop.
,, ponderosa	267,000	1½	90	,,
,, Benthamiana	18,000	2½	7	,,
,, radiata	400,000	4	60	Strong plants.
,, muricata	8,000	1½	1	,,
,, Taeda	10,000	2	2	Fair results.
Pseudo-tsuga taxifolia	35,000	1½	15	Germinated thinly.
Cupressus macrocarpa	10,000	4	2	Fair crop.
Eucalyptus Macarthuri	58,000	4	2¼	Excellent results.
,, viminalis	22,000	6	¾	
			Oz.	
,, Sieberiana	5,800	2½	2	For experimental purposes.
,, obliqua	300	2½	2	
,, piperita	300	2½	1	
,, Muelleri	100	2	¼	
Total	3,284,500	..	..	

Details of Two-year-old Trees, sown 1913–14.

Name of Tree.	Number in Seed-beds.	Number in Nursery-lines.	Height, in Inches.	Remarks.
Pinus Laricio	100,000	..	6	Strong plants.
,, ponderosa	145,000	..	8	,,
,, ,, ...	..	50,000	4	Sturdy trees.
,, austriaca	145,000	..	6	Well-rooted trees.
,, ,, ...	..	72,000	6	,,
,, radiata	..	270,000	6	Sturdy trees.
,, scopulorum	38,000	..	6	,,
,, muricata	..	9,000	5	,,
Larix europaea	..	13,000	10	Fair crop.
,, leptolepis	..	3,000	10	,,
Alnus glutinosa	..	3,000	12	Sturdy trees.
Totals	428,000	420,000	..	
	848,000			

Details of Three-year-old Trees, sown 1912–13.

Name of Tree.	Number in Nursery-lines.	Height, in Inches.	Remarks.
Pinus Laricio	457,000	4	Nearly all these trees have grown sufficiently sturdy to merit permanent planting this season.
,, ponderosa	8,800	8	
,, Benthamiana	600	8	
,, radiata	3,500	11	
,, muricata	1,500	6	
,, maritima	800	5	
,, Taeda	500	5	
Cupressus macrocarpa	50	8	
Fraxinus americana	80	8	
Populus deltoides	4,900	18	
Total..	477,730	..	

Trees transferred from Nurseries to Plantations, &c., 1914-15.

Where sent.	Name of Tree.	Number.	Height, in Inches.	Remarks.
Conical Hills Plantation	Pinus Laricio	320,200	6	An excellent growing-percentage has resulted.
	,, ponderosa	144,650	7	
	,, Benthamiana	5,425	7	
	,, radiata	115,775	8	
	,, muricata	11,875	9	
	,, maritima	1,000	10	
	,, Taeda	925	8	
	,, scopulorum	800	7	
	Picea sitchensis	29,275	8	
	Pseudo-tsuga taxifolia	1,625	10	
	Larix europaea	17,075	12	
	,, leptolepis	5,500	9	
	Alnus glutinosa	1,769	10	
	Cupressus macrocarpa	1,325	12	
	Chamaecyparis Lawsoniana	225	8	
	Betula alba	200	12	
	Populus deltoides (cuttings)	2,525	..	
		660,169	..	
Dusky Hill Plantation	Pinus radiata	2,700	10	For replanting purposes.
	,, sylvestris	10	8	
	Olearia Forsteri	100	..	
		2,810	..	
Selwyn Plantations	Pinus Laricio	10,000	6	
	,, radiata	5,000	8	
		15,000	..	
Conical Hills Plantation	As per details above	660,169	..	
Dusky Hill Plantation	,,	2,810	..	
Selwyn Plantations	,,	15,000	..	
Hanmer Springs Nursery	Populus deltoides (cuttings)	200	..	
P. and T. Dept., Wellington	Assorted pines	5,000	..	
,, Awarua	,,	1,400	..	
Department of Agriculture	,,	5,990	..	
Cromwell Domain Board	Pinus radiata	2,000	..	
Hyde Domain Board	Assorted trees	500	..	
Burnham Industrial School	,,	500	..	
Terrace Orchard Company	,,	325	..	
Brighton Improvement Society	,,	240	..	
Church grounds, Pembroke	,,	112	..	
Brightwater Domain Board	,,	60	..	
Roxburgh Beautifying Society	,,	50	..	
Tongariro National Park	Pyrus aucuparia	24	..	
Total	..	694,380	..	

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

Conical Hills Plantation, Otago.

(Area, 3,672 acres; altitude, 400 ft. to 1,050 ft.; commenced operations, 1903.)

During the year 34·25 in. of rain fell on 164 days. A glance at the meteorological chart appended will show the fairly even monthly distribution of rainfall. The maximum shade temperature was reached in December, it being 86°, and the lowest 24° in July.

Tree-growth.—The prevalence of almost persistent strong south-westerly winds has had a marked influence on trees generally at this naturally exposed plantation, particularly along the river-face, where the planting of protective shelter-beds is not practicable. The rapid progress of larch on the hillsides for the five or six years after planting indicated the suitability of the conditions for larch-growing; but gradually the wind-influence has lessened the prospects of extreme success, and immediate

steps to remedy the more unsatisfactory portions are being taken by replanting with fast-growing pines able to develop under the adverse conditions. It is not possible to even record the immunity from wind-damage by the hardy *Pinus Laricio* or *P. radiata*, although both species retain a healthy appearance, and have generally made good vertical progress. On the lower levels *Picea excelsa* are thriving; but with the gradual ascent the growth becomes less robust. The wisdom of ceasing operating with this comparatively slow-growing tree is now apparent, although in the early stages a belief was harboured that on becoming established the spruces would respond to the favourable conditions and become an important variety in our general afforestation scheme. Perhaps the result accruing from a trial planting of mossed seedling *Pinus radiata* has been the most pleasing feature of the year's operations at this station, and this idea will be extended during the coming year. Although a fair measure of success is attained from permanently planting one-year-old *Pinus radiata* that have been temporarily lined-in, the mossing system can undoubtedly be applied to the Remarkable pine with less risk of eventuating failures. Perhaps throughout the planted area progress is slightly less than that previously recorded, and other remarks outlined in last year's report can also rightly be applied this season.

Tree-planting.—Of the 660,169 scheduled trees, some 505,050 were used in extending the plantation by 192 acres, whilst 155,119 trees, principally *Pinus radiata* and *P. Laricio*, were used to replace failures. Planting at 4 ft. apart by contract labour worked out at 11s. per thousand; but in operating at a wider spacing-distance—6 ft.—the cost exceeded that figure by 3s. per thousand. The arrangement of undertaking both the preparation of pits and subsequent planting by contract labour continues to give satisfaction in operating upon new areas; but where replanting is being conducted a greater difficulty experienced in arriving at a reasonable contract price at times necessitates the reversion to the day-labour practice.

General.—All fire-breaks received their annual cultivation, the area being dealt with amounting to slightly over 103 acres. The sheep-grazing proposition, now past the experimental stage, was extended, and an additional seventy-six full-mouthed ewes were secured to (in conjunction with the small flock of sheep) keep down coarse herbage on fire-lines. No damage to trees from either deer or rabbits has come under notice, although it not infrequently happens that stalking has to be resorted to in order to clear the reserve of the former pest. Several improvements to buildings were effected, and the usual tree-growing and maintenance-work undertaken, as outlined in previous annual reports. A sum of £2,439 13s. 6d. was spent during the year, which advances the total expenditure to date to £28,384 10s. 6d.

Rainfall, Temperature, &c.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1914.	In.		Deg. F.	Deg. F.	
April	4·06	17	66	28	6
May	1·37	8	60	25	20
June	3·56	16	58	28	13
July	2·03	16	64	24	21
August	2·20	12	64	26	19
September	2·89	15	72	26	12
October	2·14	10	72	30	4
November	3·60	19	72	30	5
December	4·14	18	86	32	5
1915.					
January	3·25	11	80	36	..
February	3·79	15	82	34	..
March	2·59	12	76	32	5
Totals	35·62	169	..	..	110

H. Howe,
Plantation Foreman.

Dusky Hill Plantation, Otago.

(Area, 845 acres; altitude, 400 ft. to 800 ft.; commenced operations, 1898.)

Remarks previously made in reference to this plantation might again be rightly applied. It is, however, very satisfactory to find a healthier tone prevailing over the larch blocks; and given another favourable season for tree-growth, it is anticipated that quite a large proportion of the previously affected trees will have regained their normal appearance. On the higher levels, however, the wind caused much damage to the Douglas fir and Sitka spruce, whose leaders were with few exceptions broken off at the critical growing-stage, notwithstanding partial shelter from adjacent pines. The trial having now extended over fourteen years, it has been decided to replant the small acreage with pines, and should the spruces respond to the altered conditions every opportunity will be afforded

them of developing. In continuation of the replanting scheme, some 10,000 *Pinus radiata* will be planted on exposed positions, where trees originally placed have made no progress.

Two employees were engaged in attending to the necessary maintenance-work, which required an expenditure of £376 19s. 5d.

F. Benfell,
Plantation Foreman.

Ranfurly Nursery, Central Otago.

(Area, 49 acres; altitude, 1,400 ft.; established, 1896.)

The past year has been one of the most trying experienced for many years. A succession of north-west gales was prevalent right through the planting season and well into the month of February. In consequence, the work of lining-out trees was made very trying, and at the same time the "strike" has been very poor with *Pinus Laricio;* but other varieties, such as larch and *Pinus ponderosa*, have done exceedingly well. The absence of steady rain was also a factor in retarding the growth. The season, as a whole, has been against nursery-work, and the above conditions are accountable for the reduced output this season. The annual rainfall for the year amounts to 18·07 in. on 122 days, which shows a decrease of 6·15 in. on the previous year. The maximum shade temperature was 85°, in December. The minimum temperature in the screen was 16°, in August, and on the ground 13° during the same month. Frost occurred on 154 nights in the screen, and on the ground on 214 nights. The sowing of seeds was commenced in the month of September, and a later sowing (for supplying settlers) in December. The "strike" of seedlings has been very satisfactory, especially *Pinus Laricio*, *P. ponderosa*, *P. Benthamiana*, and *P. radiata*. *Pinus Lambertiana* failed to germinate, and *P. Taeda*, *P. muricata*, *Larix leptolepis*, and *Pseudo-tsuga taxifolia* very poorly. From 100 lb. of *Pinus Laricio* 450,000 seedlings were raised, and 50 lb. of *P. ponderosa* produced 300,000 healthy plants. The seed sown in December has done remarkably well, especially a trial sowing of *Pinus radiata* in drills. The latter were sown in drills 10 in. apart, and had neither watering nor protection of any kind. If these seedlings are not thrown out during the winter I am quite satisfied that, if sown earlier, all our seeds could be treated in this manner, which would mean a great saving in different ways. We will have to wait and see the effect of the winter before passing any decided comment; but from all appearances the experiment is a valuable one. In order to cope with the extra pine-seed supplied this season eighteen frames, 18 ft. by 6 ft., were made by the employees during the winter. The estimated number of seedlings raised for the season is 913,800, and the estimated number of trees of all ages in stock is 1,692,600.

During the season trees to the number of 708,800 were transferred to the Naseby Plantation, and to other stations and institutions 115,000. The output for the coming season will be somewhat reduced owing to climatic conditions, as outlined previously, the approximate number fit for removal being 600,000. As the land these trees are to be planted on is not clear of rabbits, the usual method of carting trees before spring will have to be abandoned; but in the meantime the trees will be lifted, sized, and heeled-in in readiness for removal in the spring. We have had some difficulty in getting chaff cut, and have been buying locally; but the present prices are almost prohibitive. We have something like 1,500 bags in stack at Gimmerburn, and arrangements have been made to have this cut up, and the surplus over what is required sold. In order to keep up the fertility of the soil, green crops have been sown and ploughed in on all lining-out ground. A portion of about 2 acres has been sown down in grass and clover for a period of two years.

The expenditure for the year amounted to £1,052 0s. 1d., and to date £16,163 18s. 9d. The average number of men employed was 4·09 for the year.

Rainfall, Temperature, &c.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1914.	In.		Deg. F.	Deg. F.	
April	2·07	15	69	24	7
May	2·30	12	62	17	26
June	1·07	11	52	21	29
July	0·50	9	56	18	25
August	0·74	7	63	16	27
September	1·05	8	69	22	18
October	1·78	9	77	23	6
November	1·81	11	72	27	5
December	1·46	8	85	28	5
1915.					
January	1·06	10	84	30	1
February	2·68	11	78	28	2
March	1·55	11	77	29	3
Totals	18·07	122	..	..	154

Details of One-year-old Trees, sown 1914–1915.

Name of Tree.	Number in Seed-beds.	Height, in Inches.	Seed sown.	Remarks.
			Lb.	
Pinus Laricio	450,000	1½	100	Good even crop.
,, ponderosa	332,000	1½	64	,,
,, Benthamiana	12,000	3	6	,,
,, radiata	102,000	6	20	,,
,, muricata	2,000	3	1	Uneven crop.
,, maritima	5,000	1½	3	Fair crop.
,, Taeda	1,000	2½	1	Poor germination.
Larix leptolepis	2,000	1	1	Poor crop.
Pseudo-tsuga taxifolia	2,000	2	8	,,
Populus fastigiata (cuttings) ..	2,800	18	..	Well rooted.
,, deltoides (cuttings) ..	3,000	18	..	,,
Total	913,800	..	..	

Details of Two-year-old Trees, sown 1913–14.

Name of Tree.	Number in Seed-beds.	Number in Nursery-lines.	Height, in Inches.	Remarks.
Pinus austriaca	251,000	..	6	Strong plants.
,, ponderosa	141,000	..	4	,,
,, Benthamiana	3,000	..	4	,,
,, scopulorum	10,000	..	4	,,
Larix europaea	..	172,000	10	,,
,, leptolepis	..	9,000	8	,,
Alnus glutinosa	..	5,800	8	,,
Totals	405,000	186,800	..	
	591,800			

Details of Three-year-old Trees, sown 1912–13.

Name of Tree.	Number in Nursery-lines.	Height, in Inches.	Remarks.
Pinus Laricio	114,600	6	Medium plants.
,, ponderosa	72,400	6	Strong plants.
Total	187,000	..	

Trees transferred from Nursery to Plantations, &c., 1914–15.

Where sent.	Name of Tree.	Number.	Height, in Inches.	Remarks.
Naseby Plantation ..	Pinus Laricio	260,925	8	A satisfactory growing-percentage has resulted.
	,, ponderosa ..	74,225	9	
	,, Benthamiana ..	11,600	10	
	Larix europaea	330,550	15	
	Populus fastigiata ..	25,075	18	
	,, balsamifera ..	1,275	18	
	Salix (vars.)	5,150	18	
		708,800	..	
Naseby Plantation	As per details above ..	708,800	..	
Selwyn Plantation	Pinus Laricio	10,000	..	
Tapanui Nursery	Alnus glutinosa	5,000	..	
Dunedin Corporation ..	,, ...	100,000	..	
Total	..	823,800	..	

A. W. ROBERTS,
Nurseryman in Charge.

Naseby Plantation, Central Otago.

(Area, 2,850 acres; altitude, 2,450 ft.; commenced operations, 1900.)

In reviewing the past season's operations an outstanding feature is the severe climatic conditions which have prevailed. A dry winter, in which the rainfall for July and August was 169 points, was followed by a backward and windy spring. Persistent north-westerly gales blew during the whole of the planting season, and continued to blow well into the month of February. So severe did the wind become at times that planting operations had to be transferred to the sheltered gullies, the more exposed situations being left till the wind abated. The good effect of occasional showers that fell was soon nullified by the north-west gales. The rainfall recorded for the year was 26·57 in., which fell on 131 days, as compared with 36·41 in. of the previous year. The minimum temperature was 12°, in July, and the maximum 83°, in December. Frost occurred on 225 nights.

Trees to the number of 708,800 were received from the Ranfurly Nursery. Of this number, 650,650 trees were planted on a new area of 239 acres, and the remaining 58,150 trees were used to replace failures in the previous year's planting. Of this season's planting larch has struck freely, and only a small percentage of failures will be recorded. Pines, however, which were planted later, suffered more severely from drought, and a slightly higher death-rate than usual has occurred. Established trees continue to make good headway, the average growth comparing well with former years. An adjoining area of 1,500 acres has been secured for afforestation purposes. Of this area about 500 acres has been securely fenced, which required 219½ chains of wire netting. Pitting was again carried on under the contract system, and a total of 406,900 pits have been prepared on the recently acquired area. A small area containing 30,000 pits was also completed on the top block, this work being carried out by day-labour. Fire-breaks have had the usual attention, the area ploughed being some 56½ acres. In order to make the plantations more secure from fire a strip of half a chain has been ploughed on the outside of the fence as well as the inside, so that double measures are taken when convenient. These outer breaks are kept completely bare by rabbits and stock, and require little or no attention. Fire depots, containing fire-fighting appliances, have also been placed at various points on the plantation. Rabbits on the new area were extremely numerous, and considerable trouble is being experienced in clearing the ground. By constant trapping, poisoning, and destroying the burrows it is hoped to have this area quite free from rabbits by the time trees are ready to be transferred from the nursery. To provide better accommodation for the employees five huts (10 ft. by 12 ft.) are being erected to replace the tents formerly used. These huts have stoves supplied, and are on skids, so that they may be removed to any part of the plantation. Tents with frames were only temporary at the best, and were in the long-run more costly than huts. The trees on the old site are making satisfactory progress, and a good deal of attention has been paid to this area in order to exterminate vermin. It is difficult to account for the presence of vermin, as the enclosure is securely netted; but as there are horses, &c., feeding alongside, a hole is often made with the feet while grazing close up. These holes are hard to detect, and I think this is a frequent cause for intrusion of the rabbits. Owing to the distance between the pits being increased to 4 ft. 6 in. for *Pinus Laricio*, *P. ponderosa*, and *P. Benthamiana*, and an average of 6 ft. for *Pinus radiata*, the present enclosure will not hold the output for 1915. As this land is infested with rabbits, I would recommend, if possible, that the remaining portion of the recently acquired area be fenced.

Trees to the number of 2,584,874 are now established on the old and new sites, covering an area of 958 acres. The expenditure for the year amounts to £1,462 16s. 11d., and to date £8,720 14s. 10d.

Rainfall, Temperature, &c.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1914.	In.		Deg. F.	Deg. F.	
April	3·45	16	68	22	15
May	3·45	13	57	15	30
June	1·58	11	50	16	30
July	0·81	6	52	12	28
August	0·88	8	58	14	29
September	1·28	10	68	14	25
October	2·30	9	76	20	14
November	2·32	14	72	22	14
December	2·21	9	83	24	14
1915.					
January	2·06	12	81	24	3
February	3·07	12	74	22	8
March	3·16	14	72	24	15
Totals	26·57	134	..	..	225

T. O. Screen,
Plantation Foreman.

Gimmerburn Plantation Reserve.

(Area, 425 acres; altitude, 1,200 ft.; commenced operations, 1903.)

There has been little or no work carried on at this station during the year, except the work of keeping down rabbits and cutting the Californian thistles. The fire-breaks were ploughed as usual, and in some places were widened. The Californian thistle is not so rank this year, owing to the presence of couch-grass and trefoil. These two plants have a very detrimental effect on the growth of the thistle, and where the clover and couch are strong almost choke it. The stacks of oaten sheaf on the land are to be cut into chaff, and the cost borne by the associated nursery. The trees have made very satisfactory progress this season, and from the nursery, a distance of about thirteen miles, the planted area is now visible. The unplanted portion of the land has been let for grazing purposes during the pleasure of the Department.

The expenditure for the year is £18 16s., and to date £2,629 17s. 5d.

A. W. Roberts,
Nurseryman in Charge.

Hanmer Springs Nursery, Canterbury.

(Area, 40 acres; altitude, 1,225 ft.; established, 1902.)

Rain fell on 132 days during the year, the total precipitation being 37·96 in. The highest shade temperature (91°) was registered on the 28th January, and the lowest (20°) on the 28th May and 8th August. Frosts were recorded on 106 nights during the year, being nearly one-fourth greater in number than in the previous year. Though rain fell on four more days than in the previous year, still there were 7·86 in. less over the whole year. Nearly 7 in. of rain fell during February and March, but the effects have been largely neutralized by a succession of dry nor'-westers. Nevertheless, weather-conditions generally have been favourable for all nursery operations, and both seedlings and lined-out stocks are in a healthy condition.

Seedling Trees.—As the fertility of the area used for seed-sowing operations for the last six years has been greatly reduced by the constant cropping, it was decided to utilize a new area which had been under clover for the previous five years. In accordance with this decision, preparations for the proper cultivation were taken in hand early in the year, the final crop of clover being ploughed in and the ground allowed to fallow for the winter months. Immediately prior to the commencement of seed-sowing operations the ground was consistently worked to bring it to as fine a tilth as possible. The seed-sowing was taken in hand on the 20th October, the work being carried out under favourable soil and weather conditions. The results obtained were highly satisfactory, the various varieties germinating well on the whole, with the exception of *Pinus Lambertiana*, which was a total failure. Remarks on the success of the various varieties may be found on perusal of the table appended. For the first time since the inception of the nursery the growing of trees for distribution among settlers was undertaken. Twelve pounds of seed was sown, resulting in a crop of 138,000 sturdy plants, the varieties being *P. ponderosa*, *P. radiata*, *P. maritima*, and *Pseudo-tsuga taxifolia*. For experimental purposes a trial sowing of 2 lb. of *Pinus radiata* was made in single drills in the ordinary lining-out ground, the results pointing to the advisability of further experiments on a larger scale. For the first time for some years past there was a total absence of the grub pest, or of any signs of disease, the whole crop presenting a fine healthy appearance. The two-year-old seedlings, comprising the varieties *Pinus ponderosa* and Douglas fir, have made satisfactory progress The estimated number of yearlings in stock is 2,460,330. The expenditure in the preparation of the ground, purchase of seeds, sowing, and subsequent labour in connection with the raising of the crop was £243 12s. 2d.

Transplanted Trees.—Lining-out operations were commenced on the 1st August and were completed on the 8th October, a total of 1,700,300 trees being dealt with, the results being satisfactory. *Larix europaea* were, however, severely damaged by late frosts, fully 50 per cent. of the leaders being destroyed, which will greatly reduce the output for plantation purposes. The Japanese larch did not appear to suffer to the same extent as the foregoing variety, the trees having made good headway, and the majority should be fit for transfer during the coming winter. Of the other varieties lined out during the season, *Pinus radiata*, *P. austriaca*, and *P. ponderosa* may be mentioned as having made excellent headway, the remaining varieties also making very fair growth. Of the three-year-old trees it may be said that the growth is not quite up to that of previous years. The plants, however, are sturdy and well rooted, and should give satisfactory results when transferred to their permanent places on the plantation. The estimated output of trees for the coming season is about 1,000,000. The total number of trees in stock on the 31st March was 4,139,597. The total number of trees raised since the initiation of the nursery is 12,747,662. Trees to the number of 928,735 were transferred to plantations and Domain Boards during the year, details of which are shown on the appended table.

General.—For the purpose of restoring the fertility of the soil in the old seed-bed ground the area was sown with rye-grass and red clover, together with a suitable application of manure, and will remain under this crop for two or three years, the crop to be eventually ploughed in for manurial purposes. With the exception of about one acre all vacant areas were put down in oats in the early spring; and, after harvesting, the stubble was ploughed in, and should act beneficially on the soil, and tend to form humus, a constituent that is greatly lacking in the soil on this nursery. A small area of wheat was grown for the purpose of supplying thatch for stacks and straw for packing.

For the purpose of supplying horse-feed about 50 acres was sown in oats during the year—30 acres autumn sown and 20 acres spring sown, the latter proving the better crop. The whole was harvested in good condition, resulting in four good stacks, containing approximately 40 tons of sheaves. The hay-crop was saved in good condition, and will give an ample supply for the season. The carrot-crop promises well, but more rain will be required to make the crop a good one. About 20 acres of the horse-paddock was sown down in suitable pasture seeds during the early spring, and, notwithstanding

the heavy north-west winds and dry weather-conditions immediately following, a good "strike" resulted, and the paddocks should now give ample green feed for some years to come.

Some work was carried out in the way of levelling, draining, and formation of borders. An extension of the water-supply was carried to the new seed-bed area, and has proved sufficient for all purposes. A lot of minor work was done in the way of maintaining tidiness of the buildings generally. Drays and implements were repaired and painted, roads shingled and kept clear of weed-growth, drains and ditches attended to, repairs effected to harness and tools, cutting and carting of firewood, shoeing of horses, &c.

To give an adequate supply of water at the stables and dwelling of the nurseryman in charge it is proposed to connect with the high-pressure water-supply from the Government sanatorium. This will greatly minimize the danger from fire, and the undertaking will not be of a costly nature. The stabling-accommodation being quite inadequate for present requirements, it is proposed to make an addition of two extra stalls, and also increase the loft-accommodation for the storage of chaff, &c. An additional room for the dwelling of the nurseryman in charge is urgently required, the present accommodation being insufficient. The erection of the proposed additions could be carried out quite efficiently and economically by the present staff. As the present nursery area is insufficient for lining-out purposes without continually cropping the same ground, it is proposed to bring a new area under cultivation. It would be advisable to purchase three additional young draught horses, and dispose of two of the aged horses.

The expenditure for the year amounted to £1,538 12s. 3d., the total expenditure to date being £13,819 6s. 3d.

The daily average of men employed during the year was 7·80.

Rainfall, Temperature, &c.

Month.	Rainfall.	Number of Days Rain fell.	Temperature.		Number of Days Frosts occurred.
			Maximum.	Minimum.	
1914.	In.		Deg. F.	Deg. F.	
April	3·61	14	76	25	3
May	4·96	14	64	20	19
June	4·73	13	62	22	20
July	1·02	10	62	22	20
August	1·02	7	66	20	24
September	3·59	9	72	26	17
October	1·77	7	82	25	3
November	3·70	16	73	33	..
December	4·82	12	82	33	..
1915.					
January	1·84	4	91	36	..
February	3·19	13	84	34	..
March	3·71	13	85	33	..
Totals	37·96	132	..	..	106

Details of One-year-old Trees, sown 1914–15.

Name of Tree.	Number in Seed-beds.	Height, in Inches.	Amount of Seed sown.	Remarks.
			Lb.	
Pinus Laricio	1,700,000	2	120	Very fine crop.
,, ponderosa	360,000	2	64	Sturdy trees.
,, Benthamiana	7,000	2½	7	,,
,, radiata	260,000	5	38	Very sturdy plants.
,, maritima	6,000	2½	3	Good crop.
,, muricata	15,000	3	1	Fair germination.
,, Taeda	4,000	3	2	Good plants.
Larix leptolepis	20,000	1½	1	Poor growth.
Pseudo-tsuga taxifolia	36,000	2½	15	Well-grown plants.
Cupressus macrocarpa	7,000	4	1	Good results.
Thuja plicata	4,500	2½	½	Good crop.
Sequoia gigantea	3,000	3	¼	Sturdy plants.
,, sempervirens	800	3	½	Poor germination.
			Oz.	
Eucalyptus viminalis	12,000	10	3	Excellent results.
,, Macarthuri	25,000	10	1	,,
,, Muelleri	30	7	½	Poor results.
Total	2,460,330	..	..	

