1909.

NEW ZEALAND.

DEPARTMENT OF LANDS:

FORESTRY IN NEW ZEALAND.

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

SIR,— Department of Lands, Wellington, 8th September, 1909.

I have the honour to transmit herewith the following report on "Forestry in New Zealand."

Some time ago you expressed a wish that such a report should be prepared, dealing not only with the state of our indigenous forests and the conditions of the timber industry (as had been done on several previous occasions), but also with the whole question of forest supply and demand the utilisation of our timbers, the need for preservation of forest-areas, the likelihood of our resources being assisted in any great measure by supplies from abroad, and the steps that have been taken to supplement the local supply by raising and planting trees in the State nurseries and plantations.

The report gives full particulars of these several points, and shows the individual areas of land still covered with forest, the quantities and varieties of milling-timber in each district, the estimated probable duration of the local supply for commercial requirements, the sources and probable supply from outside New Zealand, with details as to the results of operations of the Afforestation Branch of this Department. It is, therefore, valuable not only as a record of present conditions, but also as a guide to what may be expected to occur in the future.

In preparing the report, the best thanks of the Department are due to all those who have assisted in its compilation. The several Commissioners of Crown Lands (who are also Conservators of State Forests), their timber experts, Crown Lands Rangers, and surveyors, together with those gentlemen outside the Department who have aided our efforts, are equally deserving of credit for the careful and painstaking manner in which they have furnished the desired information as speedily as possible. I may add that I am personally indebted to Mr. W. R. Jourdain, of this Department, for the great assistance he has rendered, not only in compiling the report and procuring much of the statistics incorporated therein, but also for obtaining the many special articles on different phases of the subject. As the report was in course of preparation many months before the Royal Commission on Timber and the Timber Industry was set up, advantage was taken of Mr. Jourdain's being appointed its Secretary, to secure such articles from gentlemen best acquainted with the matters dealt with, and to insure by personal inspection and revision that the subject-matter of the report was thoroughly in accord with what was observed during the visits of the Commission to the various parts of the Dominion.

I have, &c.,

WILLIAM C. KENSINGTON,

Under-Secretary of Lands.

The Right Hon. Sir J. G. Ward, P.C., K.C.M.G., Minister of Lands,
and Commissioner of State Forests.

TABLE OF CONTENTS.

	Page.
PREFACE	3
PART I.—OUR NATIVE FORESTS:—	
(A.) General remarks	6
Review of districts	12
The indigenous trees of New Zealand	15
(B.) Detailed descriptions of districts,—	
Auckland	16
Taranaki	20
Hawke's Bay	24
Wellington	27
Marlborough	37
Nelson	41
Westland	49
Canterbury	58
Otago	61
Southland	66
(C.) Timbers suitable for coachbuilding and wheelwrighting	68
PART II.—FOREST-UTILISATION:—	
(A.) Sawmilling methods,—	
(1.) In the Kaipara district	69
(2.) In the Waimarino	70
(3.) In Westland	72
(4.) In Southland	74
(B.) Medicinal properties of trees and shrubs	76
(C.) Various processes of seasoning timber,—	
(1.) General description of methods	76
(2.) The Rueping process of creosoting	78
(3.) The Powell wood process	80
(D.) Miscellaneous methods of utilisation,—	
(1.) The wood-pulp industry	81
(2.) Secondary forest products	83
PART III.—FOREST-PRESERVATION:—	
General remarks	85
(A.) The necessity for forest-conservation	85
(B.) Deforestation and its consequences	93
PART IV.—FOREIGN SUPPLIES:—	
General remarks	97
(A.) Timber-supplies in Europe	98
(B.) The timber-supply of the United States	99
(C.) Canada's forest wealth and timber industry	100
(D.) Forest resources of Australia	104
(E.) Other sources of supply	107
PART V.—AFFORESTATION:—	
General remarks	108
(A.) Results of tree-growing in the State nurseries and plantations	109
(B.) Anticipated results	111
(C.) Notes on the growth of forest-trees in Canterbury	112
(D.) Notes on the growing of Australian gum-trees in the Waikato	117
(E.) Afforestation in England	118
Photographs	Throughout report.
Maps of forest areas	At end of report.

PREFACE.

IMPORTANCE OF SUBJECT.

THE necessity of dealing with forestry upon businesslike and comprehensive lines is becoming increasingly more important, and State recognition of the matter is now practically universal. Owing to the growing demand for sawn timber, and the use of wood in new branches of industry, the gradual diminution of the world's forest-supply is attracting serious attention. In some countries of the Old World —as, for instance, France and Germany—this danger has been grappled with for many generations, and in both those countries the State plantations are now showing gratifying results and testifying eloquently to the foresight and enterprise of bygone statesmen. In the New World, including the Americas and Australasia, it has only recently been recognised that what was thought to be a supply of timber sufficient for all possible requirements for future generations is barely adequate to meet current demands and the probable requirements of the ensuing half-century. Vast as the indigenous forests have been in these new territories, and scarce as their populations were, until recent times, in comparison with the huge areas of virgin land waiting to be settled, yet the steady influx of new inhabitants from European countries, and the unexampled increase in the use of wood for building and other commercial purposes, coupled with the enormous destruction of forests by fires, has caused the Governments of every State in the New World to take into earnest consideration the problem of meeting the future timber-supply, and guarding against a possible timber-famine. The formation of a Forestry Bureau in the United States, under the guidance of Mr. Gifford Pinchot, one of the foremost authorities on timber matters, has demonstrated how pressing is the need for forest-conservation and reafforestation in that immense republic; and, turning to our southern lands, the creation of Forest Departments in most of the States of Australia affords convincing proof that the same pinch is beginning to be felt nearer home.

GOVERNMENT RECOGNITION.

It is a matter for distinct congratulation that the Government of this Dominion has recognised the growing need for afforestation and regulation of timber-cutting for some time past. The New Zealand State Forests Act of 1885 was a commendable attempt to meet the difficulty by insuring that the sale of timber from Crown lands and State forests should proceed under careful supervision and without undue waste; and when (in spite of judicious attempts to conserve the timber-supply by extensive reservations of forest lands) it was found that the demand was increasing too rapidly to be coped with by these methods alone, a modest system of State nurseries and plantations was inaugurated in 1896, and, as its operations proved increasingly successful, they have been gradually expanded as funds warranted, and give every reason to believe that the artificial forests of the State will eventually yield a highly satisfactory supply of timber suitable for many of the requirements of the building and allied trades.

PRESENT POSITION.

The present position of the timber supply and demand in New Zealand is as follows:—

According to the details given in Table A, on page 7, it will be seen that, out of a total area of 66,568,876 acres in New Zealand, about 17,074,003 acres are still covered with forest. In 1886, the forest-area was estimated at 21,196,966 acres (*vide* "Native Forests and the State of the Timber Industry," by T. Kirk, F.L.S.). Of the present area, it is estimated that there is growing within the Crown and State forests, and on private and native freehold lands, a gross total of about 33,000,000,000 sup. ft. of timber that is, or may eventually prove, suitable for commercial requirements. The output of sawn timber for the past year amounted to 413,868,919 sup. ft., and, as indicated in the General Remarks in Part I of this report, will probably advance to an average of from 450,000,000 sup. ft. to 500,000,000 sup. ft. for the next fifty years, thereby giving an anticipated period of about forty years within which our indigenous forests can meet the full demand. As against this, the stock of trees in the State nurseries and plantations amounted to 47,835,217 at the 31st March, 1909, of which no less than 6,231,479 had been planted during the preceding twelve months. The total area of land planted with forest-trees at same date was 12,175 acres, of which 2,709 acres had been planted during the previous year.

EXPECTED AFFORESTATION RESULTS.

Although a very large proportion of the trees planted out on the various areas will not reach maturity, owing to repeated thinnings, yet it is expected that a sufficient crop will attain full size to produce an appreciable quantity of milling-timber in about fifty or sixty years from now, and that each successive year will produce a further supply to assist to meet the current demand. No precise figures can, of course, be given as to the amount of such annual crop, but an approximate idea may be gathered from the following calculations: Professor Schlich, a leading authority, in Part I of his "Manual of Forestry," estimates that one acre of larch will produce,—

Thinnings at the age of	20 years	..	20	cub. ft., quarter-girth measurement.
,, ,,	30 ,,	..	130	,, ,, ,,
,, ,,	40 ,,	..	330	,, ,, ,,
,, ,,	50 ,,	..	360	,, ,, ,,
,, ,,	60 ,,	..	360	,, ,, ,,
Final yield at the age of	70 ,,	..	3,900	,, ,, ,,

The chief species grown in our plantations have been larch, pines, and eucalyptus. It is thought that, owing to our favourable climate and the pumice soil on which a large proportion have been planted, similar results may be expected somewhat earlier, and that the final crop may be milled in sixty years' time instead of seventy years. In section (B) of Part V Mr. Goudie, the Superintending Nurseryman for the North Island, gives his anticipated results. It may be pointed out, however, that, if Professor Schlich's expectations are realised, our larches and pines will probably produce more than 30,000 sup. ft. of milling-timber (as Mr. Goudie anticipates) to the acre, and that we may hope for an output of from 40,000 to 50,000 sup. ft. to the acre at the end of sixty years. The late Mr. Matthews, Chief Forester, in section (A) of Part V, anticipated that 30,000 sup. ft. per acre would be available in fifty years' time, and it seems reasonable to reckon on a considerably greater supply if the trees are allowed to remain in the ground another ten years.

Now, the rate of planting necessarily varies, and the preceding three years has seen,—

In 1906–7,	1,992½	acres planted with	5,209,228 trees;
,, 1907–8,	2,656	,,	6,440,785 ,,
,, 1908–9,	2,709	,,	6,231,479 ,,

which gives an average planted area of 2,452 acres per annum.

If we assume that an average yield of 40,000 sup. ft. per acre will be experienced, then we may anticipate a total crop of about 100,000,000 sup. ft. per annum, exclusive of the periodical thinnings, from the present rate of planting. As pointed out, the expected timber-demand will be about 500,000,000 sup. ft. per annum at the same period, leaving a fairly large deficit to be supplied from foreign sources, or to be met from the remaining patches of indigenous forest.

With regard to the profitable utilisation of our lands in this manner, it may not be out of place to again quote from the "Manual of Forestry," in which Professor Schlich calculates that "a proprietor will get 5 per cent. *compound interest* on his outlay if he plants land valued at £1 or £2 an acre in larch." In making these calculations he has assumed that it costs £4 10s. per acre to plant land with larch if a considerable area (such as 1,000 acres) is planted; that the cost of looking after the plantations, including rates and taxes, is about 4s. an acre per year all round up to the time when the crop is cut over, allowing five days' labour per acre per annum; and that the prices realised from the sale of the larch amount to a total of £238, which includes the final crop at seventy years of age (£195 for 3,900 cub. ft.) and the periodical thinnings. Of course, conditions in this Dominion vary considerably, but it does not seem out of the way to expect that we can attain very encouraging results, which will more than justify any expenditure on our nurseries and plantations. The great State forests of France and Germany require the services of one man to 75 to 100 acres, and annually show large profits.

FOREIGN SUPPLIES.

An endeavour has been made in Part IV to show what countries are likely to be in a position to export timber suitable for our requirements. It would seem that the bulk of our pine-imports must come from Canada, or perhaps Manchuria; that Australia will still be able to furnish hardwoods and eucalypti; and that no great supply can be reckoned on from elsewhere. The outlook, therefore, is not too promising, for, vast as the western Canadian forests may be at present, the certain enormous drain on their resources from the United States will diminish the supply available for other countries, and a higher price will have to be paid gradually for the timber that is purchased in America. It therefore seems certain that the present tree-planting operations can be expanded with advantage, and that by so doing New Zealand will act wisely.

SUMMARY OF REPORT.

To summarise the information contained in the following pages, it may be stated that,—

Part I contains particulars of the indigenous forests, collected by the several Commissioners of Crown Lands and their staffs. The area of forest land, estimated quantity of milling-timber, and varieties of trees found in each land district are given, and every endeavour has been made to show the state of our present timber-supply.

Part II comprises descriptions of the methods of sawmillers in New Zealand, showing how they fell and clear a milling-bush. It also includes accounts of processes for preserving and seasoning timber, and how wood may be utilised for purposes other than the supply of sawn timber to the building trade.

Part III shows the absolute necessity for preserving a certain proportion of our native forests for protective purposes. It sets forth the evil effects of deforestation as experienced in other countries, and emphasizes the inevitable consequences that follow upon indiscriminate clearing, whilst explaining the true lines upon which forest-conservation should proceed.

Part IV contains particulars of the estimated forest wealth of the world, with as full details as possible regarding those countries from which New Zealand expects to draw supplies in the future. The relative timber imports and exports of those countries is also given, so as to show the present margin available for the outside market; and a table of the quantities of timber imported into this Dominion for the past five years, with the countries of origin, serves to indicate to what extent we are now dependent upon foreign supplies.

Part V sets forth the operations of the Afforestation Branch, and to what extent the tree-planting that has taken place since 1896 may be expected to meet the future demand for timber. The anticipated results are also given, and every endeavour has been made to show how far the State afforestation scheme may benefit future generations.

PART I.—OUR NATIVE FORESTS.

CONTENTS.

	Page.
(A.) General remarks	6
Review of districts	12
The indigenous trees of New Zealand	15
(B.) Detailed descriptions of districts—	
Auckland	16
Taranaki	20
Hawke's Bay	24
Wellington	27
Marlborough	37
Nelson	41
Westland	49
Canterbury	58
Otago	61
Southland	66
(C.) Timbers suitable for coachbuilding and wheelwrighting	68

(A.) GENERAL REMARKS.

BEFORE it is possible to form any theories or lay down any rules as to what requires to be done in order to maintain the timber industry of New Zealand, it is of paramount importance that the present supplies of milling-timber and the areas of forest land should be definitely ascertained, so that a basis may be formed upon which the requisite calculations may be made.

For many years past it has been the aim of the Department of Lands to ascertain and publish, periodically, approximate estimates of the quantities of milling-timber still available in the various parts of this Dominion, together with particulars as to the output of the sawmills, and conditions under which the industry is carried on. In the following report it is hoped to show what amount of timber, and what different varieties of same, are still contained in each of the ten land districts of New Zealand. The Commissioners of Crown Lands, assisted by their timber experts, Crown Lands Rangers, and surveyors, have supplied descriptions of the districts, indicating as far as is in their power what extent of it is still under forest, and what milling-timber is included therein. A list of all the varieties of indigenous trees is supplied, and their qualities and uses are enumerated, whilst tables at the end of the report summarise the total quantities of timber in each district. It must, however, be borne in mind that such estimates can only be very approximate, and, though the greatest care is exercised in their compilation, yet, owing to frequently occurring causes such as fires, felling of bush, and more precise inspections of particular areas, the estimates are continually varying, and are subject to periodical revision and alteration. Their use for purposes of comparison must therefore be necessarily limited, and made with caution.

As is well known, the flora of the Dominion is of a very varied nature, and botanists give no less than eighty-six varieties of trees growing in our forests. A detailed list of same is given on page 15. Of these, however, only a few are at present used for commercial purposes, and, from a milling point of view, the choice is restricted to about a dozen timber-trees.

FOREST AREA OF NEW ZEALAND.

One of the questions frequently asked concerning the forest resources of New Zealand is, "What area of land is still covered with forest?" For climatic, water-conservation, scenic, and other purposes, besides those of the timber industry, such a phase of the subject deserves serious attention. In older countries widespread interest has been taken in ascertaining what proportion of the land is still retained in a state of nature, and it is now generally thought that a certain minimum amount is absolutely essential to the welfare of the community. A table on page 99 shows how European countries fare in this respect, and it will be noticed that the percentage of the country under forest varies in a most striking manner. Sweden has about one-half of its total area under wood, mostly timber suitable for milling purposes; Germany, now one of the foremost commercial nations, has one-quarter; but when we come to the United Kingdom we find that only 4 per cent. of the land is clothed with forest, or about one twenty-fifth of the total area. This condition of affairs is deemed most serious, and the recent British Royal Commission on Coast-erosion and Afforestation drew special attention to the matter, and the necessity for rapid extension of afforestation in the United Kingdom.

Coming to our own country, an endeavour has been made to show how we stand in this respect, and the following schedule gives the areas now reported to be covered with forest:—

TABLE A.—RETURN OF FOREST LANDS IN NEW ZEALAND.

Col. 1. Land District.	*Col.* 2. Area of Land District.	*Col.* 3. Crown Forests (Crown Land, State Forests, and Forest Reserves).		*Col.* 4. Permanent Forests (National Park, Scenery and Climatic Reserves, &c.).		*Col.* 5. Alienated Forests (Private and Native Lands).		*Col.* 6. Totals.	
		Area.	Estimated Quantity of Timber.	Area.	Estimated Quantity of Timber.	Area.	Estimated Quantity of Timber.	Area under Forest.	Estimated Quantity of Timber.
	Acres.	Acres.	Sup. ft.	Acres.	Sup. ft.	Acres.	Sup. ft.	Acres.	Sup. ft.
Auckland	13,858,000	371,514	1,425,873,144	109,644	Unknown	3,188,842*	4,799,240,713	3,670,000	6,225,113,857
Hawke's Bay ..	6,063,000	536,680	1,014,465,000	3,500	Unknown	491,360	1,220,748,000	1,031,540	2,235,213,000
Taranaki	2,417,299	358,702†	39,178,000	116,915	192,000,000	959,900‡	559,120,000	1,435,517	790,298,000
Wellington	6,810,953	1,215,796	7,055,700,000	70,125	Unknown	1,320,000	5,772,000,000	2,605,921	12,827,700,000
Marlborough ..	2,768,000	338,000	97,720,000	102,000	Unknown	146,000	73,882,000	586,000	171,602,000
Nelson	4,686,000	1,936,073	3,495,631,600	133,308	242,143,000	353,649	835,112,180	2,423,030	4,572,886,780
Westland	3,894,887	1,477,660	4,475,000,000	700,000	250,000,000	140,000	900,000,000	2,317,660§	5,625,000,000
Canterbury	9,604,045	301,780	24,955,000	17,261	Unknown	11,920	6,590,000	330,961	31,545,000
Otago	8,882,800	213,860	927,862,000‖	2,364	4,728,000	52,110	290,645,000¶	268,334	1,223,235,000
Southland	7,583,892	1,158,540	354,482,000	855,600	610,000,000	390,900	330,098,000	2,405,040	1,294,580,000
Totals ..	66,568,876	7,908,605	19,179,867,944	2,110,717	1,299,871,000	7,054,681	14,621,960,813	17,074,003	35,101,699,757

Percentage of land under forest, 25·6. Percentage under permanent forests, 3·1.

* Milling-timber grows on only 1,200,000 acres of this area. † Milling-timber grows on only 7,763 acres of this area. ‡ Milling-timber grows on only 102,950 acres of this area. § The timber on about 800,000 acres of this area is unsuitable for sawmilling. ‖ Only 442,400,000 sup. ft. is milling-timber; balance is miro, tawhai, rata, kowhai, broadleaf, &c. ¶ Only 138,687,800 sup. ft. is milling-timber; balance is miro, tawhai, rata, kowhai, broadleaf, &c.

(See maps at end of report, illustrating this table.)

Although at first sight it may seem that a very large and sufficient proportion of the country is clothed with forest, and that the future supply of milling-timber is much larger than was generally supposed, yet it must be pointed out that many circumstances may prevent much of the milling-timber from ever being used for commercial purposes, and the retention of the forest covering.

For obvious reasons, such as climatic, soil-protection, river and water conservation, scenery-preservation, &c., it is absolutely imperative that large areas should permanently remain covered with forest, and, although it is usually the case that such areas are the most remote from market and on the roughest country, yet, owing to the annual shrinkage in timber-supplies, the sawmiller may ere long cast covetous eyes on many large areas of forest included in column 4 that it is imperative to retain in their natural state. For example, the Egmont, Sounds, and Tasman National Parks contain large quantities of timber, and, though at the present time it is too distant from a market, and perhaps not sufficiently valuable or suitable for commercial purposes, yet in the course of time it *may* happen that, through lack of better timber, that growing in the parks and reserves may be desired for milling, and, for the sake of a little monetary gain, extensive areas of attractive country infinitely more valuable in their native state than when cleared of their best covering may be dealt with in a similar manner to settlement lands and pastoral country, although it can rarely be utilised for any system of settlement except in extensive areas, and with little profit. However, this state of affairs may not eventuate, but it is well to draw attention to such a possibility in order that New Zealand's position with regard to timber resources may be thoroughly understood.

MILLING TIMBER.

With regard to timber suitable for milling purposes, enumerated in columns 3 and 5, a large amount is situated on hilly and mountainous country, difficult of access, and expensive to work by the miller. Then, again, the quantity per acre of milling-timber may be so small as not to warrant the expense of erecting a sawmill in the locality. Even if the bush is situated on level land and in payable quantities, yet the distance from the nearest railway may debar its working at the present time. Moreover, when the owners of the milling-bush have constructed a tramway from the scene of operations to the railway-line it has happened that their financial resources are so crippled by the heavy expenditure necessitated that they have been unable to continue working, and have been compelled to abandon operations. The expense of transport is one of the chief difficulties that has to be faced by a sawmiller, and it has been found that, unless the bush is in close proximity to the railway, the success of the sawmill is exceedingly problematical.

Bearing these matters in mind, it will be readily conceded that it will not be possible for many years to come to utilise much of our milling-timber for commercial purposes, and, although every effort is made by the millers to reduce the cost of cutting to a minimum, yet, unless certain natural advantages are associated with an area of forest land, its early use is very doubtful. Under these circumstances, although the amount of milling-timber given in the following table is probably very close to the mark, yet it must be remembered that its utilisation may be deferred for many years to come, and that the quantity of *available* timber that can be worked on a *payable* basis at the present time is only a comparatively small proportion of the whole.

The figures below indicate the *milling*-timber included in the amount given in Table A, the difference being made up of timber not suitable for milling, being varieties of trees not used by the sawmiller.

When it is noticed that out of a total area of 17,074,003 acres now under forest no less than 7,054,681 acres have been sold, and the timber thereon may be cut and destroyed at any time, whilst the timber in all the Crown forests is available for sawmilling, and will doubtless be eventually used for that purpose, it cannot be denied that an area of 2,110,717 acres (or only 3·1 per cent. of the total area of the Dominion) is a very small proportion to keep covered with forest.

TABLE B.

District.	Kauri.	Rimu.	Kahikatea.	Totara.	Matai.	Birches.	Miscellaneous.	Total.
Schedule showing the Approximate Quantity of Milling-timber on Crown Lands.								
	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.
Auckland	209,627,889	909,422,310	109,497,863	90,689,203	106,435,879	Nil	Nil	1,425,873,144
Hawke's Bay	..	625,108,000	217,104,000	50,153,000	120,500,000	1,600,000	Nil	1,014,465,000
Taranaki	..	17,824,000	8,887,260	1,347,120	2,322,680	3,082,240	5,714,700	39,178,000
Wellington	..	2,729,600,000	338,800,000	97,200,000	1,036,800,000	Nil	2,803,300,000	7,055,700,000*
Marlborough	..	63,000,000	21,000,000	320,000	5,400,000	5,000,000	3,000,000	97,720,000
Nelson	..	348,820,000	34,120,000	Nil	94,000	3,104,881,000	7,716,600†	3,495,631,600
Westland	..	3,484,000,000	293,000,000	47,000,000	26,000,000	332,000,000	293,000,000	4,475,000,000
Canterbury	..	550,000	1,375,000	700,000	500,000	21,800,000	30,000	24,955,000
Otago	..	337,630,000	12,564,000	4,020,000	43,698,000	44,488,000	Nil	442,400,000
Southland	..	142,175,000	47,292,000	4,860,000	12,860,000	112,595,000	34,700,000‡	354,482,000
Totals	209,627,889	8,658,129,310	1,133,640,123	296,489,323	1,354,610,559	3,625,446,240	3,147,461,300	18,425,404,744
Schedule showing the Approximate Quantity of Milling-timber on Private and Native Lands.								
Auckland	275,819,100	2,964,082,710	574,028,890	59,065,180	796,630,105	Nil	129,614,728	4,799,240,713
Hawke's Bay	..	752,040,000	256,000,000	64,108,000	148,600,000	Nil	Nil	1,220,748,000
Taranaki	..	292,567,250	80,725,750	25,070,000	13,459,500	4,096,000	143,201,500	559,120,000
Wellington	..	1,456,000,000	396,000,000	104,500,000	1,056,000,000	Nil	2,759,500,000	5,772,000,000§
Marlborough	..	52,700,000	14,200,000	182,000	1,800,000	3,000,000	2,000,000	73,882,000
Nelson	..	152,890,000	26,849,000	Nil	5,495,000	647,196,080	2,682,100†	835,112,180
Westland	..	786,000,000	65,000,000	10,000,000	6,000,000	8,000,000	25,000,000	900,000,000
Canterbury	..	100,000	1,424,000	398,000	468,000	Nil	4,200,000	6,590,000
Otago	..	91,965,000	3,223,000	4,098,000	26,501,000	12,900,000	Nil	138,687,800
Southland	..	144,000,000	35,100,000	6,650,000	14,263,000	93,600,000	36,485,000‡	330,098,000
Totals	275,819,100	6,692,344,960	1,452,550,640	274,071,980	2,069,216,605	768,792,080	3,102,683,328	14,635,478,693

* Only 1,294,149,000 sup. ft. is available for payable milling at the present time. † Miro, cedar, yellow-pine, silver-pine. ‡ Miro. § Only 3,001,105,000 sup. ft. is available for payable milling at the present time.

Although, as before stated, it is not claimed that these figures are absolutely accurate, yet it is believed that they are approximately correct. Constant inspections of forest areas, extending over a decade at least, and the utmost care in estimating the quantity of trees to the acre and the amount of timber in an average tree, combined with the continual checking that ensues when Crown forests are sold to a sawmiller and converted into sawn timber, has shown that in the majority of cases the estimate of the Government officer is as nearly correct as could be expected, and that, although an area may be underestimated, yet, through causes such as the unexpected discovery that standing trees are rotten and unsuitable for milling, that accidental fires often destroy valuable clumps of trees, and that the transport of timber is more difficult than had been anticipated, it is found as a rule that the Government estimate is accepted by the purchaser as being a very fair indication of the timber offered for sale and standing on any particular area. As numerous officers have occasion in the course of years to inspect and report on forest areas, and as the records of each inspection are carefully checked and verified, and seldom vary to any great extent, it can be said with some confidence that, so far as the Department is in a position to judge, the amount of milling-timber stated herein is approximately correct.

This being the case, a comparison of the present estimate with those of past years is of interest as showing to what extent New Zealand is losing its indigenous forests. It is as follows :—

ESTIMATES OF MILLING-TIMBER IN NEW ZEALAND.

Tree.	1905.	1907.	1909.
	Sup. ft.	Sup. ft.	Sup. ft.
Kauri	1,112,019,000	646,041,094	485,446,989
Rimu	22,334,145,250	17,899,348,364	15,350,474,270
Kahikatea	5,247,025,900	3,914,685,793	2,586,190,763
Totara	1,149,388,050	1,025,481,558	570,561,303
Matai	3,802,848,850	3,823,047,378	3,423,827,164
Birches	4,673,001,000	5,038,406,880	4,394,238,320
Miscellaneous	3,393,146,750	3,448,862,400	6,250,144,623
Totals	41,723,574,800*	35,785,873,467	33,060,883,437

* Quantities in two districts not completely estimated; probably an addition of 1,500,000,000 sup. ft. necessary.

SAWMILLING.

To show the extent to which these forests are annually being depleted by sawmillers, apart altogether from the recurrent fires and march of settlement, the following table is of interest :—

TABLE C.—SAWMILLS IN OPERATION IN MARCH, 1909.

Land District.	Number.	Hands employed.	Output for Year.	Cutting-capacity per Annum.
			Sup. ft.	Sup. ft.
Auckland	62	2,356	184,145,852	260,324,980
Hawke's Bay	19	481	16,798,482	37,740,000
Taranaki	21*	421	8,945,835	27,620,500
Wellington	88	1,605	73,697,000	126,370,000
Marlborough	13	256	11,408,052	20,700,000
Nelson	83	480	15,090,718	73,200,000
Westland	54	605	48,782,980	106,260,000
Canterbury	8†	50	1,000,000	3,000,000
Otago	13†	160	5,000,000	10,250,000
Southland	62†	1,000	49,000,000	90,000,000
Totals	423	7,414	413,868,919	755,465,480

* Only 18 working. † Estimate only.

COMPARISON WITH PREVIOUS YEARS.

In 1886	220	3,890	163,740,546	..
In 1895	299	4,055	191,053,466	..
In 1900	334	6,085	261,583,518	..
In 1905	414	6,912	413,289,742	704,930,600
In 1907	411	7,139	432,031,611	718,940,000

A perusal of the above will reveal the fact that, notwithstanding the distress that has prevailed in the sawmill industry during the past twelve months, and the complaints that have been made against the importation of foreign timber, the output of timber is still very large, whilst more hands have been employed than two years previously. This will doubtless occasion surprise, but, as the statistics have been compiled with much care, and each district has been separately dealt with, it is thought that the figures are fairly reliable, and can be accepted as being practically correct.

PROBABLE DURATION OF LOCAL SUPPLY.

In the report on "The Timber Industry of New Zealand, 1905," it was estimated that "the supply on hand may be reckoned to last seventy years at most." In a subsequent report on the timber industry in 1907 it was stated "that the supply is not likely to last beyond the seventy years estimated in 1905, and will probably fall short of this period to a considerable extent." In a later report on "The State Nurseries and Plantations, 1908," it was thought that "the present supply of indigenous timber may be reckoned at about fifty years at the existing increasing rate of consumption."

From the more accurate information that is now available, it will be seen that there is ample justification for the diminished estimate of our timber-supply. An impression prevails that, owing to the increasing use of substitutes for timber in the construction of buildings, &c., the future demand may not be so great as is anticipated; but, as the population of this Dominion is steadily increasing, and experience in other countries has shown that, despite the large use of such substitutes, there is a rapidly advancing demand for timber in every branch of industry, we must realise that our timber resources will be taxed to their utmost capacity in a very few years, and that future generations will have to face a serious problem that, up to now, has not been regarded with much concern.

Out of the gross amount of 33,060,883,437 sup. ft. of milling-timber estimated to exist on Crown or alienated land at the present time, it will be noticed that 10,664,382,948 sup. ft. (or nearly one-third) is composed of timber not commercially used to any appreciable extent, such as birches, miro, tawa, rata, kowhai &c. This reduces the immediately available total quantity to 22,416,500,489 sup. ft., and of this a large portion is situated on land too difficult of access to be profitably worked for many years to come. The net quantity of timber now used for commercial purposes, and likely to be available for sawmilling, would therefore amount to about 16,000,000,000 sup. ft.

As the present output of timber is over 400,000,000 sup. ft., it is a fair assumption that the average output for the next generation will be about 450,000,000 sup. ft. If the present estimated supply is divided by this amount, it will be seen that there is only sufficient timber to last the sawmiller for about thirty-five years, and this is without taking into account the inevitable loss that periodically occurs through accidental fires. At the end of twenty or twenty-five years it is expected that the annual output (or, rather, the demand for timber) will average 500,000,000 sup. ft.; but by that time some of the surplus timber that is now difficult of access may be more easily worked, and would be included in the quantity available for sawmilling, whilst no doubt timber such as *Fagus fusca*, miro, and other woods not at present used to any great extent will be in more favour and will be utilised to supplement the decreasing supply.

Taking all these considerations into account, it does not appear an unreasonable assumption that the indigenous forests of New Zealand will not cope with the full demand for sawn timber for a longer period than thirty-five to forty years. It must be remembered that during this period large supplies of foreign timber may be expected to arrive, and thus reduce the strain on our local forests; but, as every country in the world will be feeling the effects of the universal demand, it is not to be expected that such timber can be procured after the next ten or twenty years, save at much higher prices than now are current, and in gradually decreasing quantities.