Details of Two-year-old Trees, sown 1913–14.

Name of Tree.	Number in Seed-beds.	Number in Nursery-lines.	Height, in Inches.	Remarks.
Pinus austriaca	..	600,000	4	Very promising crop.
,, ponderosa	70,000	..	4	Excellent crop.
,, ,, ...	..	110,000	4	,,
,, Benthamiana	..	1,000	4	Well grown.
,, radiata	..	130,000	10	Excellent crop.
,, muricata	..	10,000	5	Medium plants.
,, scopulorum	..	7,000	3½	Very fair crop.
Larix europaea	..	200,000	10	Damaged by late frosts.
,, leptolepis	..	26,000	9	Sturdy plants.
Pseudo-tsuga taxifolia	18,600	..	4	Damaged by late frosts.
Cupressus macrocarpa	..	1,300	4	Fair crop.
Betula alba	..	500	8	,,
Cotoneaster Simonsii	..	4,800	7	Good crop.
Totals	88,600	1,900,600	..	
	1,179,200			

Details of Three-year-old Trees, sown 1912–13.

Name of Tree.	Number in Nursery-lines.	Height, in Inches.	Remarks.
Pinus Laricio	400,000	7	Made excellent growth.
,, ponderosa	100,000	8	Made only medium growth.
Total	500,000	..	

Trees transferred from Nursery to Plantations, &c., 1913–14.

Where sent.	Name of Tree.	Number.	Height, in Inches.	Remarks.
Hanmer Springs Plantation	Pinus Laricio	380,240	7	Well-grown plants.
	,, ponderosa ..	77,350	10	
	,, Benthamiana ..	12,550	7	
	,, austriaca	1,860	8	
	,, radiata	43,225	8	
	,, muricata	4,925	12	
	Larix europaea	302,000	10	
	Pseudo-tsuga taxifolia ..	4,300	12	
	Alnus glutinosa	24,625	12	
	Sequoia gigantea ..	4,225	6	
	Cupressus Lawsoniana ..	275	12	
	Eucalyptus (vars.) ..	235	15	
	Poplar cuttings	15,800	18	
		871,610	..	
Hanmer Springs Plantation	As per details above ..	871,610	..	
Selwyn Plantation ..	Pinus Laricio	15,000	..	
Department of Agriculture (experimental areas)	Larch and pines ..	42,125	..	
Total	..	928,735	..	

W. G. Morrison,
Nurseryman in Charge.

Hanmer Springs Plantation, Canterbury.

(Area, 3,668 acres; altitude, 1,225 ft.; commenced operations, 1901.)

In giving an account of the past year's operations it may be mentioned that it is the first time since the inception of afforestation-work in this district that the work has been wholly conducted by free labour, and under this new regime it is pleasing to report a successful season. The weather-conditions, which are usually very severe during the winter months at this station, were, on the whole, good, there being little cessation of work from that cause.

Tree-growth.—The prevalence of heavy north-west gales during November and December had a retarding influence on tree-growth, and also did some damage to the shelter-belts of *Pinus radiata* and *P. muricata*, many of the trees being blown over or broken off a few feet above the ground. Species more susceptible to the baneful effects than others were considerably damaged thereby in October—namely, larch, Douglas fir, and Tideland spruce. In the succeeding months, however, they made a good recovery. All pines have made good headway, those especially noticeable being *Pinus Laricio* and *P. ponderosa*. Tree-planting was commenced on the 13th May, and was completed on the 30th September, the total number of trees planted for the season being 866,435, at an average cost of 8s. 3d. per thousand. An additional 5,175 trees were utilized for replacing failures in areas previously planted. The area planted during the year was 318¼ acres, making a total of 2,531½ acres to date, containing 6,891,711 trees. An excellent "take" resulted in almost all varieties, and the growth has been quite equal to that of previous years. A trial lot of seedling *Pinus radiata* was not a success, but the failure could be largely attributed to a continued spell of dry weather immediately following the planting. These conditions affected the *Sequoia gigantea*, which were almost a failure.

Fencing.—The fencing of the new area was completed during the year, the total length being approximately four miles, the work being carried out at a labour-cost of 8s. 1d. per chain, including cartage of material from Culverden and distribution and clearing of fence-line. A length of about 20 chains of barbed wire was erected along top of the boundary-fence adjoining Fowler's property, to prevent stock from gaining access to the planted areas.

Clearing.—An area of about 200 acres was cleared of scrub at a cost of £1 2s. 1d. per acre, the heavy timber being set aside for fuel for the use of the camp and nursery. This was sledged to convenient spots for cartage.

Pitting.—Pits to the number of 782,809 were prepared for the reception of trees during the season, at an average cost of 17s. 9d. per thousand. The pits now available for the ensuing season's planting are 203,441.

Fire-preventive Measures.—These measures were carried out as usual, and all fire-breaks were kept in an effective state, the total length receiving attention being about twenty-two miles. To reduce expenditure in this item in future it is intended to graze sheep extensively, which it is anticipated will assist effectively in keeping down growth, and which eventually will do away with the necessity of ploughing, and should prove a profitable investment for the Department.

Checking Noxious Weeds and other Pests.—This branch of work also received due attention throughout the year, poison being laid for rabbits with effective results, and hares being destroyed with guns and dogs. A certain amount of pruning and cutting-out of double leaders was done in pine areas. It is anticipated that this work will require a good deal of attention throughout the whole area in future.

It is anticipated that about 1,000,000 trees will be planted during the coming season, preparations for which are now well in hand. This will complete the planting of the area now enclosed. Additional ground will therefore be required for further operations at this station. There is, however, a small area of about 60 acres adjoining Jollie's Pass which was recently set aside for afforestation purposes, and still requires fencing and clearing. Swamp ground in the enclosed areas might also be planted out with suitable trees, such as poplar, &c.; and areas under spruce on No. 1 plantation which have proved a failure will require replanting with trees more suitable to the situation. The thinning of *Pinus radiata* plantations was taken in hand during March, and it is proposed to sell the trees cut out as fuel, the prospects of a profitable return from which may be expected. It is also proposed to deal with the alder and birch plantations, which are sufficiently forward to necessitate attention in this respect.

The total expenditure for the year amounts to £2,311 14s., the expenditure to date being £22,611 0s. 2d.

The daily average of men employed throughout the year was 13·26.

A. J. Boydell,
Plantation Foreman.

APPENDIX I.—REPORT ON FORESTRY CONFERENCE IN SCOTLAND AND TOUR THROUGH AMERICA AND EUROPE.

[By R. G. Robinson, Superintending Nurseryman for the South Island.]

Sir,— Tapanui, 11th November, 1914.

I have the honour to present herewith a light review of investigations made with regard to forestry work carried on in the British Isles, America, Hawaii Islands, and part of France. The recording in this report of minute details and elaborate statistics is probably uncalled-for, although every effort has been made to disclose briefly and practically typical methods adopted elsewhere, sufficiently full to permit of a reasonable comparison being made of New Zealand measures with those of the countries visited. Should further information relative to any of the subjects discussed be required, it would be an easy matter, on reference to my notes, to submit a more lengthy contribution.

It was quite impossible, however, to adhere to the excellent itinerary of travel, embracing Germany, Austria, Switzerland, Holland, &c., kindly arranged for me by Professor Story, Mr. Forbes, and other experts, owing to the unfortunate outbreak of war, and, in fact, my position in southern France at one time was not an enviable one, particularly as travellers' cheques became temporarily worthless, and permission to sojourn in Bordeaux, and subsequent securing of passports to return to England became a somewhat difficult matter. There can be no doubt, however, that, notwithstanding the curtailment of the anticipated tour, much education in forestry matters generally has been gained, not only through the agency of personal inspections of nurseries, forests, and institutions, but by having come into contact and discussed forestry problems with many of the world's leading practical and scientific foresters, who have treated your representative with the utmost kindness and consideration. During the excitement occasioned by the thronging of the railway-carriages by French soldiers on their way to the front one of my small packages, containing, among other possessions, many valuable forestry notes and photographs, was unfortunately lost, and has thus prohibited the use of illustrative work to some extent in this document.

Itinerary of Travel.

I left Auckland on the 8th May, and on arrival at Fiji inspected the Government Experimental Farm, which is devoted almost entirely to the cultivation of tropical plants and crops. The visit proved to be an educational treat, through the courtesy of the Director, although the existing conditions make the introduction of Fijian systems into New Zealand impracticable. On the 20th May we reached Honolulu, where much valuable work is being done by the Forestry Department, whose functions include the preservation of native forests, raising forest and ornamental trees for State planting and distribution to public bodies.

Vancouver was reached on the 27th May, and, after interviewing Mr. McKay, District Forester, visits were made to Stanley National Park and the magnificent natural forests surrounding. At Victoria, B.C., two days later much information was tendered by several experts relative to forestry work by the State, and it would appear that the conservation of existing forests and regeneration of the most desirable woods receive special attention at the present moment. Special visits to forests in British Columbia were made before returning to Vancouver on the 30th May, when I visited the large Royal nurseries, and left via the Rocky Mountains for Medicine Hat, a rising town on the prairies. Inquiries were made into the raising and subsequent planting-out of trees in this very arid locality, but beyond the establishment of a huge glasshouse (costing £13,000, extending over 4 acres) for propagating purposes, and ornamental planting out of *Populus balsamifera* and *Acer negundo* in parks and avenues, and a heating system by natural gas, nothing very interesting was seen, nor did the working ideas appear to be worthy of introduction into Central Otago. Indian Head and Regina were visited on the 3rd June. At Indian Head the largest State nursery in Canada is situated, and nearly the whole day was spent in company with Mr. Ross, Superintendent of the Tree-planting Division, in inspecting the nursery, associated trial plantations, and seed-extracting house. The local experimental farm, under separate management, also provided much instruction.

Continuing the journey across Canada it was thought desirable to make a stoppage at Winnipeg, where every assistance was given me by Professors Jackson and Lees to grasp the routine of forestry education provided by the modern University there. Chicago was reached on the 6th June, and educational institutions, museums, and parks were visited, after which Lake Michigan was crossed, and the scenic wonders of Niagara Falls and surrounding forests occupied two days before steaming over Lake Ontario to Toronto, which was reached on the 9th June. Toronto is the centre of forestry education for Canada. Mr. J. White (editor of *Forestry Quarterly*), Dr. Howe (botanist), Mr. Zavittz (Superintendent of Forests), and others spent nearly the whole day with me at the University and parks, detailing systems adopted. Dr. Fernow is the head of the forestry branch of study, but, unfortunately, this gentleman was absent on an extended tour.

On the 11th June I reached Ottawa, and, under the guidance of Mr. R. H. Campbell (Director of Forests for Canada) and Messrs. Lewis and Morton (Consulting Foresters), inspected modern sawmills, paper-pulp mills, match-factories, paper-mills, large experimental farms, trial forest plots, &c., and, in addition, was made conversant regarding the recording methods at the office of the Department of Forests. In journeying from Ottawa to New York it was necessary to remain for a day at Buffalo. In New York (13th June) and surrounding district much of

an interesting nature was observed. The University, parks, nurseries, gardens, museums, and forests, &c., occupied fully my three days' sojourn there.

On the 16th June I left New York by s.s. "Mauretania" and arrived in London via Fishguard six days later. During my four days' stay in London it was possible to visit many places of extreme interest, among which were Kew Gardens, Forestry Museum, Hampden Court, parks, various educational institutions, &c., and proceeded to Edinburgh on the 26th June. The ensuing fortnight was devoted to a splendidly organized tour of inspection through Scotland's best forests, nurseries, &c., and the Royal Scottish Arboricultural Society spared no expense or trouble to make the tour of the following Home, foreign, and colonial representatives a most enjoyable and educative one:—

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

DIAMOND JUBILEE GUESTS.

Captain Archibald Stirling, of Keir, *President.*
Sir John Stirling-Maxwell, Bart., of Pollok, *Hon. Secretary.*

REPRESENTATIVES OF FOREIGN GOVERNMENTS.

France ..	Monsieur Pardé, Inspector of Waters and Forests at Beauvais.
Russia ..	Actual Councillor of State Monsieur Rauner, Vice-Director of the Corps of Foresters.
Sweden ..	Mr. Carl Björkbom, Inspector of Forests.
Denmark ..	Dr. P. E. Müller.
Holland ..	Monsieur J. H. Jager Gerlings, Inspector of the Government Forestry Administration at Breda.
Hungary ..	Mr. John Czillinger, the Royal Hungarian Inspector of Forests.

REPRESENTATIVES OF INDIAN AND COLONIAL GOVERNMENTS.

India	Mr. A. M. Caccia, M.V.O., Director of Indian Forest Studies.
Canada ..	Mr. R. H. Campbell, Director of Forestry.
New Zealand ..	Mr. R. G. Robinson, Superintending Nurseryman for South Island.
South Africa ..	Mr. K. A. Carlson, Conservator of Forests, Orange Free State Conservancy.

HOME REPRESENTATIVES.

England ..	Sir William Schlich, President Royal English Arboricultural Society.
	Professor Somerville, Oxford University.
	Mr. William Dawson, Cambridge University.
	Mr. H. J. Elwes, of Colesborne.
Wales	Professor Fraser Story, University College, Bangor.
Ireland ..	Mr. R. J. Campbell, Board of Agriculture, &c., Dublin.
	Professor Augustine Henry, Dublin.
	Mr. A. C. Forbes, Chief Inspector of Forestry, Dublin.
Scotland ..	Mr. John D. Sutherland, Member of the Board of Agriculture.
	Dr. John Nisbet, Forestry Adviser to the Board of Agriculture.
	Mr. E. P. Stebbing, Edinburgh University.
	Mr. George P. Gordon, B.Sc., West of Scotland Agricultural College.
	Mr. P. Leslie, B.Sc., North of Scotland Agricultural College.
	W. Steuart Fothringham, Esq., of Murthly, *Vice-President.*
	Sydney J. Gammell, Esq., of Drumtochty, *Vice-President.*
	Dr. A. W. Borthwick, *Hon. Editor of "Transactions."*
	Mr. Charles Buchanan, Convener of Excursion Committee.
	Mr. Robert Galloway, S.S.C., *Secretary and Treasurer.*
	Mr. Mann, *Reporter.*

In addition, during the last three days of the tour, over seventy gentlemen from all parts of the British Isles, and prominent in forestry circles, joined and travelled with the above party.

An account of the tour in Scotland is appended (see page 53).

On the 11th July, in company with Professor Story, of Wales, and Mr. A. C. Forbes, Chief Forester for Ireland, I journeyed through Wales and visited the Bangor University and experimental plots, where a speciality is made of forestry science teaching. We then proceeded to Ireland, and under the guidance of Professor Henry and Mr. Forbes it was possible to obtain an accurate idea of Ireland's ambition regarding its afforestation scheme. Specially interesting were the nurseries, trial plantations, forestry museums, and forest schools at Avondale, under the direction of Mr. Black, and Botanical Gardens and reserves at Dublin, where Dr. Henry is experimenting with the hybridization of poplars, and already has accomplished most wonderful results. On the 14th July I arrived at Chester, and, after being shown over Dickson's extensive nurseries of about 500 acres, proceeded to Dean Forest, where Mr. Robinson, Superintendent of Forestry Division, had made excellent arrangements for having me shown over England's foremost State forest nurseries, plantations, distillation-works, and forestry school for workmen. Returning to London on the 17th July I spent some days in visiting places of interest, including Oxford University (as the guest of Sir W. Schlich, Professor of Forestry), Windsor, Eton College, museums, several large private nurseries (including Sutton's at Reading), forestry exhibitions at the White City, Head Offices of the Forests and Woods Department, and was also received with much kindness by the High Commissioner and his staff.

On the 25th July I left London for Bordeaux (France), and, viewing the sand-dunes, gradually worked my way to Biarritz, Bayonne, Fonterabbia, and San Sebastian (Spain), interviewing *en route* officers of the Forest et Eaux Department regarding the sand-dune plantations of *Pinus maritima* and indigenous forests generally. The war breaking out during my sojourn in Biarritz, much difficulty was experienced in getting back to Bordeaux, where martial law was in operation, and it was necessary to remain there for eight days before being able to embark on the refugee ship "Fauvette," which, after an exciting passage, arrived in London on the 11th August. Thus, after securing all my tickets for an extensive European tour, it was impossible to use many of them, and efforts are now being made to obtain a refund from Messrs. Cook and Sons, agents.

Leaving London again on the 28th August by the R.M.S. "Osterley," insufficient time was available at stopping-places to make any excursions into forests until reaching Melbourne, where the Botanical Gardens, &c., were visited. It was also possible to acquire much valuable information from Mr. H. Mackay, Conservator of Forests, and also Mr. McIndoe, Superintendent of Nurseries at Creswick, where, in addition to the ordinary tree-raising station and plantations, the Government have made the centre for forestry education under the control of Professor Hart. A very interesting day was spent at the school and forest at Creswick.

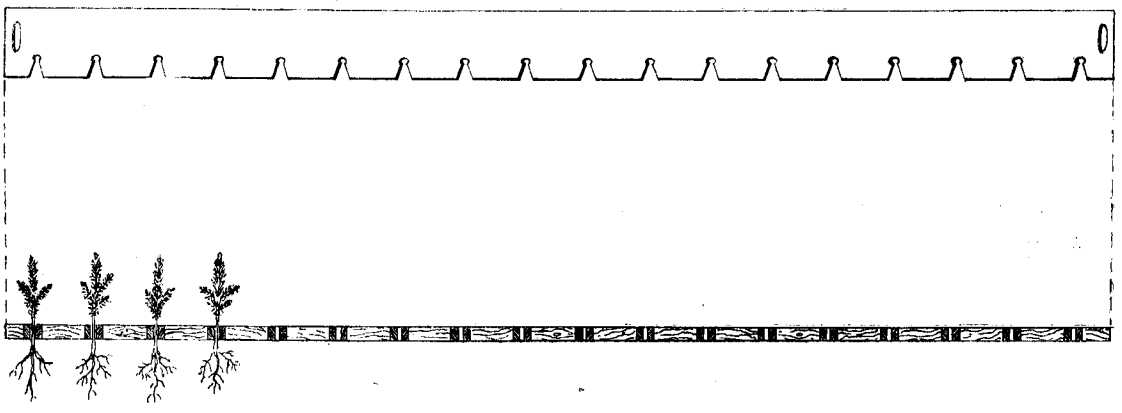
I went overland from Melbourne to Sydney, and whilst there interviewed Mr. J. H. Maiden, Government Botanist and Director of Botanical Gardens. It was also possible to discuss forestry problems with Mr. R. D. Hay, Director of Forests, and Mr. Watson, First Assistant, and before leaving Sydney a profitable day's visit was made to Gosford, where the chief New South Wales nurseries and plantations are situated. Forestry Superintendent Gollan kindly gave me all information solicited. I returned to Wellington on the 20th October, after being absent for slightly over five months and a half.

Nurseries.

Direct personal inspection of about twenty-five typical State and private-owned nurseries has convinced me that the tree-raising methods conducted in New Zealand are equal, if not superior, to the very best in operation in any of the countries visited. Undoubtedly many working specialities having an important economic bearing were noticeable here and there, and it is likely that our propagation-work could be still further perfected by the introduction of such supplementary ideas that may be adaptable. German and French nurseries are considered by experts to show greater evidence in skill in management than those in other parts of the world; still, it must be remembered that even the most advanced methods are now practised in Great Britain, although perhaps on a much smaller scale, and has thus afforded me an opportunity of making the desired comparisons. It is not necessary perhaps to particularize herewith opinions formed of each nursery or forest visited; but, as previously mentioned, should such information be required, a special article on the subject could be immediately forwarded. A light review of typical tree-raising stations will perhaps meet the position.

Indian Head Nursery, Canada.—The work is carried on here under almost precisely the same conditions as in Ceneral Otago (rainfall, 16 in. annually; maximum temperature, 100° in shade; minimum temperature, 60° below zero). Much activity is being shown by the Government in raising about two millions of trees annually, principally for free distribution to settlers willing to adhere to a planting scheme outlined by the Government in a printed pamphlet. Of course, on the prairie country shelter-belts are chiefly aimed at, and every assistance is afforded the pioneers by the forestry officials, who continue to make inspection for at least two years after the trees are planted. Certain suitable deciduous trees are raised, particularly *Acer negundo*, the seed of which is sown in drills by a machine, and subsequently kept cultivated by horse-labour. No nursery transplantation is afterwards effected, as the yearling maples take root easily in prepared ground. Such trees as *Pinus sylvestris*, *Pinus Murrayana*, *Pinus Banksiana*, *Populus Petrovski*, *Populus deltoides*, *Larix americana*, *Larix laricina*, *Picea* (vars.), and *Salix* (vars.), &c., are grown with more or less success. Some 500 to 700 acres of light ground are available for tree-raising and experimental work, and the advantage of possessing a somewhat extensive area for propagation and trial plantation work is apparent. Lining out seedlings is evidently an unusually costly undertaking, as a distance of some 20 in. is allowed between each line of conifers. Most of the maples are sufficiently advanced for permanent planting at one year old, and are transported direct from the seed-drills. Specially interesting were the hardy hedges of the Siberian pea-tree—*Caragana*—a plant that is admirably adapted for providing quick low shelter in dry intensely cold regions. A small cone-seed extractor, complete, costing about £120, is also attached to the nursery. Amongst other novel ideas seen were:—

(1.) Poplar-cutting machine (which enables a workman to make treble the number of cuttings with less exertion than by hand):
(2.) Planting-board (for lining out):
(3.) Low axle cart for removal of trees (which facilitates the removal of trees in nursery):
(4.) Special tree-digger (a specially constructed plough that should be introduced into our nurseries).



Planting-board.
Can be made any length.

Honolulu State Nursery.—Perhaps the most interesting and instructive feature of nursery-work here was the soil sterilizer, which subjects the soil used for sowing to a temperature sufficiently high to destroy weed-growth, insects, and foreign seeds. Needless to emphasize the amount

of subsequent labour in weeding this operation dispenses with, particularly in the tropics, but the use of the machine is connected almost solely with seed-sowing and pricking off in boxes. Most of the seed-sowing of the eucalypts and various ornamental trees is conducted in shallow boxes, and pricked off some eight weeks later into trays, in which they are finally transported to the planting-areas. Needless to say a very high growing percentage eventuates from such measures. The raised germinating-houses are covered with light wire gauze to prevent ingress of the troublesome ants, from which perhaps the greatest drawback in propagating is experienced here.

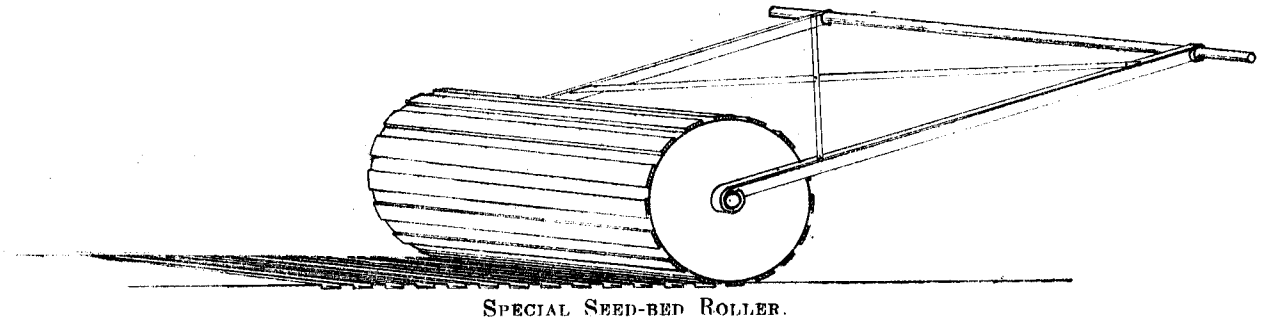
Creswick Nursery, Victoria.—Output about 1,000,000 trees annually, including the free distribution to public institutions. The area utilized for tree-raising here is situated in a sheltered valley, and much labour was devoted to still further enriching the surface by depositing light fertile soil obtained elsewhere. *Pinus radiata*, *P. Laricio* and *P. ponderosa*, *Eucalyptus corynocalyx* and *E. leucoxylon* constitute the principal trees grown, and, although the nursery is limited to about 8 or 10 acres, excellent results are obtained. Seeds of pines are sown in open drills, in which they remain for twelve months before being transplanted into lines for another season. Lining out is conducted by the ordinary spade trench method, which is evidently a very much more costly method than that adopted in New Zealand. The eucalypts are sown in cool frames, and after a few weeks are pricked off in shallow trays, to be delivered later to the plantations. This is in reality an expensive system; but complete success usually eventuates. Spade pitting for tree-planting is conducted at about the New Zealand rate, while trees are planted by another worker, who closely follows up. Fire-breaks, about 1 chain in width, are marked out so as to divide blocks into about 250 acres. About five furrows are ploughed annually on each side of the barrier, which provision for checking the spread of fire seems to meet the position. The progress of *Pinus radiata* on being planted out at 8 ft. apart is excellent, and compares at least favourably with that recorded in the Dominion. Among other varieties of trees grown in nursery may be mentioned *Pinus sylvestris* (much affected with *Chermes laricis*), *Quercus pedunculata*, *Fraxinus excelsior*, *Salix* (vars.), *Populus* (vars.), &c. Generally no methods used out of the ordinary are in evidence here.

Gosford Nursery, New South Wales.—Rainfall, 56 in. annually, on 150 days; output, 150,000 trees The function of the nursery is principally to provide trees for the creation of State softwood forests, as it is contended that aided natural reforestation of the eucalypts will dispense with any immediate necessity of raising plantations of hardwoods artificially. The pine-seeds are sown in single drills, covered with soil, and receive no rolling or frame covering. Being such a wet locality, the Superintendent considers the battering influence of rains gives sufficient firmness to seed-beds. The eucalypts, pepper-trees, araucarias, &c., of course receive more careful treatment, and are sown under a screen 7 ft. in height. After two years' progress in the drill, during which time frequent wrenchings are effected, the trees are sufficiently strong for permanent planting; but I doubt if we should be able to use such large stock in operating upon exposed hillsides. Only the more weakly plants are transplanted, and these are put into lines 2 ft. apart. Spade pitting is also adopted here, and is merely a reversed sod, and the number prepared daily by an individual depends entirely upon the nature of the surface—a fair average may be set down at 350. Trees are planted by the combined efforts of a man and boy, the latter assistant being fully occupied in carrying trees and holding each one in its place, while the man fills in with spade and completes the operation by firming. The pair of workmen usually plant 1,200 trees daily in this manner. Fire-breaks at 2½ chains wide are laid off where considered essential, but no fire-resisting trees are introduced. No horse cultivation on these barriers is applied, although an annual spring burn is carried out. Almost phenomenal growth of *Pinus radiata* is made in the associated plantation, and the planting distance (8 ft. apart) is evidently quite close enough for satisfactory bole-development.