It is therefore evident that our forest resources must be husbanded with the greatest care, and every precaution must be taken to insure that they are utilised to the greatest possible extent. No unnecessary waste must be permitted, and the occurrence of bush-fires must be scrupulously guarded against. It is only by working on these lines and by systematically taking stock of our resources that we can prevent a future timber-famine and much unnecessary distress and disorganization in the timber trade.

SAWMILLING IN CROWN FORESTS.

It may be of interest to describe briefly the methods by which the Crown forests of New Zealand, containing milling timber available for sawmilling purposes, are dealt with. Such forests comprise:—

(1.) State forests proclaimed under the State Forests Act of 1885 (now consolidated into the Act of 1908).

(2.) All other forest or bush standing on unselected Crown lands.

The two classes of forest land are under the same conditions, and administered under practically identical regulations by the Lands Department.

The Minister of Lands is also Commissioner of State Forests, and deals with those forests under the State Forests Act of 1908, and forests on Crown lands under the Land Act, 1908. The Department of Lands administers the Crown forests, the district Commissioners of Crown Lands being also the Conservators of Forests under the State Forests Act, and the Crown Lands Rangers being the Forest Rangers. In 1896 the Afforestation branch of the Department was established, mainly with the object of afforesting the treeless and in some respects waste lands of the colony.

No timber can be felled, removed, or sold without license or permit. Unauthorised possession of timber is finable up to £5, and unauthorised occupation of Crown lands, or felling, entails a fine up to £20, with the alternative of imprisonment up to one month.

After the marketable timber is cleared off the forests, the land is either replanted or disposed of under the usual provisions of the Land Act. In the case of State forests, the reservation is first cancelled.

Disposal of Timber, &c.

Timber and its products are disposed of by—(1) Sawmill license on application; (2) public auction or tender; (3) special license to fell, saw, split, strip bark, &c.

The original area of a *sawmill license* may not exceed 200 acres, nor with this limit be less than at the rate of 10 acres for each nominal horse-power of the mill in connection with which it is granted, but the holder may apply to have one or more additional areas of not more than 200 acres each, adjoining each other, reserved for his exclusive use. The total areas so granted shall not exceed the following amounts :—

	Acres.
Where the nominal horse-power of a mill does not exceed 8 h.p.	300
Where it is 9 or 10 h.p.	400
,, 11 or 12 ,, ...	500
,, 13 or 14 ,, ...	600
,, 15 or 16 ,, ...	800
,, 17 or 18 ,, ...	900
,, 19 or 20 ,, ...	1,000
,, 21 or 22 ,, ...	1,200
,, between 22 and 30 h.p.	1,300
From 30 h.p. upwards	1,500

Royalty is payable by the sawmiller to the Crown either on the sawn output of the mill, or on the estimated amount of milling-timber in the forest standing on the area licensed. A period of from four to twenty-one years is granted for the felling of the timber upon a sawmill area.

For *auction sales* it is usual to have the timber classed and estimated, to fix the upset price, and publish the particulars, with the conditions of sale attached, prescribing rates and date-limits of removal, way-leaves, payments, and surrender of the cleared areas to the Department. Sometimes the Department elects to exercise its power of reserving trees required for special purposes, and these trees are branded "F.R.," and cannot be cut by licensees.

All *kauri* timber for the supply of existing mills shall be sold by *public tender*, after due notification, estimation, and appraisement; but special licenses for single trees or clumps of trees not exceeding 100,000 superficial feet for any one license may be granted by the Conservator, with the approval of the Commissioner, on payment of such fees as they may fix.

Special licenses may be granted for cutting single trees or clumps, after appraisement and report by the proper officers, by auction or in any other way, on conditions fixed by the Department. They are issued to hand-sawyers, wood cutters and splitters, and also to adjoining settlers, for firewood and fencing-posts, &c.

In all disputes as to correctness of valuation, or statement of timber cut, or of damage done, the decision of the proper authority is final, and payment must be made at once, with right reserved to the licensee to appeal to any Court of competent jurisdiction for refund.

DETAILS OF FOREST-TREES AND USES.

The accompanying reports on each of the land districts of New Zealand contain particulars of the different kinds of indigenous trees therein, and give also the estimated area of forest land, and the quantity of millable timber to be found thereon. These reports will be valuable as forming a permanent record of the state of our timber wealth in 1909.

It is not generally known what a variety of forest-trees grow throughout the Dominion, and, as will be seen from a perusal of the remarks appended to their names, our timbers may be used for a variety of purposes that are not recognised by the public. It is hoped that the growing scarcity of timber may induce carpenters, cabinetmakers, and builders to regard with a more favourable eye much that has hitherto been neglected. Both in variety of grain, texture, and appearance, our native timbers are very attractive, and should be much more in demand than they are. Lack of sufficient seasoning may often prevent them from giving as favourable results as some of the imported timber; but, with greater care in cutting our forest-trees at suitable times of the year, and in seasoning the timber before subsequent use, it is felt that much wood that is now disregarded could be profitably utilised commercially, and would assist to meet the growing consumption of timber. Timber-merchants and others are therefore advised to read and earnestly consider the remarks and recommendations set forth in the accompanying descriptions and reports regarding various trees at present unknown to them, or other trees of whose properties they may be unaware.

REVIEW OF DISTRICTS.

The *Auckland* District is the most important from a timber point of view in the whole of the Dominion, as it contains a larger variety and greater quantity of available milling-timbers than any other district at the present time. It is estimated that on Crown lands alone no less than 1,425,873,144 sup. ft. of milling-timber is now standing, of which 209,627,889 sup. ft. is kauri, whilst on private lands there is a total amount of 4,799,240,713 sup. ft., of which 275,819,100 sup. ft. is kauri.

As is well known, kauri, the finest timber of New Zealand, is only found in this district, and is now rapidly diminishing. Each year the demand is greater than ever, whilst the supply is correspondingly less, and most of the Auckland sawmillers and timber-merchants have been unable to supply all their orders for some considerable time. Although the demand for other timbers has recently slackened off, that for kauri increases, and one of the chief reasons for milling available kauri-trees is the great difficulty of protecting them from the bush-fires which periodically sweep through the district. Kauri, from its inflammable nature, is, more than any other class of timber, very difficult to preserve, and the resin which exudes from the trees, and the *débris* at the foot, is very susceptible to fire. The

débris is commonly known as *pukahu* (usually corrupted into "bookow"), and is a compound of vegetable fibre intermingled with fallen leaves, particles of gum, and scales from the resinous bark which forms round the base of the trees, and sometimes reaches several feet in height. Not only this, but, owing to the fact that a very small touch of fire will kill a kauri-tree, the efforts of the Department to preserve clumps of kauris have been more or less frustrated. However, the Waipoua Kauri Forest is still withheld from sale in its entirety, and presents an unequalled specimen of that variety of forest in the Auckland District. (Photographs of kauri-trees may be found opposite pages 16 and 17.)

With regard to the other timbers in the district, totara is largely used, and particularly so in the southern parts of the district, in the vicinity of Taupo. (See photograph of totara-tree opposite page 41.)

Kahikatea is found all over the district, and its cutting and export in the Northern Wairoa is one of the staple industries of that locality, though recently the demand has been very small. (See photograph opposite page 34.)

Rimu is in general request, but very few other trees are used for building purposes commercially to any extent. Although tawa is a very fine timber indeed, yet it is reported to be almost unsaleable at the present time, and beech or birch, although used for mining purposes, is not required otherwise. Puriri is in fairly constant demand, and, although its supply is somewhat limited, still there is a chance of its being more used in the future than in the past. (See photograph of puriri opposite page 41.)

It is estimated that the export of timber in the Auckland District amounted to 60,422,521 sup. ft. for the year 1908-9, the value being given as £280,446, being a decrease from the previous year of 3,000,000 sup. ft., and an increase in value of £4,000; whilst for the year 1908 the imports of timber into the district were given at a little over 10,000,000 sup. ft., of a value of £62,000, being an increase of 7,500,000 sup. ft. over the previous year, and an increase in value of £36,000. At the present time there are sixty-two mills in the various parts of the district, employing 2,356 men, the output in 1908 being 184,145,852 sup. ft. The production of these mills will soon be 200,000,000 sup. ft. per annum. Judging from the known supply of 485,000,000 sup. ft. of kauri, and the fact that last year's export alone was 23,464,065 sup. ft., and taking into consideration the fact that the demand is constantly increasing, whilst fires annually destroy a large quantity of trees, the difficulty of milling trees in somewhat inaccessible positions, and the unavoidable waste that attends all sawmilling operations, it is evident that the kauri-milling industry cannot last much longer than about fifteen to twenty years, and it is highly probable that in another ten years there will be very little kauri available for commercial purposes. Although other timbers are now being largely used where up to recently kauri was always employed, yet it is impossible to replace this magnificent timber in many respects, and, although rimu is now a great stand-by of the district, yet foreign timbers, such as Douglas fir, are beginning to enter into competition with it, and their use is not nearly so profitable as the milling of kauri.

One of the great difficulties the sawmillers have to contend with is, in some instances, the comparatively small quantity of milling-timber that grows to the acre. For instance, one milling company which gave evidence before the Royal Commission stated that the average quantity of milling-timber to the acre milled by them was 8,000 sup. ft.; and, although the general average is from ten to fifteen thousand sup. ft. per acre, yet, if the country is at all broken and far from a suitable waterway or railway-line, the expense of getting out the timber makes a large portion of the forest unsuitable for sawmilling operations on a profitable basis. (In some parts of the Dominion as much as 50,000 sup. ft. per acre has been milled, but this is very unusual.)

Generally speaking, the sawmillers in the district run on up-to-date methods, and employ modern machinery as far as practicable, and it is doubtful if the forests can be worked with less waste than is now occasioned.

The supply in *Hawke's Bay* in 1909 is apparently as large as it was in 1907, but this is probably caused by more accurate measurement of the various timber areas.

The bulk of the Hawke's Bay timbers consists of rimu, over a thousand million superficial feet being supposed to exist. This timber is largely used for building purposes in place of totara, which formerly was the pre-eminent timber of Hawke's Bay; but there is only a hundred million superficial feet of totara now left, and its coming disuse is unavoidable.

Hawke's Bay was formerly one of the chief milling districts of New Zealand, and the great "Seventy-mile Bush" was its glory, as it contained such a large amount of valuable milling-timber. However, the mills around Dannevirke (which for years was the centre of the sawmilling industry) have now swept away the greater part of this forest, and the remainder chiefly exists on the slopes of the great Ruahine Ranges and the continuation of the range in the Poverty Bay portion of the district.

There is no particular area of milling-timber that now stands pre-eminent, as it is all scattered in localities more or less difficult of access, and consequently the greater part of the timber is now used chiefly for local purposes, and the export of timber from Hawke's Bay may be expected to be small for some time to come. There still remain extensive forests in the Motu and the north portion of Poverty Bay that may eventually prove of great use to sawmillers, and the completion of the Gisborne–Rotorua Railway, with a branch through the north part of Poverty Bay, is expected to create a keen demand for the timber in these districts.

In *Taranaki*, also, the bulk of the milling-timber is rimu, there being 400,000,000 sup. ft. now growing, of which, however, about one-quarter is situated within the Egmont National Park, and is therefore unavailable for commercial purposes. Only 18,000,000 sup. ft. is estimated to be on Crown land, the balance being on private and Native land. As about 90,000,000 sup. ft. of kahikatea is available, although under ordinary circumstances it is not used for buildings, yet, if the "Powellising process" described in Part II of this report proves as successful as it is claimed to be, it is highly probable that it will augment the failing supply of building-timbers in the future.

The amount of totara is thought to be 35,000,000 sup. ft., of which over one-quarter is in the Egmont National Park.

With such a limited amount of timber available, it is likely that most of it will be required for local consumption within the district. Two years ago the amount of milling-timber in Taranaki was estimated as about the same quantity as at present, but the apparent lack of diminution is probably due to the ability to make more accurate measurement.

There is supposed to be over 12,000,000,000 sup. ft. of timber in the *Wellington* District, of which one-third is rimu, the rest comprising principally matai and tawa, with a little kahikatea and totara.

Most of this timber is reported to be in the western portion of the district, situated in the famous forest of Waimarino.

In the detailed reports of each land district which follow there will be seen a special account of this forest, and from the rapidity with which sawmills are now being erected to work it, and the facility with which the North Island Main Trunk Railway can carry away the finished product, it is probable that a large portion of timber exported from the North Island for the next few years will come from this locality. Ohakune is the chief place in the Waimarino district where sawmilling operations are now and will be carried on, and the great store of magnificent rimu, kahikatea, and other timbers which grow in accessible positions should enable timber to be supplied under as profitable conditions as anywhere else in the North Island.

Another large forest is the Awarua, around and south of Taihape; but this has been so depleted of late years by contract cutting that its supply will probably be exhausted before very long.

The supply in *Marlborough* appears to have shrunk from 187,000,000 sup. ft. in 1907 to 171,000,000 sup. ft. in 1909, and this estimate corresponds with what is supposed to be the average annual output of 10,000,000 ft. Most of the present supply is in the Pelorus Valley.

About two-thirds of the timber is rimu, whilst more than half of the remainder is kahikatea. Then come matai and beech.

Probably little of the present supply will be available for use outside the district, although just now there is an export trade to Canterbury and Wellington.

For some time past the *Nelson* District has been expected to increasingly supply a large amount of timber for South Island use, and no doubt there does exist a large quantity of black, brown, and silver beech on the rugged country which forms the backbone of the district, but of the building-timbers chiefly in demand at the present time the available supply is somewhat limited. Only 530,000,000 sup. ft. of rimu is estimated to be growing in the district, 350,000,000 sup. ft. being on Crown land, but as in Marlborough, much of it cannot be worked save with great expense, owing to the inaccessible country on which it stands. Four-fifths of the available milling-timber is brown-beech (*Fagus fusca*), and with more general knowledge of its properties it will undoubtedly be largely milled in the future. The sawmilling industry does not appear to be in a very flourishing condition, and better-equipped mills and modern machinery and methods seem very desirable. No doubt, with increased demand for Nelson beech, these will follow.

Westland is now the mainstay of the South Island, and its fine reserve of native timber will undoubtedly prove increasingly profitable to sawmillers of the district as the years go by. Unfortunately, such a large proportion of the forest is on high land that it is somewhat unworkable, as what may be designated as outlying forest covers 700,000 acres, and mountain forest—that is, forest which attains a very high altitude—includes over a million acres, whilst only 750,000 acres are low-lying land.

In 1907 there was supposed to be 6,700,000,000 sup. ft. of milling-timber. Now, closer inspection reduces these figures to 5,625,000,000 sup. ft., four-fifths of which is rimu, whilst 375,000,000 sup. ft. of kahikatea and 60,500,000 sup. ft. of totara is included in the remainder.

Until the district is more developed by means of roads, railways, or steamer communication, it is impossible to profitably cut and sell most of this timber, and yet, if these difficulties could only be overcome, there is no doubt but that Westland would be a valuable source of supply for generations to come.

Its somewhat humid climate has the effect of inducing a natural regeneration of forest more easily than in any other district, and, although the valuable milling-timbers do not grow sufficiently rapidly to be taken into account during this century, yet for purposes such as the wood-pulp industry, &c., large areas should be used in this manner, and would partially affect the supply for the future, as it is estimated that the timber required for wood-pulp, being very much smaller than the ordinary milling-timber, will spring up again very rapidly, and that in ten or twenty years after an area has been cut out for this purpose the new growth will have replaced the old.

In the Grey County, out of an estimated area of 189,904 acres of milling-forest, 20,191 acres have been granted under sawmilling licenses. In the Westland County 417,156 acres are under milling-forest, of which 15,688 acres are granted under sawmilling licenses. The total number of sawmills in Westland at the present time is 54, of which 11 are not working, leaving 43 in active operation.

Two years ago *Canterbury* was supposed to have 85,000,000 sup. ft. of milling-timber, but now it is thought that only 32,000,000 ft. are available, of which 26,000,000 ft. is beech, principally black-beech (tawhai), and only 2,800,000 ft. of the remainder is kahikatea. Black-beech, however, is not so valuable as the silver-beech of Southland, and cannot be largely used for commercial purposes, though it is much availed of locally for bridge timbers, decking, sleepers, and fencing, &c. Unfortunately, a great portion of it comprises trees of very small barrel.

It will therefore be seen that the timber in Canterbury is not even sufficient for local requirements, and that, instead of exporting timber, there must every year be a constantly increasing demand for timber produced outside the district. At the present time most of the supply comes from Westland and Marlborough, though Oregon pine is now being imported by timber-merchants in Christchurch.

Otago is the least-provided district so far as milling-timber is concerned: barely 1½ per cent. of its area is known to be under forest, and, of this, a large portion is situated in the far-western part of Otago, and is practically useless at the present time owing to its comparative inaccessibility and distance from a market. The estimated amount of milling-timber on Crown and private lands available for sawmilling is only 581,000,000 sup ft., chiefly composed of rimu, amounting to four-fifths of the total quantity; the remainder being mostly matai and beeches.

The only large forest now used for sawmilling is in the Catlin's District, between Molyneux and Waikawa, and consequently the greater part of the timber used in Dunedin comes from Southland. There is another sawmilling bush at Rankleburn, but its timber is all consumed locally. One of the recent results of this scarcity of locally grown timber is the increasing import of Oregon pine in long lengths.

There is a very large quantity of kamahi in the Catlin's District, and this timber has hitherto not only been useless from a commercial point of view, but has been a decided hindrance to the settler and sawmiller. Experiment has proved it useless for building purposes, and the only use it has been put to successfully is as mining props. For this purpose there is only a very small demand. It is possible, however, that it might be a suitable timber for wood-pulp for paper-making purposes.

The remaining district in New Zealand is that of *Southland*, where over two million acres of land are covered with bush. An estimate of the milling-timber thereon shows,—

	Sup. ft.
On Crown land and State forests	354,000,000
On Sounds National Park	610,000,000
On private lands	330,000,000
	1,294,000,000

However, as over 800,000 acres of the forest land is within the Sounds National Park, and a large portion of the remainder is very rough and almost inaccessible country, it will be seen that much of the timber cannot be utilised for commercial purposes.

The quantity of timber in the district in 1907 was estimated at 661,000,000 sup. ft. This estimate did not take into account the timber within the Sounds National Park and a large area in its vicinity, and therefore, although the present estimate of milling-timber on all classes of land is 1,294,000,000 sup. ft., yet that growing on Crown and private lands is only 684,000,000 sup. ft., and of this the total quantity that it will pay the sawmiller to work during the next decade will probably not be more than 384,000,000 sup. ft., the other 300,000,000 sup. ft. being further available after that period.

About one-third of the milling-timber is rimu, and about the same quantity of beech is now available for sawmilling, whilst kahikatea is next in order of importance, and then come matai and totara. The quality of the timber, however, does not seem so good as in other districts. It is most noticeable how tawhai (silver-beech) has come into general use for furniture-making, &c.

At the present time probably 75 per cent. of the timber cut in Southland is exported out of the district into other parts of New Zealand and to Australia. It is thought that the timber industry in Southland will continue as it now is for some years to come, and, judging from the present estimated output of about 40,000,000 sup. ft. per annum from about sixty-two mills, it seems probable that, with the increased use of beech for milling purposes, the timber industry of Southland has a certain life of about twenty-five years, though perhaps with a smaller output, whilst after that time it will continue on a much-diminished basis.

It has been the custom to under, rather than over, estimate the quantities of timber, owing to the large tracts of unexplored timbered country in the western part of the district, which probably carries very much more sawmilling timber than has been supposed. Recent explorations west of the Waiau point to this conclusion, and the above period of twenty-five years is reckoned on this supposition being corroborated, and on the fact that, with the growing dearth of timber, trees not now milled will be utilised later on.

LIST OF INDIGENOUS TREES OF NEW ZEALAND.

1. Timbers of Great Durability and Large Dimensions, suitable for Constructive Works, House-building, or for Special Purposes.

1. Kauri (*Agathis australis*).*
2. Totara (*Podocarpus totara*).†
3. Totara-kiri-kotukutuku (*Podocarpus Hallii*).
4. Matai (*Podocarpus spicatus*).‡
5. Kawaka (*Libocedrus Doniana*).
6. Pahautea, or cedar (*Libocedrus Bidwillii*).
7. Northern manoao (*Dacrydium Kirkii*).
8. Southern manoao (*Dacrydium biforme*).
9. Westland pine (*Dacrydium Colensoi*).
10. Yellow silver-pine (*Dacrydium intermedium*).
11. Puriri (*Vitex lucens*).†
12. Tawhai raunui, tooth-leaved beech (*Fagus fusca*).
13. Tawhai rauriki, entire-leaved beech (*Fagus Solandri*).
14. Tawhai (*Fagus apiculata*).
15. Tawhai, Blair's beech (*Fagus Blairii*).
16. Maire raunui (*Olea Cunninghamii*).
17. Maire (*Olea lanceolata*).
18. Narrow-leaved maire (*Olea montana*).
19. The Northern rata (*Metrosideros robusta*).§
20. The Southern rata (*Metrosideros lucida*).
21. Pohutukawa (*Metrosideros tomentosa*).‖
22. Manuka rauriki (*Leptospermum ericoides*).¶
23. Maire tawhake (*Eugenia maire*).
24. Kowhai (*Sophora tetraptera*).**

* *Vide* photo opposite pp. 16, 17. † *Vide* photo opposite p. 41. ‡ *Vide* photos opposite p. 57. § *Vide* photo opposite p. 40. ‖ *Vide* photo opposite p. 56. ¶ *Vide* photo opposite p. 48. ** *Vide* photo opposite p. 49.

2. Timbers suitable for General Building Purposes, or for Special Uses, but of less Durability than the Preceding Kinds.

25. Rimu, red-pine (*Dacrydium cupressinum*).*
26. Kahikatea, white-pine (*Podocarpus dacrydioides*).†
27. Miro toromiro (*Podocarpus ferrugineus*).
28. Tanekaha (*Phyllocladus trichomanoides*).
29. Toatoa (*Phyllocladus glauca*).
30. Mountain-toatoa (*Phyllocladus alpinus*).
31. Tawhai rauriki, mountain-beech (*Fagus cliffortioides*).
32. Tawhai, silver-beech (*Fagus Menziesii*).
33. Pukatea (*Laurelia novæ-zealandiæ*).
34. Hinau (*Elæocarpus dentatus*).
35. Pokaka (*Elæocarpus Hookerianus*).
36. Tarairi (*Beilschmiedia tarairi*).
37. Tawa (*Beilschmiedia tawa*).
38. Titoki, tokitoki (*Alectryon excelsum*).
39. Tawari (*Ixerba brexioides*).
40. Mangeao, tangeao (*Litsea calicaris*).
41. Rewarewa (*Knightia excelsa*).
42. Tawhero (*Weinmannia sylvicola*).
43. Towhai, or kamahi (*Weinmannia racemosa*).
44. Porokaiwhiri (*Hedycarya arborea*).
45. Kohekohe (*Dysoxylum spectabile*).

3. Timbers of Small Dimensions, adapted to Special Purposes.

46. Horopito (*Drimys axillaris*).
47. Tarata (*Pittosporum eugenioides*).
48. Karo (*Pittosporum crassifolium*).
49. Tawhiwhi (*Pittosporum tenuifolium*).
50. Mahoe (*Melicytus ramiflorus*).
51. Huoi, or manatu (*Plagianthus betulinus*).
52. Wharangi (*Melicope ternata*).
53. Kaikomako (*Pennantia corymbosa*).
54. Ake (*Dodonæa viscosa*).
55. Karaka (*Corynocarpus lævigata*).
56. Putaputa-weta (*Carpodetus serratus*).
57. Kumarahou (*Quintinia serrata*).
58. Makamaka (*Ackama rosæfolia*).
59. Manuka, or kahikatoa (*Leptospermum scoparium*).
60. Ramarama (*Myrtus bullata*).
61. Small-leaved ramarama (*Myrtus Ralphii*).
62. Rohutu (*Myrtus obcordata*).
63. Rohutu (*Myrtus pedunculata*).
64. Kotukutuku, or kohutuhutu (*Fuchsia excorticata*).
65. Horoeka, lancewood (*Pseudopanax crassifolium*).
66. Toothed lancewood (*Pseudopanax ferox*).
67. Papauma (*Griselinia littoralis*).
68. Puka (*Griselinia lucida*).
69. Tree karamu (*Coprosma arborea*).
70. Yellow-wood (*Coprosma linariifolia*).
71. Milk-tree (*Paratrophis heterophyllus*).
72. Large milk-tree (*Paratrophis opaca*).
73. Heketara (*Olearia Cunninghamii*).
74. Akeake (*Olearia avicinniæfolia*).
75. Neinei (*Dracophyllum latifolium*).
76. Mountain neinei (*Dracophyllum Traversii*).
77. Inaka (*Dracophyllum longifolium*).
78. Toro (*Myrsine salicina*).
79. Mapau (*Myrsine Urvillei*).
80. Tawaapou (*Sideroxylon costatum*).
81. Maire (*Fusanus Cunninghamii*).
82. Ngaio (*Myoporum lætum*).
83. Toru (*Persoonia toro*).
84. Houhere (*Hoheria populnea*).
85. Makomako (*Aristotelia racemosa*).
86. Tumatukuru (*Discaria toumatou*).

* *Vide* photos opposite pp. 29, 49. † *Vide* photos opposite pp. 29, 34, 35.

(B.) DETAILED DESCRIPTIONS OF DISTRICTS.

The following detailed accounts of timbers in each land district have been supplied by officers of the Department of Lands:—

AUCKLAND.

The Auckland Land District covers about four and a half degrees of latitude, with an area of 13,858,000 acres, extending from 34° 30′ to 39° S., its greatest length being about 365 miles, from the North Cape to the 39th parallel, south of Lake Taupo, while its greatest width is about 180 miles. In the peninsula north of Auckland, indented as it is on either side by harbours and arms of the sea, and with a mean width between the Pacific Ocean and Tasman Sea of little over forty miles, the range of temperature is remarkably small. The thermometer seldom registers above 80° in the shade in the middle of summer, whilst the heat is always tempered by a cool breeze, bringing the mean summer temperature to under 70° in the shade. The frosts are hardly worth mentioning, as the minimum register is seldom below 40°; but south of Auckland sharp white frosts occur very often, more especially beyond 38° of latitude, and snow lies upon the summits of some of the highest hills or mountains in winter.

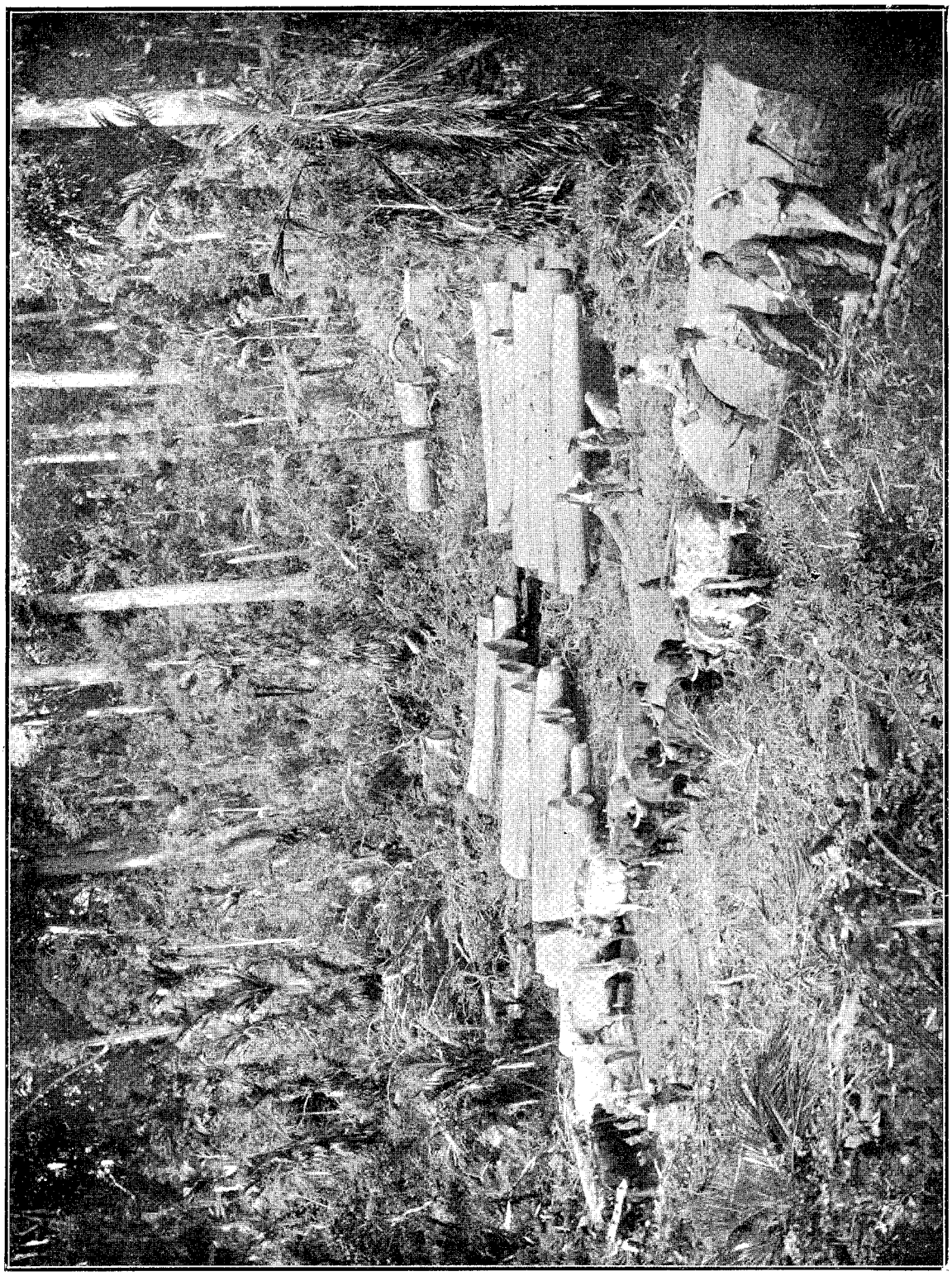
The district may be said to have no real mountains, as the most prominent peaks of the several scattered ranges or hills seldom exceed 3,000 ft. in height above the sea-level, an altitude just enough—south of 38°—to clothe the last 1,000 ft. with snow in the depth of winter.

The greater part of the district has been covered in the past with dense forests, which are now fast disappearing under the axe of the settler, and being transformed into rich pasture land. The only really good Crown lands fit for settlement in the North are still all covered with forest, and must be cleared and sown before any returns can follow. The area of forest land at the present time is about 950,000 acres north of Auckland, and 2,720,000 acres south of it. The forests contain a mixture of trees of all kinds, from the giant kauri to scrubby tea-tree or manuka, but all the bush is useful for building, fencing, and household purposes, or, at any rate, may be converted into charcoal for sale. Of kauri (the most valuable tree in New Zealand) great quantities are being yearly cut and exported or used for home consumption.



KAURI-TREES AT MATAKOHE.

Face p. 16.]



Kauri Logs at Matakohe.

The extensive forests contain many timbers of which the durability and strength are of established reputation. Of these the kauri, which is indigenous to the district, is greatly valued. The trees often attain gigantic size, and the vast groves create a profound impression upon those who view them for the first time. The great demand for this timber still continues, whilst rimu (red-pine), kahikatea (white-pine), and totara are also much used for building and other purposes. Most of the timber is disposed of in New Zealand, but during the year ended the 31st December, 1907, 63,015,330 superficial feet of hewn or sawn timber, valued at £276,401, was shipped for export at Auckland and Kaipara.

Sawmillers mostly convert the following timbers in the order named: Kauri, kahikatea, rimu, matai, totara. The smaller mills occasionally cut limited quantities of tawa, birch, tanekaha, and tarairi. With the exception of the last four, large stocks are always on hand. Puriri, pohutukawa, maire, miro, rata, kowhai, pukatea, hinau, titoki, rewarewa, towhai, kohekohe, and other kinds of trees found in the forests, although of value for special purposes, are not stocked by sawmillers, and are only cut to "special order," as the demand is only occasional and at all times limited, whilst ordinary sawmilling plants are not adapted for cutting hard woods; consequently production of some of the above-mentioned woods to order is costly and subject to delay.

Census returns compiled in 1906 furnish the information that there were in the Auckland Provincial District 83 sawmills and sash and door factories employing about 3,618 hands; but the number of persons engaged in bushfelling and other occupations in connection with the timber industry must be approximately between four and five thousand. The quantity of timber sawn in 1905 was 163,592,619 ft., and the value of all the products of the mills was £1,078,233. The logs are brought by rail or along the coast to Auckland, where it is sawn into various sizes. Several large mills and woodworking establishments have been erected in the city, and also for a considerable distance along the harbour frontage.

With the view to preserving specimens of the various timbers and clumps of forest for scenic purposes, the Government have made extensive reserves in various parts of the district.

Varieties of Timber Trees, and their Uses.

1. *Kauri.*—Used for building. Royalty, 1s. to 2s. per 100 sup. ft. Also used for joinery, furniture-making, and all general uses. Is only found growing in the northern portion of the Auckland Province, extending from Ahipara to Kawhia Harbour (or between the 35th and 38th parallel of south latitude), although there is evidence of the growth in past ages of kauri north and south of the places named. The girth of marketable trees now ranges from 4 ft. to 30 or more feet, the general average is about 12 ft., and the contents about 3,000 ft. Planks for special purposes have been sawn up to 100 ft., and boards up to 8 ft. wide free from defects. Special lengths now range from 40 ft. to 60 ft., and ordinary trade widths from 1 ft. to 3 ft. There is no pine in the world superior to kauri for general uses, and it has no equal for all-round purposes. It is utilised for house, ship, yacht, and boat building, wharves, bridges, railway and other works; large quantities are also used for mining purposes (kauri timber is much too valuable for the last-mentioned work, and is also too good for sleepers, posts, &c.). Kauri is best adapted for high-class joinery, internal fittings, furniture, turnery, carvings, &c. Of New Zealand timbers in general use kauri is the most buoyant, and is often floated two hundred or more miles before it reaches the sawmill. Mottled and figured kauri: Kauri-trees more or less mottled are found occasionally. There are several kinds of mottled—viz., plain, figured, bird's-eye, and fern-leaf. There are also several varieties of waved, dappled, feathered, and figured kauri. When converted into veneers it is highly prized, and is utilised for cabinet and other high-class work. Some of the specimens are extremely beautiful.

2. *Totara.*—Used for building. Royalty, 1s. to 2s. per 100 sup. ft. Also used for piles, very lasting in damp places. It is found in quantities more or less all over the province. It is very durable, and, of New Zealand timbers, it is the best for resisting the ravages of the teredo, and prior to the advent of reinforced concrete was largely used in the construction of wharves, bridges, &c. It also lasts well in contact with the ground, and is utilised largely for general building and joinery purposes, and if carefully selected no timber is superior for window-sashes. It is also utilised for telegraph-posts, railway-sleepers, fencing-posts, &c. Mottled and figured totara, of which the supply is limited, is much sought after for panels, furniture, inlaying, &c. Totara is easily grown from seed, and forms a beautiful tree.

4. *Matai.*—Used for building. Royalty, 1s. per 100 sup. ft. Very heavy timber, short-grained, will not float. Is found sparsely scattered in the north, but grows in greater profusion in the south of Auckland. Matai is only second to totara for durability, but is inclined to brittleness. It is used generally for house-building, especially for weatherboards and flooring, also for small bridges, with satisfactory results, and is largely utilised by settlers for fencing, &c.

5. *Kawaka.*—Not plentiful. Known locally as a "bastard totara." Scattered, scarce, and seldom used.

7. *Manoao.*—Not utilised at present. Found chiefly on high, rough country, East Coast.

9. *Westland Pine.*—Uses not known locally. Found on high land; short and stunted growth.

11. *Puriri.*—Used for bridge-stringers, railway carriage and truck frames. Royalty, 1s. per 100 sup. ft. Very hard and tough; makes good sleepers and posts. Is found throughout the province, and amongst hard woods is the most durable and valuable. For work requiring strength and stability it is superior to British oak. It is used largely for railway-works, and is well adapted for framing railway carriages and wagons, and also for many purposes connected with ship and coach building, machinery, &c. Puriri is much too good for the many purposes for which it is commonly

used—viz., sleepers, posts, firewood, &c., and no doubt its value, like that of many other New Zealand timbers, will be recognised and appreciated when it is more difficult to obtain. Puriri may be described as plain and figured. It is hard and close-grained. In weight, colour, and texture it somewhat resembles rosewood, but the figured varieties are marked like walnut, and the combination is something between both, but superior to either. Waved, mottled, and figured puriri is worthy of a high place amongst the figured woods of the world, and is suitable for high-grade work. Like all close-grained dark woods it is susceptible of the most brilliant polish. Owing to its rich markings and varied colours it is difficult to imagine any woods more ornamental than figured, waved, curled, and interlaced puriri, quantities of which are cut into veneers and used throughout the Dominion, whilst not a little reaches Great Britain and other places. The same remarks apply to mottled and figured kauri, and to a lesser extent to veneers of the following: Totara, rewarewa, mangeao, hinau, kowhai, akeake, black and white maire, kohekohe, miro, tarata. Puriri is easily grown from seed, cuttings, or slips, is quick-growing in suitable places, and is a most valuable tree for ornamental or commercial purposes.

12. *Tawhai raunui.*—Used for mining. Known locally as " tawai," or black-birch.

13. *Tawhai rauririki.*—Not used generally. It has been found that this timber will not stand the weather.

16. *Maire raunui.*—Not much used. Royalty, 1s. per 100 sup. ft. Very hard timber; scattered. Attains large size in parts of King-country. In the North maire is sparsely scattered, but is found in increasing quantities south of Auckland. It is a valuable timber, and its good qualities are not generally known, otherwise it would not be used for firewood, &c., as at present. It is utilised in small quantities by cabinetmakers and others for special works such as inlaying, &c.

17. *Maire.*—Not much used. Very hard timber; not much sought after.

18. *Narrow-leaf Maire.*—Not much used. Very hard timber. Native name, " mingi."

19. *Northern Rata.*—Mostly used for firewood. Attains large size in places. Rata is found generally scattered throughout the district. It is hard, heavy, tough, and of great strength, mostly straight-grained, and is utilised to a limited extent by wheelwrights; it is also used for arms for telegraph-posts. In the North the durability of the rata is doubted, especially if used in contact with the ground; at any rate, it is not utilised to any extent. In the course of settlement the major portion is burnt standing, and the remainder mostly converted into firewood.

20. *Southern Rata.*

21. *Pohutukawa.*—Used for ships' knees, &c. Chiefly found near the coast.

22. *Manuka rauriki.*—Used for firewood. Common to most districts.

23. *Maire tawhake.*—Its uses are not known locally. Royalty-value, 1s. per 100 sup. ft. Trees small and scattered.

24. *Kowhai.*—Used for turning and ornamental purposes. Hard yellow wood, found on banks of creeks, and coast.

Timbers suitable for General Building Purposes, or for Special Uses, but of less Durability than the Preceding Kinds.

25. *Rimu.*—Used for building, joinery, &c. Royalty-value, 9d. per 100 sup. ft. Found generally throughout the province. Rimu is found throughout the district, and large quantities are used for building purposes. The rimu north of Auckland is mostly hard and tough, and subject to gum-veins or shakes which contribute to its durability but lessens its utility for boards and for general purposes. South of Auckland, especially on high altitudes, it is not so subject to such defects, and, being of a kindlier nature, it is consequently more fitted for bench-work, joinery, and all kinds of internal fittings, for which it is largely used. It is mostly of a rich dark colour and often beautifully grained, rendering it most suitable and valuable for furniture. Rimu might well be called the " New Zealand mahogany," as the better kinds, if well and carefully selected, would form an excellent substitute for that wood in the Home market if exported in flitches. It is, in fine, a most valuable wood owing to its wide adaptability.

26. *Kahikatea.*—Used for butter-boxes, &c. Royalty-value, 6d. per 100 sup. ft. Found chiefly on low-lying or swampy land. Is found throughout the province, either exclusively in separate forests or scattered through mixed bushes. Its lasting qualities vary, and its durability during exposure is probably much greater than is generally admitted. It is used to some extent for building, especially for inside work, but its greatest use is for making butter-boxes, for which purpose no substitute can be found, and large quantities are exported to Australia, mostly for such purposes.

27. *Miro toromiro.*—Used for butter-boxes, &c. Royalty, 6d. per 100 sup. ft. Scattered throughout the province, mostly in the King-country.

28. *Tanekaha.*—Used for building and bridges. Royalty, 1s. per 100 sup. ft. Best on east coast. Scattered throughout the province. Bark used for tanning. Is found sparsely scattered throughout the province; it is durable, free-grained, and not subject to intense shrinkage, and it has been used in the construction of bridges with satisfactory results. It is well adapted for close lining, flooring, also any other purpose where a clean white surface is required. The bark of tanekaha has a high commercial value for export purposes.

29. *Toatoa.*—Used for house-lining. Scattered: best north of Auckland. Generally found on rough land.

32. *Tawhai* (Silver-beech).—Very little used. Royalty, 6d. per 100 sup. ft. Found in high rough country, and poor country south of Auckland.

33. *Pukatea.*—Used for pile-sills. Royalty, 6d. per 100 sup. ft. Chiefly found in swamps or low-lying land.

34. *Hinau.*—Used for fencing-posts. Royalty, 6d. per 100 sup. ft. Hard wood, medium growth. Scattered in most bushes, especially south of Auckland.

35. *Pokaka.*—Not used locally. Found chiefly in high places, generally scattered.

36. *Taraire.*—Used for firewood. Royalty, 6d. per 100 sup. ft. Chiefly found north of Auckland. Is found in most mixed forests. It is not generally used, though it is suitable for inside work, boxes, cases, and cheap furniture and fittings, &c.

37. *Tawa.*—Used for cask-staves. Royalty, 6d. per 100 sup. ft. Good firewood. Found generally throughout the province. Also used for inside building-timbers. Is found in large quantities in the Waikato and southern portions of the district. In the early days it was utilised extensively for staves for butter and tallow casks, quantities being exported to Australia for this purpose; it is now coming into use for ceiling-boards, panels, and tongue-and-groove lining. Some of it is nicely marked. It is also used for framing cheap buildings. It is durable for inside work, but liable to split when seasoned.

38. *Titoki.*—Used for handles for tools. Small growth. Found in small quantities, scattered.

39. *Tawari.*—Used for firewood. Found in high localities, Thames, Te Aroha, Mamaku. Largely medium growth.

40. *Mangeao.*—Used for vehicle-shafts, &c. Royalty, 1s. per 100 sup. ft. Also used for ornamental work. Is found mostly on the east and west coasts in this district, south of Auckland. It is the lightest and toughest wood in the Dominion. Some of it is beautifully figured, and suitable for panels. It is utilised for carriage-building, railway-jiggers, ships' blocks, bullock-yokes, and other purposes requiring lightness and strength. It is only fairly durable when exposed to the elements.

41. *Rewarewa.*—Ornamental uses. Value, 6d. per 100 sup. ft. Also good fencing-rails. Medium growth. Not plentiful.

42. *Tawhero.*—Used for inside house-lining. Plentiful. Soft, medium-sized timber; not generally used.

43. *Towhai.*—Used for inside house-lining. Commonly known as "tawhero." Fairly abundant.

44. *Porokaiwhiri.*—Locally known as "porokaiwhiria." Generally scattered.

45. *Kohekohe.*—Used for furniture, &c. Value, 6d. per 100 sup. ft. Medium growth; soft. Scattered throughout the province.

Timbers of Small Dimensions, adapted to Special Purposes.

46. *Horopito.*—Native medicine. Shrubby tree; leaves hot as pepper.

47. *Tarata.*—Not used locally. Sometimes called "raumatika." Sweet-smelling, gummy sap.

48. *Karo.*—Found near coast. Abundant near Auckland.

49. *Tawhiwhi.*—Locally known as "mapau," or "matipo."

50. *Mahoe.*—Shrubby tree, white wood; found everywhere.

52. *Wharangi.*—This tree is shown in Kirk's "Forest Flora" under the name of "puka." It is found in all localities. Its leaves are poisonous.

53. *Kaikomako.*—Not used locally. Used by Natives formerly for kindling fires. Also known as "kauaiti."

54. *Ake.*—Inlaying and ornamental uses. Found chiefly near the coast and on the banks of tidal rivers.

55. *Karaka.*—New Zealand laurel. Poisonous berries. Good ornamental tree. Found chiefly near the coast or river-banks.

56. *Putaputa weta.*—Not used locally. Locally known as "koroputaputa." Found on low-lying land, near rivers and coast.

57. *Kumarahou.*—Not used locally. Cannot place this timber by name.

58. *Makamaka.*—Not used locally. Not distinguished from "tawhero."

59. *Manuka, or Kahikatoa.*—Used for firewood, also Native medicine. Found everywhere, varying in size according to age and locality.

60. *Ramarama.*—Not used locally. Found chiefly growing on flat land. Very hard wood; red colour. Not plentiful.

61. *Small-leaved Ramarama.*

62. *Rohutu.*—Not used locally. Tough, wiry shrub; not plentiful; mostly found on open land.

63. *Rohutu.*—Not used locally. Small shrub, found scattered generally in light bush.

64. *Kotukutuku.*—New Zealand fuchsia. Plentiful everywhere; thickest in gullies and damp places.

65. *Horoeka.*—Ornamental uses, also bullock-whip handles. Found everywhere. Very supple timber. Grows large in King-country (attains 3 ft. girth).

66. *Toothed Lancewood.*—Ornamental. Not plentiful. Some good specimens found in northern Wairoa.

67. *Papauma.*—Not used locally. Small shrubby tree; plentiful in localities; large trees usually hollow.

68. *Puka.*—Not used locally. This name is given to three different trees—one is a parasite, one a similar plant found on the ground in high localities; also, the name is applied to the "wharangi."

70. *Yellow-wood.*—Not known locally. Found mostly on ridges in high localities.

74. *Akeake.*—Ornamental. Very hard timber. Found near coast and river-banks. Small growth.

75. *Neinei.*—Ornamental. Commonly called "spiderwood." Small growth; not plentiful.
76. *Mountain Neinei.*—Ornamental. Commonly called "spiderwood." Small growth; not plentiful.
78. *Toro.*—Generally scattered over province; best in high latitudes.
79. *Mapau, or Matipo.*—A local shrubby tree, hard timber; best specimens found on low-lying country.
81. *Maire.*—Ornamental. A local timber of medium size in most localities. Locally known as "black maire." Very hard timber. Grows very large in King-country south of Kawhia.
82. *Ngaio.*—This tree is only found on the coast. It is small and branchy. Its leaves used by Maoris as a cure for toothache.
83. *Toru.*—Not used locally. One of the best ornamental trees of the New Zealand flora; mostly found growing in open country on poor land.
84. *Houhere.*—Locally known as "whauwhe" or "thousand-jacket." Pigeons feed on its leaves when food is scarce.
85. *Makomako.*—Not used locally. A small scrubby tree; wood very light. Used by Natives medicinally.
86. *Tumatukuru.*—Only small scrubby trees. Very local, and not plentiful.

Trees and Shrubs not supplied in List.

87. *Hoema.*—Used for floating fishing-nets. Small bushy tree, found near coast. Lightest timber in New Zealand.
88. *Mingi.*—Value, 6d. per 100 sup. ft. Small-leaf maire. Generally scattered throughout province; found in quantities south of Kawhia.
89. *Poroporo.*—Not used locally. Small scrubby bush; crowfoot leaf, dark green; large yellow berries, on which pigeons feed.
90. *Kawakawa.*—Not used locally. Small ornamental shrub; jointed stems like bamboo. Leaves used by Natives for making tea.
91. *Tutuhi.*—Not used locally. Very evil-smelling shrub, found chiefly in high latitudes.
92. *Wharangi piro.*—Not used locally. Poisonous tree. Hard wood; too small for milling purposes.
93. *Whauwhau.*—Small tree; large crowfoot leaves; soft white wood. Found in most places.
94. *Raurekau.*—Not used locally. Small tree; large leaves. Known as "New Zealand coffee-tree." Inside bark used by Natives for medicinal purposes.
95. *Tumingi.*—Not used locally. Small tree. Leaves like manuka, only a little larger. Found mostly scattered throughout bush and on open land.
96. *Manakura.*—Native medicine. Nice ornamental shrub; large thick leaves; resinous sap, very strong smell of turpentine. Found on low-lying country.
97. *Patatea.*—Not known locally. Small tree; found mostly in the bottom of gullies. White, soft, pithy wood; crowfoot leaf; berries black in bunches.
98. *Tutu, or Tupaki.*—Not known locally. Poisonous shrub. Soft wood, and pithy. Found everywhere.
99. *Koromiko.*—Not known locally. Small shrub, found on open land. Used by Natives as medicine.
100. *Mairehau.*—Not known locally. Sweet-smelling shrub; leaves like tumingi. Found only in kauri-growing districts.

RETURN SHOWING QUANTITIES OF MILLING-TIMBER REMAINING AT 31ST MARCH, 1909.

——	Kauri.	Rimu.	Kahikatea.	Matai.	Totara.	Miscellaneous.	Total.
Crown lands, State forests, and forest reserves	209,627,889	909,422,310	109,497,863	106,435,879	90,889,203	..	1,425,873,144
Private and Native lands	275,819,100	2,964,082,710	574,028,890	796,630,105	59,065,180	129,614,728	4,799,240,713
Grand total..	485,446,989	3,873,505,020	683,526,753	903,065,984	149,954,383	129,614,728	6,225,113,857

JOHN STRAUCHON,
Commissioner of Crown Lands.

H. P. KAVANAGH,
Chief Timber Expert.

TARANAKI.

The Taranaki Land District is situated on the western side of the North Island of New Zealand, at about its widest part, and may be said to be the most compact and fertile district of the Dominion, for, with the exception of the upper half of Mount Egmont, and of the ranges adjoining, which absorb about 36,000 acres, the whole of the area—minus what is taken up by the rivers, streams, and lakes—is suitable for settlement, and certainly two-thirds of the district is good land. The gross area of the district is 2,417,299 acres.

The whole of the district, with the exception of a fringe of open country along the coast from Pukearuhe to Patea, averaging three miles in width, and containing about 250,000 acres, and some valleys at the north-eastern corner of the district about 150,000 acres in extent, was originally covered with heavy forest, but this is rapidly disappearing under progress of settlement and erection of sawmills to deal with such timber.

The larger timber is chiefly rata, rimu, matai, tawa, kahikatea, kohekohe, pukatea, rewarewa, hinau, with a few totara scattered here and there. Among the smaller trees may be mentioned the kotukutuku (or fuchsia), karaka, and mahoe.

An area of 72,565 acres, measuring six miles on every side from the summit of Mount Egmont, was originally set apart as a forest reserve. To this has now been added 1,040 acres on the lower slopes of Pouakai Range, with an additional 5,500 acres on the Patua Range, making a total of about 79,000 acres, which has now by Act of Parliament been set apart as the "Egmont National Park," the internal affairs of which are administered by a partly elected and partly nominated Board of ten members. At about three miles within the reserve the forest begins to get stunted; and at four and a half miles it gives place to low wiry scrub, which ceases at five miles, or an elevation of about 4,000 ft. At 5,000 ft. the moss ends; beyond this point to the summit the mountain is composed of loose scoria and lava.

Varieties of Timber Trees, and Uses.

4. *Matai.*—A large forest, now destroyed, covered the south-west portion of the province. About 25,389,500 sup. ft. in district. Durable above ground. Used in buildings, fencing-posts, and strainers. Used at present for building-frames. Value, 19s. per 100 sup. ft.

2. *Totara.*—Scattered over the province, in small lots. About 35,942,000 sup. ft. in district. Very durable. Used for bridges, culverts, all sorts of buildings, house-blocks, fencing-posts, &c. At present used for all classes of buildings and works of a permanent nature. The wood is brittle, and short in grain. Value, £1 per 100 sup. ft. This timber is exceedingly light, but durable, and can be used for nearly all classes of work of a permanent nature which requires no cross-strain.

26. *Kahikatea.*—Found on damp and swampy locations throughout the province. About 98,893,750 sup. ft. in district. Not advisable to use in house-building, owing to prevalence of dry-rot. First-class timber for manufacture of butter-boxes. Now being used altogether for that purpose. Value, 12s. per 100 sup. ft. This timber is now rapidly disappearing, owing to the large quantity used in the dairying business, both in New Zealand and Australia.

25. *Rimu.*—Found all over the district, but more particularly on the western and south-western parts, where splendid forests of this valuable timber once grew, but now destroyed by the advance of settlement and cutting out by sawmills. About 405,932,250 sup. ft. in district. Used for bridge-framing above water, fencing-posts and strainers, and generally very fine house-building and furniture-manufacturing timber. Value, 19s. per 100 sup. ft.

33. *Pukatea.*—Scattered fairly well in district. About 61,086,250 sup. ft. A fairly durable timber, and can be used for weatherboarding, fencing, and internal fittings. Value, 19s. per 100 sup. ft. This timber is eminently adapted for decorative work, as ceilings, panelling, and suchlike internal work, as well as for furniture. It is a valuable timber going to waste.

19. *Rata.*—Grows in every part of the province, but is particularly plentiful and large around the base of Mount Egmont. About 152,774,250 sup. ft. in district. Durable as framing for wagons; also used for bridges, telegraph-arms, bearings for machine-beds, all wheelwright's work, boat knees and ribs, and wagon-frames. It is excellent firewood. Value, £1 per 100 sup. ft. Grows in all parts of the province.

17. *Maire.*—Scattered in small quantities throughout the province. Durable. Used for house-blocks, all sorts of turnery, bearings, strainers, posts, and house-piles. There does not appear to be much demand for this timber, therefore it is not much used in the trade.

31. *Tawhai rauriki.*—Found in fairly large patches in the more broken country in north and north-east portions of the district. About 7,028,000 sup. ft. in district. Very durable. Useful for railway-sleepers, fencing-posts, strainers, &c. Used for house-blocks, sleepers, bridgework, and fencing. This timber is not handled here by timber-dealers.

34. *Hinau.*—Found throughout the province. Very durable. Used for piles, sleepers, bridges, culverts, posts, rails, &c. Valuable for tanning. Timber-dealers cannot quote price, as it is only used for special purposes in the settled districts.

37. *Tawa.*—Scattered all over the district. Valuable as firewood. Can be used for buckets, tubs, and butter-casks, but too heavy for boxes, and will not hold nails very well. Now mostly used as firewood. When made into boxes this wood is half as heavy again as kahikatea, is not so easily worked, and will not hold the nails well. Casks for butter have gone out of date.

41. *Rewarewa.*—Grows in isolated patches throughout the province, but preferably along the coast belt. About 1,974,000 sup. ft. in district. Not durable if exposed. Useful for ornamental and cabinet work, turnery, and all sorts of internal fittings. Timber-dealers do not quote price, being used only for special purposes, and not in large quantities.

43. *Towai.*—Grows all over the province. Strong, and fairly durable. Used for fencing-posts. Timber-dealers do not stock this wood; it is only used by the settlers as posts for post-and-wire fencing.

50. *Mahoe.*—Found all over the district. Not durable. Valuable for charcoal, but apparently not used at all. Timber-dealers do not stock this wood. Nearly all the trees are hollow, and are therefore practically useless.

24. *Kowhai.*—Scattered along streams, mostly in northern part of district. Very durable. Used for fencing-posts and strainers and small works requiring strength and durability. Not stocked by timber-dealers.

11. *Puriri.*—Splendid specimens of this valuable tree abounded along the coast belt from the Wairau Survey District to the northern limit of the province. It has now all been used up. Exceedingly durable timber, both in and out of ground or under water. The timber is very hard, and nearly black. It can be used for bridges and structural work requiring great strength and durability. The supply is practically exhausted. Used now only for furniture, for which it is an excellent timber, being of a dark colour, and polishing very well. None of this timber is milled in this province now, it having been all cut out. It is entirely a coastal tree, as the botanical name implies.

38. *Titoki.*—Found in limited quantities throughout the district. The finer growth is confined to the middle and southern portions. Very tough. It was used for oxen-yokes and dray-poles by the early colonists, but is not durable in the ground. At the present time it is used very little, being superseded by Australian timber.

45. *Kohekohe.*—Grows along the whole extent of the Taranaki coast belt. Fairly durable. Used for fencing-posts and furniture-work; it takes a fine polish. Timber-dealers only sell this timber for furniture-work.

5. *Kawaka.*—Growing on the middle slopes of Mount Egmont.—Exceedingly durable; culverts put down in 1875 on the ranges at National Park Reserve are now in a perfect state of preservation. This timber cannot be used outside the National Park Reserve, where it is protected by law from being cut or destroyed. Although a most durable timber, it is most brittle and short in the grain.

64. *Kotukutuku.*—Grows all over the district. Durable timber. Used as house-blocks, posts, and strainers; also for fencing in bush lands, as posts are very hard to burn. No price quoted by dealers, as they do not handle this timber. In bush lands it is only used for fencing purposes.

Smaller Trees and Shrubs.

There appears to be no special commercial uses to which the smaller trees named below are put. Many of them are used in the ordinary way as firewood, whilst others are used for ornamental tree-planting, such as the tarata and allied species, the puka, karaka, huio, ngaio, and a few others which do well in the open. The karaka and ngaio are especially serviceable in forming shelter along the coast-belt, standing the salt-laden winds off the sea without damage. Another valuable tree amongst the smaller growths is the ake, now practically cut out by the settler in search of maul-heads, for which purpose it is always in great demand. It was from its deep red heart (almost black) wood that the Maori of former days made all those beautiful weapons of war—the *taiaha, tawhatawha, tao, patu,* &c. It was considered—and rightly so—by the ancient New-Zealanders as the strongest, heaviest, and best of all the timbers for his weapons of offence and defence. The heartwood retains its strength, heaviness, and quality in a remarkable degree, much more so than any other of our timbers. Its drawback as a commercial product is its smallness, it seldom exceeding 12 in. in diameter. It grows freely on sandy soil, and also in the shingle and gravel of old river-beds, and is singularly easy to propagate.

Tawhai raunui.—Not plentiful. Scattered about district.
Tawhai rauriki.—Rather plentiful. Scattered about district on high lands.
Maire.—Not plentiful. Scattered throughout the province.
Maire (Narrow-leaf).—Not plentiful. Scattered throughout the province.
Manuka rauriki.—Fairly plentiful in the north.
Maire tawhake.—Not plentiful. Scattered throughout the province.
Miro.—Scattered about the district here and there.
Pokaka.—Not plentiful. Grows in northern parts of district.
Titoki.—A limited amount all over the district.
Porokaiwhiri.—Small trees scattered all over the district.
Horopito.—A fair amount round the base of Mount Egmont.
Tarata.—A fair amount in the central district.
Tawhiwhi.—A fair amount in the central district.
Huoi.—Scattered all over the district, along the banks of streams.
Wharangi.—Scattered all over the central district.
Kaikomako.—Not plentiful. Grows in the middle of the district.
Ake.—Scattered about the bush margins in the centre and northern parts of the district.
Karaka.—Small patches along the coast.
Putaputa weta.—Small quantity in central district.
Kumarahou.—Scattered about north of the province.
Manuka.—Large patches in northern district.
Ramarama.—Scattered in the middle of district.
Rohutu.—A small quantity near New Plymouth.
Horoeka.—All over the district.
Papauma.—All over the district.
Puka.—All over the district. Makes fine shelter-hedge plant.
Yellow-wood.—Small shrubs dotted about the district.
Neinei.—A limited quantity in the north of the district.
Toro.—Mostly on the ranges around Mount Egmont.
Mapau.—Scattered about the middle of the district.
Ngaio.—Grows freely near the coast, particularly at Cape Egmont. Stands the salt-borne winds of the coast. Is used in the French Riviera for coast-planting.
Houhere.—Grows along rivers (fairly plentiful) all over the district.
Makomako.—Grows on all bush-edges and in clearings all over the province.

Summary of Milling-timber in Taranaki.

——	Rimu.	Kahikatea.	Matai.	Totara.	Pukatea.	Rata.	Rewarewa.	Birch.	Total.
	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.
Crown lands	17,824,000	8,887,260	2,322,680	1,347,120	1,676,120	2,907,460	1,131,120	3,082,240	39,178,000
Alienated (private)	174,591,250	49,263,250	4,979,500	13,810,250	30,691,500	57,870,250	918,000	3,876,000	336,000,000
Native lands	25,699,750	14,685,000	8,480,000	2,871,000	2,416,250	973,000	..	220,000	55,345,000
Native lands, West Coast Commission awards	92,276,250	16,777,500	..	8,388,750	16,777,500	33,555,000	..	..	167,775,000
Egmont National Park	96,000,000	9,600,000	9,600,000	9,600,000	9,600,000	57,600,000	..	..	192,000,000
Total	406,391,250	99,213,010	25,382,180	36,017,120	61,161,370	152,905,710	2,049,120	7,178,240	790,298,000

FRANCIS SIMPSON,
Commissioner of Crown Lands.

HAWKE'S BAY.

The Land District of Hawke's Bay comprises that portion of the east coast of the North Island from Cape Turnagain, in latitude 40° 30′, northwards to Lottin Point, about thirty miles beyond the East Cape, and contains the Waiapu, Cook, Waikohu, Wairoa, Hawke's Bay, Waipawa, Patangata, Woodville, Waipukurau, Dannevirke, and Weber Counties.

It has a seaboard of 300 miles, with an average depth from the coast of forty-five miles, and embraces an area of 6,063,000 acres. Its western limit is defined by the Ruahine, Kaweka, Ahimanawa, Raukumara, and other high ranges that form the watershed between the rivers flowing through it to the sea, and those that run to the west coast and the Bay of Plenty.

The total area of forest lands in the Hawke's Bay District is approximately estimated at 1,031,540 acres, and is chiefly confined to the western portion of the district, being a stretch of country following along the slopes of the main ranges and the front hills of varying width. The approximate quantity of milling-timber included within the above area is 2,235,213,000 sup. ft. The accompanying schedules give the estimated quantity of each of the principal milling-timbers.

In the Poverty Bay portion of the district there are estimated to be 650,240 acres of land on which is standing forest, made up as follows :—

	Acres.
State forests and Crown lands	208,875
Crown lands leased	89,685
Native lands	338,539
Private freehold land	13,141
Total	650,240

As showing the importance of the timber industry, there are numerous sawmills in the district, and, outside of wool, frozen meats, tallow, and pelts, sawn timber ranks first in the value of the exports. 3,463,942 ft. of timber were exported during the year, and 59,963 posts and strainers. It is satisfactory to note that sawmills have been established at Pohui and Puketitiri, in which districts there are large areas of valuable forest. As the bulk of the sawn timber from these places must necessarily come through Napier, it follows that the port and trade of the town will reap immense benefits from the further development of the industry in its vicinity.

FORESTS ON CROWN LANDS LEASED OR UNOCCUPIED.