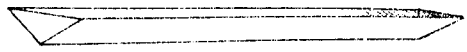
Scotland.—Some twelve Government and private nurseries were visited in various parts of Scotland, and, although State-owned institutions were perhaps on a larger scale, the delegates were certainly more favourably impressed with the tree-raising stations managed by private landowners, who until comparatively recent years, however, had been for generations practising forestry based chiefly on systems not conducive to the best results.

Murthly Nursery.—Perhaps the most interesting nursery visited was that at Murthly, belonging to Captain Fothringham, who, having studied German methods exhaustively, has endeavoured to introduce and even improve upon such ideas. Although raising less than a million trees annually, the Murthly Nursery is evidently worked on sound commercial lines. Interesting demonstrations, as follows, were given:—

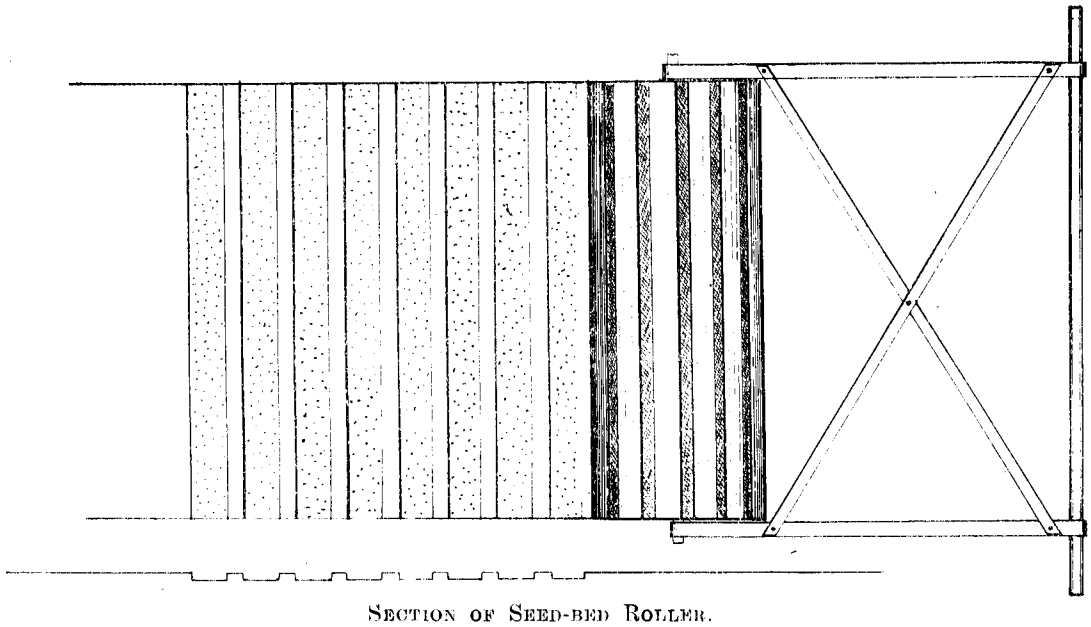
(1.) Rendering tree-seeds distasteful to birds by immersing in powdered red-lead.
(2.) Rapid seed-sowing in narrow drills made by special roller on which battens have been attached. Seeds were measured out in a long triangular scoop and tipped out with a rapid shake into the drills.
(3.) "Lining out" with special planting-board after a spade trench is made. This system absolutely prevents the undesirable bending-up of the tap roots of delicate seedlings, but is certainly an expensive process.
(4.) Extraction of pine-seeds from locally gathered cones.



Special Seed-bed Roller.



SEED-SCOOP.



SECTION OF SEED-BED ROLLER.

Local seed selection is carefully observed by Captain Fothringham, and the healthy robust condition generally of his seedlings surely indicates the necessity of strict observance of this important phase of the question if complete success in germination is to be the outcome.

Ford Nursery.—At Ford the Government has established a fairly large nursery, with an output annually of over half a million. As in other parts of Scotland, larch, Scots pine, silver and Douglas fir constitute the principal varieties grown. There was nothing at this station which, in my opinion, could be introduced with beneficial results into any of our New Zealand nurseries.

Benmore Nursery.—The privately owned Benmore Nursery, used exclusively for tree-growing, also provided plenty of scope for favourable comment. There is, however, a tendency here, as at most nurseries seen, to sow much too thickly, with the result that a fair proportion of lined-out trees assume a "leggy" appearance.

Dupplin Nursery.—Practically the same system is in force at Sir John Dewar's Dupplin Nursery and other fair-sized tree-growing stations. Protective frames for covering seed-beds are not so essential as in New Zealand, and in many cases this precaution is entirely dispensed with, thus reducing the intial raising-cost.

Dickson's Nursery, England.—At Dickson's famous 500-acre nursery at Chester a large area is devoted to tree-raising, and, as might be expected, many details of management differ entirely from ours. It was with much surprise that I noticed broadcast sowing (in wide beds) of pines, a method that was banished from New Zealand State nurseries many years ago, owing to the necessary wrenching operation being thus hindered. Much useful information was secured relative to nursery-work generally, but not directly connected with our specialty.

Forest of Dean Nurseries, England.—Several nurseries of approximately 4 or 5 acres each in extent are in existence in various parts of the famous forest, and the trees raised are utilized for afforestation, reforesting, and underplanting purposes generally. The condition of these nurseries did not sufficiently impress me to recommend the adoption of any methods in force.

Avondale Nursery, Ireland.—Ireland's chief tree-raising station is situated at Avondale, and, although not very extensive, is apparently conducted economically. It, however, occupies a highly sheltered position, which would perhaps make the transplanting of trees so raised a difficult problem in New Zealand, where high exposed hills are being afforested. No horse-work in lining out is employed, and although similar ideas are introduced here as at other leading institutions mentioned, perhaps a greater measure of success has attended the efforts of those responsible.

PLANTING-DISTANCES.

Perhaps two of the most established principles in creating satisfactory forests are—

(1) Correct selection of trees for the existing conditions;

(2) Providing sufficient density by close planting.

In Germany, and Great Britain, and part of France the planting-distance generally between such trees as pine, spruce, and larch is 4 ft., or at the rate of about 2,722 trees per acre. It is, however, now acknowledged on all sides that no hard-and-fast planting-distance should be adhered to; but that the habits and development of each tree operated with and occupying different situations should be closely watched for results that will lead to economical spacing. On the Continent the thinnings are disposed of at a sufficiently remunerative price to merit the continuance of the close-planting system; but in New Zealand, where we are faced with the necessity of having to pay a high rate of wages and no immediate prospects of making a financial

success of the disposal of thinnings or conversion of same into by-products, the question arises, Is it possible to slightly increase our planting-distance without defeating our primary object—viz., the production of straight, comparatively branchless boles? In the case where fuel only is required the presence of a few stout laterals is even beneficial.

Every chance of studying this phase was availed of during the tour, and examples seen have enabled me to arrive at the following conclusions:—

(1.) That generally the faster the development of any variety of tree the greater may be the spacing-distance allocated.

(2.) That in sheltered valleys, where humidity is more intense and usually the surface of greater fertility, there is no occasion to plant so densely as on hillsides, and the more exposed the conditions generally the greater the necessity for closer planting prevails.

Thus, in operating over partially exposed, hilly country intersected with ravines, and where perhaps surface soils and substrata differ entirely, no absolute uniformity in spacing between trees should be recognized. For instance, *Pinus radiata*, one of the fastest-growing pines, need not in my opinion be planted any closer even on the exposed sites than 6 ft. apart, whilst in a position where the humidity and other congenial conditions cause unusually strong vertical development it would be perfectly safe to plant 7 ft. or even 8 ft. apart. *Pinus Laricio*, however, a much slower grower than the previous species, requires greater density of planting, and in this case on the more elevated situations the present distance, 4 ft. apart, meets requirements; but with the gradual descent to the lower and more sheltered positions the spacing-distance might reasonably be increased until the maximum 5 ft. 6 in. (in exceptional situations) spacing is reached.

On level or light undulating country of medium altitude, where rainfall and warmth are conducive to rapid tree-growth, I see no reason why the Corsican pine cannot be most successfully grown at 4 ft. 6 in. apart. This trivial increase of distance of 6 in. between the trees lessens the number required to plant an acre by 571 trees, or in reality reduces the initial expenditure by approximately £1 15s. per acre. In Otago Central, however, where extremes of temperature are experienced and rainfall somewhat scanty, trees have a tendency to produce protective laterals at the expense of their "leaders," and thus the increasing of spacing-distance in that locality would inevitably result in accelerating the present trouble, and, of course, cannot be recommended.

Closely associated with this subject is that of thinning, referred to on page 42, but the elimination of probable waste in raising and planting of trees only is aimed at in the remarks written under this heading. The following table shows the greatly decreasing number of trees required to plant an acre of ground by gradually increasing the spacing-distance:—

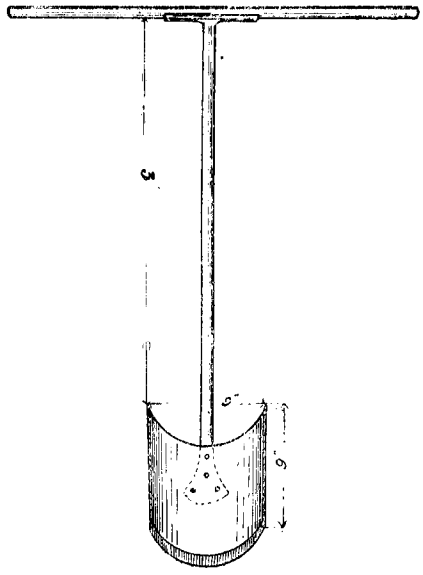
Trees required to plant an Acre.

Distance apart.	Number per Acre.	Remarks.
Ft. Ft.		
4 by 4	2,722	Present uniform planting-distance of larch and pines (excepting *Pinus radiata*).
4½ by 4½	2,151	Spacing-distance recommended in most localities.
5 by 5	1,742	Spacing-distance recommended in very humid situations.
6 by 6	1,201	Spacing-distance for *Pinus radiata* on exposed sites.
7 by 7	889	Spacing-distance for *Pinus radiata* in sheltered positions.
8 by 8	680	Spacing-distance for *Pinus radiata* in very humid situations.

Dr. Nisbet, in referring to one plantation inspected, remarked, "From the overcrowding appearance it represents, the deduction may safely be drawn that 4 ft. by 4 ft. is unnecessarily close planting for Douglas fir, and that from 5 ft. by 5 ft. up to even 6 ft. by 6 ft. is quite close enough, unless an exceptionally good market for small poles be likely to make early thinnings profitable."

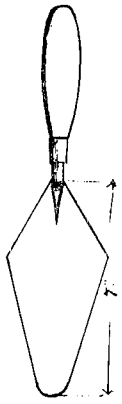
Tree-planting Methods.

Several demonstrations of pitting and tree-planting were witnessed, and, in addition to the ordinary spade pitting, a specially constructed half-circular spade was seen in operation in Scotland, and received favourable comments from the delegates present. A man is able to prepare about 600 circular holes (9 in. in diameter and 9 in. deep) per day, and is usually followed by another workman, who places the tree in the prepared hole and, using a large trowel, completes the planting operation simultaneously with the preparation of another pit. Narrow spades are also used most successfully, particularly where ground of an argillaceous nature is met with. Grubber pitting is resorted to on stony surfaces, but preference is given to the previously mentioned methods. In Canada a very serviceable wooden-handled dibbler, with foot-press attachment, was seen in operation, and this tool is a decided improvement on the heavy pipe arrow-pointed spear at times used for notching on New Zealand plantations. The combined operation (pitting and planting) in the British Isles can be estimated at from 10s. to 14s. per thousand on easily worked areas. This figure is, however, proportionately increased as the surface becomes more difficult to operate upon. Tree-planting after the land has been cultivated is very popular in certain parts of America, but this idea is not worthy of extension in New Zealand. On comparing New Zealand general methods with those seen elsewhere I am satisfied we are adopting quite up-to-date measures.

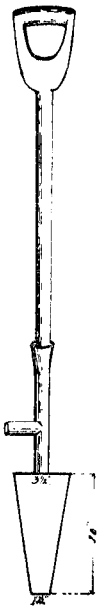


Circular-pit Digger.

Cutting Tread Dibbler.



Large Planting-trowel.
For Plantation-work.



Excellent Notching-tool.

Sowing in situ.—Foresters generally are evidently devoting a good deal of attention to the creation of pine forests by sowing seed directly *in situ*, but my observations in both America and Britain have convinced me that unless exceedingly favourable conditions for plant-life abound the measure of success attained will not justify the continuation of the practice. Generally the area being operated upon is brought to a fine state of cultivation for the reception of the seeds, which receive a coating of red-lead after having been placed in damp sand for a few days. The seeds are then either sown by hand or machine in drills or broadcast, and finally a brush harrow is drawn over the surface. Perhaps the irregularity of the eventuating stand, rapidity of weed-growth, and necessity for early thinning constitute the chief weaknesses of the method; but nevertheless there certainly should be inexpensive trials made of this and in every other phase of afforestation-work, so that sufficient local data may be acquired by the Department, and distribution of knowledge so gained if desired. Another method seen, which is worthy of trial, was sowing of an easy-germinating pine-seed in specially prepared spots. The results from this idea were sufficiently good to merit its adoption in semi-sheltered situations where there is no likelihood of rank vegetation smothering the eventuating seedlings.

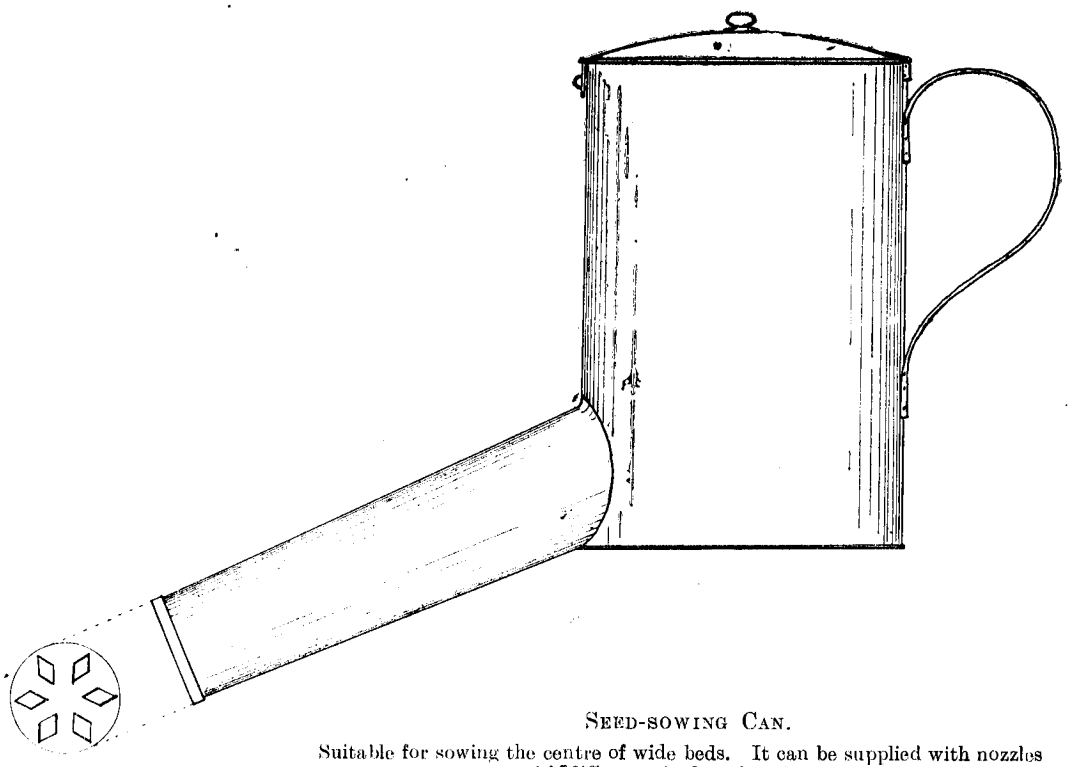
Cost of Operations.

In forming a brief comparison of our expenditure in conducting afforestation-work generally with that of countries visited the contrasting conditions in the value of labour and nature of ground being operated upon have been taken into consideration. Investigations regarding the actual cost of foreign tree-planting work disclosed such inconsistent results that it is indeed difficult to arrive at a uniform basis for comparison with our New Zealand operations. Undoubtedly our present rate of wages in New Zealand exceeds that paid labourers similarly employed in the British Isles, France, Hawaii, and even America, and we therefore cannot reasonably hope to show such low working-costs.

Comparative Rates of Pay to Nursery and Plantation Workers.

	Men (per Day).	Youths (per Day).
New Zealand	8s. to 9s.	4s. 6d.
British Isles	3s. to 4s. 6d.	2s. 6d. and 3s.
America	7s. 6d. to 8s. 6d.	4s.
France	3s. to 4s.	2s. 6d.
Austria-Hungary	1s. 10d. to 2s. 6d.	..
Hawaii (Portugese labour)	4s. 6d. to 6s. 6d.	3s. 6d.
New South Wales	8s. to 9s. 6d.	3s. 6d. and 4s.
Victoria	8s. to 10s.	4s.

In the British Isles a good deal of planting-work is conducted by working students, whose individual remuneration averages approximately 17s. per week. The proportionally large employment of low-paid youths there was noticeable in many places, and it is therefore not surprising that the cost of tree raising and planting an acre of ground ranges between £3 10s. and £6 10s. according to surface conditions, against our 30-per-cent. increase on that expenditure. In Canada, where afforestation on an extensive scale has not yet been attempted, planters endeavour to prepare the ground by ploughing and cultivating before planting for shelter and ornamental purposes, and this generally works out about 30 per cent. cheaper than in New Zealand; but, of course, less than one-half of the trees are necessary to obtain the desired results, and the nature of the ground operated upon, differing from that generally utilized in the South Island for tree-planting, offers no obstruction to cultivation. At Hawaii Islands pits measuring 18 in. by 18 in. by 12 in. are made for the reception of *Eucalyptus* seedlings, and no reliable information regarding total working-expenditure could be obtained in the few hours at my disposal there. The necessity of preparing such large holes absolutely forbids operating economically, notwithstanding the comparatively low labour cost.



SEED-SOWING CAN.

Suitable for sowing the centre of wide beds. It can be supplied with nozzles with different-sized perforations.

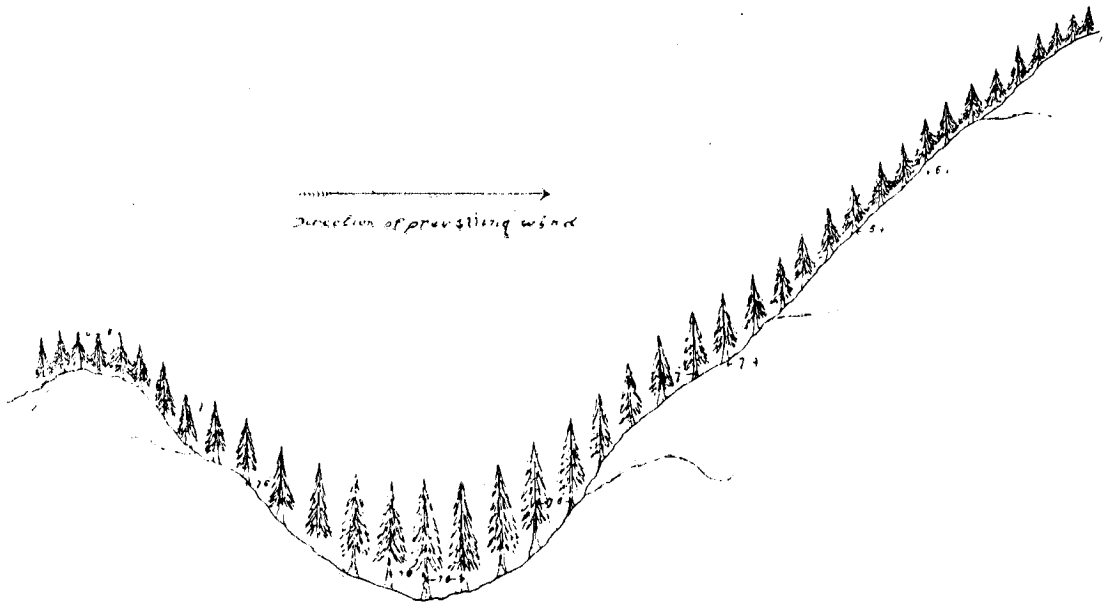
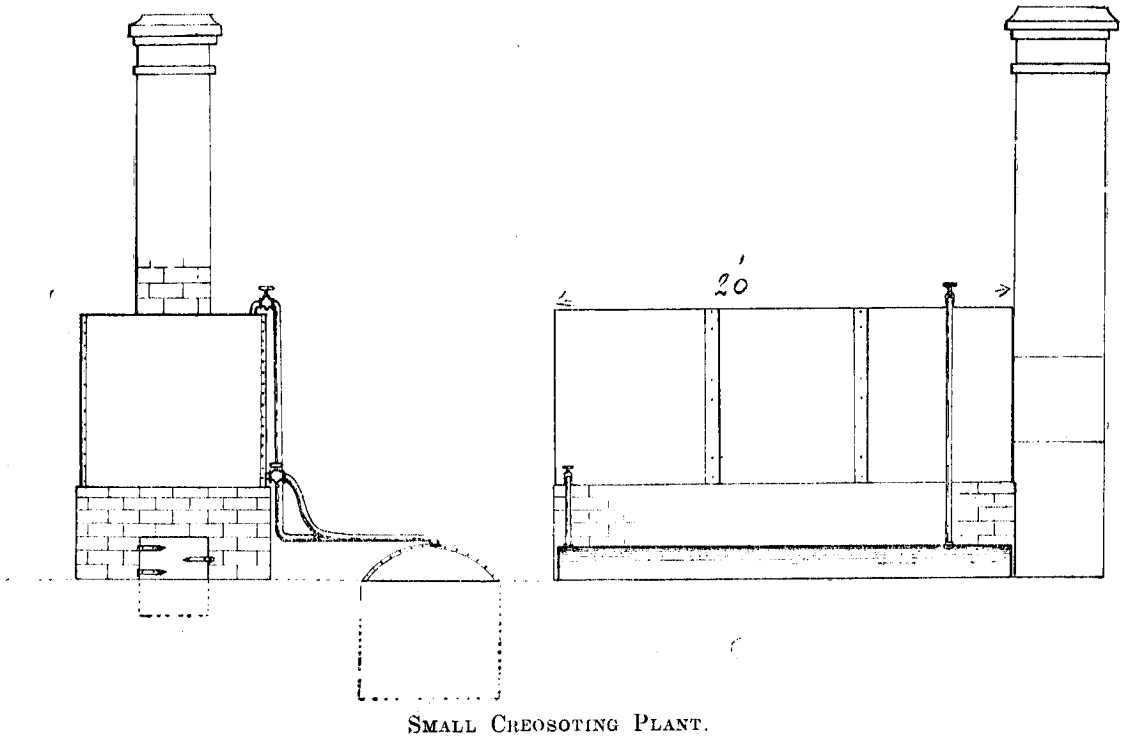


ILLUSTRATION OF THE RECOMMENDED INCREASED PLANTING-DISTANCES (PINUS RADIATA).



SMALL CREOSOTING PLANT.

After carefully examining our methods I am of opinion that, in the interests of economy and convenience, more youths should be employed by the Department in the State nurseries. The employment of a certain number of experienced men is essential, but much of the tree-raising work is of a light nature and eminently suitable for active lads, whose rate of pay to commence need not exceed 4s. 6d. per day. Such youths, on receiving a training in nursery or plantation work, could be available for undertaking special work, perhaps in the more isolated places where married men cannot reasonably be expected to go

Experimental Work.

In journeying through Canada, Great Britain, and Australia I was surprised to find that, although the necessity for the adoption of a vigorous State afforestation policy was being acclaimed on all sides, only a comparatively small expenditure was devoted to State tree-planting for timber-production; but evidently, with commendable foresight, each country is carefully conducting experimental work on a scale not attempted in New Zealand, the results of which should simplify the local sylvicultural possibilities when the time arrives for extensive application. From time to time valuable suggestions are noticed in pamphlets received from other countries, and where applicable greater inducement might be extended to district officers to co-operate with the Superintending Nurseryman in overcoming by assiduous experiments any phase of either nursery or plantation work in vogue that does not compare favourably with progressive measures advocated in such articles.

In Canada, surrounding the large, well-conducted Indian Head Nursery, a series of fifty experiments in pure planting and mixture have been undertaken with a view to ascertaining the most desirable method of associating trees in arid localities. Most original ideas have been introduced, and in many cases the recognized principles or scientific forestry have been quite ignored. The results, however, show that the behaviour of certain trees in their native habitat cannot be accepted as a criterion of possible attainments with such trees in foreign places, even where similar growing-conditions are recognized. Trees are generally planted at 4 ft. apart, and in the following mixture were noticed to be growing in perfect harmony:—

Fraxinus excelsior and *Pinus sylvestris*;
Populus deltoides and *Acer manitoba*;
Salix (vars.) and *Populus* (vars.);
Pinus Murrayana and *Fraxinus americana*;
Picea excelsa and *Caragana*;
Larix siberiana and *Acer manitoba*; &c.

Perhaps no more valuable experience was gained on the tour than that relating to the inconsistency of certain species of trees when used in admixture, and beliefs formed previously that full local conditions and experience must be gained before successful afforestation-work can be realized are now borne out by direct observations.

Although Canada at present relies principally upon replenishing her timber-supplies by both artificial and natural reforestation methods, her officers are alive to the fact that the time is rapidly approaching when tree-planting over the waste prairies will play an almost important part. Generally throughout America one is impressed with the amount of time devoted to any method from which useful knowledge might be acquired or contrivance that will tend to simplify management. In New Zealand we are now making more provision for such experimental work than formerly, although I feel sure that neither sufficient time nor expenditure is allocated this important phase.

The forestry experts of Scotland realize the absolute necessity for the Government to acquire a central demonstration area upon which experiments may be conducted, and at the termination of the Conference it was found that discussion was directed a good deal upon this aspect. The following from a report of the departmental committee might be interesting:—

"The Commissioners appear scarcely to have realized the peculiar difficulties which confront afforestation in Scotland, especially those districts on which it would confer most benefit, and where, owing to the low value of the land, it would be most likely to prove remunerative. The chief existing obstacles are—

"(*a.*) Economic difficulties concerned with rating, wintering, the occupation of the adjoining ground too high or too low to plant, and the reconciliation of sylviculture with existing interests generally:

"(*b.*) A popular and natural prejudice against afforestation, which focusses attention on the immediate disturbance to the few and disregards the benefits which sylviculture would confer on a much larger population:

"(*c.*) A widespread belief, based on the experience of ill-managed woods, that sylviculture cannot be made to pay in Scotland.

"We are convinced that nothing short of ocular demonstration will overcome these obstacles. A central demonstration area will do something in this direction; but in this area, unless it is a very large one, the place of a resident population will be largely taken by the apprentice students. Demonstration is, moreover, required in other and more remote parts of Scotland. A few cautious trials in actual afforestation appear to be an indispensable preliminary to State afforestation on a large scale."