Survey District.	Area.	Remarks.
	Acres.	
Matakaoa East	7,500	Mixed bush—rimu and red-birch.
Waiapu	1,000	,, ,,
Hikurangi	57,000	Mixed bush, with rimu and tawa.
Mata	3,000	Mixed bush, principally birch.
Mangaoporo	3,100	Mixed bush, a little rimu and red-birch.
Tutamoe	8,000	,, ,,
Raukumara East	820	Mixed bush.
Urutawa	4,000	Mixed bush—matai, kahikatea, and a little totara.
Motu	30,000	,, ,, ,,
Moanui	20,000	,, ,, ,,
Waimata	2,000	Light bush and scrub.
Whangara	1,000	,,
Ngatapa	17,000	Mixed bush, chiefly birch on ridges, with tawa and pines in gullies.
Waikaremoana	15,000	Ditto.
Tuahu	15,000	Mixed bush, rimu, beech, tawa, &c.
Waiau	14,000	Mixed bush, principally birch.
State forests and other reserves in Poverty Bay	104,960	Principally birch, though good timber is scattered throughout the gullies.
Nuhaka	6,000	Mixed bush, containing rimu, tawa, and birch.
Waitara and Mangahopai	5,200	Mixed bush—rimu, rata, birch.
Tarawera	1,400	Mixed bush.
Pohui	3,000	Mixed bush—rimu, matai, and kahikatea.
Maungaharuru	4,000	Mixed bush—tawa, rimu, hinau, &c.
Kaweka	51,800	Principally red and black birch, with a little rimu.
Patoka	700	Mixed bush, with rimu and white-pine.
Ngaruroro	10,000	Mostly red and black birch, with a little rimu.
Wakarara	27,700	Some fine rimu timber in mixed bush.
Makaretu	28,000	Birch and mixed timber.
Norsewood	41,200	Rimu, matai, white-pine, and mixed forest.
Woodville	8,700	Rata, rimu, and mixed bush.
Tahoraite	3,000	Originally rimu, matai, and totara, but mostly red and black birch, rata, &c.
Mangatoro	24,800	Mixed forest, containing rimu, matai, and white-pine.
Weber	1,500	Mostly scrubby bush, with little valuable timber.
Tautane	500	Tawa, rata, and rimu scattered through scrubby bush.
Total	536,680	

FORESTS ON PRIVATE AND NATIVE LANDS.

Survey District.	Area.	Remarks.
	Acres.	
Matakaoa West	25,800	Kahikatea, rimu, totara, puriri, and mixed bush.
Matakaoa East	10,000	Mixed bush—rimu and red-birch.
East Cape	20,000	Mixed light bush—kahikatea, rimu, totara, puriri, and a little pohutukawa.
Mangaoporo	32,000	Mixed bush—a little rimu and red-birch.
Waiapu	10,000	Mixed light bush.
Raukumara East	19,180	Mixed light bush—a little rimu, red-birch, and tawa.
Hikurangi	3,000	,, ,,
Maungawaru	55,000	,, ,,
Mata	3,000	,, ,,
Arowhana	58,000	,, ,,
Ngatereterе	5,000	,, ,,
Tutamoe	10,000	Mixed bush.
Motu	1,500	Mixed bush—kahikatea, matai, and rimu.
Mangatu	10,000	,, ,,
Ngatapa	5,000	,, ,,
Waingaromia	3,580	Light bush and scrub.
Uawa	1,000	Mixed light bush—kahikatea.
Koranga	30,000	Mixed bush—rimu, birch, tawa.
Tuahu	15,000	,, ,,
Hangaroa	3,000	Mixed bush—rimu and red-birch.
Opoiti	10,000	,, ,,
Nuhaka North	1,000	,, ,,
Nuhaka	8,300	Mixed bush, containing rimu, tawa and birch.
Waitara	7,000	Mixed bush—rimu, rata, and birch.
Tarawera	35,000	Mixed bush.
Pohui	30,800	Mixed bush—rimu, matai, and kahikatea.
Maungaharuru	2,100	Mixed bush—tawa, rimu, hinau, &c.
Kaweka	1,200	Principally red and black birch, with a little rimu.
Patoka	6,000	Mixed bush, with rimu and white-pine.
Puketapu and Tongoio	1,000	Mixed bush, mostly scrubby nature.
Ngaruroro	27,900	Mostly red and black birch, with a little rimu.
Wakarara	4,000	Some fine rimu timber in mixed bush.
Makaretu	2,700	Birch and mixed bush.
Norsewood	10,000	Rimu, matai, white-pine, and mixed forest.
Woodville	3,000	Rata, rimu, and mixed bush.
Tahoraite	5,300	Originally rimu, matai, and totara; now mostly red and black birch, rata, &c.
Mangatoro	10,000	Mixed forest, containing rimu, matai, and white-pine.
Weber	5,000	Mostly scrubby bush, with a little valuable timber.
Tautane	1,000	Tawa, rata, and rimu scattered through scrubby bush.
Total	491,360	

SCHEDULE SHOWING THE APPROXIMATE QUANTITY OF MILLING-TIMBER, HAWKE'S BAY LAND DISTRICT.

On Crown Lands.

	Sup. Ft.
Rimu	625,108,000
Kahikatea	217,104,000
Totara	50,153,000
Matai	120,500,000
Birches	1,600,000
Total	1,014,465,000

On Private and Native Lands.

	Sup. Ft.
Rimu	752,040,000
Kahikatea	256,000,000
Totara	64,108,000
Matai	148,600,000
Total	1,220,748,000
Grand total	2,235,213,000

VARIETIES OF TIMBER-TREES, AND USES.

2. *Totara.*—Scattered over the whole of Hawke's Bay, but no great quantity now remaining, as most of the timber has been milled. The Kereru Bush, in the southern portion of the district, still contains some valuable totara. Of extreme durability; used for all purposes when a lasting timber is required. When seasoned is light and easily worked. It is utilised for house and bridge building, fencing-posts, sash and door and cabinet work, and the mottled totara for furniture-veneering. As a rule totara in any quantity was to be found growing on light stony ground. There is a great demand for the timber for local use and for export.

4. *Matai* (Black-pine).—Formerly fairly plentiful in Hawke's Bay District, but now rapidly becoming scarce. Some very fine specimens in Motu and Puketitiri Forests. Very hard and durable, but brittle, and consequently not so capable of bearing strain as totara. Used for house-building (especially flooring), bridge-work (excepting long stringers), fencing, and firewood. At certain seasons of the year the tree can be tapped and a fluid extracted—very palatable, known by bushmen as matai beer.

5. *Kawaka.*—Northern portion of district. Have met with it principally in North Forest. Used to some extent in house-building cabinet-work, and is valuable in the manufacturing of lead pencils, small quantities having been exported for this purpose. An easily splitting timber, and in appearance very similar to the wood used in the superior imported lead pencils.

10. *Yellow-pine.*—To be found in parts of district in very small quantity. Ranks with totara as a durable timber. Used in house and bridge building. The timber is of a yellow colour, though the outward appearance of the tree is similar to that of the white-pine.

11. *Puriri.*—In northern portion of district, mostly along the sea-coast, in small quantity. A very hard and durable timber, and very useful for hardwood blocks in bridge-building, also fencing-posts, house-blocks, and general cabinet-work. The foliage is very beautiful, the leaves being a dark-green colour, and forming a great contrast to the usual shade of green met with in New Zealand forests. The heart of the timber is very dark, and in some cases black.

16. *Maire raunui.*—Fairly plentiful in this district: some very fine specimens to be found in Motu Bush. Remarkably hard, and difficult to cut, though easy to split. Suitable for constructive works generally, and the best firewood in the Dominion. Makes excellent hardwood blocks for bridge-work. Known to bushmen as "black heart" maire.

19. *Northern Rata.*—Fairly plentiful in this district. Tough and elastic. Not very durable when exposed to weather. Used for wheelwright's work, ship-timbers, and ribs in boat-building. Very fine firewood. The home of the *Sphœris robertsia*, commonly known as the "vegetable caterpillar."

20. *Southern Rata.*—Similar to the northern rata, but of smaller dimensions, and the trunk knotted and twisted. Makes capital maul-heads, and is used for firewood. Covered in scarlet blooms once in every three years, and when in season is very conspicuous, the blooms presenting a grand contrast to the background of green foliage of the other trees generally found in hilly country.

21. *Pohutukawa.*—New Zealand Christmas tree. Mostly to be found near the sea-coast, also in a few instances inland. Withstands the action of sea-water better than most timbers, so is useful in ship or boat building. Flower similar in some respects to that of the rata, but of a darker and duller colour.

22. *Manuka rauriki* (White Manuka).—In most parts of the district. Have met with specimens 2 ft. 6 in. in diameter. Very tough and elastic. Used in manufacture of handles for agricultural implements, shafts for drays; also excellent firewood.

24. *Kowhai* (Yellow Kowhai).—Fairly common in Hawke's Bay. Generally grows on the outskirts of a forest, along the banks of streams, and rarely attains a diameter of more than 12 in. Of extreme durability, but not much used in this district for commercial purposes on account of its small size. Makes excellent firewood, and is highly ornamental. Used for cabinet-work, and in the manufacture of agricultural implements, fencing-posts, &c.

25. *Rimu* (Red-pine).—The most widely distributed commercial timber in the Dominion. Hawke's Bay formerly contained magnificent forests of this timber, which is fast being consumed by the saw-miller. Not considered durable in exposed situations. Used in house-building, sash and door and cabinet work.

26. *Kahikatea* (White-pine).—Grows all over Hawke's Bay. No large forests of it, but mostly to be found in small clumps intermixed with other trees. It is used for building purposes, and has been known to last for twenty years; but is very liable to what is known as dry-rot and the ravages of the borer. Used in this district in limited quantities for building, and largely for fence-battens, and in the manufacture of butter-boxes. The timber has been used for railway-sleepers after being creosoted at the Woodville works; but the treatment is somewhat too expensive to allow of its coming into common use at present.

27. *Miro.*—Generally to be found on high country from 2,000 ft. above sea-level, and upwards. Not durable if exposed to weather. Used for inside house-building. At present not very highly thought of as a commercial timber. The berry is the favourite food of the native pigeon and kaka.

28. *Tanekaha.*—Mostly to be found in northern portion of district. A very tough and elastic timber, but not very durable. The bark is exported for tanning purposes. The young saplings are used by the Natives for spring traps for birds, and in the manufacture of walking-sticks, which are stained by bruising the bark, and immersing in water for several days.

33. *Pukatea.*—Fairly common in swampy parts of district. Of little commercial value. Very hardy and fire-resisting, and will live and thrive even when a good portion of the trunk has been burnt through. Very often the tree is hollow, and affords a home for the bush-bees.

34. *Hinau.*—Fairly common in Hawke's Bay. The heart of the timber is extremely durable, and is much used for fencing-strainers. The bark is exported for tanning purposes.

37. *Tawa.*—In many parts of Hawke's Bay District these trees form the greater portion of the forest. Not a lasting timber, nor durable when exposed. Its principal use is for firewood, and it will burn green as well as dry. The berry forms a staple food of the native pigeon and kaka.

38. *Titoki.*—Fairly common in Hawke's Bay. A strong, tough, and elastic timber, but will not stand in exposed positions. Used in the manufacture of agricultural implements. In this district rarely exceeds 18 in. in diameter of trunk.

41. *Rewarewa.*—Not durable in exposed situations, and liable to the grub borer, as in the case of the white-pine. Principally used in ornamental work, and in house and furniture fittings and inlaying. The grain of the timber is very pretty.

43. *Towhai, or Kamahi.*—Common throughout Hawke's Bay, usually at fairly high altitudes. Not a durable timber, and of no present commercial value.

45. *Kohekohe* (New Zealand Cedar).—In most parts of district. A very light timber, and will not stand exposure. Used in furniture-manufacture.

46. *Horopito* (Pepperwood).—An ornamental shrub too small to be of any commercial value.

47. *Tarata.*—A quick-growing tree, but not of durable character. Used as ornamental tree in gardens. Sometimes known as lemon-wood, on account of the aroma of its leaves.

50. *Mahoe, or Hinahina* (Whity Wood).—Not durable, or of any use for commercial purposes. Cattle will eat the leaves and branches.

51. *Huoi, or Manatu.*—So far, not of commercial value. The inside bark used by Natives in the manufacture of mats, baskets, &c.

55. *Karaka.*—A very handsome and ornamental shrub and tree. Timber of no commercial value. The berry was used for food by the Natives in the early days. The kernel is poisonous, and the effect of eating it is similar to that produced by an overdose of strychnine. The Natives soaked the berries in a running stream for some weeks and otherwise prepared them before deeming them fit for consumption.

56. *Putaputa weta.*—Common in Hawke's Bay, and usually found in shady gullies. It rarely exceeds 6 in. in diameter, and is of no commercial value. The timber is generally found full of large insect-bores, which probably give the tree its name.

59. *Manuka.*—Common in Hawke's Bay as a shrub and small tree. Not durable. Makes good firewood, and leaves used by Natives for medicinal purposes.

60. *Ramarama.*—Found generally in Hawke's Bay at elevations up to 1,500 ft. Rarely exceeds 6 in. in diameter. To thrive, this shrub requires the shelter of the forest. The fruit is pleasant to the taste. The timber is used to a small extent in cabinetmaking and inlaying.

64. *Kotukutuku.*—Common in Hawke's Bay District. Will last for some time in wet or swampy ground as fencing-posts. Usually considered a fairly durable timber, but is generally of too small a size and too crooked to be of much commercial value. It is very difficult to burn when green. The fruit has the distinguishing name of *konini.*

65. *Horoeka* (Lance-wood).—Rarely attains a diameter of more than 6 in. An ornamental tree, tough and elastic. The saplings were used by Natives for spring traps for birds.

67. *Papauma.*—Generally found at an altitude of 1,500 ft. above sea-level and over, but rarely on lower levels. Of extreme durability; good firewood.

Karo.—Have met with this shrub in Ruakituri Valley, but not elsewhere.

74. *Akeake.*—Generally of stunted growth in this district. Slow-growing, and a very hard, tough timber. Very useful in the manufacture of tool-handles and hardwood blocks.

78. *Toro.*—Have met with this timber in Ngapaeruru Bush. No knowledge as to its uses or durability.

82. *Ngaio.*—Principally hugs the coast-line, and not found inland. A tough timber, and fire-resisting when green. Used for fencing-posts.

85. *Makomako.*—Common in Hawke's Bay. Not a durable timber. Used in the manufacture of charcoal. The berries, when pressed out and fermented, provide a pleasant wine. This tree usually appears as a second growth after fires.

T. N. Brodrick,
Commissioner of Crown Lands.
H. M. Smith,
D. G. Robertson,
Crown Lands Rangers.

WELLINGTON.

The Wellington District is bounded towards the north by the Auckland District; towards the east by the Hawke's Bay District, to the sea; thence by the sea to the Patea River on the west coast; and thence bounded towards the west by the Taranaki District. The area contained within these limits is about 6,810,958 acres. It lies between the parallels of 39° and 41° 30′ south latitude; its greatest length north and south is about 180 miles, and its mean width east and west about sixty miles.

The Wellington District until quite recently was essentially a forest country, but out of the 6,810,958 acres contained within its borders there are now not more than 2,600,000 acres under bush. By far the largest forest is the Waimarino, having an area of at least three-quarters of a million acres,

a portion of it being nearly level land, containing magnificient timber, principally rimu, matai, totara, maire, and other pines. This forest is as yet hardly touched, though timber is being cut at Raetihi for the settlers now making their homes in the neighbourhood. A very efficiently equipped Government sawmill has been working at Kakahi for some time, and supplying all the totara required by the Public Works Department for the railway-works in the vicinity; and a sawmill at Piriaka is cutting bush on a Native reserve.

There is a large extent of bush land, drained by the Turakina, Mangamahu, and Wangaehu Rivers, extending up to the Wanganui River, and containing about 300,000 acres. Very little of this, from its inaccessibility, will be utilised for sawmilling purposes; but a great deal of it, together with a further block of 230,000 acres on the west side of the Wanganui River, will be cleared by the settlers and sown down with grass. A further block of about 100,000 acres of forest land lies in the Pohangina Valley and on the slopes of the Ruahine Range. A large portion of this has been taken up, and is now being settled.

The Awarua Block, extending on both sides of the Rangitikei River and to the summit of the dividing range, is covered with heavy bush on the lower slopes. The portion which has been sold by the Government for settlement purposes is being cleared by the settlers; but there is a large amount of very valuable milling-timber still standing in the neighbourhood of Taihape, where several sawmills are busily engaged. The timber on the east side of the Rangitikei River, reserved for milling by the Crown, is untouched. (A photograph of the Awarua Forest appears opposite.)

The forest land on the west coast extends from Pukerua to the Manawatu Gorge, on the west side of the Tararua Range, and contains an area of about 300,000 acres, the bulk of it being fit only for turning into pasture. The most available part of it, alongside the Wellington–Manawatu Railway, is being extensively cut into by sawmillers at Levin and other places on the line.

After this in size is the forest on the eastern slopes of the Tararua Ranges, extending from Featherston to the Manawatu Gorge, which includes what remains of the well-known Forty-mile Bush, containing probably about 175,000 acres. This area is being quickly denuded of timber by sawmillers and by settlers. A tract of about 50,000 acres lying to the east of the Puketoi Range cannot be utilised for milling purposes, as it is not tapped by any branch railway-line, and its distance from the main line would probably render the business unprofitable except for local purposes. Nor are there any suitable ports along the coast where timber could be shipped.

The other forests are, one near Lake Taupo, and the Haurangi Forest on the east side of the Wairarapa Lake. The former contains some valuable milling-timber, principally matai and maire; and the latter consists for the most part of beech-covered hills, and cannot be considered as valuable for milling purposes.

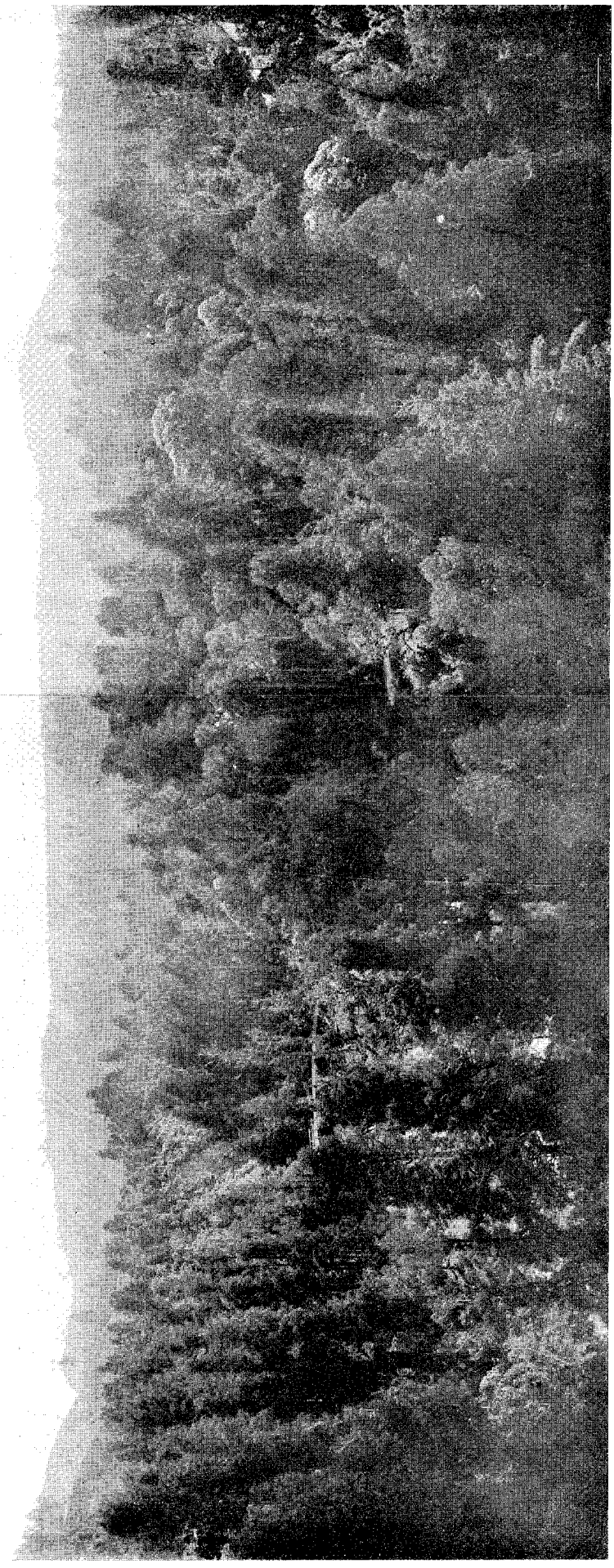
Sawmills are to be found in different parts of the district where the means to convey the timber from the forests are sufficient and not too costly, the timber cut being principally totara, red-pine (rimu), and white-pine (kahikatea): the first two are largely used in house-construction, bridge-building, and other works, and the last for butter-boxes and export to Australia, for similar use there. Others of the native woods are very beautiful, but are utilised only to a small extent.

The principal mills are near Eketahuna, for the Forty-mile Bush and Wairarapa districts; at Otaki and Shannon, in the Manawatu district; and at Taihape, Raetihi, and Taumarunui, in the interior country. There are also mills and factories in Wellington and other towns for dressing the rough material. In the whole district there were, at the census of 1906, 98 mills and sash and door factories engaged in this industry, employing 1,611 persons.

Mr. A. M. Roberts reports as follows on the Te Tuhi, Ahuahu, and Puketotara Blocks:—

The forest is of a varied description. Owing to the broken nature of the land, very few of the more valuable trees are found on it. At the higher altitudes, particularly where the spurs are at all flat-topped, the northern rata is growing in abundance. Where the spurs are sharply defined the tawhai rauriki is the chief tree. Below these two species one finds the tawa, tawhero, rewarewa, maire, manuka raurika, miro toromiro, hinau, titoki, pukatea, &c., interspersed with a number of trees of lesser degree, such as horopito, kotukutuku, horoeka, lancewood, mahoe, honi, toro, mapau, milk-tree, and an undergrowth of rangiora, karamu, supplejack, &c. On the few flats, and where the country is more undulating, will be found a few totaras, rimus, matais, and kahikatea. These four latter species are, however, in very small quantity, and hardly sufficient for settlers' needs. Undoubtedly the chief fencing-material in this locality will be the tawhai rauriki, which is growing in abundance, and, if properly seasoned, will be found to have great lasting qualities. On the western sides of the blocks an area of 100 acres has been reserved, mainly consisting of northern rata. It will, in years to come, be valuable as a means of burning papa, there being no road-material in the district.

In speaking of forest timbers it may not be out of place to mention the pitau punga. This is a variety of the well-known punga fern-tree. The Maoris use it for the studs of their *wharepunis*, for which purpose it outlasts all other known timbers. Some of these *wharepunis* have been standing for upwards of fifty years, and their studs are as sound now, or even sounder, than when first put in the ground. A great many of their whares are also built of this timber. The larger trees are selected for this purpose. After being cut down, they are sawn into strips or slabs, each strip being about 12 ft. to 15 ft. long, 7 in. in breadth, and 2 in. deep. A few days ago I personally inspected a whare built of this material. It has been standing for upwards of thirty years, and its slabs and posts are still as hard as concrete. The Maoris assure me that it is vastly superior to totara for lasting purposes, and freely assert that it will stand for one hundred years or more. In confirmation of this statement, it is a noteworthy fact that nearly all their graves are marked by four pitau posts. From inquiries made, the pitau punga is usually cut down when about twenty-five years of age, the heart is at that time very



AWARUA FOREST, NEAR TAIHAPE. [*N.Z. Graphic, photo.*

[*Face p. 28.*]



TOTARA, KAHIKATEA, AND RIMU.

hard, being similar to maire in this respect, but it is easily worked with the saw. No reason is given for the manner in which it gradually assumes its hard flinty character, but probably the extraction of its gums and juices by the sun and other agencies has something to do with it.

Mr. District Surveyor J. Stevenson deals especially with the Waimarino Forest :—

The forest in the Waimarino district is the finest I have ever seen, and on the flat land around Ohakune and Raetihi it is magnificent. The trees are growing very thickly, and tall and straight in the barrel, and sound, and from a sawmiller's point of view, an ideal forest for milling, the trees being so easily got at and brought to the mill, and the quantity being estimated at from 20,000 sup. ft. to 40,000 sup. ft. per acre. I have heard of it cutting as high as 45,000 sup. ft. to the acre of rimu, matai, miro, and kahikatea, the only timbers that are milled here.

On the hilly country the bush is not so heavy, there being fewer large trees to the acre, and a larger proportion of the smaller timbers, such as tawa, tawhero, &c., and on this hilly country ratas and rewarewa grow more profusely than on the flat land.

There are very few totaras in this district, and the few that are there are hardly worth taking into account in making an estimate.

Hinau and maire grow over the whole district, but are not milled. Hinau is used a little for fencing-posts, and sometimes for house-blocks. Maire is used for firewood, and a very limited quantity for straining-posts for bridges, &c. Rewarewa is found all over the district, principally on the ridges.

Tawa grows more profusely to the south and west—towards the Wanganui River—of Raetihi. Also in the Manganui-a-te-ao Valley to the north-west; while to the east along the Wangaehu River, and towards Mount Ruapehu from Karioi, there is a large belt of "red-birch," as it is called here—tawhai raunui (*Fagus fusca*) I think it is. This birch is said to be a durable timber, and some fencing-posts at Karioi are still perfectly sound which are said to have been in the ground for over thirty years. This birch timber, I think, would do very well for building purposes, but do not know of it having been used as such, and it is not milled. There is a large area of this birch, mostly fine large trees, and easily got at. The timber very much resembles totara in appearance, and would require an expert to tell the difference in the plank.

It is an impossibility to give more than a wild guess at the quantities of timber in most of this district. The whole bush area contains good milling-timber, but a great deal of it is totally inaccessible at present.

The blocks of bush land I know most intimately belong to the Natives, and it is fast being taken up for settlement, and at present is too far from railways and a market for any one to think of milling it; and whether it would do to hold for milling in the future, when roads and railways are put through, is questionable.

The blocks immediately round Raetihi containing milling-timber are as follows :—

	Acres.
Ohutu Block, Native land, leased to settlers, say	40,000
Otiranui Block, Native land	5,000
Raetihi Block, Native land, mostly leased to sawmillers	16,500
Tawhito-Ariki, Crown land (bush still standing)	2,000
Tupapanui Block, Native land	5,145
Mairekura Block, Native land	3,366
Reserve A Block, Native land	14,850
Ngatipare Block, Native land, about	1,610
Morikau Blocks, Native land (half leased to settlers)	30,000
Mairehau Block, Native land	(not given.)
Papahaua Block, Native land, about	10,000
Whaharangi Block, Native land	10,000
Waimarino No. 3 Block, Native land	18,350
And the bush still left on the various settlers' holdings in the district round Raetihi, say about	50,000
	206,821

Taking the area of the different blocks mentioned, and estimating the amount of milling-timber—*i.e.*, rimu, matai, miro, and kahikatea—at 10,000 sup. ft. to the acre, and, say, one-half of the blocks contain milling-timber, the amount would come to 1,034,100,000 sup. ft., which, at the rate of 10s. per 100 sup. ft., would amount to the sum of £5,170,500.

The quantity of timber, or more, I believe, is there, but what proportion of it can be utilised for milling is a most difficult question to answer. Still, I think a good proportion of it will be milled, though a great deal of the land in the blocks mentioned is totally inaccessible at present, and, where accessible, a long way from a market and railway.

The timbers in this district, so far as I have observed, I would place in the following relative order of abundance in numbers and quantity: Rimu predominates; then there would come matai, miro, hinau, maire, tawa, tawhero, birch, kahikatea, rata, rewarewa; totara is very scarce, only an odd tree here and there; and most of the smaller trees and shrubs are found over the whole district.

Rangers Sutherland and Smith's joint report has special reference to the southern and eastern portions of the province, and is as follows :—

The southern and eastern portion of the province reaches from the Akitio River, on the Hawke's Bay boundary-line, to Wellington on the south, and comprises portion of the western slopes of the

Ruahine Range, in the north-western corner. The centre of the district is intersected by the Tararua and Rimutaka Ranges, and towards the east coast by the Haurangi, Maungaraki, Puketoi, and Waewaepa Ranges; the whole are more or less covered with native indigenous forest trees and shrubs.

The indigenous forest trees of economic value in the various ranges named are totara, rimu, matai, kahikatea, tawhero, tawa, tawhai, pukatea, maire, rata, hinau, miro, rewarewa. The smaller trees and shrubs of less economic value, but of value for scenery and water-conservation purposes, are: tarata, mahoe, konini, horoeka, akeake, ngaio, mapau, makomako, ramarama, manuka, &c.

The major portion of forest lands in this portion of the district are situated on the verge of the settled lands along the lower slopes of the ranges, and are practically without access, and, owing to the steep and broken nature of the lands, cannot be considered to contain timber of extra value for milling purposes. On the lower slopes of the ranges, in the various forest reserves, there may be some available milling-timber, but, as it is scattered throughout the whole of the district, it is impossible to give an approximate estimate of the quantities of the various forest trees of economic value.

Mr. Assistant Surveyor T. A. Johnston reports on the timber trees in the Ruatiti and Mangatiti Blocks:—

These blocks furnish a great variety of classes of bush, from manuka flats along the two main streams from which the blocks take their names, to birch spurs on the steeper and higher points, with all the differing grades of heavily timbered flats, tawa sidlings, and tawhero ridges. But although there are many good trees of the more useful kinds, such as matai, rimu, kahikatea, &c., yet the bush could not be called milling-bush, for the small clumps of these trees are too scattered, and the country too broken, to allow of them being collected at a mill at reasonable cost, and, besides, the mills themselves would have to be so far from a market, or good means of communication with a market. There will be plenty of good timber for the requirements of incoming settlers—for fences, yards, outbuildings, &c.—but that is all.

Totara.—There are only a very few scattered totaras here, and many of these are not sound.

Matai.—There is a fair sprinkling of good matai, mostly on the small river-flats, and as the roads, and consequently the homestead-sites, are for the most part on these, this timber will be very handy for building purposes.

Maire.—There are a fair number of these trees widely distributed throughout both blocks. This wood is very useful where hardness is required, as for mauls, and some parts of bridge-work, but is very hard to work. It is also much used for firewood.

Rata.—This is the largest and most widely distributed tree we have. Having developed from vines, these trees are generally hollow, and often twisty and knotty, so are hard to work, and are little used except for firewood when dry. It is very plentiful and very hard, and might make good blocks for street-paving.

Rimu.—This is our most beautiful timber tree, and though we have some fine trees of this variety, yet it does not occur in any patches large enough to be payable to mill at this distance from a market.

Kahikatea.—Kahikatea is also plentiful, but is confined more to the river-flats, where there are some splendid specimens.

Miro.—There is very little miro here, and what trees there are are not very large. This timber lasts fairly well when not exposed to too much weather, and is often sold for better timber. The gum from miro, even in its raw state, is a splendid adhesive, and suggests that, if it were experimented with, it might supply an article to beat many now on the market.

Hinau.—There are a few hinaus, mostly scattered along the ridges. This timber lasts well in the ground, and so makes good strainers, but is very heavy and tough to work. Out of its bark the Maoris make a good permanent black dye.

Rewarewa.—These trees also, like hinaus, are mostly found along the ridges. There are a good number here, but they are of little use where they cannot conveniently be got at, for cabinet-work and the like.

Titoki.—There are very few of these trees here. They are the toughest wood we have, and are useful for such articles as swingle-trees.

Our most plentiful trees are tawa and tawhero, but neither of these woods is turned to any use in this district. We have also a few pukatea, of which the same can be said.

Our underscrub consists chiefly of mahoe, karamu, rangiora, makomako, toru, matapo, akeake, manuka, tutu, &c., and is very much entangled with vines, mostly supplejacks. Of these, the only ones I have seen used extensively are supplejacks, which I have seen being made into coal-baskets in Dunedin. I believe that many of our shrubs, if properly tested, will be found to have powerful medicinal properties. Rangiora and tutu will at certain times of the year poison stock. Koromiko-leaves and manuka-berries are used in the bush as a costive medicine. Also many of our trees have permanent dyes, and the Maoris make a good permanent brown dye out of the bark of brown-birch (tawhai), also a good permanent black dye out of hinau-bark. They also use many native berries for small quantities of brighter but less permanent dyes. The barks of some trees, such as tawhero, might, if tested, be found useful for tanning.

There is a splendid belt of milling-timber between Raetihi and Rangataua, and extending from there along the flats right up past Makatote. There are now, to my knowledge, ten mills working between Raetihi and Rangataua, and though further north the matai, kahikatea, &c., give place to kaikawaka and yellow-pine, yet these latter are also good timber, the last being considered by many as little inferior to totara for lasting either above or below ground, while the other is a splendid timber to work, and lasts pretty well out of the ground. The heavy birch timber, too, around Karioi lasts fairly well in a dry climate.

VARIETIES OF TIMBER TREES, AND USES.

2. *Totara.*—Habitat: North and South Islands, but most plentiful in the North Island. Generally distributed through forests. In this district it is distributed as follows: In South Wairarapa and open parts of North Wairarapa, in odd clumps of a few trees. Most of the lower parts of the main bush have been worked out. On the west coast a few odd trees occur. In the Awarua Block, generally eastward from Utiku, there is a good extent of totara, and a little in Kaitieke, Wangaehu Valley, and Waimarino. It is a very durable timber, easily worked, and taking a good polish, but it is rather brittle. It is probably the best timber for general purposes in the Dominion. It is used for wharves, bridges, fencing, firewood, cabinet-work, and for building purposes; especially for piles, sleepers, bottom plates, floor-joists, and floors, as it lasts well in damp places—fifty years or more. The Maoris used it for their canoes, and the bark for lining their whares. Totara-knots are in demand for cabinet-work, owing to the beautiful grain and the fine polish they will take. The royalty-value averages about 4s. per 100 sup. ft., but varies very much according to locality and access to mills. The market price, after working at mills, on truck, is 15s.

3. *Totara kiri kotukutuku.*—Habitat: North and South Islands. This is the mountain species, usually occupying the upper spurs and the upper parts of valleys. Economically the tree is distinguished from the true totara by a smaller size, more sap-wood, and a woolliness of fibre. It is also not so durable. It is distributed generally throughout the district, usually in small patches, and in inaccessible places.

4. *Matai.*—Habitat: North and South Islands, generally distributed. In this district the main forests are in Wairarapa and along the Main Trunk Railway, as Awarua, Rangataua, and Horopito, and in the blocks to the westward. It is generally found on rather dry river or shingle flats and on the summits of ranges or spurs up to an elevation of 1,800 ft., or rather higher in the northern parts. It is a durable timber, lasting thirty or forty years if cut when the sap is down and seasoned. It lasts well either in or out of the ground. It is used for bridges, buildings, fences, firewood. It makes excellent flooring, as it shrinks with the grain only. It is very hard, and takes an excellent polish. It is a strong timber, with a high breaking-strain. It is becoming scarce, and in some parts the supply is only sufficient for the use of the settlers; but there is still a fair quantity in some localities, and doubtless other uses will be found for it when the softer timbers, such as totara and rimu, become scarce. Its royalty-value is about 2s. per 100 sup. ft., but, after working, the value at mills, on truck, is 12s.

5. *Kawaka, or Kaikawaka.*—Habitat: Hilly parts of the North Island. Mr. F. A. Thompson says that this species of *Libocedrus* is, as far as he can ascertain, absent from the Wellington District, the tree commonly called kaikawaka, or kawaka in the Waimarino Forest, seems always to be the pahatea, or cedar. Messrs. H. Lundius and J. Ammunson, Crown Lands Rangers, refer to two varieties —viz., dark and pale, the former lasting about forty years, and the latter only about five years. It is only used for small bridges at present, and has no commercial value just now, as it grows in remote and, until lately, inaccessible places; but it will doubtless be used for many more purposes when better known. It is a rather small tree, the average diameter being 15 in., and length of barrel 21 ft. Mr. H. E. Girdlestone says it is found on the slopes of Ruapehu. A young forest of this tree is found in the high portion of the Motukawa Block, near Turangarere, and by the time these trees reach maturity the timber will have become better known and more valuable.

6. *Pahautea, or Cedar.*—Habitat: Mountainous districts of North and South Islands, at altitudes of from 1,000 ft. to 3,000 ft., but seldom below 1,500 ft. This tree has possibly been confounded with the kawaka, or kaikawaka. Mr. A. M. Roberts says, "It is hard and durable, and well adapted for bridge and other constructive works. It is also utilised for building, and is specially valuable for wharf-piles or bridges, being well known as a resistant to all water-microbes." Mr. O. N. Campbell says, "It is a poor timber, but might be used for pencil-cases; it is not used; is generally called kaikawaka, and often mistaken for totara." Mr. T. A. Johnston says, "It is not very durable when exposed. Has not so far been milled, on account of its inaccessibility. It is found in large quantities in the Waimarino, at an altitude of about 2,300 ft. to 2,600 ft. Average barrel, about 18 in. It splits and chips easily." Mr. F. A. Thompson says, "This tree occurs on the summit of the Ruahines, behind Raumai, and forms part of the forest from Makatote northwards to Whakapapa, at altitudes of from 3,000 ft. to 1,000 ft., but rarely below 1,500 ft. It is chiefly remarkable for its lightness and fissileness, and is evidently a very durable timber, but is apt to split in seasoning." This species is often erroneously called kawaka, but, so far as Mr. Thompson can discriminate, the kawaka does not grow in our district, though perhaps it may be found higher up on the mountains.

7. *Northern Manoao.*—Habitat: Mr. H. E. Girdlestone says that it is grown on the slopes of Ruapehu; Mr. F. A. Thompson, that it appears to be restricted to the district north of Auckland City; and Messrs. Lundius and Ammunson say that it is found chiefly in the Waimarino district, at altitudes of over 200 ft., and that it is used for bridge-work, but has no present commercial value. It is a durable timber not well known as yet, but it will no doubt be more used when better known, as it works up well and easily. It grows the same size as kaikawaka.

8. *Southern Manoao.*—The southern manoao and Westland pine appear to be identical. The trees grow on the Ruahines, behind Raumai, and in the Waimarino Forest near the plains. The timber is excellent for bridge purposes, and very durable.

9. *Westland Pine.*—There is a diversity of opinion with reference to this timber, probably due to its being better in some localities than others. It appears to be identical with the southern manoao. Mr. O. N. Campbell says, "Habitat, high altitudes. An occasional tree, mostly stunted, and of no value." Mr. T. A. Johnston says, "Habitat, North and South Islands. Tough and durable. Slow-growing. Used for sleepers. Not worked in the Waimarino Bush. Good firewood. Found in the Hautangatahi Forests, and at high altitudes in the Waimarino Forest, from 2,400 ft. Not very plentiful. Trees small."

12. *Tawhai ruanui* (Tooth-leaved Beech).—Habitat: North and South Islands. This is a fine tough wood, very hard, and, if properly seasoned, very lasting. It is used mainly for fencing and firewood. It grows at altitudes of from 500 ft. to 3,000 ft. or 4,000 ft. on all our wooded ranges. In the Waimarino south and west of Ruapehu it is very plentiful. In the Te Tuhi, Ahu Ahu, and Puketotara Blocks, where the spurs are sharply defined, it is the chief tree. It is little used at present, and has no commercial value, but will no doubt be used for many purposes as other timbers decrease and it becomes better known. The bark is rich in tannin, and may also contain medicinal properties.

13. *Tawhai rauriki* (Entire-leaved Beech).—Usually called "black-birch." Is very commonly spread over the whole district, at high altitudes. It is used chiefly for firewood. It is a fine tough wood; very hard to work when seasoned. Its drawback as a timber tree is that it warps badly. The bark is rich in tannin, and may contain medicinal properties. In the past it has been used for tanning.

14, 15. *Tawhai*, and *Tawhai* (Blair's Beech).—Mr. F. A. Thompson writes, "I am not clear about the distinction between these two beeches. They add much to the beauty of mountain landscapes from 1,000 ft. to about 3,500 ft. altitude. Found in most localities at that height. Chiefly useful as a beautiful and ornamental tree.

Tawhai (Silver-beech).—Common on all the higher ranges throughout the district. It is readily distinguished from the other beeches by its cherry bark, leaves, and salmon-coloured wood that cuts like cheese.

16. *Maire raunui*.—Found in small quantity in most parts of the district, but is most plentiful in the Waimarino. It is a very hard and durable timber, but as yet is not used for many purposes—mainly for straining-blocks in bridges, bearings, rollers for mills, and any other purposes where hard wood is required. It lasts well in and out of the ground. It makes a splendid fuel, giving out a fierce heat. As this timber becomes better known, it will be used for many purposes, such as cabinet-making, &c. It is, however, subject to a borer-worm.

Narrow-leaved Maire.—Found mostly in high parts of the country. Is very hard, but generally too small for timber.

18. *Northern Rata*.—Habitat: North Island and northern parts of the South Island. This is usually found on hill-tops and dry ridges; it is very tough, and when not in contact with the ground, durable timber, lasting about fifty years; it is little used, however, owing to its being generally twisted and knotty. It is mainly used for arms for telegraph-poles, knees for vessels, firewood, and wheelwrights' work. It has been used for purposes requiring bending, such as for shafts and hockey-sticks. Many of the trees are very large, but, as it develops from a vine, the trees are frequently hollow.

22. *Manuka raurika*.—Habitat: North Cape to Otago. It grows mostly on ranges, sometimes forming a good part of the forest, and sometimes in small clumps. Trees of 40 ft. in height and 2 ft. in diameter are not uncommon. The timber is very hard and durable, with a strong fibre. It is easily worked, and is much used for tool-handles, for which purpose it is specially adapted. It has otherwise no commercial value at present.

23. *Maire tawhake*.—The only mention of this timber is in Mr. F. A. Thompson's report. He says, "Sometimes also called Whawhakoa. I found a little of this at Levin, near the Ohau River."

24. *Kowhai*.—Habitat: North Cape to Southland. Generally on river banks and flats. It is found all over the district. It is a very durable timber. Mainly used for fencing, tool-handles, and wheelwrights' work, and occasionally for buildings. It has no present commercial value. Mr. F. A. Thompson refers to three varieties—viz., *tetraptera*, *microphylla*, and *prostrata*. He says, "The former variety is plentiful in most parts of the district; the latter on scrubby mountain sides and gullies. The variety *grandiflora* I have never seen."

25. *Rimu* (Red-pine).—Habitat: North Cape to Stewart Island. Generally all over the district. This is the most plentiful tree in the district, Mr. J. Stevenson estimating the proportion to other trees in the Waimarino Forest as—Rimu, 66 per cent.; matai, 17 per cent.; miro 12, per cent., &c.—and it is equally abundant in other parts. It is a fine tree, growing from 70 ft. to 100 ft. in height. It lasts very well out of the ground when properly seasoned, and is the principal building-timber of the Dominion. It is principally used for buildings, bridges, and cabinet-work. For the latter purpose, and also for lining and panels, it is in great demand, owing to the beauty of the grain and the fine polish it takes.

Its royalty-value is 1s. per 100 sup. ft., but after working, its value at mills, on truck, is 8s.

26. *Kahikatea* (White-pine).—Habitat: Monganui to Southland. Grows in low-lying damp or swampy ground, but occasionally on high ground in very sheltered basins, in all parts of the district. This is a good timber for inside work if felled at the right season and properly seasoned, but it is subject to dry rot unless so treated, and sometimes even then. If exposed it will only last about ten years, except when it is creosoted for sleepers. Properly treated, it has been known to stand perfectly sound for inside work for sixty years. It is a soft easily worked timber, and is much used for making butter-boxes and packing-cases. It is also used for wood-pulp. A considerable quantity is exported to Australia.

27. *Miro toromiro*.—Habitat: North and South Islands, from Mongonui to Stewart Island. Found all over the Wellington Land District, mostly at low altitudes on dry flats, but sometimes at fairly high altitudes. The timber lasts well when not exposed to the weather. It is fairly strong, and is used for buildings, bridges, cabinet-work, runners for bush-trams, &c. The bark contains medicinal properties, and the gum—a very strong adhesive—is used by bushmen for healing cuts. Royalty-value, 1s. per 100 sup. ft.

33. *Pukatea*.—Habitat: Monganui to Westland. Found in damp ground and low altitudes, gene rally near the coast. The timber is strong, with a tough fibre, very hard to split, and would mak good fencing material. The heart is durable, and is used for cabinet-work.

34. *Hinau.*—Habitat: North Cape to Otago. Grows mostly on ridges. The timber is very hard and durable, and lasts well in the ground, but is very heavy and hard to work. It is used for fencing, and especially for strainers. It is also used for house-blocks. It should be well seasoned before use, as otherwise it is apt to split. A good permanent black dye is made from the bark.

35. *Pokaka.*—Habitat: Generally distributed over the Dominion, but rare in some parts. In this district it is found chiefly at high altitudes in the Rangitikei district and in eastern Wairarapa. The bark may be found to contain medicinal properties.

37. *Tawa.*—Habitat: Auckland to Nelson. In this district it is everywhere fairly abundant. The timber, which is not very durable, is light, white, coarse-grained, and easy to work. Used for butter-boxes, coopers' staves, charcoal-making, and firewood. It burns freely, and can be used for this purpose green. It may come into more general use for such purposes as house-lining as more valuable timber becomes scarce.

38. *Titoki, Tokitoki.*—Habitat: Mongonui to Westland. Not very plentiful in this district. The timber is very hard and tough, straight-grained, and easily worked. It is used for all purposes requiring toughness, strength, and elasticity, such as bullock-yokes, axe-handles, wheelwrights' work, &c. It is apt to become brittle, however, when very dry.

39. *Tawari.*—Mr. F. A. Thompson says "It is probably restricted to the Auckland and Hawke's Bay Districts, but I have not come across it." It is not mentioned in the other reports.

41. *Rewarewa.*—Habitat: Mongonui to Marlborough. Found in small quantities all over the district, generally on ridges. It is used for cabinet-making, and also for fencing, owing to its splitting easily. Hard to burn. Royalty-value, 1s. per 100 sup. ft. Generally known as "honeysuckle."

42. *Tawhero.*—Habitat: North part of the North Island, in high rugged country, mainly on sharp ridges, on poor soil. There are two varieties—pale red and white. The timber is not very durable. It is sometimes used for fencing, but generally only for firewood. It burns well when dry. The bark contains 10 per cent. of tannin. Of no commercial value.

43. *Towhai, or Kamahi* (Black-beech).—Habitat: South part of Auckland to Stewart Island. Found plentifully on high sandstone ridges in all parts of the Wellington District. The timber is very similar in appearance to totara, and is said to be very durable. It can be used for bridges and fencing, and will no doubt be used for building and other purposes as other timber grows scarce, and it becomes better known. The bark may have medicinal and tanning properties.

44. *Porokaiwhiri.*—Habitat: South part of North Island and north part of South Island. In this district it occurs in every bush plentifully, from scrub to trees about 1 ft. through. The timber is soft and perishable, and not of economic value. The red berries afford good pigeon-food.

45. *Kohekohe.*—This tree is only mentioned by Mr. F. A. Thompson, and he only says (referring to this district), "I have never found this tree except from Wellington to Levin."

46. *Horopito.*—Habitat: Found in all parts of New Zealand. Generally distributed, but most plentiful on high spurs. The timber is strong and durable, but it is not used except for cabinet-work. The bark may contain medicinal properties.

47. *Tarata.*—Habitat: North and South Islands. The timber is tough and elastic, and makes fair tool-handles. Occurs in large quantities as underscrub. The timber is of no commercial value, but leaf may contain medicinal properties.

50. *Mahoe.*—Habitat: North and South Island, from North Cape to the Bluff. It is generally an indication of good soil. The timber is not durable, and is of no practical use. The Maoris used it for making charcoal for their *wharepunis*. The berries make a splendid ink, of a deep-violet colour.

51. *Huoi, or Manatu.*—Habitat: South of Mongonui to Chatham Islands. Commonly called ribbon-wood. It is found all over the Wellington District, but is of no present commercial value. It contains resin, and may be of value on that account. A small quantity is used for cabinet-work and inlaying, the wood being white and even-grained, and is easily split. Good baskets can be made from the bark.

52. *Wharangi.*—This shrub or small tree is also sometimes called "rangiora." It is found in large quantities among the underscrub in the Wellington District. It has no commercial value. The leaf is poisonous for horses and cattle.

53. *Kaikomako.*—Habitat: North Cape to middle of South Island. Grows in low-lying ground, in small quantities. It is a strong hard wood, and should make good fencing-material. It is sometimes called "kohikomiko."

54. *Ake.*—Also called "akeake" or "ake rautangi." Habitat: North and South Islands and Chatham Islands. Generally near the coast. It is a very strong and tough wood, mainly used for fencing and mauls, and for fuel. It is very common in the Wellington District.

55. *Karaka.*—Habitat: North Island and in the north part of the South Island; also at the Chathams and Kermadec Islands. Generally found near Native cultivations and clearings, and often near the coast. It is a very handsome tree, but the timber is not durable. The berries are much prized by the Natives, who make an excellent food of them. The leaves are used as fodder.

56. *Putaputa weta.*—Habitat: Mongonui to Stewart Island. Found in small quantities only among the undergrowth in this district.

59. *Manuka, or Kahikatoa.*—Habitat: In all parts of the Dominion. The wood is fairly durable, and is used for posts and fuel. There are three varieties—viz., red (kahikatoa), white (kapuka), and pale (kaikaia). The red variety is the most durable.

60. *Ramarama.*—Habitat: North part of South Island and south part of North Island. Generally found on wet and swampy land. Used for fencing-rails. The bark may be of commercial value.

62, 63. *Rohutu.*—Habitat: Hauraki Gulf to Otago. Generally found in wet and swampy land. The timber is of no practical use.

64. *Kotukutuku, or Kohutuhutu.*—The native fuchsia, often called "konini." Habitat: North Cape to Stewart Island. The timber is strong and fairly durable, but it is not much used, owing to its being generally twisted and gnarled. It is used for posts, especially in places likely to be fire-swept, as it is very hard to burn.

65, 66. *Horoeka.*—Habitat: Whangarei to Stewart Island. Found all over the Wellington District, generally near streams. The wood is strong and elastic. It is sometimes used for coach-building purposes, and for tool-handles.

67, 68. *Papauma, Puka.*—Habitat: Papauma, Colville Peninsula to Stewart Island; puka, North Cape to Nelson. Generally found in high altitudes, and only used for fuel. It is widely distributed in the Wellington District. It is a climber, with the same characteristics as the rata.

71. *Yellow-wood.*—A shrub found all over the Wellington District, generally in damp ground. The leaves may have a medicinal value.

78. *Toro.*—Habitat: North Cape to Awatere and Westland. Widely distributed in the Wellington District. It is much used by the Maoris for construction purposes.

79. *Mapau.*—Habitat: North Cape to Stewart Island. Found near the coast all over the district. It is not durable, and is used for fuel only. It burns well.

82. *Ngaio.*—Habitat: Kermadec Islands to Otago. Generally found in open lands and clearings, and most common near the coast. It is strong and durable, but too twisty to have much value. It is sometimes used for bullock-yokes and for boat-building. The leaves may have a medicinal value, and the berries make a good ink.

85. *Makomako.*—Habitat: North Cape to Stewart Island. Usually known as "wine-berry." It is found in the open, and on edge of clearings. The wood is light, and not durable. It has no commercial value. The leaves may have a medicinal value.

SUMMARY OF TIMBER IN WELLINGTON DISTRICT.

Name of Tree.	Approximate Area of Private and Leased Lands.	Approximate Area of Crown Lands and Reserves.	Private.		Crown.		Totals.
			Approximate Quantities of Private Lands, West Coast.	Approximate Quantities of Private Lands, East Coast.	Approximate Quantities of Crown Lands, West Coast.	Approximate Quantities of Crown Lands, East Coast.	
			Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.
Totara ..	West Coast 1,306,000 acres.	West Coast 896,000 acres.	103,450,000	1,050,000	67,200,000	30,000,000	201,700,000
Matai ..	East Coast 14,000 "	East Coast 400,000 "	1,044,800,000	11,200,000	716,800,000	320,000,000	2,092,800,000
Kahikatea..	Total 1,320,000 acres.	Total 1,296,000 acres.	391,800,000	4,200,000	286,800,000	120,000,000	784,800,000
Rimu ..			1,433,600,000	22,400,000	2,089,600,000	640,000,000	4,185,600,000
Tawai ..			326,500,000	3,500,000	224,000,000	100,000,000	654,000,000
Tawhero ..			653,000,000	7,000,000	448,000,000	200,000,000	1,308,000,000
W. beech ..			3,000,000	500,000	4,000,000	1,500,000	9,000,000
Maire ..			195,900,000	2,100,000	134,400,000	60,000,000	392,400,000
Rata ..			391,800,000	4,200,000	268,800,000	120,000,000	784,800,000
Hinau ..			20,000,000	2,000,000	30,000,000	8,000,000	60,000,000
Pukatea ..			4,000,000	1,000,000	6,000,000	2,000,000	13,000,000
Tawa ..			587,700,000	6,300,000	403,200,000	180,000,000	1,177,200,000
Rewarewa			7,000,000	1,000,000	8,000,000	2,000,000	18,000,000
Miro ..			522,400,000	5,600,000	358,400,000	160,000,000	1,046,400,000
Kahikawaka			10,000,000	..	65,000,000	..	75,000,000
Manoao ..			5,000,000	..	20,000,000	..	25,000,000
			5,699,950,000	72,050,000	5,112,200,000	1,943,500,000	12,827,700,000

The figures given in the foregoing schedule include all kinds of timber, whether grown in localities accessible from a milling point of view or in inaccessible localities.

If the marketable timber only is considered—that is, timber grown in localities that may be worked by mills—then the figures should be as given below.

ON THE WEST COAST.

Waimarino District (extending from Piriaka to about Rangataua).

On Crown lands (area, about 60,000 acres)—

	Sup. ft.
Totara	30,000,000
Matai	300,000,000
Rimu and miro	660,000,000
Kahikatea	60,000,000
Maire	3,000,000
Total	1,053,000,000

On Native and privately held lands, including leases (area, about 135,200 acres)—

	Sup. ft.
Totara	67,600,000
Matai	676,000,000
Rimu and miro	1,487,200,000
Kahikatea	135,200,000
Maire	67,600,000
Total	2,433,600,000



A Kaikatea.

Face p. 34.]



KAHIKATEA FOREST, NAUMAI, SHOWING NIKAU-PALMS.

[*E. A. Marchant, photo.*

Rangitikei District (extending from Rangataua, down the Main Trunk Line to Mangaweka, as far as Ruahine Ranges, and including Rangiwahia District).

On Crown lands (area, about 14,000 acres)—	Sup. ft.
Totara	14,000,000
Matai	28,000,000
Rimu and miro	112,000,000
Kahikatea	42,000,000
	196,000,000

On Native land and privately held land, including leases (area, about 23,500 acres)—	Sup. ft.
Totara	23,500,000
Matai	47,000,000
Rimu and miro	188,000,000
Kahikatea	70,500,000
	329,000,000

Southern Portion (extending from Apiti to Waikanae).

On Crown lands (area, about 5,000 acres)—	Sup. ft.
Totara	35,000,000
Matai	11,000,000
Rimu and miro	10,000,000
Kahikatea	13,000,000
	69,000,000

On Native and privately held land, including leases (area, about 20,000 acres)—	Sup. ft.
Totara	10,000,000
Matai	12,000,000
Rimu and miro	100,000,000
Kahikatea	80,000,000
	202,000,000

Grand Totals for West Coast (Area, 240,000 acres).

	Sup. ft.
Totara	180,100,000
Matai	1,074,000,000
Rimu and miro	2,557,200,000
Kahikatea	400,000,000
Maire	70,600,000
	4,282,600,000

Royalties paid.

Totara	4s. per 100 sup. ft.
Matai	2s. ,,
Rimu and miro	1s. ,,
Maire	3s. ,,
Kahikatea	6d. ,,

Average Prices for Timber at Mills, "on Trucks."

Totara	15s. per 100 sup. ft.
Matai	12s. ,,
Rimu and miro	8s. ,,
Kahikatea	6s. ,,
Maire	No rate.

EAST COAST.

Northern Portion (comprising the Akitio County).

Approximate area of private and leased lands, (5,500 acres)—	Sup. ft.
Totara	1,000,000
Miro and rimu	10,000,000
Matai	1,500,000
Kahikatea	1,000,000
	13,500,000

Crown lands (reserves, 10,000 acres)—

	Sup. ft.
Totara	1,000,000
Miro and rimu	11,000,000
Matai	1,000,000
Kahikatea	500,000
	13,500,000

Middle Portion (Pahiatua, Eketahuna, Mauriceville, and Masterton Counties).

Private and leased lands (6,850 acres)—

	Sup. ft.
Totara	1,055,000
Miro and rimu	13,700,000
Matai	1,250,000
Kahikatea	1,000,000
	17,005,000

Crown lands (approximate area, 1,000 acres)—

	Sup. ft.
Totara	8,000
Miro and rimu	1,597,000
Matai	8,000
Kahikatea	16,000
	1,629,000

South Portion (South Wairarapa and Hutt Counties).

Approximate area of private and leased lands, 2,000 acres—

	Sup. ft.
Totara	500,000
Miro and rimu	4,000,000
Matai	500,000
Kahikatea	1,000,000
	6,000,000

Crown lands (approximate area, 980 acres)—

	Sup. ft.
Totara	4,000
Rimu	3,000
Matai	4,000
Kahikatea	4,000
	15,000

Grand Totals for East Coast.

Total area of private and leased lands, 14,350 acres; total area of Crown lands, 11,980 acres—

	Private. Sup. ft.	Crown. Sup. ft.	Total. Sup. ft.
Totara	2,555,000	1,012,000	3,567,000
Miro and rimu	27,700,000	12,600,000	40,300,000
Matai	3,250,000	1,012,000	4,262,000
Kahikatea	3,000,000	520,000	3,520,000
	36,505,000	15,144,000	51,649,000

Average Royalties.

Totara	2s. to 4s. per 100 sup. ft.
Miro and rimu	6d. to 1s. ,,
Matai	1s. to 2s. ,,
Kahikatea	6d. ,,

Average Prices at Mill.

Totara	16s. to 18s. per 100 sup. ft.
Rimu	12s. 6d. to 14s. ,,
Matai	15s. to 17s. ,,
Kahikatea	10s. to 15s. ,,

JAMES MACKENZIE,
Commissioner of Crown Lands.

H. M. LUNDIUS,
Crown Lands Ranger.

J. AMMUNSON,
Crown Lands Ranger.

H. E. GIRDLESTONE,
Assistant Surveyor.

MARLBOROUGH.

The Marlborough Land District, occupying the north-east corner of the South Island, and containing about 2,792,500 acres of land, is bounded generally on the north and east by Cook Strait and the east coast as far as the Conway River; thence by that river to its junction with the Towy River; from this point, by straight lines, rivers, and the summits of watersheds, to the western side of Tennyson Inlet, Pelorus Sound. From the Conway to the Acheron River it abuts on to the Canterbury Land District, and from that river to Pelorus Sound it is bounded by the Land District of Nelson.

The widest part of the district is from Cape Campbell to Tophouse, a distance of about sixty-seven miles, and the extreme length from Cape Jackson to the Conway is 120 miles.

Physical Features.

The district throughout is generally mountainous, but none even of the highest peaks are covered with perpetual snow, although Tapuaenuku, the highest of the Inland Kaikouras, attains an altitude of 9,462 ft. Of the Seaward Kaikouras, or Looker-on Mountains, the highest points are Manukau and Te Ao, Whakari, which are 8,562 ft. and 8,516 ft. respectively. There are several lesser peaks, from 4,000 ft. upwards.

The portion of Marlborough north-west of the Wairau River, extending to the boundary of the Nelson Land District, and including the County of Sounds, in all about 280,000 acres, was originally covered with dense forest. In the valleys and on the lower hill-slopes, rimu, kahikatea, matai, totara, miro, and tawa were the principal forest-trees. The higher portion of the hills and steep spurs are clothed with the various species and variety of birch (beech), to which along the shores of the Sounds were added pukatea and kohekohe, the latter locally called cedar.

Since 1860 sawmills have been at work in various parts of the district. Thirty-five mills have been erected, and have worked for longer or shorter periods. Havelock, on the Pelorus Sound, is at present the headquarters of the timber trade.

The hills along the shores of the Sound will, for many years, furnish birch sleepers. There are other timbers left in places, but nowhere sufficient to justify the erection of a mill, unless pukatea wood, hitherto neglected, could be utilised. It is a light, tough timber, well adapted for boat-building and for packing-cases. The quantity of pine timber remaining in the Kaituna and Onamalutu Valleys is small, but there is a good supply of birch and other wood, suitable for fencing and firewood. On these valleys the Wairau Plain is mainly dependent for timber.

The Pelorus Valley, with its tributaries the Wakamarina, Rai, Ronga, and Opouri Valleys, still contain about 170,000,000 ft. of convertible timbers, exclusive of the birch, of which there is a large amount of the best quality on the hills and terraces. The Wairau, Blenheim, and other districts extending southwards must depend for the future on this source for all their building-material.

In the neighbourhood of Kaikoura, along the base of Mount Fyffe, and in the Hapuku Valley, there is another small block of forest land in which three small sawmills have been erected. The quantity of timber suitable for sawmill purposes in this block is very limited, but it will furnish the neighbouring country with firewood and fencing for many years.

Varieties of Timber Trees, and Uses.

2. *Totara.*—Grows generally on flats and lower slopes of hills, up to about 3,000 ft. to 3,500 ft. About 500,000 sup. ft. in the district, the bulk of which is in Kaikoura district. Very durable. Useful for nearly all kinds of construction—fences, piles, shingles, building, sashes, doors. Used for general purposes for which good timber is required—telegraph-poles, sleepers, &c. Value, £1 5s. undressed to £1 8s. dressed per 100 sup. ft. Probably the most valuable timber in New Zealand; of great utility. Not good firewood, as it sparks too much to be safe.

3. *Totara kiri kotukutuku.*—Grows generally on flats and lower slopes of hills, up to about 3,000 ft. to 3,500 ft. About 300,000 sup. ft. in district. Very inferior timber to totara; of very little special value. Frequently passed off upon unsuspecting persons as totara. Value, 15s. per 100 sup. ft. Should be classed with kohekohe and other inferior timber for general purposes.

4. *Matai.*—Grows generally on river and alluvial flats, lower slopes of hills, &c. About 8,000,000 sup. ft. in district. A good durable timber. Too brittle for many constructive works. Used for rusticated weatherboards, floors, framing of houses, house-blocks, piles (bridge), fence-posts, &c. Value, 18s. undressed to £1 1s. 6d. dressed per 100 sup. ft. A good valuable timber, especially for floors, for which purpose it is probably the best New Zealand timber we have. Would be much used for bridges, but it is too short in the grain to be used much when subject to lateral strain.

5. *Kawaka.*—Grows on high damp ranges and shady side of hills. About 10,000 sup. ft. in district. Not durable, and of little value for anything. Would cut into good house-lining, and perhaps boat-planking if it was accessible. Good cabinet-wood. It is used very rarely, as it is very scarce on low ground. It may sometimes be used as strainers on mountain fences. It is scarce in Marlborough. Useless as fuel; will not burn. Would probably make good shingles.

6. *Pahautea.*—Not known in this district apart from Kawaka.

9, 10. *Westland Pine, Yellow Silver-pine.*—A little of this is found on the very high tops in Marlborough, in the form of scrub. It is fairly plentiful in the Grey Valley, on the hilltops at Amuri, and on some of the high bush-clad ranges in Poverty Bay. A remarkable feature about this timber is that the dense black smoke which it gives off in burning does not make the eyes smart.

12. *Tawhai raunui* (Tooth-leaved Beech).—Grows on river-flats, lower slopes of hills, generally particularly well up to 4,000 ft. Of all the *Fagus* tribe there is about 10,000,000 sup. ft. in district. A fine durable timber. Useful for all constructive works—piles, beams, bridge-decking, all outside

flooring, palings, and all kinds of purposes to which good well-splitting timber is applied. It is principally used at present for verandah-posts, floors, wool-shed floors, gates, straining-posts, hurdles, bridge-beams, and piles. Value, 17s. per 100 sup. ft. A splendid tree. Good, well-splitting timber of salmon-colour, with rough, thick, brown bark. Sheds its leaves in December. To the unlearned this tree is not easily distinguished from the black-birch in its timber.

13. *Tawhai rauriki* (Entire-leaved Beech).—Grows on alluvial flats and lower slopes of hills. Including all beeches, say, 10,000,000 sup. ft. in district. Good durable timber, frequently much shaken in heart. Useful for most of the purposes of *Fagus fusca*. Is used for posts, strainers, palings, bridge-decking. Value, 19s. per 100 sup. ft. This is probably the tree I know as "black-birch," and is much esteemed by the settlers for fencing. Like all the *Fagus*, it is much given to warp, cast, and crack in seasoning.