There can be no doubt of the immediate importance derived from district experimental plantations, where trials with various trees, planting-distances, and methods could be undertaken with little expense. I would earnestly suggest that in localities where there are even remote possibilities of future State afforestation-works being undertaken small areas of, say, 5 to 10 acres be acquired for demonstration and experimental purposes.

In Victoria, where the Forestry Department still adheres to the excellent idea of experimental co-operation with private persons situated in localities where sylvicultural knowledge is desired, trees are established free of charge for the purpose, although the Department exercises the right through its officers to direct the actual planting or subsequent work associated with any such experiment. Needless to say that in this way an immense amount of valuable information has been secured at a comparatively trifling expenditure.

Educational.

The educational facilities afforded many forestry students in each country visited are such that any intelligent, persevering man of fair education may become proficient by a moderate expenditure, although there can be no doubt that the making of an ideal expert—a man who combines the theory of sylviculture with experience in actual management—can scarcely be anticipated from solely a university training, where usually facilities for conducting any extensive practice in general forestry work are meagre. Students generally are not, however, compelled to spend much of their time at the actual practical forestry work, and at each of the schools and universities visited every opportunity was afforded the young men of becoming most valuable officers, many of whom subsequently specialize in certain branches.

Several of the delegates familiar with the educational aspect in Scotland, England, Ireland, and Germany unreservedly discussed the question with me, but as full details of the regulations applying to forestry education have been printed in a recent report published in Scotland, I am appending same herewith, assuming that perhaps this recent document has not yet reached you. In Great Britain untiring efforts are also being directed to improve the status of the working forester by the publication of well-written journals and pamphlets. At schools connected with the nurseries and forests at Parkend, England, and Avondale, Ireland, an excellent theoretical and practical training is possible; but, of course, in each centre the instruction in theory is imparted by a specialist.

At Creswick, Victoria (and this is the first forestry school in Australasia), a similar arrangement is in existence. Students are accepted of from fourteen to sixteen years of age, after passing a competitive examination They receive free board and residence and a training, extending over three years, in all branches of forestry, including English, botany, algebra, geology, chemistry, physics, and surveying, and after three years are usually given positions as Assistant Ranger, commencing at a salary of about £150 per annum. The school adjoins the nursery and plantations, and, although a comparatively small institution—at present only six students attend—the value accruing from the training of foresters is appreciated by the State.

In Canada about three years' study at the Toronto University is sufficient for a fairly-well-educated youth to secure his B.Sc. (Forestry) degree, and such a graduate then generally receives an appointment as either—

(1.) Instructor in the Forestry Branch (devoting his time to the compilations of statistics and pamphlets and office-work generally, in addition to advising private persons and public institutions regarding suitable planting schemes):

(2.) Ranger of Native Forests (protecting the dominion's interests generally and the supervision of timber-cutting, fire-prevention, &c.).

After having looked into the measures adopted elsewhere towards the educating of forestry officials, I am convinced of the advantages that would be derived by the State in the addition to the staff of one or two officers possessing special scientific qualifications. The duties of one such officer might include—

(1.) The theoretical education of our most promising young officers and cadets:
(2.) Investigating and reporting upon tree-diseases, abnormal growths, &c.:
(3.) Survey-work in connection with plantations:
(4.) Assisting with the compilation of afforestation statistics.

During my stay at Edinburgh a Mr. Fraser, a young New-Zealander, who recently obtained his B.Sc. degree in forestry and had finished his education in Germany, signified his desire to join the New Zealand Forestry Branch, and I believe his services as an assistant at a moderate salary should also be secured by the Department, believing that the infusion of his knowledge with that already gained in the Dominion might be helpful in many ways. There can be no doubt that a vast amount of valuable knowledge has been acquired by certain tree-planting enthusiasts throughout the Dominion, and every effort should be made to secure the co-operation of these gentlemen in diffusing knowledge gained through the medium of a forestry journal or pamphlets periodically issued. The ways and means of organizing a thoroughly efficient service to meet the future demands of the fast-expanding afforestation scheme surely requires much consideration, and I feel sure the inclusion of an officer on the staff advanced in scientific matters will tend to strengthen the position of the present management, and have at the same time a more satisfying effect upon those who are ever ready to criticize harshly the efforts of the Department.

Underplanting.

Realizing the early necessity of introducing shade-bearing trees into our artifically formed forests if the desired density is to be retained, all information possible was secured relative to underplanting. An opportunity was afforded me of inspecting, at Sir Ronald Munro Ferguson's Novar Estate, Scotland, what was considered by the visiting delegates to be one of the finest examples of underplanting in the world.

Briefly, an area of approximately 600 acres was planted with larch, which after twenty-seven years became so seriously affected with *Peziza wilkommii* that immediate steps to introduce such shade-bearers as *Tsuga Mertensiana, Abies grandis, Thuja gigantea, Pseudo-tsuga taxifolia, Chamaecyparis Lawsoniana* were taken. A sufficient number of standards of *Larix eurapœa*

were allowed to remain for protective purposes. The results after fifteen years are almost incredible. All the larches left have made a complete recovery from the canker, and the shade-bearers, conspicuous in the order named above, are quickly overhauling their originally planted associates. In my opinion, however, the moist conditions prevailing and unusual richness of the surface-soil greatly favoured the measures adopted, and it would not be reasonable to anticipate success to such an extent on exposed hillsides or in the more arid localities. The inspection, however, disclosed the respective merits of certain shade-enduring trees, and certainly paves the way for further researches in our New Zealand plantations. Under the shade of the larch standards *Tsuga Mertensiana* was showing to greater advantage; but this tree not possessing the economic value of the Douglas fir (whose excellent shade-enduring capabilities are proved at Novar), the latter tree for general underplanting should be given precedence. Arrangements will be immediately made to procure for trial purposes a small supply of *T. Mertensiana* seed, and reports be submitted from time to time of the results accruing.

At the Earl of Seafield's estate the results of a most interesting and promising experiment is now being watched. Beneath old oak stands—at thirty-five trees to the acre—Douglas fir has been introduced at 4 ft. to 5 ft. apart; but the difficulty attached to the removal of the "heady" oaks without causing damage to the young firs—ranging from 15 ft. to 20 ft. in height—appears to be the only objectional phase connected with the undertaking.

Throughout the greater part of Scotland the rigid climatic conditions forbids the pure planting of the Douglas fir, and underplanting with the species has been generally resorted to in the more successful plantations. Under the canopy formed by oak standards *Fagus sylvatica* were seen thriving, and these trees, particularly in the moist fertile flats, grow rapidly and attain large dimensions in admixture with any of the light demanders.

Thinning.

Much diversity of opinion exists on this very important question—thinning of plantations—and delegates were not at all unanimous in their utterances as to the time or method that should be employed to bring about the maximum of success. It was generally resolved upon, however, that in the interests of (1) girth-development, (2) correction of individual irregularities, (3) maintenance of a healthy state, thinning is absolutely essential, and it is by far a wiser policy to even curtail the extent of planting and devote the amount necessary in assisting nature by the judicious removal of suppressed, ill-formed, and superfluous trees than allow nature to produce (even allowing for the predominance of the stronger trees) perhaps double the number of poles irrespective of their commercial value. Bearing in mind the attitude that is taken by prominent Dominion arboriculturists in reference to the abandonment of thinning in our State plantations, early in the tour I ventured to impart full information regarding our planting-distances, development of trees, wages question, &c., to various specialists, and thereby opened a field for profitable discussion, which was continued from time to time as instances of correct and faulty practices came under our notice.

Pruning is, however, almost superfluous in a well-planted forest, and fortunately so, as with the ever-increasing density the impossibility of detecting malformed individual trees is evident. Much depends upon the purpose for which timber is required, and a method of thinning any plantation suitable for the ultimate production of timber of big girth cannot rationally be applied when, for instance, big supplies of telegraph-poles are aimed at.

Instances were noticed, where plantations of injudicious mixtures or where wide planting had been undertaken, in which all attempts to regulate the development of timber had failed, and generally underplanting had finally been resorted to. One valuable point which impressed me was the greater uniformity of plantations growing on poorer soils and the more sustained struggle for supremacy by individual intolerant trees. This fact also required to be given earnest consideration in formulating a thinning scheme. Then, again, the treatment of plantations of light-demanding trees must not be precisely similar to that where the tolerant varieties constitute the main portion.

It should, then, be our ambition in New Zealand to plant as far apart as possible (consistent with modern sylvicultural practices) so that subsequent labour in thinning will not be unduly heavy. The exact period at which the first thinning of, say, larch plantations might be undertaken with greatest success depends upon the progress of trees, general uniformity and amount of individual suppression. In Tapanui district, for instance, I see no necessity to interfere with the trees (apart from removing decayed laterals from trees on, say, six fringing lines as a precaution against fire) before the twentieth year, and in Central Otago, where development is slower, before the twenty-fifth year. On the other hand, there is a likelihood of our Hanmer Springs plantations requiring first attention as early as the eighteenth year after planting. At each plantation small areas should remain untouched, and nature allowed to work out the problem of profitable timber-producing begun by artificial methods.

The expenditure usually incurred in the initial thinning operations makes the financial soundness of the afforestation proposition indeed speculative, particularly where the rate of wages is high. Judging by the amount of labour devoted to this phase in portions of the British Isles, I would estimate that an outlay of between £3 and £5 per acre would be required to effect the first thinning; but it is only reasonable to assume that a fair return from such outlay would accrue in most localities by disposal of the larger "sticks" for fuel.

Disposal of Thinnings.

The importance of making provision for the profitable disposal of thinnings, or at least some monetary return from the labour directed, cannot be overlooked, and we are faced here (particularly

in the localities where transporting facilities are absent) with a problem that can only be worked out satisfactorily by experiments. In the first thinning of larch or pines much of the removed timber will consist of small decayed props and slash; but this effects the desired clearance for future remunerative cuttings. In districts where firewood is a scarce commodity, or where railway communication is in close proximity, there is no reason why a small portable sawing plant cannot be worked on profitable lines and suitable "sticks" sawn into blocks for fuel or temporary pit-props.

Creosoting Sheep-stakes, &c.

In Scotland the durability of fencing-stakes, pit-props, &c., is enhanced by creosoting, and many estate-owners have constructed small creosoting plants, measuring approximately 20 ft. by 3 ft. 9 in. by 4 ft., the cost of which ranges between £60 and £90. Sheep-stakes can be treated for about 1d. each, but railway-sleepers require from three to four times the quantity of creosote. Briefly, at Murthly Estate the timber is stacked in the boiler and creosote poured in until all timber is covered. A well-arranged furnace quickly brings the liquor to a boiling-point, and the timber is allowed to remain in the creosote for forty-eight hours. Although thorough impregnation is not effected by the treatment, the years' experience gained shows that it is quite sufficient to greatly prolong the usefulness of the timber containing little heartwood. A Scots pine or larch railway-sleeper absorbs about a gallon of creosote. A small inexpensive experiment on similar lines to the above could, I believe, be undertaken with good prospects.

Distillation-works.

Another interesting form of utilizing unmarketable cord-wood and small waste timber was witnessed at the Forest of Dean, England, where a large distillation-works has been lately introduced. From Mr. Robinson, Chief Forester, and the Chemist in charge the following information was obtained, and was printed as an appendix to the recently issued report:—

WOOD-DISTILLATION.

"*Wood-distillation Works, Forest of Dean.*

"These works have been erected with the object of utilizing the considerable quantities of almost unmarketable cord-wood and small branch-wood which are left over when the broad-leaved areas in Dean Forest and the adjoining woodlands are felled. The works were opened in October, 1913.

"The total capital cost has not yet been adjusted, but was approximately as follows: Buildings, £8,000; machinery, £6,500; fittings, architect's commission, fencing, &c., £1,000: total, £15,500.

"The patent process of Herr F. H. Meyer, of Hanover-Hainholz, was adopted, after inquiry, as the most suitable, and the machinery was designed and supplied by his firm, the engine, boiler, and principal non-patented apparatus being of English manufacture. The buildings were erected from Herr Meyer's plans by Mr. E. Maples Linton, architect, of Newport, Mon.

"The works are designed to produce charcoal, wood-tar, wood-alcohol, and grey acetate of lime, which is used in the manufacture of acetone. It is not intended at present to manufacture acetone, but the works have been designed for installing the additional machinery necessary for that purpose, if required.

"The contractor estimated that the following products would be obtained from the plant by carbonizing 420,000 cubic feet of wood per annum: Grey acetone of lime, 384 tons; tar, 270 tons; charcoal, 1,380 tons; wood-spirit, 90 tons (equal to 23,400 gallons of 8·61 lb. each). As production commenced only a few months ago, sufficient time has not yet elapsed for the purpose of enabling the results and estimates to be fully compared, but the experience already gained leads to the conclusion that the above output will scarcely be obtained.

"Most of the wood used is oak, which is brought in by hauliers from the Crown forests, in the centre of which the works are situated, and is stored in large stacks, a stock of 1,500 to 2,000 cords being kept at the works.

"*The Process.*—The retort for the carbonization of the wood is built of iron plate, and is about 56 ft. in length and 7½ ft. in diameter. It is fired from a furnace on the left side, and is set in flues which enable the wood to be carbonized effectually. The wood is packed into cylindrical-shaped trucks, each holding about 2 cords, or 256 cubic feet, stacked, and five trucks form one charge for the retort. When ready the iron door of the retort is lifted and the trucks of wood are drawn in by an electric motor. The door is then securely closed and the temperature raised to between 330° and 350° C. Distillation usually commences in about two hours, and continues for twenty to twenty-two hours.

"After the process is completed the door at the other end of the retort is raised, and the trucks, which now contain charcoal, are quickly drawn by motor and run into an iron cooling-chamber similar in form to the retort. The doors at each end of the cooling-chamber are made secure and the exterior is irrigated with water to expedite cooling. From the cooler the trucks of charcoal are removed on the following day to the charcoal-shed, where they are emptied and the charcoal filled into bags ready for despatch.

"During the process of distillation about 70 per cent. of the weight of the wood is given off in the form of gases, which pass out of the top of the retort through two copper pipes into a tar-separator, where the tar is condensed and flows into a tank. The tar is then run into a *montejus* and lifted by a compressor into the tar-still, where it is freed from the acid, oils, and water remaining in it. It is run direct from the still into casks, and is then ready for marketing.

"The gases and vapours, freed from tar, pass out at the top of the separator and on into a tubular condenser, where the naphtha and acid vapours are condensed and run into large

storage-vats. This pyroligneous liquor, as it is called, is left in the vat three or four days to free it from any tar in suspension, and is then ready for further treatment. The incondensible gases pass from the tubular condenser into a gas-washer, where any residual naphtha or acid is removed by water, and are then conveyed by a pipe to the furnace, where they are utilized in the process or carbonization.

"The pyroligneous liquor, freed from tar, is pumped from the storage-tanks across the yard to a vat in the acid-room and neutralized with lime, which has been prepared in a lime-mixing tank outside. The liquor is stirred continuously by a mechanical stirrer until the mixing and neutralization are complete. Thence it is pumped into settling-tanks at the top of the building, then into sludge-tanks on the first floor, where further impurities are removed, and thence into a storage-tank in the acid-room. It is now pumped into a small 'clear-liquor' tank on the top floor, and runs thence into the iron column of the continuous apparatus, where the neutralized-acid liquor is completely separated from the naphtha. This apparatus consists of a wrought-iron base or still, containing a copper coil, surmounted by a series of cast-iron plates. The neutralized liquor is run off continuously from the still into a tank below, and while still hot is pumped into an evaporating-pan. It is there boiled down to a strength of about 10° Baumé, and when this point is reached is run into the pan of a rotary dryer. This is a large wrought-iron drum, heated internally with live steam. The drum revolves slowly in a shallow tank and picks up a coating of the neutralized liquor. The liquor is dried, as the drum revolves, to a content of about 70 per cent. of grey acetate of lime, and then removed by a series of scrapers on the other side. The acetate, which is now in a pasty condition, is spread upon a concrete drying-floor, under which pass the gases from the retort to the chimney-stack, and after being dried for several hours is filled into sacks. The acetate now contains from 84 to 85 per cent. of true acetate of lime.

"The naphtha which runs from the top of the iron still and column, after being freed from the acetate-of-lime liquor, as previously described, and also from some of the heavy oils, is passed through a copper wash-column, into which a weak solution of sulphuric acid trickles, and is here further purified. Thence it goes into a second column, where it is treated with a weak solution of caustic soda, and more oils are separated out. After passing through a small condenser the purified methyl alcohol is run into a storage-tank below, and is ready for filling into drums for despatch.

"Power is provided by a 27 ft. by 7 ft. 6 in. boiler, made by Messrs. E. Danks and Co. (Limited), of Oldbury, which supplies steam to the following machines: A 35 h.p. single-cylinder non-condensing engine, made by Messrs. Marshall, Sons, and Co. (Limited), of Gainsborough; a Worthington steam-pump for the cooling water; the fan engine; the condenser engine; the evaporating-pan; the rotary dryer; the continuous apparatus; the tar-still; the tar-condenser; and the boiler-feed pump.

"The main engine drives by shafting a dynamo, which, in addition to lighting the works, provides power for the motors used in charging and discharging the retort and cooler, and for the acid-pump, the neutralized-liquor pump, the clear-liquor pump, the evaporator pump, the lime-stirrer, and the rotary dryer."

Up to the present time the financial success of the undertaking is uncertain, but, of course, a great deal depends upon the demand for the products. Some twenty-five men are employed at the works, which, roughly, puts through 60 cords of wood per week, and extracts principally 20 barrels of tar and 200 gallons of naphtha. Timber is thus utilized up to 6 in. in thickness and cut to about 6 ft. lengths. Oak and beech are the principal timbers operated upon, and are both much superior to larch or pines for the extraction of chemicals.

Pulp-wood.

In Ottawa, under the guidance of R. G. Lewis, B.Sc.F., several hours were spent at J. R. Booth's extensive paper-pulp and saw mills in inquiring into methods of paper-pulp manufacture, and perhaps the few following notes may be interesting. The mills, which are situated on the Ottawa River, turn out about 125 tons of paper-pulp daily. Of the timbers mostly adapted for the purpose Canadian spruce heads the list, with a 90·4-per-cent. total; then Balsam fir, 8·9 per cent.; poplar, 0·5 per cent.; basswood, 0·1 per cent.; elm, 0·1 per cent. Inquiries elicited the fact that pines generally are not perfectly suitable owing to their extremely resinous nature, and larch and other hardwoods do not possess the desired texture for easy conversion. Briefly, logs 7 in. to 8 in. in diameter are cut in the forests during the winter into 14 ft. and 16 ft. lengths, but as the river usually becomes frozen a year often elapses ere they can be rafted down to the mill. By an endless gripping-chain they are lifted from the river and sawn into 2 ft. lengths. The blocks are then carried along on an elevator to the paring-machine, which quickly removes all bark and drops them into the grinding-box, where revolving stones grind the timber to fragments with the aid of water. The pulp is then carried along on rollers, pressed, and put into leather-like bundles. Some twelve hundred men are engaged at the pulp and saw mills, where *Pinus strobus* (used extensively for match-making at Eddy's adjoining famous factory), *P. Banksiana*, *P. resinosa*, and spruces are the principal woods operated with.

The establishment of a paper-pulp works is evidently a very costly undertaking, and unless tremendous supplies of suitable timbers are available the outcome would surely result in financial loss. At present only a comparatively small acreage is under the Piceas in New Zealand, nor was it intended to extend planting with any of the species. I am unaware if any tests have been made regarding the suitability of our kahikatea or other softwoods for pulping, but if not it would doubtless be desirable that a small parcel of various indigenous timbers be sent to the Canadian Forestry Department, who would have no objection in obtaining expert opinion on the matter.

Tree-seeds.

What is written on the procuring of tree-seeds in the report of the Royal Commission on Forestry, 1913, is borne out by personal investigations. Several seed specialists attended the Conference in Edinburgh, and the results of their studies and recommendations regarding the seed selection, testing, extracting, &c., were placed before delegates in a series of extremely interesting conversations. Undoubtedly we in New Zealand have hitherto not paid sufficient attention to the sources of our seed-supply, but in this respect we do not stand alone, as other countries have also disregarded the absolute necessity of insisting upon agents procuring seed of good parentage, guaranteed germinative capacity, and distinctly true to name.

Instances were noted in experimental areas of the remarkable contrast in vigour and appearances generally of trees of a similar variety eventuating from seed collected from parent trees occupying different situations. The superiority in every respect of results from seed taken from healthy, medium-aged, and straight-boled specimens was conspicuous, and surely convinced even the most sceptical of the advantage that must arise from using "pedigree" seed generally and ignoring the tendency to purchase cheap supplies on the plea of economy. Of late, wherever possible, tree-growers on the Continent personally direct collecting for their own sowing, and many of the estate-owners have constructed small seed-extracting kilns suitable for the quantity of cones handled. Several such plants, costing between £25 and £60, came under my notice in Scotland, while the larger and more complete Canadian extractor, including building, trays, engine, and screens, was equipped for about £140.

Various means are employed by foreign Forestry Departments in the procuring of tree-seeds for their afforestation-work, but, generally, specially trained men, who thoroughly understand the indigenous and other extensively grown timbers, are placed in charge of collecting gangs and are made responsible for the securing of the required type of seed.

The American foresters are well aware of the confusion which has been created by the distribution of seeds traded under the name of *Pinus ponderosa*, but themselves get over the difficulty in their experimental plantations by recording from which district or State the seeds were obtained, and retaining distinguishing particulars. Subsequently it is a simple matter to decide from which *P. ponderosa* variety most success might be anticipated.

The opinions of foreign foresters, however, coincided with those of our leading New Zealand sylviculturists—viz., if we possess a sufficient number of trees that have reached a moderate age, and have by their development and economic value shown their partiality to existing conditions, there is no occasion to effect large importations of seed. Should the quantity or variety required, however (and this is at present likely), be unavailable from locally-grown trees, every effort should be made, on placing orders with known reliable merchants, to have expert representation in the country in which the seeds are collected, and from this source our Department would be in a position to more accurately determine the season's prospects by an official report bearing on the purity, parentage, and germinative capacity of the seed and district from which it was gathered. This additional precaution will perhaps slightly increase the purchasing cost, but our position would be more secure.

Already the whereabouts of quite a large number of excellent seed-producing pine, spruce, and gum trees are known; but too much stress cannot be directed upon the importance of the idea originating from the Royal Commission on Forestry—viz., "That the Government cause an economic survey to be made of the various plantations throughout the Dominion." Such information is, I believe, periodically collected in America and Great Britain, and the possession of knowledge relating to the adaptability of certain trees to various conditions influences greatly the preparation of afforestation schemes and subsequent working plans.

In my opinion the time is opportune for establishing in each island a small kiln (costing about £40), which could be utilized for the extraction of the various coniferous seed, in addition to providing suitable subsequent storage accommodation for same. Although perhaps it is not desirable to outline collecting and extracting methods here, it might interest you to hear that such seeds as *Pinus ponderosa*, Douglas fir, &c., are collected by the American Forest Service at about a 50-per-cent. cheaper rate than this Department is usually called upon to pay in New Zealand. It is gratifying to hear from Australia and other places of the high esteem in which New Zealand *Pinus radiata* is held, and Dr. Henry and Mr. Elwes, both eminent enthusiasts, are of opinion that the remarkable pine grown in the Dominion is assuming characteristics almost unknown to the species in its natural home, and that evidently our climatic and other conditions are ideal for its propagation.

Acquirement of Land for Afforestation Purposes.

From personal interviews with several forestry experts attending the Conference it was possible to gather useful information bearing on the selection of areas for creating artificial forests, although generally the opinions expressed coincided to a great extent with those already held by officers responsible. Too much importance cannot be attributed to the acquirement of areas, and our experience shows the necessity in the future of a still more thorough investigation into the capacity of any waste lands resumed for tree-planting purposes.

In a country possessing the topographical features of New Zealand the prevalence of strong winds can only be anticipated, and adding to this the customary snowfalls and low atmospheric temperature during the winter period, particularly in the South Island, climatic conditions alone on the highlands are not conducive to the ideal development of timber. Land that will simply grow trees may prove quite incapable of yielding a crop sufficiently well grown to make the undertaking financially sound. Observations made clearly show the fallacy of attempting to create forests with either indigenous or exotic trees on very exposed, abrupt hillsides from 1,000 ft. upwards, where it is impossible to provide shelter by introducing belts of faster-growing

varieties. Such tree-planting may be useful from an aesthetic point of view, a deterrent to erosion, and may be the means of maintaining a more even flow of water in the valleys; but I am so convinced that the injurious influence of elevation and aspect on tree-growth generally demands still more consideration being exercised in choosing an area for afforesting than has been hitherto looked upon as necessary.

The proposition frequently advanced by enthusiasts during the past few years regarding tree-planting in Central Otago at altitudes exceeding 3,000 ft. cannot be recommended, excepting where the object, by surface-covering with stunted trees, is to regulate water-drainage and enhance appearances. No reliable conclusion of returns from a specified expenditure in tree-planting generally at each centre of New Zealand has been arrived at, and it can only be concluded that the more suitable a locality for timber-development is—with, of course, a reasonable local demand for the product—the greater profit from the undertaking might be expected, and thus the expenditure of a greater sum on afforestation in districts possessing the more favoured conditions is justified.

Another important phase is the accessibility of an area and its proximity to railway connection and industrial centres. Suitable planting-areas that may be regarded at present as inaccessible will likely enough be linked up with light lines sufficiently early for transporting any produce raised therefrom. On such areas, however, the wisdom of planting trees such as *Pinus Laricio*, *P. ponderosa*, Douglas fir, &c., requiring a longer rotation period, is apparent, whilst provision should be made to form plantations solely of the faster-growing trees—eucalypts, *Pinus radiata*, poplars, &c.—on waste lands more conveniently situated.

Sand-dunes in France.

Although compelled to hurriedly withdraw from the sand-dune district in the western portion of France, owing to the unsettled state of the country, it was nevertheless possible to acquire a fair amount of useful knowledge regarding the wonderful reclamation of thousands of acres of country between Bordeaux and northern Spain. What was once a barren sandy waste, apparently incapable of adding to the resources of the more favoured surroundings, has been converted into a magnificent forest in various stages of development, and providing remunerative employment to many hundreds of persons. Although a fair variety of trees has been introduced, the maritime pine, *Pinus maritima*, constitutes the principal timber, resin, and reclamation tree. The upright habit of growth of the species and continued rapid vertical development would indicate that, generally, the recognized *Pinus maritima* now growing in New Zealand possesses different characteristics. This, however, may be attributable to the less suitable atmospheric conditions. I have arranged with a French official at Bayonne to forward a parcel of seed procured from some of the finest standing native trees (the seedlings of which, I understand, are exceptionally sturdy), and it will thus be possible to conduct an interesting experiment, the result of which may be helpful in simplifying the more complex forms of dune-reclamation.

Uses of Pinus maritima.

In New Zealand we have been educated to look upon the maritime pine as being a somewhat low-growing bushy tree, the timber of which possesses little or no commercial value; but these opinions of the pines growing naturally on the west coast of France are quite contrary to fact. The timber is used extensively for sleepers, poles, flooring, &c., and quite a number of mills and creosoting plants are kept almost constantly employed in operating solely with the timber removed from sand areas. It is interesting to note, however, that a preservative treatment is essential if durability is desired, but the French people have so specialized in creosoting methods that this is neither a difficult nor costly operation.

Extraction of Resin.

A particularly profitable industry which is undertaken by the Government is resin-extraction, which utilizes much peasant labour, especially during the spring and summer periods when sap is in a more active state. Arrangements had been made with an official for the collection of details regarding the financial and other aspects of the work, but again we were compelled to cancel the meeting for reasons previously mentioned. The following points of interest, however, will show in what direction investigations were made:—

(1.) Resin-extraction is commenced when trees are about fifteen years old, and by the subsequent extent of tapping the life of the tree is partially regulated.

(2.) Branchy trees are tapped more vigorously and continuously, as the commercial value of timber from such trees is not so great as from straight-boled specimens.

(3.) Extraction of resin naturally has a deteriorating effect upon both the timber and the development of the tree, but generally trees are felled before the timber becomes badly affected.

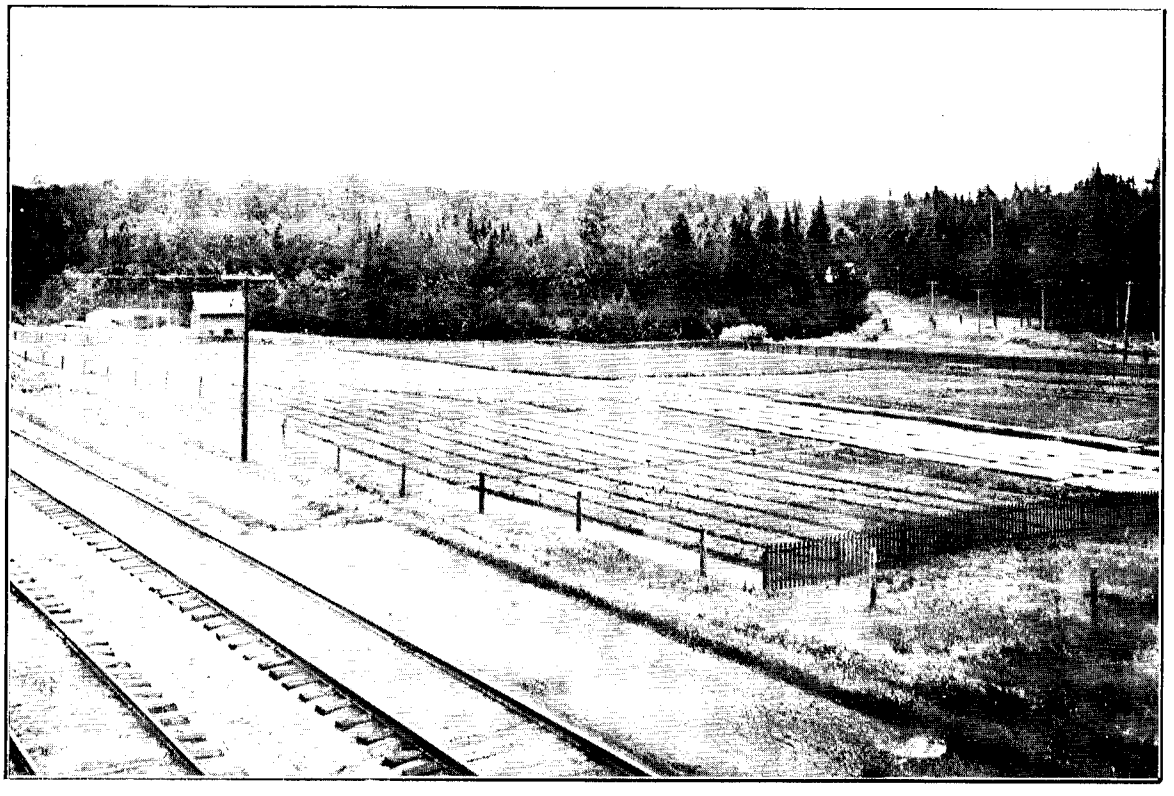
General Remarks.

The process of reclamation has been exceedingly simple, and may be summarized as follows:—

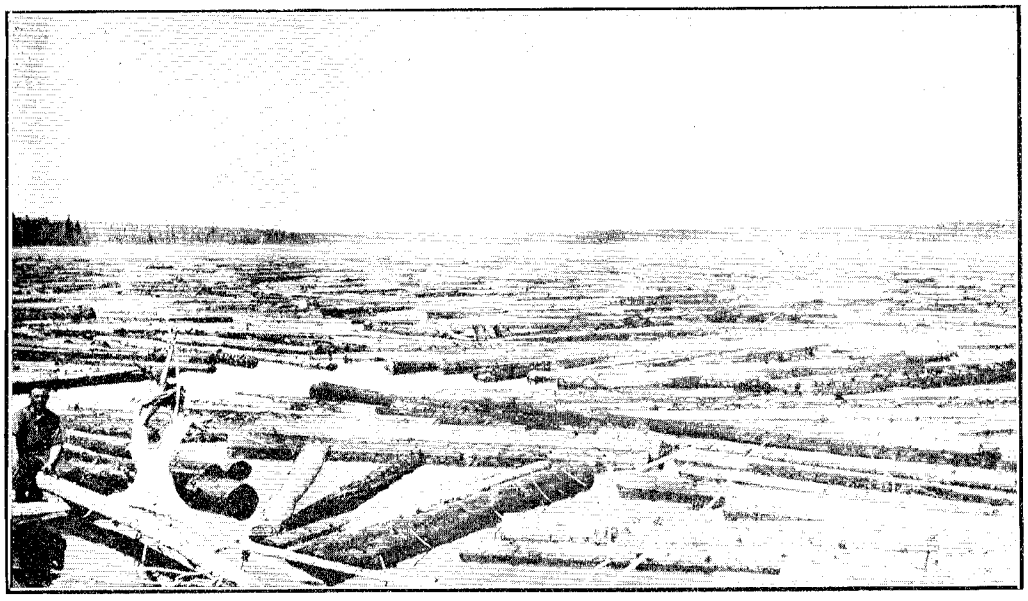
(1.) Planting of marram-grass (*Psamma arenaria*) at about 3 ft. apart fringing the sea-coast, and continued at various distances inland according to the severity of the prevailing sea-winds.

(2.) Having formed protective dunes, which at times extend half a mile or more from the beaches, several outer lines of *Pinus maritima* at about 4 ft. apart are planted, whilst individual trees throughout the main forest stand at from 5 ft. to even 8 ft. apart, which distance is evidently sufficiently close for the development of useful boards, &c.

Scots Pine Transplants, Cross-section of. Transplanting-beds, Adirondack Nursery (U.S.A.).

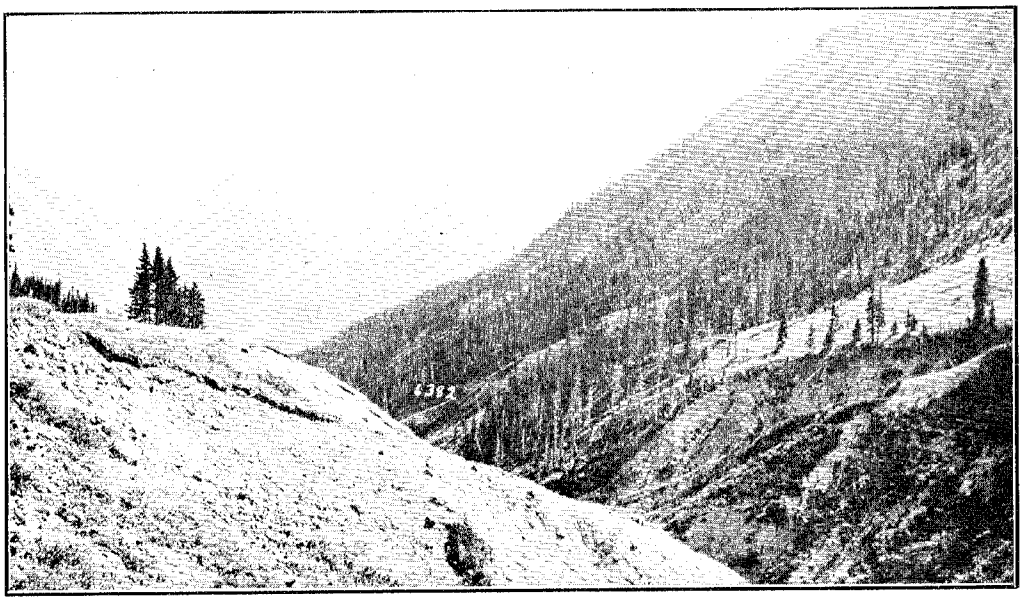


General View of Nursery, near Saranac Lake (U.S.A.). Note Proximity to Railway.

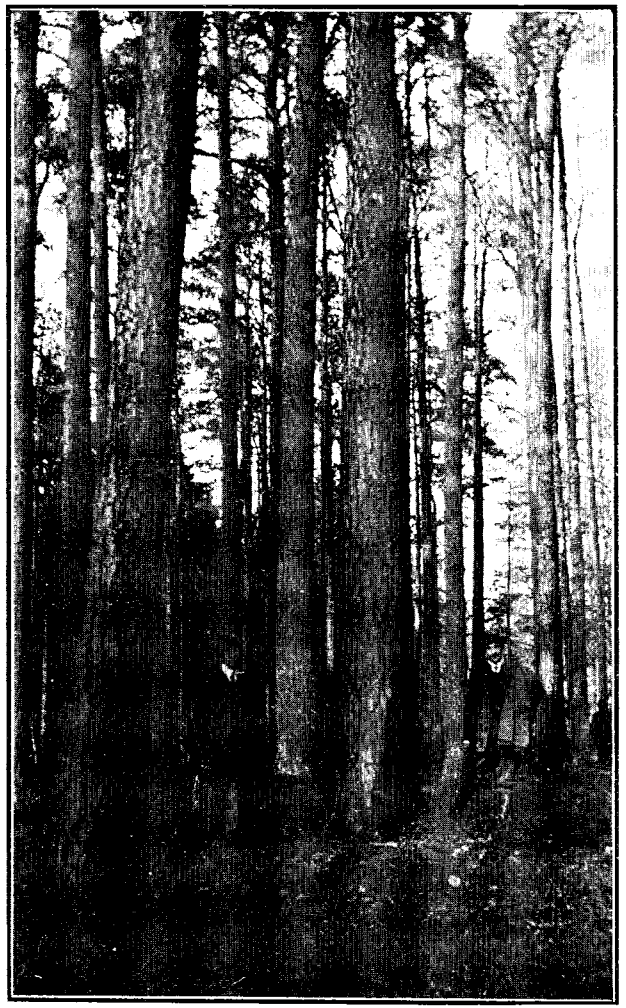


Pine and Spruce Logs ready for rafting, Saskatchewan (Canada).

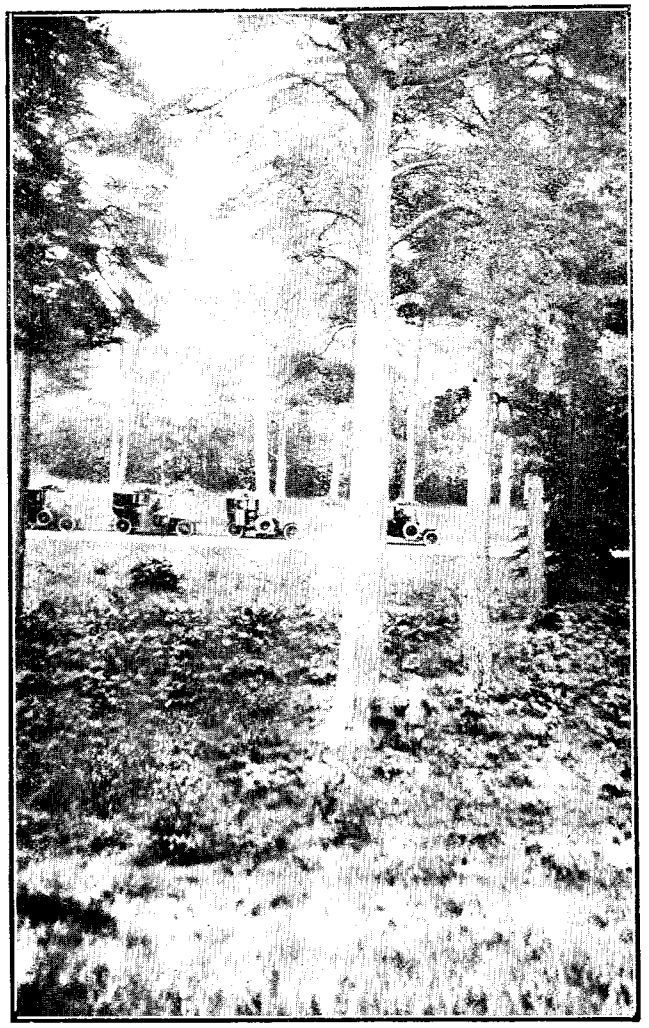
Picea canadensis, Alberta (Canada). Forests of this Type are utilized for Paper-pulping.



Part of Brasen Forest, Alberta (Canada). Note the Erect Growth of Pines, even at the Higher Altitude.



Some of the Famous "Laird's Walking-sticks" on Dr. Farquharson's Estate, Scotland.



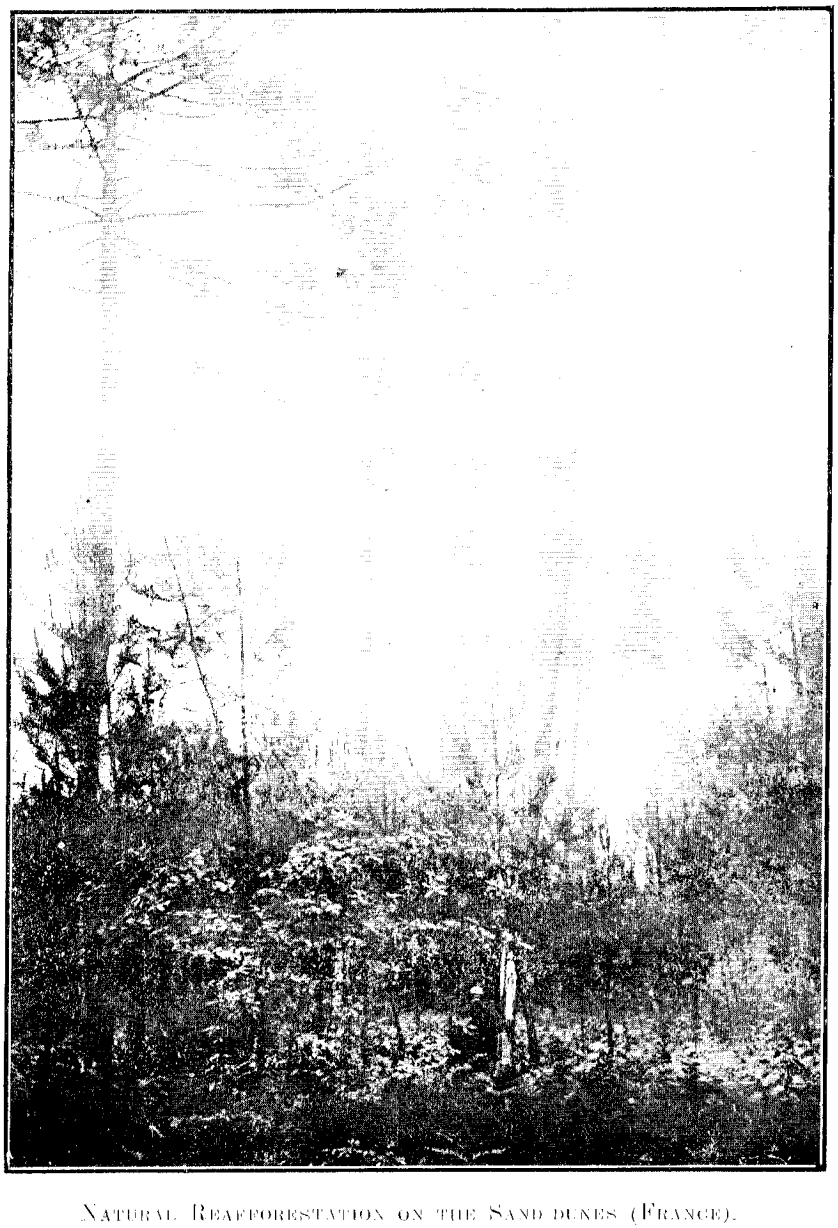
Ballogie, Scotland. Scots Pine: Height 108 Feet; Girth, 11 Feet 10 Inches.

Natural Regeneration of Pinus sylvestris in Scotland. Note the Excellent Parent Trees left for Seeding Purposes.

A Magnificent Specimen of Pinus maritima growing on Sand-dunes, France. Girth, B.H., 13 Feet 2 Inches.

Women gathering Pine-cones and Stage in France. (Pine-needles and Small Branches used for bedding Stock.)

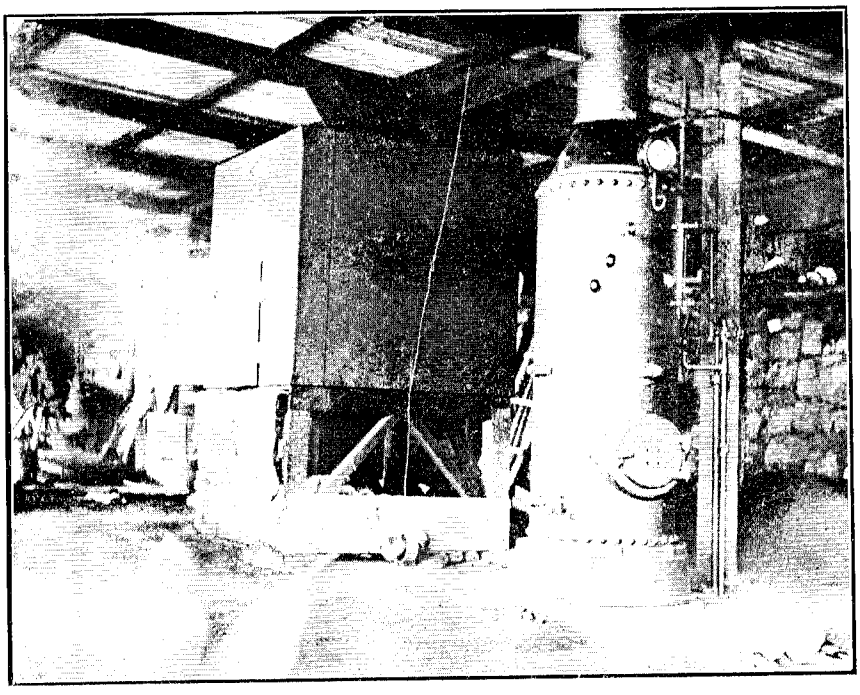
Native Forest of Pinus maritima near Bayonne (France).



Natural Reafforestation on the Sand dunes (France).

Abernethy Forest (Scotland). A Deer Forest not managed for Timber production. Old Scots Pine.

Birham Hill and Wood (Scotland). Party of Delegates to Conference.



Soil sterilizer at Hawy Island.

(3.) Where possible, assisted regeneration is effected by cutting the parent tree down and allowing a large portion of the cone-bearing tree-head to remain on the ground. In such places a perfectly dense pine forest becomes quickly established.
(4.) Homesteads of workmen were noticed here and there throughout the pine forests, and quite a large area is now devoted to the profitable cultivation of *Secale sativa*, which is used for breadmaking.

Willow-growing.

One important phase of forestry that up to the present has received little attention by the State is willow-growing; and, realizing the scope for improvement in this direction, investigations were made in England from a specialist, Mr. W. Paulgrove Ellmore; and with your approval a series of experiments will be conducted with several species of the *Salix* family, eminently suitable for manufacturing cricket-bats, baskets, &c., binding banks of rivers and watercourses, sewage-farms, &c. There can be no doubt that by judicious management willow-culture will return speedy and profitable returns, particularly if the selection of varieties is carefully undertaken. Generally, commercially valuable willows are expected to thrive and become profitable under extremely moist and even water-logged conditions, but this belief is erroneous.

Regarding the economic value of willows for basketmaking Mr. Ellmore says, "Willows to pay handsomely must under all circumstances be pure to their kind, because there is three weeks' difference between sap-rising in the earliest and latest varieties, and for buffing purposes the colour must be uniform, and a guarantee should be obtained with cuttings that they are true to name."

French people are large growers of excellent canes, but the value of this produce is usually discounted by the inclusion of inferior kinds in the bundles. In Germany and Belgium, where the soil less suitable for the higher grade of willows is utilized for the industry and the best species is not cultivated, an inferior material is produced.

Salix triandra (white or buff) is used extensively for high-class basketmaking, whilst *S. viminalis* constitutes one of the cheaper species. Very vigorous canes are produced by the former willow, one plant of which not infrequently stools out twenty or more rods annually nearly 6 ft. in length. For sewage-farms *Salix hippophaefolia*, a willow with great absorbent powers, is strongly recommended. The *Salix alba* (var. *caerulea*) is now looked upon by makers of high-class cricket-bats as being of most value for the work, and discussions on the subject with several gentlemen intimately connected with the industry have convinced me of the coming dearth in the supply of willow-wood and the advisability of making at least some small provision for this anticipated shortage by forming white-willow stands and small experimental stooling-plots in each district where State tree-planting is in progress. The demand for peeled willows in England also shows a rising tendency, and the present value for the rods averages about £26 per ton.

Forest-fire prevention.

In no place visited was such adequate provision against the prevention and spread of fire in artificially-raised plantations noticed as in New Zealand, although in America of late years a tremendous amount of labour is being directed upon the judicious conservation of natural forests, and in many cases the sawmillers themselves have realized the absolute necessity of co-operating with the Government in order to eliminate the irresponsibility among smaller holders to maintain the efficiency of the excellent fire-prevention scheme organized. Mr. Campbell mentioned that some 50,000 dollars was expended in the present year in fire-fighting alone in Canada. Specially educated men are engaged to patrol over forest areas, and, in addition, on the more-elevated positions here and there tall lookout towers are constructed. From these towers one is able to locate the outbreak of fire, and by telephonic communication quickly direct the combined energies of the forest workmen where required. Regarding the native forest Fire Patrol Force in British Columbia Chief Forester Macmillan says, "The fire-protection staff for 1913 totalled in midsummer about 320 men, an increase of 50 per cent. over the total of 212 for 1912. . . . The total cost of the patrol alone was about 190,000 dollars." The remarkable activity of the recently formed St. Maurice Fire Protection Association may be gauged from the fact that during its initial year, 1912, about 525 miles of trails and portages were cut and cleared, and three lookout stations established with telephonic connection with the existing telephone-lines along the railway and between the settlements. The fire-protective work is carried out under the following general heads, for which special appropriations are set aside out of the funds of the association:—

(1.) Appointment and placing of district chiefs by the manager, who shall have jurisdiction over the fire rangers within their districts, and the organization and administration of all protective work and fire-fighting.
(2.) The installation and maintenance of telephone-lines.
(3.) The compilation of suitable maps of each district to facilitate fire-fighting therein, showing location of tools, roads, trails, streams, lookouts, telephone-lines, and ownership, and the distribution of uniform copies thereof to all agents of the association.
(4.) Placing of fire rangers on definite routes to cover largest area efficiently.
(5.) The distribution of fire-fighting apparatus.
(6.) Construction of lookout-stations for the early apprehension of fire.
(7.) Building trails.
(8.) Perfecting organization and establishing systematic reports.

(9.) Promoting co-operation between—(*a*) Provincial and town authorities; (*b*) managers and railroads, telephone and telegraph line; (*c*) adjacent logging operators; (*d*) fishing and game associations, &c.

(10.) The creating of a reserve fund for the immediate and emergency fighting of fires which may be discovered upon the lands of the association, and which will need attention until the landowner can be advised thereof and respond.

Although, of course, certain provisions for checking the spread of surface fires are not overlooked, probably the moist conditions prevailing in Great Britain render the adoption of our somewhat elaborate scheme unwarrantable. In England, Scotland, and France (sand-dune plantations) the barriers are much narrower, and I failed to observe the systematic method adopted in New Zealand of the introduction of fire-resisting poplars, birch, &c., for lining the interior breaks or external fringes. Very little special cultivation was seen, although the sheep-grazing proposition evidently finds favour in certain districts, after natural regeneration has been accomplished. Usually reference to the fire-break question is given by writers, but the little notice taken by planters in the general provisioning for the control of fires gave me much surprise. Apart from the erection of lookout towers in extensive plantations, nothing worthy of adoption here was seen that can be included under this heading.

Regeneration of Forests.

In Scotland the regeneration of pine and larch forests is proceeding apace, and on quite a number of private estates much interest is being shown in this direction. At the Earl of Seaforth's Strathspey forest splendid results were seen, and the inclusion herein of notes on our itinerary may be interesting.

"The woods on the Strathspey Estate are situated at altitudes ranging from 600 ft. to 1,600 ft. The soil for the most part is of a shallow and light nature overlying rock or pan. The superficial accumulations on the level ground of this district consist principally of gravelly and sandy till, and this also may be said in a less degree of the higher ground, while small alluvial flats occur along the valleys.

"The woods are purely coniferous, the main crop consisting of Scots fir with a small percentage of larch and spruce. The shallow nature of the soil, combined with the prevalence of early and late frosts, makes it a little difficult to deal with conifers other than those mentioned, unless as underplants.

"As most of the time was devoted to the inspection of natural woods, it may be advisable to mention briefly the broad lines that are adopted in Strathspey for the purpose of restocking by self-seeding. Natural regeneration of both Scots fir and larch occur all over the estate to a greater or less degree according to soil-conditions, &c. The treatment of all woods from their younger stages upwards bears relation to the general methods of sylviculture, but the woods from about eighteen years of age are generally grazed by sheep or cattle. When woods have reached the end of the rotation they are thinned gradually and treated more or less under the compartment or selection system. The preparatory stage comprises several thinnings, and, although it varies according to exposure and the condition of the crop, there are generally three cuttings or thinnings, then seeding stage and final felling. The period over which these stages may extend depends upon the forest conditions; in some cases it is short, the young plants showing quite early; in others it extends to ten years and over. A commencement is made by removing all inferior trees or trees not suited for the main purpose or object in view. The point aimed at is to leave trees with narrow crowns, long clean boles, and having healthy appearance, thus fostering strong fresh shoots and ensuring a plentiful supply of healthy seed. Briefly, the procedure with a crop of, say, two hundred trees to the acre is as follows: First thinning, a hundred trees are removed; second thinning, fifty trees; third thinning, thirty-five trees: thus fifteen trees are left as seeding-trees, which are removed when the area is more or less restocked. This method has been found to work well here, and has the advantage of not only allowing the seeding-trees to develop shoots sufficient to grow healthy seed, but there is little or no danger from wind-blows.