14, 15. *Tawhai, Tawhai* (Blair's Beech).—I do not know the difference between these two—one or both of these form the great bulk of the timber-trees in the Marlborough District. It is not durable timber, or of any considerable use except for firewood. It is almost worthless for milling purposes, owing to its costing and warping so much.

16. *Maire raunui*.—Grows on low country and river-flats, but is scarce. It is a very good, valuable timber for fencing or any purpose for which hard durable timber is useful; and splendid firewood. Used for posts, house-blocks, or mauls. Formerly used as journals for machinery, and for teeth of gearing-wheels. None obtainable in the market. I only know of a few of these trees in this district. There are several fine trees at the Waipapa Homestead, Clarence River, and a few scattered through the bush; but they are rare enough to call for remark when seeing one.

19. *Northern Rata*.—Found from sea-level to 2,000 ft., but very scarce. Not durable when exposed to weather; very tough when old; good firewood. Useful for any purpose where toughness is required. None obtainable in this district. It is only occasionally met with on the hills, but does not attain the dimensions it does up north.

20. *Southern Rata*.—Grows on shores of sounds or lakes; also on high dry ranges and cliffs. Scarce. Fairly durable, strong, hard wood; good firewood; good ship-knees and boat-ribs. Useful for wheelwrights' work, but difficult to obtain. This is a far superior timber to *robusta*, being harder and more lasting.

22. *Manuka rauriki*.—Grows from sea-level to 3,000 ft. altitude, and all over New Zealand. Plentiful. Not durable, but strong; makes fairly good fence-rails; good firewood; also good wharf and bridge piles; said to be proof against the teredo-worm in some localities. At present used chiefly for rails, firewood, and wharf-piles occasionally; never heard of it being sawn up for milling-timber. Value, about £1 10s. per cord. A valuable and useful tree for firewood, for which purpose it is generally used. Grows well all over the Dominion.

23. *Maire tawhake*.—Not known from the other maire trees.

24. *Kowhai*.—Grows on low flats and lower slopes of hills. Formerly abundant in district, but now nearly all used. Very hard, durable timber, much esteemed for fencing-posts for any situation other than sandy soil, where it does not last very well; valuable for thrust-blocks for truss-bridges; good plane-blocks or other such purposes; splendid firewood. Value, £7 10s. per 100 posts. This tree was abundant in this district, but is now nearly all used. Used to grow to large size in Kaikoura district, being sometimes over 3 ft. in diameter.

25. *Rimu* (Red-pine).—Grows from sea-level to 2,000 ft., but generally on river-flats. About 120,000,000 sup. ft. in district. Resiny heart very durable; other parts fairly so. Useful for all kinds of things for which good sound timber is applicable. Most generally useful timber in the country. Now used for building-construction, bridges, sashes and doors, and all kinds of work both inside and out; also used for cabinet-work. Value, from 15s. undressed per 100 sup. ft.; tongued and grooved, 18s. 6d. per 100 sup. ft. Probably the most valuable timber we have for general purposes, and also the most beautifully figured timber in the Dominion. Will only be appreciated at its true worth for inside decoration after it has all been used up or destroyed. Useful alike for rough outside work or fine cabinet-work, but is getting rapidly worked out in this district.

26. *Kahikatea*.—Grows generally in low damp flats and swamps, but also on slopes of hills. About 35,000,000 sup. ft. in district. Not at all durable; tough when green. It is useful for boxes, casks, temporary structures, templates, wheelbarrows, and other purposes where lightness is of value. Now used chiefly for butter, soap, candle, and other boxes, temporary structures, &c. Value, from 13s. to 16s. 6d. per 100 sup. ft. This timber is fairly abundant in this district, and grows into a very fine tree, frequently over 4 ft. in diameter. Trees growing on the hills are said to be of better timber, especially when of yellow colour. Owing to its liability to attack by a small beetle it is almost worthless for general building and permanent purposes, but it is valuable for all temporary work and box-making.

27. *Miro toromiro*.—Grows much the same as rimu. Quantity rather scarce—say, 50,000 sup. ft. Not durable, but strong. If cut by the mills it is probably sold as rimu. It would make good bridge-beams, if obtainable in suitable dimensions. Not frequently used, or, if so, sold under some other name. Slightly resembles matai to the casual observer. Is chiefly known as the tree upon which the wood-pigeon feeds during the shooting season. It is of no very great economic value, owing to its scarcity.

28. *Tanekaha*.—Found from sea-level to 2,000 ft. Scarce. Not very durable; strong, tough wood; very good for sprits, masts, and booms of boats. Bark used for tanning, saplings for boats, spars, poles, &c. I do not know the distinction between tanekaha and toatoa. The latter is, according to my experience, the Ngatikahungunu name for tanekaha. Under this name it is found abundantly—in the forest up the Hoe, Waikaremoana, &c., where the Natives use the bark as medicine.

29. *Toatoa.*—Found from sea-level to 2,000 ft. Scarce. Not very durable; strong, tough wood; very good for sprits, masts, and booms of boats. Bark used for tanning, saplings for boats, spars, poles, &c.

30. *Mountain Toatoa.*—Grows on mountain-ranges. Scarce. Makes good walking-sticks.

31, 32. *Tawhai rauriki* (Mountain-beech).—Grows on the high tops and upper parts of the bush ranges. Plentiful. Not durable. It is of little or no use, except for firewood, and not very good for that.

33. *Pukatea.*—Generally grows on alluvial flats. Fairly plentiful in the Sounds. Not generally considered durable, but some of its heart-wood, grown on dry land, lasts probably better than any other wood in the water. Used slightly for weatherboards, but not generally cut. This timber is, I think, better than supposed for weatherboards. The tree is said to be an indication of good land.

34. *Hinau.*—Grows on river-flats, but chiefly on lower slopes of hills, up to about 3,000 ft. Plentiful in the Sounds and Kaikoura districts. It is only fairly durable, but is extremely tough and strong. At one time it was used as the best timber for the surf-boat planking, but is now hardly ever used. Would probably make good casks and boxes. It is generally passed over when getting milling-logs. This tree has a berry which affords a great deal of food to birds and pigs when it falls from the trees, and formerly was used by the Natives as food. The honey found in the hollows of this tree is said to be superior to that in any other tree; why, I do not know.

37. *Tawa.*—Grows from sea-level to 1,000 ft. Only extends to near the head of Pelorus River. Plentiful in the Sounds, but not found south end of the district. Not at all durable; hard and brittle when dry. Good firewood. Sometimes cut into boards, but unless put up green is almost too hard to drive nails into. Splits very readily. Used almost entirely for firewood, though at one time butter-casks were made from it. Value, about £1 a cord. This timber is plentiful in the Upper Pelorus, and there are one or two small trees in Kaikoura; but the southern limit may be said to be the head of the Pelorus River. This tree is generally thought to indicate good soil.

38. *Titoki, Tokitoki.*—Grows on river-flats and lower hills. Although found all over the district, it is not plentiful. Not durable when exposed to wet, but is very tough and springy, and makes good cart-poles, shafts, &c., for a time, but does not last well; it also makes good tool-handles. This timber is, I think, often neglected for inferior timber when elasticity and toughness is required.

43. *Towhai, or Kamahi.*—Grows along the banks of streams, on flats, or high spurs, being fairly plentiful in the district. Not at all durable, and is of little or no use except for firewood. The bark is useful for tanning. This timber is considered an indication of poor soil.

44. *Porokaiwhiri.*—Grows from sea-level to 1,500 ft., but is rather scarce in the district. Neither durable nor strong, but nicely figured, and is suitable for cabinet-work. Not used, except for firewood when handy.

45. *Kohekohe.*—Habitat: From sea-level to 500 ft., chiefly in the North Island. Ends about head of the Sounds. At one time it used to cover a considerable area of this district, but is now scarce. Fairly durable; light, but not strong. Makes good fence-posts, and is also suitable for cabinet-work and for shingles. Used at present for fencing and for firewood. Known locally by settlers as cedar. Stops rather abruptly about the head of Queen Charlotte and Pelorus Sounds; I have never seen it south of this.

46. *Horopito.*—Grows generally all over the district, being plentiful in places. It is of no use for anything but cabinet-work, the wood being nicely marked. Sometimes called by settlers "pepper-wood." It is a small tree in this district, rarely being over 3 in. in diameter.

47. *Tarata.*—Grows from sea-level to 2,000 ft. all over the district, though very scarce. Not durable. Timber of no value. Good and ornamental shelter-tree, for which it is used. An exceedingly handsome tree. Grows well all over the district, but is not plentiful.

48. *Karo.*—Grows in places throughout the district, but is very scarce. Heavy close-grained wood; not durable. So scarce as to be generally unknown. It is a very handsome plant, but is not frequently met with in this district.

49. *Tawhiwhi.*—Grows generally on low country and river-flats, but is rather scarce. Heavy compact wood, but not durable. Only useful for firewood or for a hedge-plant, for shelter. I know this plant as "rautawhiri."

50. *Mahoe.*—Habitat: From sea-level to 3,000 ft., being rather abundant in certain localities. Not durable. Good firewood. Is used by the Maori to obtain fire by friction. Known as "white-wood" by the settlers; is supposed to be an indication of good soil.

51. *Huoi, or Manatu.*—Habitat: From sea-level to 3,000 ft., but scarce. Poor, useless timber for all but firewood; called "lacebark." Known here as "whauai." There are two kinds—the one which grows into a small tree, and the other, a shrub, growing high up the mountains. The flower of the latter looks like a large orange-blossom, with a scent like primrose.

54. *Ake.*—Grows generally on river-flats and low country. Fairly plentiful in Kaikoura district, but scarce in North Marlborough. Heavy, dense, strong wood. Useful for mauls or for other purposes requiring strong dense wood, and also for cabinet-work, &c. Used now for posts, mauls, &c. It is a very handsome tree, with long thin bright-green leaves. Wood looks like *Lignum vitæ.*

55. *Karaka.*—Grows along the coast, wherever the Natives have settled; but scarce. Poor soft timber. Does not even burn well. The berry is used by the Natives for food. Always found associated with old Native cultivations.

56. *Putaputa weta.*—Grows generally on river-flats; but scarce. The tree is too small to be of any value, though it makes good walking-sticks. A handsome tree.

59. *Manuka, or Kahikatoa.*—Grows from sea-level to 3,000 ft., being rather abundant in places. Fairly durable. Good firewood. Useful for many rough purposes, firewood chiefly.

60. *Ramarama.*—Grows on river-flats and low country, but is rather scarce. Tough strong wood when green, and in this condition makes good tool-handles. Used now for firewood and for tool-handles. Not plentiful, but occasionally met with.

61. *Small-leaved Ramarama.*—Much the same as the other ramarama.

64. *Kotukutuku.*—Grows all over the district, from sea-level to 2,000 ft. and higher. Rather plentiful. The old trees are said to be very durable. Wood is heavy and full of sap. Of no great value. Poor firewood. Now used for posts, sleepers, &c. Grows abundantly in damp places.

65. *Horoeka* (Lance-wood).—Sparsely scattered over district, from sea-level to 2,000 ft., but scarce. Generally too small for any useful purpose. Handsome grain; good for cabinet-work, though it is not often used for anything, being too small. It is difficult to follow the identity of this tree, owing to the great difference between the leaves and general appearance of the saplings and old trees.

66. *Toothed Lancewood.*—Grows the same as horoeka. Very scarce, if here at all. Though not quite so inflammable as kowhai, it is a splendid firewood. Greatly sought after for posts. Splits well, but generally the trunk is greatly distorted.

67. *Papauma.*—Grows all over the district. Used to be very plentiful, but is now much worked out. At one time it was very plentiful in the Kaikoura district. It is a very durable, strong, heavy, compact wood, being suitable for fencing-posts, sleepers, &c. It is also a good firewood. With perhaps the exception of puriri, this timber makes the most durable posts obtainable.

68. *Puka.*—Grows generally all over the district; but scarce, though fairly plentiful in the Kaikoura district. It is a very durable strong compact heavy wood, being suitable for fencing-posts, sleepers, &c. It is also a good firewood. It frequently grows up trees, and becomes a climber.

69. *Tree Karamu.*—Grows generally on low land; being fairly abundant, especially in the Kaikoura district. Not durable. Too small for useful work. Good firewood, only being used for that purpose.

70. *Yellow-wood.*—Grows generally on low country, being abundant along the coast from Clarence to Conway. Not durable. Trees too small to be useful. A very valuable cattle-feed. This is what is known locally as "raurekau."

74. *Akeake.*—Probably "akepirau"; if so, fairly plentiful along the sea-coast and river-banks. Very hard yellow-heart wood. Burns well, but with an unpleasant smell.

75. *Neinei.*—Grows on high mountain-passes generally, but very scarce in Marlborough, being rarely seen. It is of no economic use. It is plentiful in passes of the Spencer Ranges.

76. *Mountain Neinei.*—Grows on high mountain-passes, but is very scarce in Marlborough, only being found on high wooded passes. It is plentiful in passes of the Amuri district.

77. *Inaka.*—Grows generally on top fringe of mountain vegetation, and is plentiful on the mountains. Small. Not durable. Burns well. Sometimes known as "tahine." Very plentiful in the Amuri district, up the Rainbow and Wairau.

78. *Toro.*—Grows in mountainous country generally, being fairly plentiful. Not durable when exposed. Burns fairly well when green. Used as firewood. It is generally found growing in beech forests, and is useful as forming the only fuel there when green.

79. *Mapau.*—Grows generally on dry clay spurs, but is not plentiful in this district. Is not at all durable. Handsome grain; suitable for cabinet-work. Used slightly for cabinet-work, and also for firewood. It is known also as "matipou."

82. *Ngaio.*—Plentiful along the coast-line, especially along east coast and from Kaikoura to Conway. Does not thrive at a great height, probably less than 1,000 ft. It is a hard compact wood, but is not durable when exposed. Good firewood. Useful for shelter-trees and for bullock-yokes. The ngaio of the east coast of Marlborough is the finest of the sort seen anywhere.

85. *Makomako.*—Grows from sea-level to 3,000 ft., being fairly plentiful in clearings not attended to. It is light and tough while green, but is not durable when exposed. It makes good poles. The wood much resembles willow. This is the light-wood wine-berry, or currant-wood of the settler. Comes up in all clearings as a second growth.

86. *Tumatukuru.*—Grows on river-flats, stony ground, river-beds, &c., the small kind being fairly abundant on the river-beds of this district. It is very tough and hard, but is not durable. It is useful for tool-handles, hedges, or anything where elasticity is an advantage. It also makes good firewood, and is greatly esteemed as such. Frequently it grows only as a small shrub, but in the Ada Valley it becomes a tree 18 in. to 24 in. through. It is said to make a splendid hedge, but is very slow growing. Frequently called "taumatakura" ("wild Irishman") or "matagourie."

SCHEDULE SHOWING ESTIMATED QUANTITY OF MILLING-TIMBER IN THE MARLBOROUGH LAND DISTRICT.

	Crown Lands. Sup. ft.
Rimu (red-pine)	63,000,000
Kahikatea (white-pine)	21,000,000
Matai (black-pine)	5,400,000
Totara	320,000
Beeches	5,000,000
Miscellaneous	3,000,000
Total	97,720,000

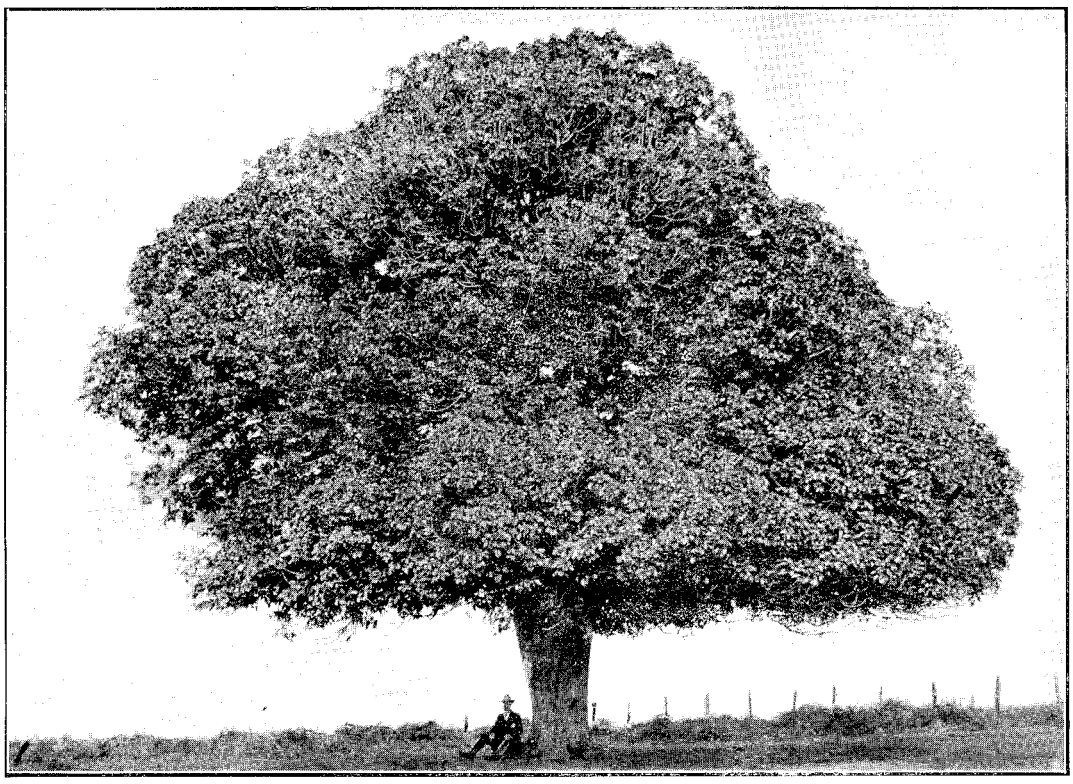


RIMU AND KAHIKATEA IN WAIMARINO FOREST.

[*C. T. Salmon, photo.*

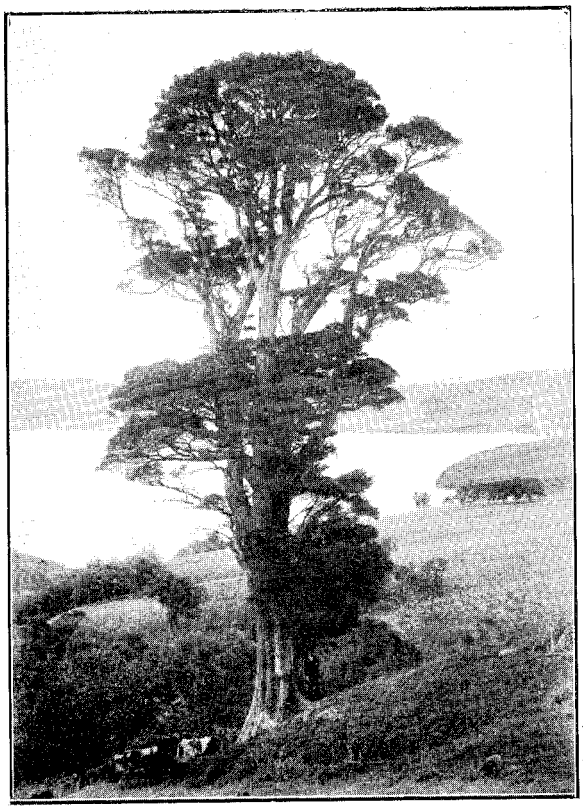


A RATA-TREE (WHIRINAKI SURVEY DISTRICT).



Puriri (*Vitex littoralis*).

[*Grace Matthews, photo.*



Totara (*Podocarpus totara*).

[*Grace Matthews, photo.*

Private Lands.	Sup. ft.
Rimu (red-pine)	52,700,000
Kahikatea (white-pine)	14,200,000
Matai (black-pine)	1,800,000
Totara	182,000
Beeches	3,000,000
Miscellaneous	2,000,000
Total	73,882,000

The miscellaneous timber is pukatea, hinau, miro, &c., and a quantity of timbers not usually cut by the sawmills, although many are either rejected or sold under some other name, when they have qualities of their own sufficient to secure a ready sale if they were known.

F. Stephenson Smith,
Commissioner of Crown Lands.

F. Ward,
Crown Lands Ranger.

NELSON.

The Nelson Land District, comprising an area of 7,322 square miles, is situated at the north-western corner of the South Island, extending from latitude 40° 30′ south to about latitude 42° 30′ south. It is bounded towards the west and north by the sea from Perpendicular Point, on the west coast to Pelorus Sound (a distance of about 520 miles); towards the south-east by the range leading over Elliot Peak and the Rai Saddle to the Pelorus River, thence by that river to its source in Slaty Peak, and by the western watershed of the Wairau River, the St. Arnaud Range, and the Spenser Mountains to the northern watershed of the Grey River; towards the south by the watershed between the Grey River and the Inangahua River, and the watershed between the Inangahua River and the Mawhera-iti River to Mount Faraday, and thence by the Paparoa Range to Mount Pecksniff (4,250 ft.), and by the Pororari River to the sea.

Of the varieties of timber trees of great durability, &c., it is ascertained that there are in the Nelson district fifteen kinds, and among the latter the following are too rare and small in dimensions to be of any commercial value—viz.: *Podocarpus totara*, *Podocarpus Hallii*, *Podocarpus spicatus*, *Dacrydium Kirkii*, *Leptospermum ericoides*, and *Sophora tetraptera*. Pahautea (*Libocedrus Bidwillii*), although not so rare as the varieties mentioned, is small, and so scattered that to secure 100,000 ft. of timber it would be necessary to work a very large extent of forest. The silver and yellow pines, together with *Fagus fusca* and other species of *Fagus*, are the most valuable timbers in the district. The silver and yellow pines are used almost exclusively for railway-sleepers, the yellow-pine more particularly, as it is acknowledged superior in every respect to silver-pine. These pines are growing in patches locally known as "yellow-pine bushes," and are rapidly becoming "worked out"; as a matter of fact, clumps of virgin pine are rarely found. That these species of *Dacrydium* can be cultivated with ease on the large areas of waste "pakihi" land in Buller County is the opinion frequently expressed by experts, and in this connection Ranger Hursthouse has observed young trees growing in "pakihi," and on old clearings which have escaped the ravages of fire. *Fagus fusca*, popularly known as brown-birch, tawhai (*Fagus apiculata*), *Fagus Blairii*, *Fagus cliffortioides* or mountain-beech, and *Fagus Menziesii* known as silver-birch, constitute four-fifths of the forest of this district. *Fagus fusca* is used in heavy construction-works, and is the most valuable of all the birches; but no doubt in the near future *Fagus Solandri* and the other species will be brought into use for general building purposes, cabinet-making, and furniture. A small table made out of birch, silver-birch, and red-pine (the birch-wood of the table was used as studs and weatherboards in the Inkerman Battery, Reefton, for twenty-five years), is an excellent specimen of how birch can be utilised.

Of the twenty-one varieties of timber suitable for general building purposes, but of less durability than the varieties in Class I, only thirteen are found in this district, and rimu stands out pre-eminently as the most useful. The quantity available is estimated at 529,284,000 sup. ft. This estimate is rather under than over the mark. The difficulty of obtaining supplies of rimu for milling purposes is increasing every year in this district, owing to the inaccessibility of the trees. The only forests of rimu of much value for working on a large scale are situated at Karamea and Cape Foulwind. There are isolated patches at Little Wanganui, Mokihinui, Ngakawau, and throughout the Buller Valley, sufficient to supply local requirements. Kahikatea (white-pine) is scattered all over the district, and the estimated quantity is 62,003,000 sup. ft., a little less than one half of which is growing on private lands, Native lands, and reserves. The other timbers in Class II, with the exception of silver-birch, are all more or less valueless for milling purposes on account of their small dimensions and scarcity. They are useful for mining-props and kindred purposes.

Of the timbers of small dimensions enumerated in Class III thirty-one are found in the Nelson district. They comprise scrubs or small trees, several of which—such as tarata, wharangi, ake, puka, heretara, neinei, ngaio, and houhere—are suitable for garden-cultivation as hedge plants and shrubs. All of these varieties are easily grown, and many bear a wealth of beautiful flowers.

Out of a total of 4,572,886,780 sup. ft. of millable timber, the various species of *Fagus* account for no less than 3,954,389,080 sup. ft., equal to about four-fifths of the millable timber in this district,

VARIETIES OF TIMBER TREES, AND USES.

2. *Totara.*—Grows chiefly on ridges, up to an altitude of 1,500 ft., and on river-flats; the latter must be thoroughly dry. Has rare durability in and out of water. Used for the construction of bridges, wharves, marine piles, telegraph-poles, boat-building, furniture, shingles, posts and rails, wood pavements and kerbing. Value, 20s. per 100 sup. ft. One of the most valuable timbers in New Zealand. Chief defect, brittle. Easily worked. Resists the teredo. Grows to a height of 60 ft. Practically cut out in Nelson District.

4. *Matai, or Black-pine.*—Grows on river-flats of recent formation, where land is good, and thoroughly dry and rocky. 5,812,000 sup. ft. in district. Has great durability and strength, lasting in either wet or dry ground. Bark could be utilised for tanning purposes. Used for purposes of buildings, such as joists, flooring, piles, and studs; bed-plates for machinery, bridge-construction, railway-sleepers, and fence-posts. Value, 18s. per 100 sup. ft. Cannot be excelled for flooring for churches, theatres, and skating-rinks. Takes a splendid polish. Very scarce—a few clumps here and there throughout the district, but not obtainable in payable quantities.

6. *Cedar.*—Grows on swampy, poor land, intermixed with silver or yellow pine, and on mountain-slopes up to an elevation of 2,000 ft. 16,100,600 sup. ft. in this district. Very durable. Suitable for inlaying-work. Used for legs and sills for small bridges, fence posts and rails, piles, and small furniture. Value, 15s. per 100 sup. ft. Rarely exceeds 2 ft. in diameter in Nelson district. Resists fire to a remarkable extent: standing as a pile or telegraph-pole it will char in the outer skin, but will not burn. Its life is equal, if not superior, to that of matai or totara if the timber is from a thoroughly sound tree. Grows to a height of 50 ft. to 80 ft., except on swampy land, where it is stunted. Distribution mainly confined to northern portion of Nelson. Not obtainable in payable quantities.

3. *Totara kiri kotukutuku.*—Grows chiefly on ridges and high country; but is rare, there being a few odd trees throughout the Buller district. Similar to *Podocarpus totara*, but less durable. Used for same purposes as *Podocarpus totara*. Value, 18s. per 100 sup. ft.

8. *Southern Manoao.*—Grows on mountain ranges. Durable, but too small for industrial purposes. Used for posts, mine-props, &c. Grows at an elevation of from 2,000 ft. to 4,000 ft. above sea-level.

9. *Silver-pine* (Westland Pine).—Grows on sea-coast, and on poor swampy land; rarely on ranges flanking the coast, except in isolated clumps in rimu forest. 2,082,100 sup. ft. in district. Very durable and strong. Tar may be extracted from branches. Can be used for purposes of furniture. Easily worked. Used for railway-sleepers, fence-posts, bridge-piles, furniture, and house-piles. Value, £1 to £1 1s. per 100 sup. ft. Very limited supply, confined to southern portion of Nelson. Grows from 20 ft. to 40 ft. high. Considered the best generally useful timber in New Zealand.

10. *Yellow-pine.*—Grows on sea-coast and terraces. Usually in clumps, growing with cedar, on poor swampy land. 3,033,000 sup. ft. in district. Very durable. Much heavier than silver-pine. Used for railway-sleepers, fence-posts, piles, and in house-construction where durability is required. Value, £1 to £1 1s. per 100 sup. ft. Like silver-pine, possibly the most valuable timber in this district. Considered superior to silver-pine for sleepers. Will be cut out at no distant date. Grows up to height of 40 ft.

12. *Brown-birch* (Tawhai raunui, Tooth-leaved Beech).—River-flats where soil is light, sandy, and dry, resting on open shingle bottom, and on sidelings and mountain-slopes. Not necessarily on poor land. 2,236,888,080 sup. ft. in district. Very durable. If kept continually wet, would last from twenty-five to fifty years. When alternately wet and dry its life is from ten to fifteen years. May be used for wood-pulp for paper-manufacture, and distilling for acetic acid, tar, wood-naphtha, and the bark for tanning purposes. Used for bridge-construction, wharf-piles, beams, decking, sleepers, house-piles, floor-joists, fence posts and rails, and as mining-timber for leg-caps, stoping, lathes, stamper-beds, tramways, mills, palings, props, &c. Value, 13s. to 15s. per 100 sup. ft. One of the best timbers in the district if carefully selected. Warps if exposed to the sun. The best quality grows on flats where soil is light and sandy, resting on open shingle bottom. This timber, with other varieties of *Fagus*, comprises about three-fifths of the Nelson forest. Grows up to an altitude of 25,000 ft. above sea-level.

13. *Black-birch* (Tawhai rauriki, Entire-leaved Beech).—River-flats, low-lying localities, on sidelings and mountain-slopes. 651,229,000 sup. ft. in district. Less durable than *Fagus fusca*, but strong and tough, if not cut when immature. May be used for street-paving, or converted into wood-pulp for paper-manufacture, or distilling for acetic acid, tar, and wood-naphtha, or tanning purposes. Used for bridges and other constructive works, fence posts and rails, building-timber, mining-props, and spokes of wheels. Value, 13s. 6d. to 15s. per 100 sup. ft. Confined principally to northern Nelson district. There is great difference of opinion respecting the durability of this timber; it is not a favourite timber with sawmillers. Great care requisite in seasoning. Grows up to elevation of 2,500 ft. above sea-level.

14. *Tawhai.*—Same as tawhairauriki (above).

15. *Black-birch* (Tawai, Blair's Beech).—Grows on wet, sour ground, resting on coal-measures or old-man bottom (Pliocene). Decay sets in quickly when put to use. May be used for the same purposes as *Fagus solandri*. Used for mining purposes. Designated "black" or "swamp birch" in Inangahua County. Supply very limited.

19. *Northern Rata.*—Grows on rich soil, river-flats. Very durable in dry places. May be utilised for coach-building, railway-carriages, machine bearings and beds. Used by settlers for firewood. Very scarce; grows at Karamea and Brighton, Buller district.

20. *Southern Rata.*—Grows on rich and poor land, sea-coast, or in mountainous country. Very durable in dry places. May be used for coachbuilding, including carriages, machine-bearings, &c. Used for special construction-works at coal-mines, and for firewood. More valuable than northern rata, owing to straighter growth and greater density. Grows chiefly at Ngakawau, Kawatiri, and Brighton, but not in quantities to be of value for commercial purposes.

22. *Manuka rauriki.*—Grows on poor land, partly open country. Very durable under cover. Used for hop-poles, posts and rails, and firewood. Commonly known to bushmen as "tea-tree." Should be in the category of noxious weeds.

24. *Kowhai.*—Grows along river-banks, in good soil. Very durable; tough and strong. May be used for wheelwrights' work, axe-handles, slashers, &c. It is equal in all respects to the imported hickory. Used as fence-posts. Excellent for cultivation as a floral shrub. Very rare.

25. *Red-pine* (Rimu).—Grows on sea-coast, valleys, and lower slopes of main ranges, usually light soil. Seldom found above altitude of 2,000 ft. above sea-level. 529,284,000 sup. ft. in district. Not durable when exposed, except the rising heartwood of old trees. Used for general house-building purposes—window-sashes, doors, mantelpieces, dadoing, ceiling-panels; dredge-construction, poppet-heads, paddocks, lathes, underground props, sawmill-tramways, rails, sleepers, palings, shingles, and pickets. Value, 8s. to 9s. per 100 sup. ft. Very useful timber. Takes a high polish. Estimated quantity of timber, though comparatively large, is very scattered and inaccessible.