"After the Scots pine woods here begin to open up, or are opened up, admitting light and air, the ground is very thickly covered with heather and moss, which if not disturbed would render self-seeding impossible, or at least of little consequence. In order to combat this as little as possible the woods are grazed heavily or closely by farm stock: thus the heather is to a certain extent kept in check and the mossy surface disturbed and broken up. The breaking-up of the surface for the reception of seed could be done by workmen, but this would add considerably to the expense, and as almost the same benefit can be got by pasturing that method is adopted here. At the seeding stage all sheep and cattle are removed.

"Although the selection and compartment system is always applied here, evidence is not wanting that the strip system would be successful in some cases.

"*Tominourd Plantation.*—The area of this plantation is 1,031 acres, and rises in altitude from 620 ft. to 1,350 ft. Up to 1,000 ft. the crop grew well, but beyond that elevation the trees fell off considerably. The north side to the extent of 520 acres has been recently felled or cleared of old trees, the crop then being an equal mixed one of Scots fir and larch. The fellings extended over a period of seventeen years. To begin with, larch came a pure crop where the herbage was mainly heather, but latterly the percentage has increased in favour of Scots pine. On grassy surfaces self-seeding has not been nearly so perfect, especially on the lower levels, and artificial planting must be resorted to in order to make the crop complete. The young natural larch here is almost completely free from disease, and, although in places the plantation is so thick and close as almost to exclude light and air, the plants remain immune. Larch-aphis (*Chermes laricis*) attacks the crop occasionally, but so far has not acted as a serious check. So long as the larch remain healthy they will be left to form a pure crop, but if they begin to show signs of disease

they will be immediately thinned out and underplanted. The main point here is the area of pure larch."

The visiting foresters were of unanimous opinion that such results can only be achieved after a persistent study of local conditions. Evidently each expert present realized the necessity of reducing the initial expenditure in creating forests, if financial success is to be the outcome of his labours, and perhaps regeneration and underplanting of forests either artificially formed or natural were two of the most discussed phases of the question during the whole tour.

In British Columbia and other parts of America regeneration of spruces and hemlocks by the strip system is fostered, but there is always a danger of uprooting of surrounding trees attending the removal in blocks of such shallow-rooting trees, and consequently much discretion requires to be exercised in selecting suitable spots for carrying out the proposition. The usual practice is—(1) The removal of commercially valuable timber; (2) burning of a fair proportion of slash; (3) permitting small clumps of well-formed trees to remain here and there for seeding purposes; (4) protecting the area from injury by live-stock. There is no doubt that the robust nature of the spruces and hemlock, suitability for pure planting, fertility of seeds, and simplicity of germination render the members of the *Picea* and *Tsuga* families eminently adapted for natural regeneration.

The perpetuation of our native forests is generally looked upon as being quite possible with adequate protection; but perhaps the natural regeneration of the forests has not received very much attention, principally owing to the slow progress of indigenous trees generally. It has occurred to me that areas relieved of the first- and second-grade timber might be advantageously underplanted with such fast-growing exotics as Douglas fir in the shadier, and pines in the more open, situations. This artificial reforesting would, in localities where noxious weeds speedily take possession of the ground and agriculture is not undertaken extensively, likely become profitable at an earlier rotation than where virgin land is operated upon. A small experiment would indeed be interesting. The following numbers of pounds of seed per acre are used in broadcast sowing burnt areas:—

Variety of Tree.	Quantity per Acre.
Ash	30 lb.
Balsam fir	35 lb.
Beech	120 lb.
Birch	25 lb.
Elm	25 lb.
Maple	40 lb.
White-pine	10 lb.
Tamarack	10 lb.
Spruce	10 lb.
White-oak	10 bushels.
Red-oak	8 "
Black-oak	8 "

Diseases of and Injury to Trees.

Much of an interesting nature regarding the damage to seedlings and trees was observed, and perhaps the inclusion of a few brief notes thereon will not be out of place.

Firstly, I was much surprised to find that little damage to seedlings in nurseries results from the very limited presence of the grass-grub, *Odontria* sp., and officers in charge showed much surprise on relating our experience with the pest in New Zealand. Fallowing ground is, however, resorted to in several places where the cockchafer—*Melolontha vulgaris*—is known to exist, and this precautionary measure is usually attended with success. Seedlings of larch and pines were slightly more affected with *Chermes laricis* than those in our New Zealand nurseries; but, strangely enough, *Pinus sylvestris* (Scots pine), which is raised so extensively in Scotland, and is usually literally smothered with aphis in New Zealand, is almost immune from this insect. "Damping-off" was noticed frequently, particularly where thick sowing had been undertaken, in the more moist localities throughout the British Isles, and the remedies resorted to in such cases coincide with those adopted in New Zealand—viz., judiciously thinning out and facilitating freedom of sunshine and air about the seed-beds.

Larch Needle-shedding.—The mysterious development of premature needle-shedding of larch, both in our nurseries and plantations, was specially borne in mind, and a similar state of affairs, although in a smaller degree, was noticed at the Forest of Dean, England, and Avondale, Ireland. On pointing out this peculiarity to officers I was informed that it was generally believed that the cause of discoloration was due to unfavourable atmospheric conditions—late frosts, winds, &c.—but it was unaccountable how perfectly healthy specimens remained surrounded by affected trees. It is evident that the development is not looked upon so seriously as in New Zealand, and I would strongly recommend that our co-operative investigations into the cause be continued.

Peziza Wilkommii.—Several opportunities were afforded me of studying the effects of the dreaded larch-canker, which has played havoc with plantations, and, in fact, absolutely prohibited the growing of the European species in certain places. The Japanese larch (*Larix leptolepis*), however, has proved itself to be not so susceptible to the disease, and accordingly is receiving more attention of recent years. The fungus responsible for the disease produces sporophores on the bark or decayed branches, and the resulting spores are liberated, particularly during moist weather in the autumn and spring periods, and being carried about by wind it is not difficult to understand the rapidity with which the disease spreads over large areas. Although pure planting is still being carried on, generally speaking, larch is used in admixture with shade-

bearers, in anticipation of thus being able to more successfully combat the fungus. In young plantations much vigilance is exercised for the presence of the disease, and each employee is educated sufficiently to be able to also instantly detect same. Instantaneous action in removing affected trees and decayed timber and branches in the vicinity is taken on the officers being made aware of the outbreak, and this is frequently followed by underplanting with tolerant varieties.

In the damper localities plantations of larch were seen where *Fumago vagans* had obtained a hold. I understand this form of honeydew is best overcome by thinning, and allowing more air to circulate through the plantation. The ill effects arising from the presence of such diseases as pine-needle blister (*Peridermium pini*), ash-canker (*Nectria ditissima*), coral spot (*Nectria cinnabarina*), beech-scale (*Cryptoccus fagi*), pine-sawfly (*Spphyrus pini*), and pine-weevil (*Hylobius abietes*) were also noticed, and valuable notes taken in reference to remedial measures.

The destructive squirrel now abounds in the British Isles, and instances were numerous of the damage caused by its presence. Evidently few varieties of trees are immune from the attack, but generally pines and larch suffer mostly. The animals ringbark the trees some distance below the crown, which in course of time dies. Strong laterals are then usually developed.

Brief Remarks on certain Trees.

In placing our reliance specially upon *Pinus Laricio*, *P. ponderosa*, *P. radiata*, *Pseudotsuga taxifolia*, *Populus deltoides*, and selected eucalypts to fulfil future requirements, the Department cannot reasonably be accused of indiscretion; but the wisdom of having operated so largely with European larch in pure stands is problematical. At all events, our oldest larch plantations have now reached the critical period, when disease in various forms might be expected, and extreme vigilance for any outbreak of fungus should be exercised. Pure planting of larch in Great Britain is looked upon as being a decidedly doubtful proposition, owing to the susceptibility of the tree to canker; but many planters evidently still risk this wholesale loss in their eagerness to raise similar magnificent larch forests to those seen frequently during our tour. Larch-timber commands a much higher price than the largely grown Scots pine, and in consequence of its greater durability is more needed for the requirements of the country.

Pinus sylvestris undoubtedly occupies first place in Scotland's native forests. The species admirably lends itself to reafforestation by reason of its simplicity of propagation and, strangely enough, only isolated trees were noticed affected by *Chermes laricis*. At every attempt to grow the Scots pine in the Dominion we have been frustrated by the attacks of this aphis. The question arises again, however, whether the seed used was gathered from healthy specimens; and a further trial sowing of special seed selected from some of the famous "Laird's Walking-sticks" will be made in the hope of raising a few pines of excellent parentage for experimenting with on high altitudes. It might be mentioned here that much success is attained throughout portion of the prairie country in Canada with *Pinus sylvestris*, which is also recognized as being adaptable for the creation of dense shelter-belts.

I was much impressed with the vigour of the Russian poplars—*Populus Petrovski*, *P. certinensis*, and *P. wobsteriga;* and each species also makes rapid headway, even when planted on alkali surfaces.

It would appear that the requirements of Manitoba maple (*Acer negundo*), *Picea alba*, and the excellent leguminous Siberian pea-tree could also be furnished in Central Otago, where specimens will be sent on trial as soon as possible.

In Scotland, *Pinus Laricio* does not seem to have been persevered with to any great extent, and nurserymen complain of the high transplanting death-rate in operating with this species. In England, however, rather more value is placed upon the Corsican pine, but it also is excluded from the list of the principal trees grown.

The bull-pine is also dealt with similarly, and it is surprising that even in America, where such magnificent forests of *Pinus ponderosa* abound, only comparatively little has been done with the species in the drier localities.

Along the Pacific coast was noticed growing profusely the red-cedar (*Thuja plicata*), the timber of which is used extensively for shingles. In view of the value of the timber, experiments now being conducted with the red-cedar in the South Island should be undertaken with greater vigour.

Both *Tsuga Mertensiana* and *Abies grandis* are recognized as being very valuable for ground-protective work, and should, in my opinion, receive more consideration in the future.

In the eucalypts it is absolutely impossible to recommend with any degree of certainty the general planting of any particular species, and it is purely a matter of experimenting with seedlings raised from known, valuable, acclimatized trees. A brief discussion in Sydney with Mr. J. H. Maiden on the subject convinced me of the great study that is entailed in becoming thoroughly conversant with the Australian hardwoods. In Victoria and New South Wales the Forestry Department are aiming in the meantime at producing soft timber by planting *Pinus radiata*, *P. Laricio*, and in a less degree *P. maritima*, believing that by the conservation of existing gum forests and assistance in natural regeneration of same the supply of hardwood will be sufficiently regulated to meet anticipated future demands.

Several demonstrations of the value of *Pinus radiata* for case-making and indoor construction-work point to the ultimate success of our extensive operations with this fast-growing tree. It is well to bear in mind, however, the havoc that high winds occasionally play with the species, particularly when the ground is in a thoroughly moist state, and care should be exercised to judiciously include protective belts of deeper-rooting trees less liable to be uprooted or broken off in situations requiring this provision

PREPARATION OF WORKING PLANS.

Several somewhat complicated schemes were exhibited to me, but in each case the contrasting conditions necessitated the formation of almost entirely different plans. Elaborate descriptions and statistics of what might be expected were also perused and noted. On discussing various points with the compilers it was noticed that they were unanimous in the belief that to prepare working plans before the sylvicultural possibilities of the tree-planting district were known is not practicable, for a certain working scheme applied to one plantation may not be adaptable to another young forest, where perhaps climatic and other conditions differ. The revision of working plans periodically is also unavoidable, and an original outlined has frequently to be abandoned and superseded by another into which the actual results has supplied a reliable working basis.

No attempt will be made here to outline in detail form the recording practices seen, believing that at a later date full information in a more lengthly article will be acceptable. Such important points, however, as the following are invariably resorted to in connection with the initial plantation formation-work:—

(1.) Survey of acquired areas and laying off of roads and fire-lines before planting commences:
(2.) Preparing plans for subsequent recording of progress:
(3.) Printing of special recording-books and tickets.

For quite a number of years after the initiation of the Forestry Branch in New Zealand no attempt was made to keep accurate records of trees planted in compartments or plans showing the planting schemes adopted, and accordingly in endeavouring to effect a remedy in the earlier planted forests we are confronted with an insurmountable difficulty through the close growth prohibiting the necessary freedom for survey-work. It is apparent that, unless the blocks, roads, fire-lines, and boundaries of a newly acquired area are defined by a surveyor there is little hope of subsequent incontestible recording or satisfactory management. With each succeeding year the increasing extent of our afforestation-work exacts the application of more intricate labour, and I would strongly recommend that the Superintending Nurseryman of the North and South Islands respectively be asked to co-operate and discuss the question of working plans and other important matters at a convenient date.

I have, &c.,
R. G. ROBINSON,
Superintending Nurseryman for South Island.

James Mackenzie, Esq., Under-Secretary for Lands, Wellington.

ROYAL SCOTTISH ABORICULTURAL SOCIETY.

ITINERARY OF TOUR OF INSPECTION OF WOODS AND AFFORESTABLE LANDS IN SCOTLAND MADE BY THE SOCIETY'S GUESTS, 29TH JUNE TO 10TH JULY, 1914, AND REFERRED TO IN MR. R. G. ROBINSON'S REPORT. (FROM THE SOCIETY'S TRANSACTIONS, VOL. XXVIII, PART 2.)

MONDAY, 29TH JUNE.

The representatives of India, Canada, South Africa, and New Zealand were entertained for three days at Dupplin Castle, Perth, after which the party assembled at the Station Hotel, Perth, at 9.30 a.m., where the motor-cars were in waiting.

Scone.

The following are particulars of the trees and plantations visited on this estate:—

Lynedoch Old Pleasure-grounds.—Two Douglas firs, the first to be brought into this country. As plants they were sent with others by David Douglas, and were planted in 1834. The larger tree now contains 573 qr. girth cubic feet over bark. The total height is 115 ft. Most of the young Douglas trees on the estate were raised from seed obtained from these trees.

Drumcairn Plantation.—Conifers and broad-leaved species—pure and mixed trial plots. Age, twelve to thirteen years. (1) *Abies nobilis;* (2) Lawson's cypress; (3) sycamore; (4) sycamore with Japanese larch; (5) Norway spruce; (6) European larch; (7) Japanese larch.

Drumveigh Plantation.—Age, fifteen to sixteen years. (1) Scots pine and Japanese larch; (2) Norway spruce and Japanese larch.

Longhill Woods and Portable Sawmill.—Scots pine, spruce, and larch. Ages, sixty and 115 years. Damaged by gales of 1911 and 1912.

Large Scots pines are being converted into railway-sleepers and boards; smaller Scots pine into pit-crowns, small sleepers, and pillar-woods; spruce into boards and rickers; and larch into planks, hutch-boards, fencing-materials, &c.

Taymount Douglas Fir Plantation.—Planted in 1860 with Douglas fir and larch at the rate of 1,210 plants per acre, 303 being Douglas fir and 907 European larch. The whole of the larch were cut out by 1880, having become very much diseased. In 1887, 600 to 700 stems were removed. In 1888 the stems were pruned to a height of 15 ft. to 20 ft. In 1896 the pruning was continued to a height of 30 ft. In 1897 damage was done by wind to the north end. In 1912–13 blown and dead trees amounting to 106 stems were removed. Average number of stems per acre, 143; average volume of stems per acre, 6,276 ft.

Murthly.

Arrived at Kingswood about 1.30 p.m. The nursery, sawmill, creosoting-tank, and examples of well-grown sawn Douglas were seen. In the Byres Wood the substitution of coniferous timber crops for old oak coppice is being carried out, the species used being Douglas, hemlock, *Thuja plicata*, and *Cupressus Nootkatensis*, and the ages varying from one to eight years. From the Byres Wood the party went to the Ringwood, and were shown a plantation of pure Douglas, fourteen years old, and already lightly thinned. The forestry museum, containing specimens of timber, fungoid and insect pests found on the estate, was visited.

TUESDAY, 30TH JUNE.

Murthly.

Arrived at Bee Cottage, on the Perth–Dunkeld Road, three miles from Dunkeld, at 9 a.m. The first plantation inspected was a pure Douglas plantation, eight years old, also mixtures of European and Japanese larch, and Douglas and experimental plots of hemlock, *Thuja plicata*, and a supposed hybrid between the European and Japanese larch. Passing by Rohallion Lodge the party was shown a plantation of larch planted at wide intervals and filled up after a lapse of five years with Douglas and other species.

Dunkeld.

The party left the Birnam Hotel at 2.30 p.m., and proceeded by motor through the Dunkeld woods, viewing good old larch and spruce, planted 1820–30. The greater part of this wood is not worked commercially, but kept for æsthetic purposes. On the upper road to Loch Ordie a large area of good larch (altitude, 1,000 ft. to 1,500 ft.) was passed. Some of this wood is now being cut and manufactured at a sawmill in the locality. After leaving Loch Ordie the party proceeded to Dunkeld House via Dowally Sawmill, inspecting on the way plantations of European and Japanese larch, and a (supposed) hybrid larch between these two. After passing Dunkeld House a plantation of fine larch mixed with beech was seen, large silver-firs and parent larch. Motors were then taken to convey the party to Ladywell Nurseries *en route* to the Birnam Hotel, which was reached about 6.30 p.m.

WEDNESDAY, 1ST JULY.

A start was made from Birnam at 8 a.m., the route being taken via Blairgowrie and the Devil's Elbow (altitude, 2,200 ft.) to Braemar, which was reached about 10.30 a.m.

Mar.

Mar is one of the oldest, if not the oldest, deer forest in Scotland. The woods on the estate, apart from the natural forest, vary in age from about thirty to a hundred and twenty years. They were planted solely for shelter to the deer, which is necessary in a rigorous climate, and have been managed since with that object in view. Commercially, timber is of little value at Mar, as the cost of haulage would in many cases be more than the value of the timber. The planted woods are solely composed of pine and larch, and what remains of the natural forest is, of course, pine.

The party motored along past the Linn of Dee and a few miles beyond it into Glendee. Good examples of larch growing at high elevations were seen on the way. Returning from Glendee we went in the direction of the Derry, where one or two younger plantations were observed, and thereafter proceeded past Mar Lodge, on the north bank of the Dee, to the Fife Arms, where lunch was obtained.

Balmoral.

Leaving Braemar at 2 p.m., the afternoon was devoted to an inspection of parts of the old Ballochbuie Forest, Garmaddie Wood, Craig-gowan and Balmoral grounds.

THURSDAY, 2ND JULY.

Ballogie.

The party met at the lodge at 10 a.m., drove through the main avenue and out by the east gate, past Marywell as far as Sawmiller's Croft. We walked through Craigmore Wood (about fifty-five to sixty years old), the top of cleared ground and Slithery Brae, and then drove round to Hunter's Lodge, down to Carlogie, and back to Potarch for lunch, taking Balnacraig on the way.

Finzean.

Met at Corsedardar Stone at 2.30 p.m. Left cars and walked through Shannel Wood to clearing and back, rejoining cars and driving to Finzean by east avenue. Drove down main avenue, past "Laird's Walking-sticks," out at lodge, and on to Durris via Strachan.

Durris.

Met at Knappach Bridge at 5 p.m. Inspected plantations at Balbridie and North Brae (oak and young larch). Drove on to Balladrum; left cars and walked through Douglas fir plantation. Drove to Strathgyle to see Menzies plantation, and then straight to Aberdeen via Smithy and Marycultur Bridge, arriving at the Grand Hotel about 7.30 p.m.

FRIDAY, 3RD JULY.

Leaving Aberdeen at 8 a.m., the party motored via Keith to

Orton,

where excellent examples of Scots pine and larch woods were seen. After lunch the party proceeded up the valley of the Spey to inspect the Seafield Woods, Strathspey, a detailed reference to which will be found elsewhere in this report.

Upper Tomvaich Plantation.

This area is divided into two compartments—(1) containing 267 acres, and (2) 36 acres. (1.) The crop consists of Scots fir of about ninety years of age, with a few larch-trees, standing to the number of about forty to fifty trees to the acre. A number have been marked for sale, but about fifteen trees have been left to the acre as seeding-trees. (2.) This area consists of Scots fir standards, with an outcrop of natural plants. This part was fenced against sheep a number of years ago, only cattle and horses being allowed access. Young plants have come up well, and show what might be expected from the larger area.

Lower Tomvaich Plantation.

This wood has an area of 208 acres, divided as follows: (1) 200 acres of Scots fir and larch standards, (2) 8 acres of old Scots fir, with an undercrop of natural Scots fir and larch. The large area is to be thinned out and left to fill up naturally, farm stock being excluded. The 8 acres formed until a few years ago part of the same area. When fenced off against farm stock natural plants came up freely, which shows pretty conclusively what might be expected from the adjoining area. The standards have been left too long, but are to be removed next year. Meantime the area is a pretty picture, and shows well the result of the system adopted.

Policies of Castle Grant.

On the right is Drumdunan Wood—250 acres—consisting of a pure crop of Scots fir reared naturally. A number of old standards are left on the drive side to form a wind-screen and shelter to the young crop. These trees show the nature of the previous crop.

Milton and Old Grantown Woods also form part of the policies, and carry a crop of Scots fir about 140 years of age. The trees have long clean boles and a limited branch area. The woods in their young stages are very carefully thinned, and from notes it has been ascertained that for a long number of years only dead trees were taken out, which no doubt accounts for the clean nature of the stems. The highest of the trees, measuring from the top of the leader, is 109 ft., and many have clean boles up to 70 ft. and 80 ft. From old history it appears that the plants for this wood were carried from Abernethy Nursery, a distance of six miles, on panniers strapped on the backs of ponies, and that they were of a larger size than is now generally employed in planting, consequently they were all pitted.

Lower Lynmacgregor Wood.

This wood contains a more or less pure Scots pine crop, and was planted sixty-two years ago. No thinnings of any consequence have been taken out beyond dead and completely suppressed trees. In some part a light thinning was necessary.

SATURDAY, 4TH JULY.

Curr Plantation.

This plantation extends to 260 acres, and contains a natural crop mainly of Scots pine, with a few larch. The trees are of various sizes and ages, the oldest being about thirty-five years of age; but the difference is small, as the plants come up with surprising regularity. There is very little space entirely bare of trees, and, generally speaking, it can be said that the whole area is fully stocked. Naturally the trees form thickets in spots specially favourable to the germination of seed, but in these parts a few of the strongest have gone ahead and formed themselves into dominant stems, to the suppression of those not able to keep abreast. Thinning in some parts is now absolutely necessary. The soil is of an open tilly nature, admirably suited for the reception of seed and the growing of Scots fir and larch, especially the former. The old timber in this wood, which is only about one mile from the estate sawmill, was used for estate purposes, the trees being taken out as the young plants came up. This is the method from which the best results have been obtained in the way of a natural crop. It is scarcely to be expected that with ordinary and regular thinnings, each taking a few months, in stated years the same satisfactory result would be obtained. A few old trees remain, which show the nature of the old crop.

Balnagown Wood.

This wood has an acreage of 73 acres and a crop of Scots fir standards, with an undercrop of natural plants. The number of standards per acre varies according to the condition of the undercrop, whether complete or otherwise. In this wood also the old timber is manufactured at the estate sawmill, and accordingly the management is similar to that followed in the case of the Curr plantation, and somewhat different from the management generally followed. The mother trees are being taken out as the young crop comes up, none being removed until the latter is complete. This method is giving here a closer and more complete crop than generally can be had from stated and complete fellings.

The soil in this wood is of exceptionally poor quality—viz., a thin, rough, and poor soil, gravelly, with a little peat or rough humus. That the soil is poor in this case is evident from the appearance of the old crop and from that of the smallest of the natural plants. It appears, however, that once the young crop has attained the age of about seven years the growths are much stronger, and the plants assume a much more vigorous appearance. Judging from the specimens of the old crop left, it is very doubtful if it would pay to spend money in planting here; but as restocking is done naturally and therefore without expense, the chances of profit are more favourable than they otherwise would have been.

Abernethy Forest.

As this area forms part of the deer-forest, everything is left to work out naturally, nothing whatever being done to assist a new crop. So far this has been secured in a somewhat more or less complete form, and thus the wood represents trees of all ages coming up together. The branch area of the young trees here, when grown openly, is not of the same rough nature as in the case of those grown on the lower levels of the country, so that trees of different ages grow together without causing each other any serious damage. All that is done by way of management is to remove the old trees when they have fostered a new crop.

A number of the trees that formed part of this forest are still to be seen, but those left are somewhat rough and branchy. The timber of these trees is of the best quality, of exceptional durability, and stands well extreme weather exposure.

Proceeding to Aviemore Railway-station, train was taken for Inverness, which was reached about 4.30 p.m.

Novar.

In the afternoon and evening a short visit was made to the Novar Woods. Motors conveyed the members to Inchcholtair, where larch underplanted with *Abies grandis* were seen. Afterwards Crosshill was visited, where larch underplanted with various conifers were inspected, and on the way back to the station experimental plots and beech of natural regeneration under oak were noticed in passing. Dingwall was reached at 8.35 p.m., and Inverness at 9.30 p.m., where the party stayed for the week-end.

MONDAY, 6TH JULY.

Glen Mor.

The party assembled at Muirtown Pier, on the Caledonian Canal, at 7.45 a.m., and left by steamer at 8 a.m. for Oban. In the course of the sail down the canal members had an opportunity of seeing the area of 60,300 acres dealt with by Lord Loval and Captain Stirling in their forest survey of Glen Mor, which was published by the society in 1911. In the preface to this report the Council of the society says that the report establishes the following propositions:—

"(1.) That it is possible to create forests in the Highlands, even in districts where the economic conditions appear most adverse, without seriously impairing existing sources of weath.

"(2.) That afforested areas will, even in the early stages of the movement, gain greatly in employment and population.

"(3.) That the actual work of planting can and ought to be cautiously begun as soon as the progress of the survey justifies the selection of definite areas."

Several members of the party were able to give explanations regarding this area and the problems dealt with in the report.

Oban was reached at 7.5 p.m., where the party was accommodated in the Great Western Hotel.

Annual Excursion.

Members (about seventy) taking part in the annual excursion assembled at Oban on Monday evening, 6th July, where they were joined by the society's Diamond Jubilee guests.

TUESDAY, 7TH JULY.

The combined party left Oban by train at 7.30 a.m. via Taynuilt and pass of Brander for Loch Awe Station, and were conveyed by steamer "Loch Awe" down the loch to New York pier.

In the course of the sail a good view of the country on both sides of the loch was obtained, and some patches of good woodland and much land covered by natural scrub, birch, oak, alder, and ash were noticed, which gave a general idea of the possibilities of the country from a forestry point of view. It should be noted, however, that some parts which look most promising from the loch are rather disappointing when walked over, and it is not wise to conclude that land which has the appearance of being covered by scrub is actually so, as the scrub is often on dry ridges with flat bogs between, yet they appear as continuous masses of scrub woodland.

Interliever Estate.

(Area, 12,628 acres.)

The estate was purchased by the Commissioners of Woods in 1907 for the purpose of conducting an afforestation scheme on a large scale. The first cost of the estate was £25,115; the redemption of fixed charges has since amounted to £2,417, and payments for acclimatization values of sheep stock to £4,024, making a total of £31,556. A further payment of small amount for acclimatization value will have to be made on the determination of the existing tenancies.

General Description.—The estate is situated at the west end of Loch Awe, on which it has a frontage of about eight miles and a half. The loch lies at an elevation of about 120 ft. above

sea-level, while the highest point on the estate is about 1,450 ft. The rocks are marked by the Geological Survey into two main types—schists (epidiorite, hornblendic, chloritic, and talcose) and grits (greywackes, quartizite, and quartz-shist). There are also a number of intrusive dykes of basalt and dolorite. The route followed by the society lay almost wholly on the schists.

The soil changes rapidly from place to place; on the steeper slopes it is generally a yellowish loam of good depth; on the gentle slopes there is everywhere a tendency for peat to form, and on badly drained sites this formation goes on to a depth of several feet. The whole area has been heavily glaciated, generally in a direction parallel with the loch, with the result that the ground on the upper slopes is very broken. What were formerly numerous small glacial lakes are now the sites of peat bogs. At the north end of the property, near New York pier, and again near Ford, there are considerable areas of fluvio-glacial deposits.

The sea is only four miles distant from the western boundary of the estate, but a certain amount of shelter is derived from the intervening high land. Apart from persistent winds, the climate is mild and well suited to tree-growth. The rainfall varies from 70 in. to 90 in. per annum; the snowfall is light and does not lie long. Winter frosts are of short duration, and are not severe. Late spring and early autumn frosts are frequent.

In general, the conditions obtaining on this estate are not unrepresentative of very large areas of rough grazing-land along the west coast of Scotland.

Utilization at Time of Purchase.—At the time of purchase the estate was divided into four farms carrying the stock indicated below:—

Name of Farm.	Approximate Area.	Sheep.	Rental per Annum.
	Acres.		£
Salachry	635	300	66
Torran	2,800	1,900	190
Arichamish	4,900	2,750	150
Barmaddy and Cruachan	4,000	1,750	190
Totals	12,335	6,650	£596

Torran farm carried, in addition, some twenty to thirty cattle.

There were also some 200 acres of scrub, oak, ash, and birch of little value, and about 80 acres of plantations.

Considerable outlay has been necessary on the buildings which were on the estate at the time of purchase. Up to the 31st March, 1914, approximately £2,495 was spent on repairs and improvements to houses and buildings let with the farms, and sporting, and in erecting two new cottages. This is exclusive of outlay on buildings used for forestry purposes.

Afforestation Operations.—Nursery: In the summer of 1908 8¾ acres of land at Ford were fenced off to form a nursery, and in the following spring plants were lined out and seed sown in 2½ acres of it. The nursery was subsequently extended to the total of 8¾ acres. The soil is light and gravelly, and has gradually been worked into condition. The want of a good supply of farmyard manure has been felt, but guano and artificial manures have been used with fair success.

Planting: At the time of purchase the lease of Acrihamish Farm was falling in, and it was judged advisable to begin planting operations at the east end of that farm. The method employed was to fence off a block containing, roughly, 400 acres, and to cut off successive strips of about 150 acres each by a temporary fence running more or less at right angles to the loch. In this way the ground was grazed up to the time of resumption for planting. The permanent fencing has been exclusively iron and wire, with hare-netting. For temporary fencing iron and wire have also been used, but with a sheep-netting only. The greater part of the planting has been done with the half-round planting-spade. The only exceptions were in 1909–10, when the plants were notched in, and later when a rocky face was planted with the planting-arrow, and some small lots of large-sized plants were pitted. The bulk of the plants have been two-year two-years, but some two-year one-year, and a few two-year seedlings have been used as well. The areas actually planted from year to year are as follows:—

Year.	Area planted.	Total Number of Plants used for Planting and Beating up.
1909–10	190	674,000
1910–11	169	664,100
1911–12	187	509,600
1912–13	178	445,900
1913–14	150	346,600
Totals	874	2,640,200

Of the total number of trees planted out, 1,474,100 were lifted from the nursery at Ford, while the remaining 1,166,100 were purchased from nurserymen in this country. Of the plants in the nursery a small proportion only have been purchased from nurserymen abroad, the remainder being obtained from seed or from British nurserymen. It is hoped, now the nursery is in full working-order, that practically all the plants required will be raised direct from seed.

In the initial stages a good deal of Scots pine was planted on the upper slopes, but subsequently the use of this tree was abandoned, both on account of its unsuitability for the conditions and because of the damage done to it by black game. In general, the better soils have been planted with larch and Douglas fir, according to exposure, with a limited quantity of silver-fir and beech. The bulk of the ground, however, is only suited to spruce, and both the Sitka and the common spruces have been largely employed. The common spruce is, of course, very slow in establishing itself, and it is difficult to say at this stage how it will grow on the upper slopes. Much of the early planting was experimental in nature, particularly that relating to planting of peat on upturned turfs.

The first plantings were made in blocks of about 150 acres, which were treated as unfits for accounting purposes. The present system is to divide each block into compartments, bounded by natural topographical features or by permanent roads, and not exceeding about 30 acres in extent.

It is proposed in future to leave unplanted all ground of a doubtful nature, and for this purpose a detailed mapping of the soil is being carried on as opportunity permits. About 1,200 acres of plantable land have been mapped out on Barmaddy and Cruachan Farms in this way, and it is hoped that by the time planting of that has been completed sufficient data will be available to decide on the value of those large areas which in the state of existing knowledge are of doubtful nature.

Small Holdings.—The area of land on the estate which is adapted for the use of small holdings is strictly limited, but it is being scheduled for that purpose as planting proceeds. The policy which the Crown is following in this respect is to equip small holdings as they are wanted and as they can be placed to the advantage of the holder himself. The rapid multiplication of small holders is prevented, first, by the fact that considerable capital was sunk in bothy accommodation, in the first instance, in order to push on with planting operations; and, secondly, by the fact that there was very little ground in the immediate neighbourhood of planting operations.

The following buildings have been erected and were occupied at the end of 1912–13: Bothy at Cruachan; two cottages at Ford (occupied by nurseryman and handyman); cottage at Ford (converted into nursery bothy); cottage at Kilmaha (occupied by trapper).

Expenditure.—The chief items of expenditure directly applicable to afforestation operations to 31st March, 1914, are as follows: New works—Purchase of seeds and plants, £1,434; preparation of ground and planting, £1,814; fencing, £919; drainage, £435; erection and improvement of houses and buildings, £3,078. General maintenance—Killing vermin, £186; repairs to houses and buildings, £265; machinery and implements, £280; bothy caretaker and upkeep, £613; preparation of produce for sale, £182.

Labour afforded by Afforestation Operations.—The question of the amount of labour absorbed by afforestation operations on an estate of this kind is of particular interest at the present time. It is estimated that in 1908, when the property was used almost solely for grazing and game, a total of 6,800 days' male labour was expended on it. For 1912–13 the total is estimated at 11,000 days, representing an increase of 62 per cent. The latter is exclusive of time spent on the construction of new buildings. It may be assumed that the amount of employment will increase slowly until the time for thinning the young plantations arrives, when a considerable increase should take place.

Itinerary.

The party left the steamer at New York pier, and passed on the left hand a mixed conifer wood (larch, silver and Douglas fir, Scots pine, &c.) about thirty-five years old. Traces of the storm of 1911 were observed, as well as the excellent growth of silver-fir, which is a feature of considerable sylvicultural interest. Silver-firs have been measured on the estate with a height of 75 ft. at thirty-five years' growth. Proceeding along the road or track, the ground which is to be planted in 1914–15 was passed through. After leaving the iron and wood structure, erected for accommodation of workmen, the ground to be planted in 1915–16 was traversed, and an example of the best quality of planting-land seen. Just before the men's bothy is reached, and for some distance after it has been passed, a good general view of the higher land to the right of the road was obtained.

At the bothy a coloured plan showing the plantable land on Barmaddy and Cruachan was examined. After a walk of about two miles from the pier the oldest part of the new plantation area is reached (planted 1909–10). On leaving the road groups of Douglas and larch lay on the left; passing on, larch were seen on both sides, and also a group of Douglas and Sitka spruce extending right across the path; proceeding, a small group of silver-fir, with Sitka spruce and common spruce, in damp places were noticed. A few minutes were spent in examining groups of Douglas fir, Sitka spruce, larch, silver-fir, and Scots pine growing in the hollow on the roadside.

On passing over the ridge a group of silver-fir was seen doing very well on the steep face, and shortly afterwards plants a year younger were reached; below the path a group of very healthy spruce were seen adjoining an old ash wood, and right and left of the path a group of Douglas fir. Walking along the bottom of the steep bank the workmen's cottages were passed, and also some promising larch.

On reaching the top, after a stiff climb, a very poor quality of land for afforestation is encountered. Spruce only has been planted, and is thriving indifferently or badly. On reaching an area (about 12 acres) planted on upturned turfs, two sections of about 1 rood each are marked off: in each there are 600 plants—450 common spruce and 150 Sitka spruce. The whole was planted in the spring of 1912, the common spruce being three-year selected seedlings, and the Sitka two-year one-year transplants, small size. A little soil was left in each hole when planting, but nothing has been done since planting. In plot No. 1, 125 of the 450 spruce are absolutely dead

or nearly so, and 25 of the 150 Sitka are dead or nearly so. The average height of the common spruce and Sitka is equal at 6·2 in., and the greatest growth last year in any single plant of each species is 3 in. In plot No. 2 the deaths are 140 and 30 respectively. The average height of spruce is 6·2 in. and of Sitka 7·5 in., and the greatest growth 3 in. The plants showed evidence of suffering very badly from wind; and it is very doubtful if ground of the quality, at the altitude and with such exposure, is worth treatment of any kind. The above experiment is to be followed up shortly by a more elaborate series on peaty soil.

The party then passed down through ground planted in 1912–13, and during the latter part of the walk some of the best planting-ground was passed.

Some effects of the wind-storm of 1911 were observed in the mixed coniferous wood to the right of the road after passing Acrihamish Farmhouse.

On reaching Ford a halt was made to walk through the nursery. Unfortunately, the seedlings and young plants were very badly damaged by frost on the morning of the 24th May last.

Poltalloch.

Leaving the nursery at Ford at 1.20 p.m., the party proceeded to Poltalloch. Upper Largie plantation, extending to 18 acres, was first noticed. It was clean cut and replanted in 1907 with European larch and spruce rides. Behind this plantation lies one of the estate nurseries, formerly the mansion-house garden previous to the present mansion house being built. A little further on was seen an attempt at cheap cottage-building, the constructive timbers of which are entirely native spruce and larch, creosoted by the immersion process. Auchavaan Wood was next noticed. It extends to about 87 acres, and was planted in 1838, mostly with European larch. Three sections of this wood were badly damaged by the Tay Bridge gale, and afterwards replanted.

Poltalloch was reached about 2 o'clock, when luncheon was served, and thereafter an hour was devoted to the gardens and policies. At 4 o'clock the party left Poltalloch and went direct to Duntroon nursery, part of which is still used as a garden for Duntroon Castle. Leaving Duntroon at 4.45 p.m., a halt was made at Kilchoan Banks plantation, extending to about 120 acres, clean cut down in 1905 and replanted in 1907–8–9 chiefly with larch, with the exception of the high tops and valleys, which are planted with Scots pine, spruce, and Douglas respectively. The next stop was made at the estate sawmill and workshops, where specimens of round and converted timber were seen, also a Douglas fir felled in 1909, which attained a height of 96 ft., and yielded 253 cubic feet squared at 27 in. The average circumference of this tree was 9 ft. Leaving the sawmill at 6 o'clock, the party proceeded past the head of Loch Craignish through the pass of Melfort to Oban.

WEDNESDAY, 8TH JULY.

Leaving Oban about 8 a.m., Poltalloch property was reached about 10 o'clock. Ballymeanoch plantation was first looked at. It was cut down in 1903 and replanted in 1905–6. The great Crinan Moss, extending to about 5,000 acres, will next be crossed. Several unsuccessful attempts have been made to utilize the peat. At Bellanoch Bay timber is extensively shipped from the estate. Between Bellanoch and Achnamara there is an extensive plantation of about 268 acres, planted between 1869 and 1876 in groups of European larch, Scots pine, silver-fir, alder, and poplar. In common with other woods on the estate, this one has been much damaged by the 1911–12 gales. At Achnamara, Loch Sweene, woods planted in 1856 and extending to about 120 acres were examined.

Returning from Achnamara via Bellanoch, mixed plantations extending to about 73 acres, planted in 1860, were seen at Barknakill. At Cairnbaan, Craiglass Wood (22 acres, planted 1876) was visited, and a clump of Douglas fir in it showing abnormal growth compared with other species planted noticed.

The party then proceeded via Lochgilphead to Inverary, where lunch was served, and afterwards resumed the journey via the head of Loch Fyne, Strachur, and Loch Eck to Dunoon.

THURSDAY, 9TH JULY.

Glenfinart.

A start from Dunoon was made about 9 a.m. for Glenfinart. The wooded part of this estate occupies a position surrounding Glenfinart Bay, on the eastern shore of Loch Long. The dominant species of tree is larch, ranging in age from a few years up to ninety years. In addition, there is a certain proportion of fine old Scots pine and occasional specimens of exotic conifers. The hardwoods consist mainly of beech, sycamore, oak, and birch scrub.

Portindornaig Wood.—This consists of the pure larch plantation of about 100 acres, containing two age-classes, the younger of which is about sixty years and the older ninety years of age. Until November, 1911, the younger age-class was well stocked; as a result of the gales, however, about 40 per cent. of the timber was blown. The trees have a good height-growth, are well shaped, and contain on the average about 25 cubic feet. The older age-class contains a certain admixture of Scots pine and spruce, and the individual trees are of the same high quality as the younger age-class. The soil is shallow, in parts being only a few inches in depth, but seems to be well suited to the growth of larch. The value of the material is greatly enhanced through the facilities for its transport. The timber is hauled down to a natural loading-bank at the water's edge, where it is loaded with the ship's crane.

Scots-pine Woods.—On the hillsides overlooking Glenfinart House the remains of extensive Scots-pine plantations are to be found. These contain fine specimens of Scots pine, some of which have a cubical content of over 80 ft.

Laggandrishaig Plantation.—This is a thriving young plantation of about 60 acres, consisting of a mixture of larch, Scots pine, and spruce. It takes the form of a belt running along the loch-side, and is bounded all the way by the road. It was established seven years ago on a cleared area, upon which, after draining, two-year seedlings were notched about 2 ft. 6 in. apart.

Benmore.

About three miles beyond the last plantation visited the marsh is crossed and the adjoining estate of Benmore entered upon. This estate extends along Loch Long for about three miles to Strone Point, from which it continues along the eastern shores of the Holy Loch and the slopes of the Echig Valley to Loch Eck. The remainder of the estate occupies a position to the west of Loch Eck and lies between it and the Masson Valley. On the estate there are some 2,000 acres of woodlands between thirty and forty years of age, in addition to some 200 acres of natural oak and birch scrub. These occur in scattered blocks and separate enclosures, some of them a few feet above sea-level, while others rise to a height of 1,200 ft. The dominant species comprising the woodlands are larch, Douglas fir, Scots pine, spruce, and *Thuja gigantea*. In addition a large variety of exotic conifers have been planted in small groups throughout the plantation.

Gairletter Plantation.—This is situated on the north-east shore of Loch Long, with an easterly exposure, and rises from sea-level to about 130 ft. Two years ago, when it was blown down, the plantation was fully stocked, the trees standing 4 ft. to 9 ft. apart. The average height-growth of the Douglas fir was about 70 ft., while that of the *Thuja* was about 60 ft. The stems of the Douglas fir showed natural pruning up to two-thirds of their height. Average annual increment per stem was about 0·6 cubic feet for Douglas fir, and for *Thuja* about 0·3 cubic feet. The stems numbered on the average about 890 per acre, half of that number being pole-size, while the remainder were of timber-size. There were about equal numbers of Douglas and *Thuja*. The volume of timber per acre, according to quarter-girth measurement (deducting 1 in. for bark) was as follows: Douglas fir, 5,000 cubic feet; and *Thuja*, 2,430 cubic feet. This gives the high total of 7,430 cubic feet per acre.

Natural Regeneration Plots.—On the lee side of Rashfield Wood two small areas were enclosed about four years ago with the idea of obtaining natural regeneration. These plots will now be found to contain a fair crop of *Thuja* seedlings.

Japanese Larch.—At Puck's Glen, on the lowland, two strips of Japanese larch have been successfully established. These are now nine years of age, and range from 14 ft. to 18 ft. high. It is interesting to note that it has been found impossible to establish European larch on this land on account of disease.

Nursery.—An area of about 4 acres was broken in last year to form a nursery. The soil seems well suited for the raising of seedlings, and it is naturally drained by a gravelly subsoil. In the spring of the year breaks were laid out 30 by 40 yards, in which the following plants were lined out: 100,000 one-year seedling larch, 100,000 one-year seedling silver-fir, 50,000 two-year seedling silver-fir, 20,000 one-year seedling Douglas fir, 110,000 two-year seedling *Thuja gigantea*. Sowing operations were delayed until the 18th May on account of wet weather, when ten seed-beds were laid off and the following seeds sown: 100 lb. Douglas fir (which was purchased direct from America), 30 lb. *Cupressus Lawsoniana* (home seed), 11 lb. Norway spruce, 1 lb. Sitka spruce, and small quantities of birch and alder. It is intended to utilize these seedlings mainly for underplanting larch and Scots pine.

Cruach Wood (Sample Plot).—The sample plot selected, 1 chain in width at base, and extending for 2 chains up the hillside, has an elevation of about 500 ft. above sea-level, and is situated on a steep slope with an eastern exposure. It consists of a practically pure crop of Douglas fir, which is now thirty-five years of age. At the time of planting the ground was described as being steep, undulating, and rocky. The surface soil was a sandy peat, with heather on the ridges and the tops of rocks, while the intervening hollows were of an open, sandy, and gravelly nature. The subsoil consisted of clay slate and quartz rock, which occurred in alternating layers. The soil is now greatly improved by the humus formed from the rich fall of foliage annually, but the peaty nature of the ground is still very apparent in many places. The age of the plants at time of planting is said to have been "two-year seedlings, twice and thrice transplanted," and the planting method adopted seems probably to have been a rough form of pitting. The hillside is so steep that the planters are said to have been obliged to kneel on the ground while planting to avoid slipping down the hill.

In default of exact measurements and stem-analysis, it may be taken that the mean of the percentages of the current annual growth in girth and growth in height will give a fairly correct estimate of the percentage of current annual growth in cubic contents. In such case it would be 5 per cent.; and with the present volume of 3,255 cubic feet per acre, the increment for the year 1912 may be estimated at 5 per cent. of this, or 162¾ cubic feet, making a total of 3,417 cubic feet when the plantation will have completed its thirty-fourth year of growth. This shows an average annual increment of 100½ cubic feet (square of quarter-girth measurement and with full bark allowance deducted).

Larch Wood (Golden Gates).—This contains the oldest standing timber on the estate. It is composed of a mixture of larch, Scots pine, and spruce, from seventy-five to ninety years of age. The wood is now mature and has been sold. As a preliminary to selling, the standing trees were surveyed with a view of arriving at the average of stems. This was found to contain 60 cubic feet of timber (quarter-girth measurement), and was used as an indicator to calculate the total volume of timber in the wood.

The annual excursion concluded with the party returning to Dunoon about 3.45 p.m., in time to allow members to leave for their destinations by the afternoon steamers. The society's guests returned to Edinburgh, and were accommodated in the North British Station Hotel, Princes Street.

FRIDAY, 10TH JULY.

In the morning the Corporation of Edinburgh drove the society's guests round the places of interest, and afterwards entertained them to lunch in the City Chambers. The Conference was held in the afternoon, and the reception and dinner in the evening.

During the progress of the tour quite a large number of receptions and functions were held, and we were specially honoured by being the guests at Balmoral Castle.

VARIOUS SCHEMES FOR TRAINING FORESTRY OFFICERS IN ENGLAND AND SCOTLAND.

PRESENT PROVISION FOR INSTRUCTION IN FORESTRY AT EDINBURGH, GLASGOW, AND ABERDEEN, WITH PARTICULARS OF ATTENDANCE.

I. EDINBURGH.

Forestry has been taught at the University of Edinburgh since the year 1888. The instruction in forestry and the allied subjects is now provided by joint arrangement between the University and the East of Scotland College of Agriculture.

Course for Degree of B.Sc. in Forestry at Edinburgh University.

This degree was established by an Ordinance approved by Order in Council dated 11th February, 1907. The course for the degree can be taken in three winter sessions and two summer sessions. The present subjects of study and the normal order in which, under existing arrangements, the work is taken are as follows:—

FIRST YEAR.—Natural philosophy, chemistry, botany, and zoology. (The lectures in the four subjects above named are as prescribed for the First Examination in Pure Science, and candidates for the Forestry degree are required to pass that examination in the above subjects.)

SECOND YEAR.—*Winter Session.*—(*a.*) "First course" of forestry (including 100 lectures in sylviculture, forest protection, and forest administration, with weekly excursions and a period of two weeks' practical work in the woods under the direction of the lecturer).

(*b.*) The student at present also takes one or more of the following courses in this session—Forest botany, forest entomology, forest chemistry, and forest engineering.

April Vacation.—This vacation and part of May (four to six weeks in all) is spent in doing practical forestry work, such as planting, felling, and other estate forestry work under the direction of foresters on estates in Scotland.

Summer Session.—(*a.*) Practical forestry, three days a week for two months (May to July). The work is done in the woods under the supervision of the University lecturer, and is devoted to the "Description of a compartment."

(*b.*) Geology, surveying, and geometrical drawing.

Summer Vacation.—Two months (August and September) spent in practical work in German forests.

THIRD YEAR.—*Winter Session.*—(*a.*) "Advanced course" of forestry (including 100 lectures in mensuration, forest management, and forest utilization, with practical demonstrations and excursions, as may be arranged).

(*b.*) Such of the subjects included above with the second year's work (winter session, subhead (*b*)) as are not taken in that year.

Summer Session.—Students will be offered the opportunity of undertaking a short post-graduate practical course after gradation in March. Practical work in Germany will be required from those graduating in July.

There is a final examination in the work of the last two years. The First Science Examination above mentioned (in the four pure science subjects) must be passed before the candidate can be admitted to the final examination. Definite regulations are now being prescribed as to the order in which the classes should be taken. Only five full courses out of the whole number need be taken at the University of Edinburgh; the remainder may be taken elsewhere. In practice, however, they are usually all taken within the University. The practical courses must be undertaken under the orders and supervision of the University forestry staff.

Staff.

In the four subjects of study for the First Science Examination, and also in geology, engineering, surveying, and drawing, forestry students attend the ordinary classes along with other students. Forest entomology, forest chemistry, and forest engineering are taught to forestry students in special classes, but by professors and lecturers who are also engaged with the work of other classes. Forestry proper is taught by Mr. E. P. Stebbing, who has been recently granted the services of two assistant lecturers, who will give their whole time to the forestry students. Forest botany is taught by Dr. Borthwick.

Accommodation and Equipment.

The only special accommodation at present provided is the University Forestry Museum and a small room for the forest entomological collection. A new building is, however, about to be erected and equipped to accommodate the museums and laboratories required for instruction and research in the various branches of forestry.

Demonstration-ground.

The weekly excursions and the longer periods of practical work in Scottish woods, which form part of the ordinary course (see under "Second Year, Winter Session"), take place on various private estates. The acquisition of an area for a forest-garden has been for a long time past under consideration, and it is hoped that the arrangements will shortly be completed.

Attendance.

The "first course" in pure forestry forms an optional part of the curriculum for the University degree of B.Sc. in Agriculture and for the diploma of the College of Agriculture, and some of those who attend this course are agricultural students only. The rest either proceed to the forestry degree, taking the advanced course in forestry or, not being degree students, take the advanced course in forestry with the idea of making themselves as efficient as possible in this subject alone.

The enrolment of students in the forestry classes for the winter session 1911–12 is as follows: First course, 23; advanced course, 8.

The attendance at the forestry course in the preceding five years was as follows (including only those who completed the whole course and obtained class certificates):—

	First Course.	Advanced Course.*
1906–7	6	...
1907–8	15	...
1908–9	22	1
1909–10	13	4
1910–11	24	8

East of Scotland Agricultural College, Summer Course for Foresters.

A short course of daily lectures, covering four weeks in the summer, is conducted at the East of Scotland College of Agriculture. The subjects include forestry, botany, chemistry, and forest mensuration and surveying.

II. Glasgow.

Forestry has been taught at the West of Scotland Agricultural College since the year 1906. The students attending the ordinary day course in this subject are of two kinds: (*a*) University and Agricultural College students whose attendance at the forestry class qualifies for the degree of B.Sc. in Agriculture; (*b*) working youths and foresters pursuing a special course for the College certificate in forestry (see below).

Ordinary Course in Forestry.

The forestry course qualifying for the B.Sc. degree and for the College forestry certificate consists of eighty lectures given during the winter session, dealing with sylviculture, forest management, protection, and utilization. The lectures are supplemented by occasional excursions and practical demonstrations, and from eight to ten written examinations are held. The course is not continued in the summer session,† and there is no advanced course.

College Certificate for Foresters.

The course is for working youths and men only. It extends over a period of two and a half years, during which time the student is required to spend six months in Glasgow, taking the following classes throughout one winter session at the West of Scotland Agricultural College, in addition to the ordinary course in pure forestry described above: Botany (150 hours), chemistry (150 hours), soils and manures (40 hours), zoology (40 hours), book-keeping (40 hours), and surveying (35 hours).

Previous to this period of study students are required to spend eighteen months on an estate, where they (1) perform the duties of a working-forester, (2) keep a journal recording full details and costs of the work done each day, and (3) attend such local lectures and examinations as the College may decide to hold. Periodical examinations are held in local centres by the instructor. At the end of the course a final examination, theoretical and practical, is held, and certificates are granted to students who satisfy the examiners.

Staff.

The College Professor of Forestry, Dr. J. Nisbet, is the only teacher of this subject. Special teaching in forest botany, forest entomology, forest chemistry, &c., is not at present provided.

Accommodation, Equipment, &c.

The lectures are given in the College buildings, in which also the various collections of specimens, maps, tools, instruments, &c., are housed. The present accommodation is inadequate, but ample provision is expected to be made when the new College buildings are erected.

The College as yet possesses no forestry experiment-station or demonstration area.

* The advanced course was first introduced in 1909, and, in that and the following year, only covered a single summer session.

† But see "Summer course" on following page.

Attendance.

For the winter session 1911–12, 114 students are enrolled at the day class in forestry. The enrolment at the corresponding class in the preceding five years was: 1906–7, 2; 1907–8, 3; 1908–9, 3; 1909–10, 8; 1910–11, 8.

Evening Classes.