26. *White-pine* (Kahikatea).—Grows on good soil, deep, and inclined to be swampy. 62,003,000 sup. ft. in district. Not durable. Used for butter-boxes and cheap furniture. Value, 9s. per 100 sup. ft. Quickly attacked by wood-borer. At one time was mistaken for yellow-pine, and attained an undeserved favourable reputation.

27. *Miro* (Miro toromiro).—Grows on all classes of land. 183,000 sup. ft. in district. Suitable for flooring and inside building, if matured. Will not last if exposed to weather. Used for mine-props. At one time passed as black-pine, and used for sleepers. Scattered over southern portion of Nelson District.

28. *Tanekaha.*—Grows on poor soils, sea-coast, and mountains. Not durable when exposed to the weather. Excellent wood for violins and string-instruments. Used occasionally as mine-props. Rare in this district. The bark of this timber is valuable for tanning purposes.

29. *Mountain Toatoa.*—Grows on high altitudes. Not durable. Not used. Too small for purposes of utility.

31. *Mountain-beech* (Tawhai rauriki).—Grows on high altitudes above 3,000 ft., and on sour ground at lower level, resting on coal-measures or Pliocene. Strong, but not durable. May be converted into wood-pulp for manufacture of paper, or distilled for acetic acid, tar, and wood-naphtha, or the bark may be ground for tanning purposes. Used occasionally for mine-props. Forms chief portion of the forest between 3,000 ft. and 4,000 ft. altitudes.

32. *Silver-birch* (Tawhai, Silver-beech).—Grows from sea-level to snow-line, on damp or very dry ground. 1,066,272,000 sup. ft. in district. Not durable when exposed to the weather. Can be used for furniture, buckets, and wine-barrels; also for wood-pulp for paper-making, or distilled for acetic acid, tar, and wood-naphtha, or for tanning purposes. Used for mining purposes and for firewood. Value, 7s. per 100 sup. ft. Trees 2 ft. to 3 ft. in diameter grow at elevations of 3,000 ft. to 4,000 ft. above sea-level. Boards sawn from this timber twelve years ago are still sound. The only timber of value in Nelson which grows above 3,000 ft. level. Grows in damp soil or well-drained country. The timber growing on the high country is worth £30 an acre for mining purposes.

33. *Pukatea.*—Grows on good soil, swampy land. Only the heartwood of old trees is durable. Not used. Rare; a few trees near the Oparara River, Karamea district.

34. *Hinau.*—Grows on sea-coast and mountain-sides. Heartwood durable and suitable for straining-posts, bridge-sills, &c. Occasionally used as mine-props. A few trees throughout the district.

35. *Pokaka.*—Grows on sea-coast and mountain-sides. Not durable. Suitable for paper-making. Used for mine-props. Rarer even than the hinau.

38. *Titoki.*—Grows along sea-coast. Very rare, only found as small shrubs along warm coast to the north of this district.

43. *Towhai, or Kamahi.*—Grows on poor land, sea-coast, and mountain-sides. Fairly durable in some localities. Suitable for paper-pulping. Used for mine-props, firewood, and fence-posts. Too small and irregular for milling-timber.

44. *Porokaiwhiri.*—Grows on sea-coast, river-banks, or warm sandy soil. Not durable. Too small to be of use, except possibly for paper-making. Not used. Small quantities along sea-coast of district.

46. *Horopito* (Pepperwood).—Grows from sea-coast to 2,500 ft. Not durable, or of a size to be of much use. Not used. Scattered throughout the district as common scrub.

47. *Tarata.*—Grows on sea-coast and river-banks. Not durable. Not used. Rare and small; a few odd trees on coast.

49. *Tawhiwhi.*—Grows on sea-coast and river-banks. Not durable. Not used. Rare and small; a few trees on coast.

50. *Mahoe.*—Grows on warm sandy soil, river-flats. Not durable. Suitable for paper-making. Not used. Small quantity, chiefly on flats around Karamea.

51. *Huoi.*—Grows on good soil, chiefly river-banks, &c. Not durable. Suitable for paper-making. Very suitable for cultivation in gardens.

52. *Wharangi.*—Grows on sea-coast. Rare. Not durable, and too small to be of any use. Not used. Poisonous to horses and cattle.

53. *Kaikomako.*—Grows on river-flats near the coast. Not durable, or in any quantity to be of value. Not used. Very rare, odd trees being found in northern part of district.

54. *Ake.*—Grows on sea-coast (strictly littoral). Durable, hard, tough, excellent for mauls or where hard woods are required. Used for mauls and fence-posts. Rare. Few trees on beach at Totara, Buller, and Karamea Rivers. Most suitable for garden-hedge; grows quickly.

55. *Karaka.*—Grows on sea-coast. Not durable. Not enough to be of any value. Not used. Rare. Very few trees found along the coast. Suitable for garden-cultivation.

56. *Putaputa weta.*—Grows on sea-coast and hills. Not durable. Suitable for paper-making. Not used. Scattered in small quantities throughout the district.

57. *Kumarahou.*—Grows on sea-coast and mountain-sides. Not durable. Suitable for paper-making. Used occasionally as mine-props. Scattered in small quantities throughout the district.

59. *Manuka* (Kahikatoa).—Grows on river-flats, also poor land. Fairly durable. Used for fence-posts and firewood. Small quantity found throughout the district.

62. *Rohutu.*—Grows on river-flats, edge of forest. Not durable, and too small to be of any use. Not used. Small quantities found throughout the district.

63. *Rohutu.*—Grows on sea-coast to about 1,500 ft. Not durable. Not used. Small quantities found in the district.

64. *Kotukutuku.*—Grows in shady gullies, good soil, river-flats. Old trees are durable. Suitable for fence-posts. Used for fence-posts. Small quantity found throughout the district.

65. *Horoeka* (Lancewood).—Grows on sea-coast and mountain-sides. Not durable, and too small to be of much value. Not used. Scattered throughout the district.

67. *Papauma.*—Grows on sea-coast and mountain-sides. Fairly durable, though too small to be of value. Not used. Small quantities throughout the district.

70. *Yellow-wood.*—Grows on mountain-sides. Not durable; too small to be of any value. Not used. Not uncommon in high country.

72. *Large Milk-tree.*—Grows on river-flats, good soil. Fairly durable; clean, straight, tough. Suitable for axe-handles and such-like. Not used. Rare; odd trees found throughout the district.

73. *Heketara.*—Rocky cliffs and river-banks. Too small to be of any use, though fairly durable. Not used. Not uncommon, especially near Mount Frederick. Suitable for cultivation in garden; grows easily.

74. *Akeake.*—Grows on sea-coast and mountain-sides. Very durable in North Island. Too small here for use. Not used. Not uncommon in Buller Valley.

75. *Neinei.*—Grows on sea-coast and mountain-sides. Durable, though too small for use. Not used. Common throughout the district.

76. *Mountain Neinei.*—Grows from 2,000 ft. to 4,000 ft. above sea-level. Too small and scarce to be of any use. Not used. Confined to the mountain ranges. Not common.

77. *Inaka.*—Grows on sea-coast and mountain-sides. Too small and scarce to be of any value. Not used. Scattered throughout the district.

78. *Toro.*—Grows on sea-coast and mountain-sides. Not durable when in contact with ground. Occasionally used as mine-props. Scattered throughout the district.

79. *Matipou, or Mapau.*—Grows near sea-coast, warm situations. Not durable. Excellent firewood. Not used. Rare, only a few odd trees found along coast. Good hedge-plant.

82. *Ngaio.*—Found along sea-coast north of Ngakawau River. Not durable or of any value. Too rare. Suitable for shrub-cultivation.

84. *Houhere* (Lacebark).—Grows on river-flats, banks, and good soil. Not durable. Should be suitable for paper-making. Not used. Easily cultivated as a garden-shrub.

85. *Makomako* (Wine-berry).—Grows in new clearings, roadsides, river-banks. Not durable. Should be suitable for paper-making. Not used. Rapid in growth, requiring to be cut every year to keep clearing clean.

86. *Tumatakuru.*—Grows on sandhills and mountain-sides. Durable and tough, though too small to be of any value. Not used. Not common, occasionally seen on sandhills and in Buller Valley.

68. *Puka* (Broadleaf).—Grows on sea-coast and mountain-sides. Not durable. Not used. Common throughout the district.

Schedules of Quantities of Timber.

On Crown Lands.

Number on Map.	Locality: Survey District.	Area.	White-pine.	Black-pine.	Red-pine.	Yellow-pine.	Silver-pine.	Black-birch.	Brown-birch.	Silver-birch.	Cedar.	Miro.	Total.
		Acres.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.
1	Onetaua	2,080	100,000	..	1,100,000	..	..	2,300,000	22,000	..	16,000	..	3,538,000
2	Pakawau	11,800	..	..	6,120,000	46,000	26,000	6,100,000	12,200,000	47,000	29,000	..	24,568,000
4	Kahuranga	31,600	..	..	12,480,000	..	..	29,000,000	37,000,000	..	..	..	78,480,000
5	Wakamarama	5,200	..	..	2,600,000	..	..	3,000,000	5,200,000	1,000,000	..	..	11,800,000
6	Aorere	35,400	..	..	1,770,000	97,000	21,000	35,000,000	2,000,000	826,000	400,000	..	40,114,000
7	Waitapu	16,280	..	..	8,140,000	..	..	9,600,000	16,000,000	1,000,000	..	..	34,740,000
8	Totaranui	22,240	..	..	12,100,000	..	..	1,800,000	22,000,000	800,000	..	..	36,700,000
9	Wakapohi	46,080	1,000,000	..	24,000,000	..	..	30,000,000	38,000,000	14,400,000	..	..	107,400,000
10	Gouland	2,560	..	..	..	..	..	..	3,000,000	1,000,000	..	..	4,000,000
11	Waingaro	29,120	..	..	..	..	..	5,824,000	32,000,000	8,000,000	..	..	45,824,000
12	Takaka	34,400	..	..	17,000,000	..	..	10,300,000	30,000,000	17,000,000	..	..	74,300,000
13	Kaiteriteri	20,880	..	..	10,500,000	..	..	12,500,000	16,500,000	10,100,000	..	..	49,600,000
15	Oparara	77,536	500,000	..	42,160,000	250,000	250,000	70,000,000	77,000,000	32,000,000	..	..	222,160,000
16	Leslie	92,000	..	..	..	..	..	..	90,000,000	30,000,000	..	..	120,000,000
17	Harapaki	6,400	..	..	..	..	..	3,200,000	7,000,000	2,000,000	..	..	12,200,000
18	Flora	16,000	..	..	..	..	..	..	12,800,000	11,000,000	..	..	23,800,000
20	Mount Arthur	20,000	..	..	6,000,000	..	..	9,000,000	18,000,000	12,000,000	..	..	45,000,000
21	Motueka	7,240	2,170,000	..	..	..	..	3,620,000	5,800,000	4,000,000	..	..	15,590,000
22	Kongahu	10,000	3,000,000	..	..	..	..	6,000,000	8,000,000	4,000,000	..	..	21,000,000
23	Otumahana	64,800	2,000,000	..	..	..	..	20,000,000	54,000,000	36,000,000	..	..	112,000,000
24	Tasman	75,000	..	..	..	..	..	..	72,000,000	32,000,000	..	..	104,000,000
25	Wangapeka	38,000	3,800,000	..	..	..	..	14,000,000	30,000,000	17,000,000	..	..	64,800,000
28	Waimea	18,040	..	..	..	..	..	10,800,000	22,625,000	9,000,000	..	..	42,425,000
29	Maungatapu	1,480	500,000	..	940,000	..	..	1,000,000	1,790,000	827,000	..	..	5,057,000
30	Wakapuaka	4,040	..	..	2,420,000	..	..	3,230,000	3,000,000	810,000	..	..	9,460,000
31	Tapumutu	1,020	..	..	510,000	..	..	816,000	1,000,000	420,000	..	..	2,746,000
32	Wangamoa	3,400	..	..	1,700,000	..	..	2,100,000	2,800,000	1,360,000	..	..	7,960,000
35	Mokihinui	24,840	..	..	12,820,000	590,000	340,000	15,400,000	30,670,000	12,600,000	..	..	72,420,000
36	Marina	100,040	..	..	..	..	..	..	100,000,000	80,000,000	..	..	180,000,000
37	Taupo	7,040	..	..	..	..	..	2,800,000	5,700,000	3,500,000	..	..	12,000,000
38	Maunga	11,200	..	..	..	..	..	..	11,200,000	7,850,000	..	..	19,050,000
39	Owen	21,120	..	..	1,200,000	..	..	..	18,000,000	18,000,000	..	..	37,200,000
40	Tainui	3,840	..	..	..	..	..	..	3,900,000	3,000,000	..	..	6,900,000
41	Tadmor	29,480	..	..	9,700,000	..	..	16,240,000	31,000,000	9,000,000	..	..	65,940,000
42	Gordon	13,040	..	..	6,500,000	..	..	7,824,000	10,500,000	1,000,000	..	..	25,824,000
43	Rintoul	7,800	..	..	3,000,000	..	..	4,000,000	6,000,000	2,000,000	..	..	15,000,000
44	Ngakawau	21,997	..	..	9,420,000	..	..	13,900,000	20,700,000	4,000,000	..	..	48,020,000
45	Steeples	5,789	..	..	30,000,000	..	..	4,500,000	1,000,000	500,000	..	..	36,000,000
46	Kawatiri	3,394	..	..	500,000	..	..	3,000,000	1,500,000	500,000	..	..	5,500,000
47	Orikaka	36,480	2,620,000	..	17,240,000	..	..	10,480,000	50,000,000	23,000,000	2,700,000	..	106,040,000
48	Lyell	37,960	..	..	..	..	..	..	25,000,000	20,000,000	..	..	45,000,000
49	Matiri	43,117	1,000,000	..	..	..	..	..	45,000,000	30,000,000	..	..	76,000,000
50	Hope	42,240	..	..	..	..	..	..	40,000,000	27,500,000	..	..	67,500,000
51	Howard	40,515	..	..	1,000,000	..	..	..	37,000,000	23,000,000	1,000,000	..	62,000,000

Schedules of Quantities of Timber—*continued.*

Number on Map.	Locality: Survey District.	Area.	White-pine.	Black-pine.	Red-pine.	Yellow-pine.	Silver-pine.	Black-birch.	Brown-birch.	Silver-birch.	Cedar.	Miro.	Total.
					On Crown Lands—continued.								
		Acres.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.
25	Motupiko	12,990	..	..	3,900,000	..	..	7,800,000	23,000,000	7,420,000	..	..	42,120,000
53	Waitakere	42,740	200,000	..	20,000,000	250,000	250,000	25,000,000	22,000,000	2,000,000	500,000	..	70,200,000
54	Ohika	81,848	..	..	17,800,000	100,000	60,000	35,600,000	68,000,000	26,000,000	200,000	..	147,760,000
55	Inangahua	65,910	5,000,000	..	9,670,000	20,000	39,600	..	32,000,000	18,300,000	..	77,000	65,106,600
56	Maruia	6,100	100,000	..	..	..	..	..	4,880,000	2,190,000	..	..	7,170,000
57	Tutaki	62,500	..	..	..	..	..	..	69,760,000	32,350,000	..	..	102,110,000
58	Rotoroa	50,120	1,700,000	..	3,300,000	..	..	..	53,000,000	32,000,000	..	..	90,000,000
59	Arnaud	24,520	360,000	..	1,100,000	..	..	11,000,000	22,000,000	10,000,000	..	..	44,460,000
60	Roto-iti	5,960	..	..	..	..	..	..	6,000,000	3,000,000	..	..	9,000,000
61	Brighton	51,160	..	..	6,000,000	..	..	2,000,000	32,000,000	28,000,000	..	..	68,000,000
63	Mai Mai	25,000	4,000,000	..	..	..	..	..	20,000,000	20,000,000	..	..	44,000,000
64	Reefton	48,194	1,800,000	44,000	5,230,000	10,000	121,000	100,000	40,000,000	20,000,000	..	46,000	67,351,000
65	Burnett	24,211	..	..	..	..	..	..	18,000,000	10,000,000	..	..	28,000,000
66	Matakitaki	65,900	1,000,000	50,000	2,000,000	..	..	..	58,000,000	40,000,000	..	..	101,050,000
67	Sabine	25,080	..	..	..	..	..	..	36,000,000	22,000,000	..	..	58,000,000
73	Part Mawheraiti	40,312	2,020,000	..	38,900,000	76,000	202,000	1,000,000	39,920,000	24,000,000	..	..	106,118,000
74	Waitahu	84,400	1,250,000	..	..	..	..	..	94,208,000	30,120,000	..	..	125,578,000
75	Rahu	29,440	..	..	..	..	..	..	17,000,000	27,160,000	..	..	44,160,000
76	Una	28,080	..	..	..	..	..	..	28,000,000	14,000,000	..	..	42,000,000
85	Lewis	8,320	..	..	..	..	..	..	5,312,000	8,000,000	..	..	13,312,000
86	Travers	12,800	..	..	..	..	..	..	11,000,000	9,480,000	..	..	20,480,000
	Total	1,936,073	34,120,000	94,000	348,820,000	1,439,000	1,309,600	449,834,000	1,756,987,000	898,060,000	4,845,000	123,000	3,495,631,600
					On Private Lands.								
1	Onetaua	1,260	63,000	..	630,000	..	..	1,260,000	10,080	..	12,600	..	1,975,680
2	Pakawau	31,300	1,600,000	626,000	15,000,000	130,000	80,000	15,650,000	30,000,000	939,000	123,000	..	64,148,000
3	Paturau	7,680	786,000	220,000	3,930,000	..	..	4,716,000	7,860,000	..	..	..	17,512,000
5	Wakamarama	42,000	3,360,000	827,000	29,400,000	..	..	25,200,000	46,200,000	2,000,000	..	..	106,987,000
6	Aorere	3,000	400,000	110,000	1,000,000	320,000	93,000	600,000	4,200,000	..	420,000	..	7,143,000
7	Waitapu	1,000	60,000	20,000	800,000	..	..	200,000	1,200,000	100,000	..	..	2,380,000
8	Totaranui	4,000	120,000	..	3,200,000	..	..	1,300,000	4,800,000	..	..	..	9,420,000
12	Takaka	4,000	93,000	47,000	2,700,000	124,000	62,000	1,620,000	5,100,000	342,000	1,200,000	..	11,288,000
13	Kaiteriteri	6,000	108,000	51,000	4,200,000	..	..	1,800,000	6,420,000	..	..	..	12,579,000
15	Oparara	3,740	394,000	..	8,480,000	..	..	5,400,000	1,870,000	..	..	..	16,144,000
20	Mount Arthur	4,960	..	..	1,000,000	..	..	2,486,000	4,900,000	400,000	..	..	8,786,000
21	Motueka	3,000	..	32,000	1,200,000	..	..	1,500,000	3,300,000	320,000	..	..	6,352,000
22	Kongahu	1,000	..	..	3,000,000	..	..	7,000,000	3,000,000	2,000,000	..	..	15,000,000
23	Otumahana	9,000	2,000,000	..	5,000,000	..	..	9,000,000	6,000,000	3,000,000	..	..	25,000,000
25	Wangapeka	6,160	..	..	1,850,000	..	..	3,000,000	6,160,000	1,850,000	..	..	12,860,000
26	Wai-iti	3,000	..	..	1,500,000	..	..	963,000	2,400,000	872,000	..	..	5,735,000
28	Waimea	5,000	250,000	300,000	3,000,000	..	..	1,000,000	6,000,000	627,000	..	..	11,177,000
29	Maungatapu	5,800	..	..	2,700,000	..	..	820,000	7,000,000	400,000	..	..	10,920,000

On Private Lands—continued.

31	Tapumutu	900	50,000	30,000	450,000	..	..	500,000	1,000,000	214,000	..	..	2,244,000
35	Mokihinui	7,000	750,000	..	3,500,000	..	..	3,000,000	9,000,000	1,300,000	..	..	17,550,000
41	Tadmor	20,000	420,000	300,000	10,000,000	..	..	12,000,000	23,000,000	8,000,000	..	..	53,720,000
42	Gordon	10,000	320,000	260,000	6,000,000	..	..	8,000,000	13,000,000	6,000,000	..	..	33,580,000
43	Rintoul	5,000	270,000	180,000	3,800,000	..	..	5,000,000	5,500,000	4,000,000	..	..	18,750,000
44	Ngakawau	200	..	..	200,000	..	..	180,000	240,000	..	..	..	620,000
45	Steeples	200	300,000	..	900,000	..	..	120,000	500,000	..	..	..	1,820,000
46	Kawatiri	1,000	900,000	..	..	..	..	100,000	500,000	..	..	..	1,500,000
49	Matiri	23,600	4,000,000	1,200,000	600,000	..	..	..	40,480,000	14,720,000	..	..	61,000,000
51	Howard	3,605	..	..	1,100,000	..	..	1,500,000	2,100,000	2,500,000	..	..	7,200,000
52	Motupiko	13,050	..	..	4,000,000	..	..	7,000,000	13,000,000	7,000,000	..	..	31,000,000
53	Waitakere	900	..	..	500,000	..	..	1,000,000	..	50,000	..	..	1,550,000
55	Inangahua	6,900	5,420,000	6,000	8,710,000	..	..	490,000	4,680,000	1,128,000	..	60,000	20,494,000
56	Maruia	25,890	1,600,000	600,000	..	..	..	..	23,255,000	21,170,000	..	..	46,625,000
57	Tutaki	13,000	..	..	..	..	..	..	13,700,000	7,400,000	..	..	21,100,000
59	Arnaud	404	..	..	..	..	..	100,000	500,000	270,000	..	..	870,000
60	Roto-iti	3,000	..	..	..	..	..	..	8,400,000	900,000	..	..	9,300,000
61	Brighton	1,520	..	..	500,000	..	..	..	..	..	..	..	500,000
63	Mai Mai	800	..	..	..	..	..	..	800,000	800,000	..	..	1,600,000
64	Reefton	9,120	214,000	46,000	900,000	20,000	37,500	..	9,240,000	8,000,000	..	..	18,457,500
65	Burnett	15,000	..	..	..	..	..	..	13,500,000	9,160,000	..	..	22,660,000
66	Matakitaki	4,240	..	..	..	..	..	..	6,300,000	2,800,000	..	..	9,100,000
73	Part Mawheraiti	2,000	400,000	..	520,000	..	..	..	2,000,000	2,000,000	..	..	4,920,000
75	Rahu	..	..	..	..	..	..	..	..	..	..	..	..
	Total	309,229	23,878,000	4,855,000	130,270,000	594,000	272,500	122,505,000	337,115,080	110,262,000	1,755,600	60,000	731,567,180

On Native Lands.

15	Oparara	260	106,000	..	520,000	..	..	400,000	130,000	..	..	..	1,156,000
30	Wakapuaka	13,000	1,300,000	92,000	6,500,000	..	..	3,900,000	13,000,000	7,800,000	..	..	32,592,000
32	Wangamoa	3,000	1,200,000	230,000	1,600,000	..	..	1,400,000	3,600,000	420,000	..	..	8,450,000
34	D'Urville	28,160	365,000	318,000	14,000,000	..	..	11,264,000	33,000,000	2,400,000	..	..	61,347,000
	Total	44,420	2,971,000	640,000	22,620,000	..	..	16,964,000	49,730,000	10,620,000	..	..	103,545,000

On Reserves.

15	Oparara	..	..	..	..	..	..	..	..	..	..	..	..
22	Kongahu	..	..	..	..	..	..	..	..	..	..	..	..
23	Otumahana	..	..	..	..	..	..	..	..	..	..	..	..
26	Wai-iti	3,605	200,000	200,000	1,200,000	..	..	1,700,000	3,605,000	1,100,000	..	..	8,005,000
28	Waimea	..	..	..	..	..	..	..	..	..	..	..	..
32	Wangamoa	400	47,000	23,000	200,000	..	..	240,000	400,000	..	..	..	910,000
35	Mokihinui	19,000	..	..	5,000,000	..	..	19,000,000	3,000,000	500,000	..	..	27,500,000
36	Marina	..	..	..	..	..	..	..	..	..	..	..	..
41	Tadmor	..	..	..	..	..	..	..	..	..	..	..	..
42	Gordon	..	..	..	..	..	..	..	..	..	..	..	..
43	Rintoul	..	..	..	..	..	..	..	..	..	..	..	..
44	Ngakawau	18,000	..	..	8,000,000	1,000,000	500,000	18,000,000	4,000,000	1,500,000	500,000	..	33,500,000
46	Kawatiri	15,000	..	..	4,500,000	..	..	13,000,000	5,000,000	1,000,000	..	..	23,500,000
47	Orikaka	3,800	..	..	..	..	..	..	7,800,000	1,200,000	9,000,000	..	18,000,000

SCHEDULES OF QUANTITIES OF TIMBER—*continued.*

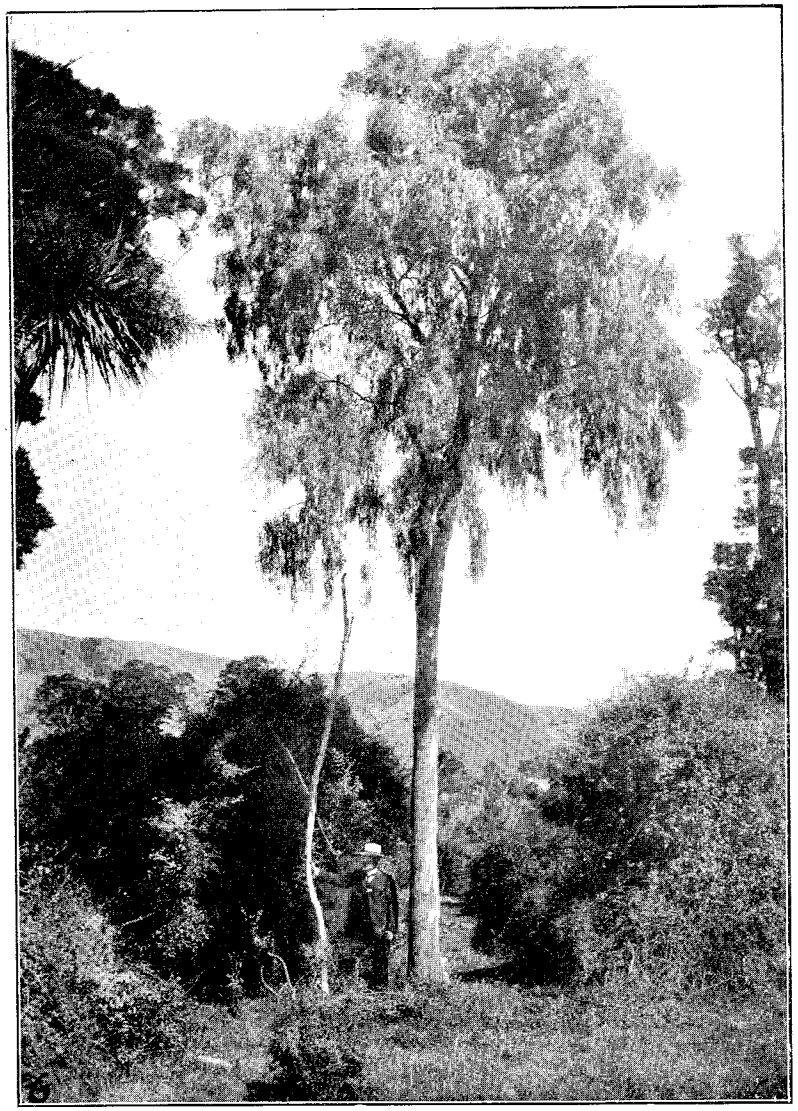
Number on Map.	Locality : Survey District.	Area.	White-pine.	Black-pine.	Red-pine.	Yellow-pine.	Silver-pine.	Black-birch.	Brown-birch.	Silver-birch.	Cedar.	Miro.	Total.
	On Reserves—continued.												
		Acres.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.
48	Lyell	14,000	..	..	680,000	..	..	..	14,600,000	6,000,000	..	..	21,280,000
49	Matiri	1,963	..	..	..	..	..	..	2,000,000	1,200,000	..	..	3,200,000
50	Hope	9,200	..	..	..	..	..	..	8,000,000	7,360,000	..	..	15,360,000
51	Howard	2,600	..	..	1,300,000	..	..	826,000	2,600,000	2,000,000	..	..	6,726,000
52	Motupiko	200	..	..	87,000	..	..	160,000	350,000	..	..	..	597,000
54	Ohika	8,000	..	..	3,000,000	..	..	8,000,000	5,000,000	2,000,000	..	..	18,000,000
55	Inangahua	4,470	..	..	447,000	..	..	..	3,576,000	2,620,000	..	..	6,643,000
56	Maruia	16,000	600,000	..	..	..	..	..	14,000,000	9,300,000	..	..	23,900,000
57	Tutaki	..	..	..	..	..	..	..	..	..	..	..	..
58	Rotoroa	5,100	..	..	..	..	..	..	7,100,000	4,000,000	..	..	11,100,000
60	Roto-iti	3,600	..	..	360,000	..	..	..	3,600,000	3,000,000	..	..	6,960,000
65	Burnett	2,900	..	..	..	..	..	..	4,000,000	2,000,000	..	..	6,000,000
2	Pakawau	1,870	187,000	..	1,000,000	..	..	..	825,000	1,870,000	..	..	3,882,000
29	Maungatapu	3,000	..	..	1,800,000	..	..	1,000,000	3,600,000	680,000	..	..	7,080,000
	Total	133,308	1,034,000	223,000	27,574,000	1,000,000	500,000	61,926,000	93,056,000	47,330,000	9,500,000	..	242,143,000
	Total on Crown, Native, and Private Lands, and on Reserves.												
..	Crown lands	1,936,073	34,120,000	94,000	348,820,000	1,439,000	1,309,600	449,834,000	1,756,987,000	898,060,000	4,845,000	123,000	3,495,631,600
..	Native lands	44,420	2,971,000	640,000	22,620,000	..	..	16,964,000	49,730,000	10,620,000	..	..	103,545,000
..	Private lands	309,229	23,878,000	4,855,000	130,270,000	594,000	272,500	122,505,000	337,115,080	110,262,000	1,755,600	60,000	731,567,180
..	Reserves	133,308	1,034,000	223,000	27,574,000	1,000,000	500,000	61,926,000	93,056,000	47,330,000	9,500,000	..	242,143,000
..	Grand totals	2,423,420	62,003,000	5,812,000	529,284,000	3,033,000	2,082,100	651,229,000	2,236,888,080	1,066,272,000	16,100,600	183,000	4,572,886,780

F. W. FLANAGAN,
Commissioner of Crown Lands.



MANUKA-TREES, AUCKLAND DOMAIN.

Face p. 48.]



KOWHAI (*Sophora tetraptera*).
[*Grace Matthews, photo.*



RIMU-TREE (MANGANUI SURVEY DISTRICT).

WESTLAND.

The Westland District occupies the central portion of the western watershed of the South Island. The main length is 225 miles, and its average width twenty-seven miles. The area is 6,086 square miles, composed for the most part of the great central snow-clad mountain-chain and its outrunning ranges, intersected by narrow valleys, and subsiding westward into undulating plateaux, river-straths, and shelving coasts.

The main range, Southern Alps (which is the dividing elevation or backbone of the South Island), constitutes the eastern boundary of Westland for its entire length. This mountain system is snow-covered almost from end to end, and its ice-clad lofty peaks uplift from the snowfields which cap the less abrupt elevations, and which fill the immense intervening hollows (*névés*). Subsidiary ranges, varying in height, radiate chiefly from "knots" in this great central chain, and are snow-coated most of the year. From these, again, ravined ridges descend steeply into the valleys, or fall abruptly to the level of the inland plateaux of the littoral country. The westward faces of these spurs at one time formed the sea-wall. From the sheets of *névé* snow, alluded to above, numerous glaciers, with feeders from the lateral ranges, extend down the upper main valleys, presenting every form of ice-action, and from these the principal rivers take their rise. Parallel with the central mountain-chain, and linked to it by low narrow saddles in the northern districts, are isolated mountains, varying in extent and height, which are the remnants of an ancient granite range that once extended along the old coast-line. The bold flat-topped Paparoa Range, lying between the central Grey Valley and the sea-coast, is another island hill. And the seaward country between Jackson and Big Bay, in the far south, is wholly occupied by high outlying hills directly connected with the inland ranges. From Jackson Bay to the northern boundary of the district there is an almost continuous extent of drift country lying between the foot-hills of the great mountain-chain and the sea-coast; a continuity of broad-topped hills and hillocky ridges of moderate elevations; immense terraces of glacial drift, river and lake gravels, shallow valleys, and gently sloping coastal lands.