Evening classes in forestry are held for the benefit of students who are unable to attend the day classes. The complete course consists now (since 1910) of sixty-four lectures and eight written examinations, and covers two years' attendance (thirty-two lectures and four written examinations in each year, delivered twice a week during the months of October to December and January to March). The subject-matter is similar to that of the day course. The attendance at the classes in the last five years was:—1906—Part I, 6; Part II, 8; Part III, 3. 1907–8—Part I, 12; Part II, 3; Part III, 3. 1908–9—Part I, 6; Part II, 6; Part III, 7. 1909–10—Part I, 12; Part II, 12; Part III, 8. 1910–11—Part I (sylviculture), 14; Part II (management), 7.

Summer Course.

Up to 1908 a special four-weeks course was provided for foresters, but this was discontinued when the present arrangements for the forester's certificate were introduced. During July, 1912, however, a four-weeks course will be held, consisting of forty lectures in forestry and four whole-day excursions, together with special courses of lectures in (1) forest botany and plant physiology, and (2) elementary chemistry and physics by the College Professors of Botany and Chemistry.

III. Aberdeen.

Forestry has been taught at the Aberdeen and North of Scotland College of Agriculture* since the beginning of the session 1908–9. Attendance at the classes in this subject qualifies for the University degree of B.Sc. in Agriculture. Forestry is not a subject qualifying also for the College diploma in agriculture, but students who gain the agricultural diploma and also pass in forestry can have the fact recorded on their diploma. The classes are attended by numbers of students other than those proceeding to a degree or diploma.

Ordinary Course.

The forestry course qualifying for the degree consists of fifty lectures only, given daily during the first half of the winter session. It deals with the principles of sylviculture, forest management, protection, and utilization, and forest mensuration. The lectures are supplemented by excursions in the neighbourhood.

A further course of fifty hours (lectures, laboratory-work, and practical demonstrations) is held during the second half of the winter session. This class is continuous with and supplementary to that held during the first half of the session. The course is not continued in the summer session.

Summer Course for Foresters.

A four-weeks course of instruction for foresters is conducted in the summer from the middle of August. It includes lectures, demonstrations, and excursions. This course was attended by fifteen foresters in 1910.

Evening Lectures.

Popular evening lectures in forestry are delivered under the auspices of the College of Agriculture throughout November and December in Aberdeen, at Marischal College. The average attendance at these lectures in 1910 was 140.

Courses of lectures are also given at suitable centres throughout the College area. These lectures deal with branches of forest work, and are intended for working foresters. Courses have been given at Evanton, Alness, Kildary, Kiltarlity, Dyke, Fettercairn, &c., and single lectures have been given at numerous other centres. At the courses of lectures the average attendance at some centres has been about twenty, and at others it has been as high as sixty.

Staff.

The University lecturer in forestry, Mr. W. Dawson, is the only teacher of this subject. Special teaching in forest botany, forest entomology, forest chemistry, &c., is not provided apart from his lectures. The ordinary University classes in botany, zoology, geology, agricultural chemistry, and land-surveying are attended by students who are making a special study of forestry.

Accommodation, Equipment, &c.

The forestry classes are held in the botanical department of the University. The accommodation provided is hardly adequate, as there is a large amount of materials and specimens forming the teaching equipment. There is at present no forest-garden, but proposals for the acquisition by the College of Agriculture of an area of 270 acres of Woodland are now under consideration.

Attendance.

Twenty-four students are enrolled for the first half of the winter session 1911–12 (ordinary course of fifty lectures).

* The College of Agriculture, though constitutionally separate from the agricultural department of the University, is more intimately related to it than is the case at Edinburgh and Glasgow. All the College lecturers are University lecturers, and from most points of view the two institutions are identical.

The attendance in the preceding years, including only those who completed the course and obtained class certificates, was as follows:—

	Ordinary Course (Fifty Lectures with Excursions).	Further Course (Second Half of Winter Session).
1908–9	8	...
1909–10	22	...
1910–11	22	16

THE SCHOOL OF FORESTRY, FOREST OF DEAN.

REGULATIONS.

1. The school is for working-men only.

2. Only those willing and able to perform the ordinary work of a Crown workman will be received. When not in school students will be under the same regulations as Crown workmen, and will have to work under the orders of the Crown woodman of the district to which they are sent at any work ordinarily done by Crown workmen.

3. The ordinary hours of work are from 7 a.m. to 5 p.m., with half an hour off for breakfast and one hour for dinner; but for six weeks before and after Christmas the hours are from 7.30 a.m. to 4.30 p.m., with half an hour for breakfast and half an hour for dinner. Every alternate Saturday is a half-holiday, the men working till 1 p.m.

When the distance to the work is more than three miles from a student's lodging, a time allowance of seventeen minutes is allowed for each extra mile.

Usually two afternoons a week, from 1.30 p.m. to 4 p.m., are spent in the class-room.

4. Students must be between the ages of twenty and twenty-five, inclusive, on the date of admission. Students over this age will only be admitted under special circumstances.

5. For the present the number of students to be admitted in any one year is limited to twelve.

6. These twelve places will be first offered to men already in the Crown employ, whether in the Forest of Dean or elsewhere.

7. Vacancies, after providing for persons in the Crown employ, will be open to others.

8. Students pay all travelling-expenses to and from the Forest of Dean.

9. The following are the rules as to pay:—

(*a.*) Students already in the Crown employ in Dean Forest will draw the same pay as they are already receiving; if getting less than 2s. 6d. per diem, they will be given this amount from date of admission to the school.

(*b.*) Students already in the Crown employ on estates other than Dean Forest will, while at the school, receive 15s. per week from the Dean Forest funds. The deputy surveyor or Crown receiver of any other Crown estate may, however, recommend promising students for an additional allowance, to be paid from the funds of that estate, on condition that the student agrees to return at the end of the school course to work on the estate which has paid the allowance. The amount of the allowance will in each case be decided by the Commissioner of Woods and Forests.

(*c.*) Students not already in the Crown employ will be paid 15s. per week.

(*d.*) No student will get any increase of pay while at the school.

(*e.*) On days when, owing to the weather, no work can be done, no pay is given, the rule "No work, no pay," being strictly adhered to. On the average, students lose about twelve days' work and pay in the year on this account.

10. A building has been erected at Parkend, where the classes are held, and lodgings are provided in this building for eight students, a preference being given to students in the first year of the course. A cleaner and cook is provided by the Crown, and students lodging there pay 11s. per week for board, lodging, and washing.

11. When there is no vacancy in the school building, board and lodgings can be obtained in Parkend at from 11s. to 12s. per week.

12. The amount received for pay will usually cover all expenses. If it is insufficient an allowance must be obtained from parents or others.

13. No charge is made for the education given, and all necessary books and stationery will be supplied by the Crown, but axe, spade, and other implements, except felling-saws, must be provided as required by the students. These usually cost about 15s. in all.

14. The course of lectures will extend over a period of two years, beginning the first week in October in each year.

15. The instruction given will extend over the whole subject of forestry, theoretical and practical, including subsidiary subjects necessary to a forester; the instruction given in the class-room and forest is designed to make a student thoroughly qualified to act as forester or woodman on any estate in the United Kingdom.

16. Periodical examinations will be held by the instructor, and by E. P. Popert, Esq., Braceland, near Coleford, Gloucestershire. At the end of the course a final examination, theoretical and practical, will be held. Students who satisfy the examiners will receive a certificate signed by the Commissioner of Woods and Forests.

17. The fact of having successfully passed the school examinations will give no claim for promotion in the Crown Service. Ordinarily, other qualifications being equal, a passed student will be preferred for promotion over a man who has not been through the school course.

18. Misbehaviour or unsatisfactory progress during the course of study will render a student liable to immediate dismissal from the school.

19. If applications for trained men are received from private estates these will be offered

to any student deemed suitable, but no guarantee of employment at the end of the school course is given by the Crown.

20. It is suggested that if possible each student shall bring a bicycle with him. As the distances to be covered are sometimes several miles, the use of a bicycle is advantageous.

21. All applications for admission should be addressed to V. F. Leese, Esq., Deputy Surveyor, Whitemead Park, Parkend, near Lydney, Gloucestershire, and should be received by him before 31st August in any year.

Syllabus of Instruction.

SYLVICULTURE.

(i.) *The Foundations of Sylviculture.*—The utility of forests. Climate and soil in relation to the growth of trees. Growth in height, diameter, and volume. Duration of life. Reproductive power. Pure and mixed woods. Methods of treatment. Clear cutting. The shelter-wood compartment. Group and selection systems. Two-storied high forest. Coppice. Coppice with standards.

(ii.) *Formation and Regeneration of Woods.*—Choice of species. Fencing. Draining. Sowing. Planting. Natural regeneration. Formation of mixed woods. Choice of method of formation.

(iii.) *Tending of Woods.*—Preservation of a proper density of the crop. Cleaning of woods. Pruning. Thinning. Tending of open woods.

(iv.) *The Sylvicultural Characteristics of the British Forest-trees.*

FOREST PROTECTION.

The protection of woods against frost, drought, snow, storm, weeds, fungi, various diseases, fire.

Protection against domestic animals, animals of the chase, rodentia, and destructive insects.

FOREST MENSURATION.

Measurement of felled trees; of standing trees; of whole woods. Increment. Form factors. Valuation of woods.

FOREST UTILIZATION.

The felling and conversion of timber.

FOREST MANAGEMENT.

The normal forest. The normal distribution of age classes. The normal increment. The preparation of a simple working plan. Collection of statistics. Description of compartments. Division and allotment of the area. Determination of the yield. The keeping of accounts and books of control.

SURVEYING.

Practical geometry. Calculation of areas. Chain survey. Use of prismatic compass.

PRACTICAL WORK IN THE FOREST.

Nursery-work. Sowing. Transplanting. Weeding. Budding. Grafting. Planting. Pruning. Thinning. Felling, with axe and saw. Barking. Hedging. Fencing. Draining. Wattle-hurdle making. Measurement of timber and standing woods. Actual preparation of a working plan.

BOTANY (ELEMENTARY).

External morphology of seed, root, bud, stem, leaf.

Internal morphology. Cell-structure. Formation of wood. Annual rings Bark.

Physiology. Nutrition. Assimilation. Respiration. Transpiration.

Reproduction. Flowers—Sepals; petals, stamens; carpels. Fertilization.

Systematic botany. Characters of the most important natural orders. The practical recognition of British forest trees and shrubs.

Timber—Structure of; weight of; harness, durability of; seasoning; heating-power; defects in; the antiseptic treatment of; recognition of.

MISCELLANEOUS WORK.

During the course of two years the students are working as ordinary labourers in the Forest of Dean, and are employed at all the various duties of a working woodman.

Extract from Annual Report of the Commissioners for 1909–10.

Since the school started thirty-two men have obtained the full certificate, and two a partial certificate. Of the thirty-two with full certificates—One is forester in British East Africa; one is assistant pole-inspector, Postal Department; four are woodmen in Crown forests; one is foreman of school gang in Dean Forest; twelve are labourers in Dean Forest; nine are foresters or woodmen on private estates; one is taking a further course of instruction at Armstrong College, and is likely to go as forester to East Africa; one is managing his mother's farm, his father having recently died; two obtained situations on leaving the school, but left them, one for farm-work, and the other is now in a timber-merchant's office. Of the two men who obtained partial certificates, one is employed in the woods on a private estate, and the other has left forest work.

FORESTRY APPOINTMENTS IN THE BRITISH ISLES, INDIAN EMPIRE, AND CROWN COLONIES AND DEPENDENCIES.

(All the posts mentioned in this list are pensionable except those marked *.)

ENGLAND.

Office of H.M. Woods and Forests.—New Forest, Alice Holt, Parkhurst and Bere—Deputy Surveyor, £920; Forest of Dean—Deputy Surveyor, £725; Forest of Dean—Assistant Deputy Surveyor and Consulting Forester to Commissioners, £425; Head of Forest School, £250.*

Board of Agriculture and Fisheries.—Forestry Inspector, £300–£400.

Oxford University (Department of Rural Economy).—Sibthorpian Professor of Rural Economy, £700;* Reader in Forestry,† £300.*

India Office.—Director of Indian Forest Studies (now at Oxford University), £900.

Cambridge University (Agricultural Department).—Reader in Forestry, £400.*

University College of North Wales (Agricultural Department).—Lecturer in Forestry, £300.*

Leeds University (Agricultural Department).—Lecturer in Agriculture, Botany, and Forestry, £225.*

Armstrong College (Agricultural Department).—Lecturer in Forestry, £220.*

Royal Agricultural College, Cirencester.—Lecturer in Estate Management and Forestry, £300* (resident).

SCOTLAND.

Edinburgh University and East of Scotland College of Agriculture.—University Lecturer in Forestry, £400*; University Lecturer in Forest Botany and Forestry Lecturer at the Agricultural College, £260–£280.*

West of Scotland Agricultural College.—Lecturer in Forestry, £350.*

North of Scotland College of Agriculture.—Lecturer in Forestry, £350.*

IRELAND.

Department of Agriculture and Technical Instruction.—Chief Forestry Officer, £600; Assistant Forestry Inspector, £300–£400.

INDIAN FORESTRY SERVICE (IMPERIAL BRANCH).

(N.B.—In reckoning the salaries the Indian rupee has been taken as equivalent to 1s. 4d. sterling.)

Inspector-General of Forests, £2,120. Assistant Inspector-General of Forests, ——. Two Chief Conservators (Burma and Central Provinces), £1,720. Twenty Conservators—Grade I, £1,520; Grade II, £1,360; Grade III, £1,200. 184 Deputy and Assistant Conservators; five Foreign Service appointments; six officers employed at the Forest Research Institute and College, Dehra Dun (these draw a local allowance in addition to their grade pay)—£304, rising by annual increments of £32 to £560; thereafter by annual increments of £40 to £1,000.

The appointments of Conservator and Deputy and Assistant Conservator are allotted to the various provinces as follows: Burma, 65; Madras, 28; Bombay, 27; Central Provinces, 24; Bengal, 11; United Provinces, 19; Punjab, 12; and Eastern Bengal and Assam, 18.

CEYLON.

Conservator £1,050–£1,200; Deputy Conservator, £750–£900; Deputy Conservator, £600–£750; Assistant Conservators, Grade I (three), £400–£500; Assistant Conservators, Grade II (four), £300–£350.

EAST AFRICA PROTECTORATE.

Curator of Forests, £500–£700 (duty pay, £50‡); Verderers (two), £300; Verderers (one), £200; Foresters (thirteen), £120.

UGANDA.

Superintendent of Forests (vacant); Assistant Superintendent, £200–£250.

SOUTHERN NIGERIA.

Conservator, £1,000 (duty pay, £200‡); Deputy Conservator, £600–£800 (duty pay, £120‡); Assistant Conservators, 1st grade (three), £500–£700 (duty pay, £60‡); Assistant Conservators, 2nd grade (six), £300–£400.

GOLD COAST.

Conservator, £800 (duty pay, £160‡); Assistant Conservators (three), £300–£400.

FEDERATED MALAY STATES.

Conservator, £1,020–£1,200; Deputy Conservators, Grade I (two), £660–£840; Deputy Conservators, Grade II (two), £540–£660; Assistant Conservators, Grade I (five), £360–£480; Assistant Conservators, Grade II (five), £300–£360.

† This post is at present held by Sir W. Schlich, K.C.I.E., &c., with the honorary title of Professor of Forestry.
‡ Duty pay is not drawn by the officer while on furlough.

UNIVERSITY OF OXFORD.

NOTES ON THE REGULATIONS FOR THE DIPLOMA IN FORESTRY.

A. The Diploma in Forestry generally.

1. The diploma in forestry is granted to diploma students who have (1) pursued an approved course of study at Oxford; (2) undergone a course of practical work at places and under conditions approved by the Delegates for Instruction in Forestry; (3) satisfied the examiners in prescribed examinations.

2. The course of instruction commences at the beginning of Michaelmas term in October of each year. Candidates who desire to join a college should address the senior tutor of it. Those who wish to matriculate as non-collegiate students should address the Censor of Non-Collegiate Students, Students' Delegacy, High Street, Oxford. In either case, candidates should call on the Professor of Forestry as soon as they reach Oxford.

3. Candidates, on joining, should either have been accepted as probationers for the Indian forest service, or have passed responsions (or an equivalent examination), or have given evidence of having received a good general education satisfactory to the committee which deals with the matter. No definite rule is laid down as to what is understood by a good general education. A knowledge of Greek is not essential, but in the case of a candidate who knows neither Greek nor Latin a knowledge of at least one modern foreign language would be required. There is no age-limit as regards the diploma.

4. The course of instruction comprises at present—(1) Physics and chemistry; (2) general botany; (3) general geology; (4) zoology; (5) forest botany; (6) forest engineering and surveying; (7) forestry, comprising sylviculture, mensuration, valuation, management, including working plans, protection, utilization, and administration; (8) German. Additional instruction is given to probationers for the Indian forest service in Indian geology, forest law, and systematic botany of Indian trees.

5. The practical course extends over not less than six months, and as the major part of it is at present done in Germany, a knowledge of German is necessary—that is to say, translation from and into German and colloquial German. A candidate can acquire that knowledge during the first year of his residence at Oxford, but it is desirable that he should possess a knowledge of the rudiments of the language on joining the course of instruction for the diploma.

6. The ordinary course extends over three academic years, but candidates can obtain the diploma in two years by taking the practical course in instalments during the vacations; in the latter case some knowledge of chemistry and physics is essential on joining.

7. Students are examined departmentally in physics and chemistry, forest engineering and surveying, and German. The other subjects are arranged in two parts—namely: Part I, comprising general botany, general geology, forest botany, and zoology; Part II, forestry. The examination in the subjects belonging to Part I is held on or about the 1st July, and that in Part II on or about the 1st October in each year.

8. The diploma in forestry can be combined with the taking of a university degree. Candidates who have passed in Part I, which they do in July of the second year, receive a certificate which excuses them from passing the preliminary examination in the Honour School of Natural Science, so that they can proceed to the final examination in that school as soon as they have three academic years' residence.

Candidates who have taken the diploma in forestry are excused two subjects out of three for a pass degree.

9. A candidate can meet all expenses (board, lodging, and instruction, including the practical course on the Continent) connected with the diploma course with £300 as a non-collegiate student; if he joins a college he will require at least £400.

10. The detailed regulations for the diploma in forestry can be obtained from the Clarendon Press Depot, 116 High Street, Oxford. Price, 6d. a copy.

Oxford, 22nd May, 1914.

B. Probationers for the Indian Forest Service.

11. Candidates for probationerships in the Indian forest service must have taken a degree in some branch of the Honour School of Natural Science before they are accepted by the Secretary of State for India, and after that they must take the diploma in forestry. This takes not less than five years in all.

Under the arrangement explained above they can combine both, provided they have passed responsions and an additional subject, by taking the course for the diploma during the first two years, passing in Part I of the diploma examination and devoting the third year to preparing for an honours degree in either botany, zoology, or geology, subjects in which they have already done a great part of the work in the diploma course. In this way candidates can reduce their course of study by one year, and they have studied for a profession in case they should not be accepted for the Indian service.

12. Candidates for probationerships in the Indian forest service must be under twenty-two years of age on the 1st January of the year in which they apply for a probationership; hence they should be under nineteen years and ten months of age when they join at Oxford in October. They will do well to join a year earlier, as it gives them an extra year if necessary for obtaining an honours degree in natural science.

The notes on entering the Indian forest service are at all times subject to alterations which the Secretary of State for India may make.

Further details can be obtained from the Secretary, Revenue and Statistical Department, India Office, London S.W.

APPENDIX II.—THE TIMBER INDUSTRY.

EXTRACTS FROM REPORTS OF COMMISSIONERS OF CROWN LANDS.

AUCKLAND.

(H. M. SKEET, Commissioner of Crown Lands.)

DURING the year, owing to the war and the consequent stringency of the money-market, the prolonged briskness experienced in the timber trade for the past number of years has somewhat received a check so far as the local market is concerned. This, however, in the general opinion, is considered to be but of a temporary nature.

The export trade is still considered fairly satisfactory, and large shipments of timber have been made and are on order for Australia and the United Kingdom, and from a report published by a large timber-business firm in London the latter market is stated to be very firm. The constant demand for kahikatea timber is most noticeable, and this again raises the question of the necessity for taking steps to conserve this timber for the future requirements of the Dominion. The decrease of trade has caused many of the mills to shorten time and reduce hands, while in other cases the work has been carried on by shortening time only. It has also been found necessary in some cases to cease bush operations, partly owing to the decrease in the local demand for kauri timber, but principally on account of the increased kauri log supplies obtained towards the latter part of the year through heavy freshes experienced. In the Hauraki Peninsula alone it is estimated that about 14,000 kauri logs were received at the booms, representing approximately 28,000,000 ft. of timber, valued at about £140,000.

Sawn-timber Business.—The high market prices ruling for sawn timber of all kinds are still being maintained, although varied discounts are allowed by the sawmillers to builders and others where it is desirable to reduce the accumulated stocks of the classes of timber of the lower grades unsuitable for export.

During the year the Leyland-O'Brien Timber Company (Limited) have erected in the city a new sawmill, factory, offices, stores, stables, and yards, at a cost of about £20,000. In this mill a new feature has been adopted for the purposes of driving the planing-machines, &c., by the installation of electric motive power generated by the mill engine consuming the mill waste. The Kauri Timber Company have also effected considerable improvements and alterations to their Auckland mill and yards.

Considerable activity has taken place in the Tauranga district in the purchasing of rimu timber, one company that has recently been promoted having cutting-rights over about 252,000,000 ft. of timber. It is the intention of the company to erect a large sawmill at the terminus of the Tauranga–Gisborne Railway. The bulk of the timber owned by this company is adjacent to heavily timbered Crown lands, the principal of which is known as the Maungatotara Block, recently measured and found to contain about 28,000,000 ft. of valuable timber.

Sales of Timber.—The further withholding of timber from sale, as in the past year, is considered desirable, and sales should only be effected when sufficient demand arises to render these necessary. The following are the sales effected in the various kinds of timber during the year ended the 31st March, 1915:—

—	Kauri.	Rimu.	Kahikatea.	Totara.	Matai.	Miscellaneous.	Total.	Amount realized.
	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	£ s. d.
Crown lands ..	437,390	76,912	151,254	98,793	31,331	74,981	870,661	895 6 5
State forests ..	10,221,651	521,378	117,932	54,603	..	..	10,915,564	22,367 1 0
Totals ..	10,659,041	598,290	269,186	153,396	31,331	74,981	11,786,225	23,262 7 5

Timber-measuring.—Four parties have been kept constantly engaged measuring timber during the year, in addition to that the Crown Lands Rangers have measured several minor lots urgently applied for within their respective districts.

The following shows the various kinds of timber measured, cost of measuring, and approximate value of same: Kauri, 12,257,127 ft.; rimu, 9,382,080 ft.; kahikatea, 2,213,267 ft.; totara, 10,411,918 ft.; matai, 3,489,643 ft.; miscellaneous, 1,496,206 ft.: total, 39,250,241 ft. Approximate total value, £37,754. Total cost of measuring, £1,187 2s. 7d. Cost per 100 superficial feet, 0·727d.

Fires.—Notwithstanding the exceptionally long dry season, all the Crown forests were free from fires this year with the exception of one instance, when assistance was obtained and the fire extinguished without damage to the standing timber. This satisfactory state is mainly attributed to the prompt action taken by the Department in prosecuting Austrian and other gum-diggers for trespassing in Crown forests. Several kauri forests, however, owned by sawmillers have suffered from fire, which will necessitate the early felling and working of the timber

EXPORTS AND IMPORTS OF TIMBER FOR PERIOD ENDED 31ST MARCH, 1915.

Exports.

—	From Auckland.		From Kaipara.		Total.	Value.
	Super. Feet.	Value. £	Super. Feet.	Value. £	Super. Feet.	£
Kauri	11,566,497	103,616	5,433,184	39,278	16,999,681	142,894
Kahikatea	11,921,587	55,248	19,234,330	78,161	31,155,917	133,409
Rimu	1,623,660	6,148	2,135,629	6,992	3,759,289	13,140
Other kinds..	36,302	223	..		36,302	223
	25,148,046	165,235	26,803,143	124,431	51,951,189	289,666

Imports.

	Superficial Feet.	Value. £
Auckland	8,715,864	78,882
Kaipara	12,919	155
	8,728,783	79,037

Timber-floating.—Eleven new licenses have been granted during the year, and the total number of licenses now in existence is 134.

MARLBOROUGH.

(H. G. PRICE, Commissioner of Crown Lands.)

There are ten sawmills working in this district. The total output was 11,280,035 ft., made up of 10,562,428 ft. from State forests and 717,607 ft. from Crown lands. The royalties were £2,962 and £196 respectively.

Messrs. Brownlee and Co.'s mills, which have been working for many years, have cut out nearly all their available timber. There is a good deal of milling-timber yet at the head of the Opouri Valley, which is being worked by the Marlborough Timber Company.

WESTLAND.

(H. D. M. HASZARD, Commissioner of Crown Lands.)

The most prolific source of revenue, and an industry that provides employment for some nine hundred men, is sawmilling. The quantity exported during the year ended the 31st December, 1914, was 50,009,441 ft. This industry has suffered more than any other from the effects of the war. The tightness of the money-market and the consequent decline in building operations has so reduced the demand for timber that sawmillers have found it necessary to curtail their output. The revenue for the year fell short of that derived during the preceding year by some £2,000. The prospects for the coming year are much brighter, as large orders have been received from Australia. Some difficulty is, however, likely to be experienced in the matter of procuring the necessary labour to replace men formerly employed by the sawmills who have volunteered for active service. Of the revenue that will be derived from timber licenses during the ensuing year it is estimated that some £2,500 will be on account of timber cut from lands that were reserved under the Midland Railway contract, and as the Mining Act provides that such revenue shall be deemed to be goldfields revenue it will not be collected by this Department.

Attention is drawn in the report of the West Coast Timber and Land Commission to the unsatisfactory method of dealing with timber in this district, and recommendations for placing it on a better basis are made. The opinions expressed in the report are entirely in accord with those of the Timber Commission of 1909 and the Forestry Commission of 1913.

SOUTHLAND.

(G. H. M. MCCLURE, Commissioner of Crown Lands.)

Owing to the outbreak of war and the consequent cessation of building operations the past year has been a very bad one for the timber industry, although the number of mills (fifty-six) worked during the period shows an increase of three over last year—thirty mills worked on Crown and State forest lands, eighteen on partly Crown and State and partly private bush, seven on private lands, and one on landless Native lands. None of the mills worked full time during the year, and the majority worked only three days weekly short-handed. Many were closed down from three to six months, and the total output was very low—viz., 26,000,000 ft. With the exception of some 500,000 ft. all the timber was delivered to Christchurch and to places south thereof.

The number of persons employed in the industry was 530, and the wages paid amount approximately to £67,000.

The prospects of the trade are not bright, but are somewhat better than they were three months ago.

Approximate Cost of Paper.—Preparation, not given; printing (1,250 copies, including illustrations), £85.

By Authority: JOHN MACKAY, Government Printer, Wellington.—1915.

Price 1s. 9d.]