Thus, Westland may be roughly classed into two divisions—viz., highlands and lowlands, the former consisting of the great main range (Southern Alps) and its western mountainous offshoots, with numerous intervening valleys; the low-lands, again, comprising the champaign country between the high-lands and the sea-coast.

Generally speaking, the whole of the district is covered with dense forest, from the sea-beach to the grass-grown tops of the high ranges, even the broken mountain-faces being wrapped with exuberant foliage.

The height of the "bush-line," sometimes called the "grass-line," above sea-level varies all over Westland, sometimes dropping to 2,800 ft., and again rising to 5,000 ft.; the mean height may be taken as 3,500 ft. In a few localities the forest is slowly forcing its way upwards.

Alpine Forest.

From the "grass-line" (3,500 ft.) down to 2,000 ft. the forest may be termed "alpine," and consists of numerous varieties of scrub, and various kinds of small trees, stunted, twisted, and gnarled by frequent gales and snowfalls. In certain localities, such as the Upper Grey Basin, the Mahitahi, Landsborough, &c., the bush forest grows right up to the grass-line, stunted, but yet a forest tree; in such places there is rarely any alpine scrub. This alpine forest, as yet, has been incapable of commercial use, the scrubs not being of any known value, and the stunted trees below the scrubs being only fitted for woodwork for mountain roads, mines, or firewood. However, with a view to utilising this alpine bush for wood-pulping, under the provisions of section 141 of "The Land Act, 1908," two wood-pulp reserves, aggregating 50,000 acres, have been set apart in the Teremakau Valley, and a company has taken up an area of 30,000 acres, and is now importing the necessary machinery, and expect to commence operations at an early date. Should this venture prove successful, it is assured that other mills will be started, as there are large areas available in all parts of the mountain country which carry forest reputably suitable for the manufacture of wood-pulp.

The approximate total area of alpine forest—*i.e.*, from 2,000 ft. up to the "grass-line"—is 812·5 square miles, or 520,000 acres.

Mountain Forest.

Along the seaward faces of the ranges outrunning from the main divide and the diversified slopes of the intervening valleys up to 2,000 ft. above sea-level, there are immense quantities of high-class milling-timber, such as red-pine, totara, cedar, beech, and even rata (the latter with a fair workable barrel). All such timbers are tough, with nicely figured grain, and well fitted for all industrial purposes in which strength, flexibility, durability, or ornamental beauty is desired. This great belt of timber is, for the most part, at present not come-at-able, owing to the initial cost of procuring the timber and the expense of transport, which prevent its commercial exploitation.

The mountain-valleys of the larger rivers—viz., those which flow from the main divide—have in their lower portions fairly flat floors where the rivers are flanked by high, narrow-topped drift terraces which are covered with good commercial forest, but of no great local extent. Small flats and narrow level-surfaced well-timbered areas on the immediate banks of the rivers are ordinary features, but these have become much reduced in extent, owing to the continued damage by floods. Consequently, it may be confidently affirmed that while in all the inland valleys there are large quantities of fine milling-forest on the bottom-lands, the flanking terraces, and lower hillsides, yet these timbers are only available at present for mining purposes, bridge and road works, or for the scattered homesteads of such settlers as dare the reclamation of the wilderness.

Difficulty of access and consequent cost of cartage, for the most part, preclude all present attempts to commercially utilise the forests of these mountain-valleys; and all attempts in the past of utilising these swift snow-born rivers for flotation of timber have been disastrous and ruinous.

The approximate total area of "mountain forest"—*i.e.*, between 600 ft. and 2,000 ft. above sea-level—is 1,627·8 square miles, or 1,041,280 acres.

Forest in the Low Lands.

As noted above, the low lands comprise fairly high hummocky rounded hills, glacial moraines of all classes, high tablelands, broad plateaux, immense areas of sea-formed terraces, lacustrine formations, and the ordinary fluviatile deposits in the numerous river-valleys.

Dispersed all over these low lands are numerous lakes. All vary in character—coastal tidal lagoons, shallow reedy sheets, deep hill-girt waters. The deeper lakes occupy the basins scooped out by ancient glaciers that have receded ages ago. Some, again, are slowly filling up with the shingle poured into them by the mountain rivers and streams, whilst others are rising very slowly but definitely, and a few are only remnants of very extensive sheets of water, as the high marginal lake-formed terraces prove.

In conjunction with their effluents, these lakes, in some cases, form valuable waterways for the transport of timber, minerals, produce, and goods.

Numbers of pakihi, or open lands, of more or less extent, occur all over the district, these, of course, being devoid of forest.

Leaving out the lands already denuded of bush by the settler, sawmiller, and miner, and also the comparatively small areas of the lakes, pakihi, rivers, and swamps, we may say that the whole of the low lands is covered with forest. The varieties of trees differ considerably, according to soil and altitude. Kamahi and rata are the chief timbers—very useful for firewood and mining purposes; and, being spread nearly over the whole district, constitute an inexhaustible supply. Rimu is the chief milling-timber, and this also, intermixed with miro and hinau, is widely distributed from the seaboard to the interior uplands. Valuable stretches of white-pine belt the low-lying coastal lands, river-margins, environs of lakes, and swampy depressions; and the same may be said of the silver-pine, though numerous detached areas of these timbers also occur on many broad terraces where free drainage is checked by the impervious nature of the impacted glacial drift on which the soil rests. Patches of black-pine (matai) are met with, generally on the deep alluvium of river-bottom lands; also rarer clumps of totara; stunted totara frequently occur on the small ridges and hollows of the strips of the sand-dunes along the sea-coast; while cedars, more or less singly, are scattered along the flanks of the inland hills and all over the lower terraces and plateaux, but rarely within six miles of the coast. Very often isolated "islands" of fine tall cedars occur in the saddles between the interior high lands and the foothills and the elevated terraces of the low lands. Kowhai never grows large, and is rarely found inland, but often lines the sluggish streams and lagoons immediately along the sea-coast; but, owing to its small size hereabouts, it is of no commercial value. Broadleaf is found in dry-bottom lands, mostly in scrub form and in patches, but scattered isolated mature trees of workable size occur in many localities. All the forest, in a narrow strip along the sea-coast, is "wind-clipped"; the result of exposure to the prevailing westerly gales from the open ocean being that all these timbers, great or small, are toughened and full of "pattern," as the furniture-men say.

"Wind-rows" are of infrequent occurrence, and only four of any magnitude are known—viz., in the Teremakau, Thomas, Arawata, and Ahaura Valleys. These are invariably due to the easterly gales which, at times, sweep up the eastern faces of and over the main divide, to roar down the Westland valleys, often for a few days, and do immense damage to much of the inland forest.

At irregular intervals—from eight to twenty years—we have heavy successive falls of snow, often followed by a great easterly wind, the double effect of the snow and wind pressure being to devastate the forest, principally in a belt lying between 1,200 ft. and 2,500 ft. above sea-level. Sometimes the strip of fallen timber extends right along the mountain-faces of the mountain-range, with breaks here and there, principally on the subsidiary ridges and spurs, where partial shelter obtains. Again, it frequently happens that the main gale and snowfall are confined in extent and strength to the north or south, and thus certain forest lands are either swept or escape damage. The effects of this extraordinary weather-damage to the mountain forests remain for many years, for in scrambling up through the bush which so closely coats our hillsides we often fall in with a belt of fallen timber, and experience much toil and vexatious delay in dodging a way over and under an interlocked abatis of prostrate tree-trunks, greasy with decay, and smothered in between with a dense undergrowth eagerly pushing its way into the unwonted sunlight. A certain quantity of forest is periodically destroyed by land-slides and river-floods. In the higher regions of the watersheds of our great alpine rivers an irregular descent of small snow-slides occurs; these gash lanes through the alpine forest, leaving streaks of bare rock and shale completely swept of vegetation. At long intervals, immense avalanches plunge down from the high, surcharged snowfields and ice-filled gullies, tearing away large quantities of forest, eventually sweeping into and often completely filling up the whole valley-floor, and there overlying a fair extent of timber. Again, in the inland valleys, during the intervals of rest, the mountain-sides become gradually covered with a coating of dust, sand, and disintegrated shale, derived from the frost-riven rocks above the bush-line. This shale and dust coating is constantly working its way down through the bush (which roots into and partially binds it), partly by gravitation and partly by snow-thaws, until it reaches the base of the mountain, and there for many years may remain at rest. Eventually a wave of shingle (the residuum of some great avalanche higher up the valley) raises the bed of the river, and forces its waters against the toe of this shale-screen; the boulders, driven by the raging current, pound and hammer down the loose drift, with the frequent result that large slips, loaded with timber, come down for thousands of feet. Often this shale accumulates on these sidelings, being held back by the tree-

trunks and matted undergrowth until it fairly curves out into an unsafe bulge, which, on becoming saturated with water, and receiving the impact of a sudden thaw, streams downward in forest-devastating strength. Frequently the whole of the sides of a great inland valley are screened by the accumulated rock-waste and shale of ages past, and these so completely overgrown by scrub and forest that hardly a break is visible in its splendid canopy of varied greenery. But, as noted above, the "safety" slope of the water-soaked mass of loosened mountain waste eventually becomes so weakened that even such a "shoogle" as the continued tremor of an earthquake sets the shale into such destructive motion that the valley now presents aspects of bare, rugged faces, destitute of all vegetation except that clinging to those portions of the ridges and spurs, which from their rocky nature and location were immune from this disaster.

Fires never cause any serious damage in the low lands. This is owing to the humid climate, for it may be confidently asserted that it is impossible to burn the standing forest; and the extreme difficulty of getting a "good burn," even of fallen bush and other undergrowth, is one of the greatest drawbacks to our pioneer settlers. Along the main roads, the "second growth" has to be periodically cut down, and when dried is frequently fired, but in no case does the fire extend into the adjoining forest. In a few localities, where immature bush intermingled with manuka scrub skirts the road, the fire may spread for a few chains, but does no damage to any commercial timber. In a short time these semi-burnt areas are again overgrown.

Sometimes the sheep-farmers, who in summer depasture flocks on the grass lands immediately above the bush, set the strong, coarse herbage in a blaze, and consequently fire the adjoining alpine forest, which is thereabouts chiefly composed of stunted brooms, akeake, yellow-pines, &c.; all these shrubs are full of turpentine, and therefore very combustible. Nevertheless, such fires rarely extend more than a short distance down or along the faces of the mountains, and, as only a few scattered grass-grown hilltops are available as sheep pastures, a very small area is liable to be burnt. Comparatively small scattered acreages of timber in the low lands are killed by water being dammed back by land-slides, and also by the *débris* and tailings from gold mining and sluicing claims; but the total damage from these sources during the past forty-five years aggregates comparatively a small acreage.

In Westland, wherever the forest has been destroyed by either natural or artificial causes, its recuperative powers are magnificent, for whenever spaces are swept of bush by landslides in the high lands almost immediately these bare streaks are covered with greenery, usually in the first place *fuchsia* and lace-barks, and in a few years these gaunt scars are quite healed up, and it takes the expert's eye to detect the locations of the original slips. Likewise, in the low lands, the abandoned sites of sawmills, mining camps, or other artificial clearings are soon covered with luxuriant small bush; in fact, our settlers experience considerable difficulty in keeping down and effectually getting rid of what is known as the "second growth."

In ancient times this district was occupied by a forest, of which only a few isolated gigantic trees now exist, and these are scattered singly all over the low lands; they comprise white, red, silver, and black pines, hinau, totara, manuka, and beech, as well as birch. A small number are still erect and flourishing, but others again have fallen, and startle the bushmen, when they happen on them, by the huge size of their prostrate trunks. So far as we yet know, no extra large trees are to be met with on the high lands of Westland: they all occur on the low lands, between the foothills and the sea-coast.

One marked feature of our forest is the absence of old trees—that is to say, no decayed matured trees, either standing or fallen, are to be seen. In the high lands certainly, dead, fully matured trees occur amongst the beech, cedars, and totara in the higher mountain forests, but rarely below 1,500 ft. above sea-level. As this upper timber naturally decays, rimu and other kinds which are completely new to higher lands are taking their place, and these young immature trees may be easily picked out as they dot and fleck by their bright foliage the sombre older forest.

All over the low lands, in almost every place where clearings in the forest are made or occur through land-slides, certain shrubs, plants, and ferns (totally distinct from the ordinary bush undergrowth) forthwith spring up with a strong and vigorous vitality, thus showing that in ancient times the district was more or less destitute of bush, and was assuredly mostly covered with the ordinary vegetation characteristic of open country. Contemporaneously with these scrub and bracken-fern growths, possibly the old giant forest, previously noted, may have been distributed over this champaign country in clumps and irregular strips, whence the present forest may have gradually spread, and, owing to climatic changes, obtained complete possession; the seeds of the previous open-country growths meanwhile lying dormant in the soil, ready to shoot up when exposed to direct sunlight.

The approximate total area of forest in the low lands—*i.e.*, between the seaboard and 600 ft. above sea-level—is 1,181 square miles, or 755,840 acres.

The total area of forest lands in Westland is 3,621·3 square miles, or 2,317,660 acres.

Varieties of Timber Trees, and Uses.

Note.—In the following descriptions, the sizes of the barrels of the separate timbers are given, as for sawmilling, and not the actual height, &c., of the whole trees.

2. *Totara.*—Occurs in limited areas, from Nelson boundary down to Gorge River, in South Westland. Usually grows on stony flats of rivers, on the lower foothills, and (only as stunted trees and creeping wind-clipped scrub) immediately along the sea-board. Grows in fairly large patches, but usually as scattered trees amongst other timber. Average size, 20 ft. by 2 ft.; a fair number of odd trees 50 ft. by 4 ft. It is principally used for house-building, stock-yards, fencing-posts, shingles, sleepers, window-sashes and fittings, bridge-work, and especially for fine furniture. It will not do for boat-building, as it is too easily cracked; but the small gnarled twisted trees which grow along the narrow strips of old sand-dunes bordering the sea-coast and adjoining lagoons furnish first-class knees, thwarts,

&c., palings for fences, and shed-roof shingles. One forest of this timber, called "white-heart" by wood-cutters, with small red core, may be termed "immature." Often, owing probably to weakness of soil, the saplings grow hollow and useless; but there are a few scattered areas of mature, well-grown trees which are fitted for any purpose requiring lasting qualities; also a small quantity of stumpy trees, full of knots and twisted grain, much used for furniture. The immature timber noted above is not lasting, and fences made of it rot in about six years; but the heavier totara and the knotty trees are very durable, and are fitted for any purpose requiring durability.

3. *Totara kiri kotukutuku.*—Occurs from the Nelson boundary to Big Bay. Grows chiefly inland, and rarely found immediately adjacent to sea-coast; often found on faces and tops of mountain-spurs up to 2,000 ft. above sea-level; fit for milling, occurs only in small patches and strips, also as isolated trees such as those on limestone ridges east of Greymouth; very little sap-wood, usually termed "red heart." Average size, 35 ft. by 2 ft. 6 in.; largest, 60 ft. by 6 ft. A giant tree grows in Upper Kakapotahi Valley, which is 25 ft. by 9 ft.; and yet another high up the Wanganui River. This timber has an assured character for durability. It is in great demand for buildings, bridges, culverts, sleepers, fencing, and furniture. The bark is also much used by settlers for the roofing of sheds, stacks, &c. Could possibly be used for cotton-reels, pencils, &c.

The above two timbers are intermixed, and information regarding each variety is very conflicting. It is very questionable whether the dwarf totaras immediately bordering the sea-coast and the "grass-line" on the mountains are not each a distinct variety, and therefore not to be classed with either 2 or 3.

4. *Matai.*—Occurs from Nelson boundary down to Cascade River. Never found on hills; always on river-flats, and generally as big trees; grows on good land; only saw one patch (50 acres) of immature trees; small areas occur on the flats of nearly all the rivers, also scattered trees; odd trees in Jackson Valley have a fine crop of berries, which are fed off by wild pigeons and other birds. Known in Westland as "black-pine." Average size 4 ft. to 60 ft. by 3 ft.; also found quite 8 ft. through, with short, bunched trunks dividing into several long heavy branches. Does not taper, but keeps diameter right up. In lieu of better adjacent timber, is used by settlers for fencing. Much of it has a nice wavy grain, and is used for heavy furniture and inside house-fittings, mantelpieces, &c. Reckoned best timber for flooring, as it does not shrink. Also for small bridges, culverts, and firewood. Not considered good lasting wood in ground, but excellent under water, as wharf-piles, &c.

6. *Pahautea, or Cedar.*—Is found from Nelson boundary down to Cascade River. May be termed a mountain timber. Small patches almost invariably occur in the damp mossy saddles between the main and foot hills, and on sides of hills and terraces odd trees are also found nearly all over the district, and in a few instances in patches ranging from 1 to 100 acres, such as in Clearwater Valley, &c., the greatest area being in the Upper Whitcombe Valley, where it constitutes the main forest; but there, as elsewhere amongst the ranges (2,000 ft. above sea-level), it is evidently dying out, there being many dead trees, upright and lying. The dead and green standing trees are usually smothered with a streaming white moss. Generally prefers damp, wettish soil. Fairly extensive areas of stunted and immature trees occur on the thin wet soil which rests upon impacted glacial moraines. Average size, 30 ft. by 18 in.; largest known, 4 ft. diameter, 80 ft. barrel; tapering spars of 70 ft. and 80 ft., 2 ft. and 2 ft. 6 in. in diameter at base, are fairly frequent. Clean straight trunk; branches small and high up; very fine and straight in grain. Splits easily. Sodden and heavy when green, and will not float, but extremely light (cork-like) when seasoned. Will not burn green, and poor firewood when dry. Brittle timber, with soft surface; apt to twist as laths; clean-grained wood does not warp so much as that with "oval" grain. Used for house-building (especially inside fittings), bridges, culverts, telegraph-poles, sleepers, venetian-blind laths (several makers do not use it on account of timbers warping badly), fencing-posts, palings, punts, and sluice-boxes. Bark used for roofing. Good timber for flumes; and much valued for canoe and boat building, on account of its extreme lightness, but must be varnished or otherwise it becomes water-soaked. Makes choice furniture. Should do for pencils, &c. Much esteemed by settlers and miners, but not in favour by others, for local sawmillers receive few orders for this timber. Very durable, but posts when set in sandy ground along sea-coast are apt to rot, the timber breaking off in small irregular dry cubes.

9. *Westland Pine.*—Grows throughout district. This timber, known locally as "silver-pine" and "white silver-pine," is more plentiful than yellow silver-pine. It grows on the low lands between the main hills and the seaboard, but is not to be found in the inland valleys nor on the mountains. It is very rare south of the Arawata River, but occurs in areas of moderate extent and also as isolated trees almost everywhere else. Flourishes best on the damp oozy soil which overlies the impervious impacted gravels of the terraces and plateaux; also on the margins of swamps, sluggish creeks, and lagoons. It likewise occurs, in its early growth, as scrub, and is frequently associated with manuka scrub. Brittle, short-grained, and will not stand strain; free in grain, and easily worked. Timber whitish in colour; soft thin bark. Is fairly light, and rafts well. Excellent for veneering. The sun has little effect on the sawn timber, and it is not attacked by the borer. Is found on margins of swamps, in standing, dead, sapless sticks, which are the favourite ones for settlers for making gates, wheelbarrows, &c., and never alter. This pine rots slightly on end after lengthened period; also decays around nails in the open. The silver-pines are said to have properties akin to the spruce-woods of America, and to have a similar effect on the health of bushmen living in a silver-pine bush to that obtained by people residing in the American spruce forests. Seedlings rapidly replace this pine. Average size, 20 ft. by 18 in.; largest, 3 ft. 6 in. diameter and 35 ft. barrel. Very large trees to be found in Upper Grey Valley, on plateaux west of Lake Brunner, at Waitaha, Saltwater near Okarito, and Bruce Bay. These extra-big trees are often hollow, or full of "shakes." It is popularly esteemed "imperishable," and deserves the term. Trees are often dug out of swamps with the heartwood unchanged; such logs

are eagerly sought for by settlers for fencing-posts, and even those of small size are made use of. On sandy ground along the sea-beach posts rot slightly at surface of ground, and it is also attacked there by a large grub. Palings set up fifteen years show no decay. Used for house-piles, telegraph-poles, railway-sleepers, fencing-posts, furniture (especially that made from the mottled pine), sash-frames, palings, and also cut by special machinery into staves for construction of water-pipes. The scrub is used for fascines.

10. *Yellow Silver-pine.*—Occurs from Nelson boundary down to Big Bay. Known often as "pink pine." Fine areas on the undulating country west of Lake Ahaura; also between Lake Haupiri and Crooked River. Grows principally on ridges, hills, and mountain spurs. Dark yellow heart, and heavy—twice the weight of Westland pine, and much tougher. Bark is red or light brown. Only averages 1 in. sap-wood. Streaks of seedlings grown on ridges between Waitaha and Wanganui Rivers. Grows stunted, on high plateaux and mountains. Shrinks slightly, but loses weight very slightly. Average size, 18 ft. by 16 in.; largest, 20 in. diameter and 30 ft. barrel. One of the most durable timbers known. The scrub, or young pine, is greatly valued for fascines, in connection with roadworks and drainage. Principally cut for railway-sleepers, fencing-posts, house-blocks, &c.

12. *Tawhai raunui* (Tooth-leaved Beech).—In North Westland this timber occurs in upper valleys of Grey, Ahaura, and Teremakau; on eastern and western slopes of Paparoa Range; on Mount Tekinga; around Bell Hill; and across terraced lands to Ahaura River. In South Westland, grows in detached areas of considerable extent. A little is to be found in Upper Haast, Cascade, and Pyke Valleys. A considerable quantity of fine quality covers the inland slopes of Mount Delta up to 2,000 ft. above sea-level. The finest area occurs in the Upper Arawata Valley, commencing about two miles below Thomson Creek, but not very thickly thereabouts; it extends from the river back across the flat to the range, and up to 2,000 ft. above valley-floor constitutes the main timber, and goes right up to the Ten-hour Gorge. It extends similarly on northern bank of Arawata River, and goes up the Waipara Valley about a mile; here it is somewhat sparse on the north side, but fine forest on flat on south bank, and for 1,000 ft. up. This area is covered with splendid timber. The whole of this Arawata forest is in full vigour; no dead trees; only a few wind-blown trunks to be seen. It is reported that a few isolated trees occur in the Upper Arahura and Teremakau Valleys, but we cannot locate them at present. It is a noble-looking tree when growing isolated; a few such happen at Arawata. It is easily split if thin wedges are used. The trees are covered with thick bark, which is easily stripped in summer. Very little sap-wood. In this forest there is very little undergrowth, the ground being covered with a thick mat of dead leaves. It is doubtful if this timber could be floated down the Arawata River, which is a broad, shallow, shingly stream, although subject to great snow-floods in summer. The construction of a light railroad is quite easy, and cheap. A few seedlings grow on the outskirts of the forests, and are fairly plentiful on the adjacent islands and open lands in the river-beds. Average diameter, 3 ft.; barrel, 80 ft.: maximum diameter, 13 ft.; barrel, 25 ft. (this tree branches out into several enormous limbs). Spars of 90 ft., with equivalent thickness, are common. Warps badly, and shrinks on end. Has the reputation of being one of the most lasting timbers in the Dominion. Trunks of fallen trees, with all sap rotted away, are otherwise perfectly sound. Extensively milled in Middle Grey Valley and adjoining country. Almost exclusively used in the coal-mines at Blackball, Brunner, and at the State coal-mine, Runanga, having great transverse strength; is also used for fencing. Very poor firewood.

13. *Tawhai rauriki* (Entire-leaved Birch).—This timber is much intermixed with *Fagus fusca* and other woods, and is to be found in Upper Grey Valley and Paparoa Range, but is not met with again until between Paringa Valley and Big Bay. It forms the main timber of the Upper Arawata Valley, above the Ten-hour Gorge. Grows generally on poor infertile soil; likes dry soil best. Is locally known as "black-heart." Sends out small branches; the lower ones decay rapidly, and, after easterly gales, litter the ground with small sticks. Little or no undergrowth. On sidelings fairly erect, and on flat ground very straight. No distinct forests, but occurs mixed with other forest; isolated groves or trees. Seedlings very prolific on ground bared of forest by wind. Average diameter, 2 ft.; barrel, 60 ft. It is not durable when young, but when fully mature is fairly lasting. Not used by settlers; very poor firewood. Miners use it in wet tunnels, where it is said to last, and to withstand heavy pressure.

15. *Tawhai* (Blair's Beech).—The "Official Year-book" for 1896, page 398, says this timber grows at Little Grey, but there is no record of where it exists.

19. *The Northern Rata.*—Is met with throughout Westland, but not plentiful in northern division. Grows on Bell Hill, Mount Tekinga, and stunted on sides of Teremakau Valley; grows from the seaboard up to the grass-line on the mountains, but is not plentiful far inland; plentiful north of Mahitahi River, but less frequent south of that valley; very extensive location on hills behind Okarito, also on sea bluffs and connecting inland ridges and terraces; grows plentifully on spurs and low hills adjacent to coast. A gnarled stunted growth often occupies the sea-faces of the numerous headlands. Is intermingled with the southern rata, and is difficult to distinguish at a distance. It does not grow as a forest, but in patches and as isolated trees. It grows full height on mountains up to 2,000 ft. above sea-level; thence the rata dwarfs until it reaches the "grass-line," where it is simply a scrubby bush, twisted and gnarled by storms and snow-falls, and in some localities it lies flattened along the ground like a creeper. Its flowers, intermixed with those of the southern rata in mass (very profuse every third year), redden the forest roof for months, commencing to blossom first along the seaboard, thence gradually blooming on the higher inland terraces, and at last flushing the gaunt ravined mountain-sides with a riotous crimson magnificence, especially splendid when outlined against the tints of the great glaciers. These flowers form luscious food for bees, and also for kakas, which follow up the recession of the blossoms right into the valleys of the high inland ranges. At this period these parrots become

very fat, and of fine quality. A narrow strip of seedling forest (6 ft. high) occurs along the margin of the sea-coast between the Rivers Waiatoto and Arawata. Young isolated trees are to be found everywhere, intermixed with mature forest. Average diameter, 4 ft. 6 in.; barrel, 8 ft.: maximum diameter, 14 ft.; barrel, 12 ft. Trunks usually compounded of several growths, and these not solid right through; they are also, for the most part, very short, as a few feet from the ground they divide into huge irregular branches; hence it is difficult to estimate dimensions. It is not a durable timber, and frequently rotten logs are met with in the forest; nevertheless it lasts well under water. It was formerly used for bridge trenails, but is now discarded, owing to its liability to rot. It will not float. It is first-class firewood, and makes good mauls, handles for axes, picks, &c. Being very heavy, a segment is often used as a monkey for driving bridge-piles. Old matured logs cut up into fine furniture, panels, &c., and take fine polish. Good for rollers for saw-benches, &c.; wooden bearings as good and smooth as iron. Used for arms for insulators on telegraph-poles.

20. *The Southern Rata.*—Occurs over the whole district; common for the most part, but sparse in some localities. It is found (dwarfed) about up to the "grass-line," 3,500 ft. above sea-level. It grows straight; keeps its barrel right up. Splits easily, and can be sawn into planks. It works well with tools; and is a first-class firewood. Trunk oval-shaped, or flat-sided. Finest quality usually along seaboard. Locally known as "iron-wood." Average diameter, 2 ft. 6 in.; barrel, 40 ft.: maximum diameter, 4 ft.; barrel, 60 ft. One in Upper Whitcombe Valley 9 ft. in diameter. It is not appreciated as a durable timber. Has the same uses as the northern rata.

22. *Manuka rauriki.*—Occurs only in isolated patches and strips throughout the district. A few scattered full-grown trees are to be found in the Poerua Valley and on an island in the Teremakau River abreast of Taipo; a third small patch of matured isolated trees grows in the Upper Kakapotahi Valley; and several others are growing in the Waitaha and in the Lower Haast. It is a very scarce timber in Westland, the above localities being the only instances we know of where mature trees are met with. Average diameter, 1 ft.; barrel, 20 ft.: maximum diameter, 2 ft. 6 in.; barrel, 30 ft. It is not durable. Used for skids, under-water skids for boat-landings, and paddles for canoes. Good firewood.

23. *Kowhai.*—To be found immediately adjacent to sea-coast in Westland, from extreme north down to Jackson Bay. Only grows as a small tree in a narrow fringe, and not plentifully, along the margin of tidal waters; it is never found inland. Average diameter, 6 in.; barrel, 9 ft.: maximum diameter, 2 ft.; barrel, 12 ft. (only large one known, at north mouth of Paringa River). Farmers report favourably of its durability. Used at times by settlers for fencing-posts.

Timbers suitable for General Building Purposes or for Special Uses, but of less Durability than the preceding Kinds.

25. *Rimu* (Red-pine).—Grows throughout the district, from the sea-coast to the foothills, and penetrates the inland valleys up to 2,000 ft. above sea-level. Is the chief milling-timber of Westland. It is usually found in forests, of greater or smaller extent. These forests mainly occupy the terraces, plateaux, and rolling country of the low lands easy of road and tram access, from the extreme north right down to the Arawata River. Large areas, especially in the great basin of the Grey River and its tributaries, and broad belts of excellent marketable timber along the seaboard. Large forests of rimu cover the hill-slopes and mountain-faces of the high lands, and are not commercially available at present, but doubtless in the future this timber will be sent down in shoots and milled, for it is a much tougher and finer variety than that in the low country, being full of "pattern," and therefore valuable for furniture-making. It is more or less mixed with other timbers. It is also found in strips right along the sea-coast, where the outward trees are somewhat wind-blown, but tall, and fit for the sawmill; likewise inland, along the river-banks, and sweeping up the adjacent mountain-faces to a height of 1,250 ft. above sea-level. Saplings and seedlings are widely distributed. Average diameter, 3 ft.; barrel, 40 ft.: maximum diameter, 6 ft.; barrel, 50 ft. At Hohonu there is a giant—diameter, 7 ft.; barrel, 100 ft. Used for house-building (for outside work and inside fittings), fence-pickets, palings, props in gold-mine tunnels and in coal-workings; blocks in sluice-boxes, for gold-saving; piles, stringers, and decking for bridges and culverts; and furniture, the figured timbers being in demand. It only makes a second-class firewood. The bark is sometimes used for tanning purposes. Old trees have often heavy "shakes," which are generally full of hard resin; a chemical firm in Sydney was furnished with a few pounds of it, but it is not known what use was made of it. Heartwood very durable in all situations; has stood well as marine piles. Sap-wood does not last well, but is much used for weatherboards, which rot quickly on ground contact, but do fairly well higher up.

26. *Kahikatea* (White-pine).—Is found throughout the whole length of the Westland District. Occurs wholly in low lands, and does not grow inland on the high lands; never found on high hills nor on mountain-slopes, but is frequent on the smooth-sided knolls and rolling uplands of the low lands; an immense aggregate acreage of choice marketable timber skirts the numerous lakes, lagoons, swamps and sluggish streams; scarce below Paringa River; none between Arawata and Cascade Rivers; a small patch of good timber between Pyke Valley and Big Bay; very rare between Big Bay and Cascade, only odd trees. Prefers damp location; isolated trees often grow in water on edge of lakes. The trees from drier country are of yellow colour, and hard; grows in detached areas, or varied acreage and shape; these, for the most part, covered with dense bush, wholly of white-pine, and again in clumps and narrow streaks of mature trees dotted amongst the other forest. A fair quantity of immature trees, saplings, and seedlings fringe the numerous tongues and belts of mature forests which project into the swamps. Average size, 45 ft. by 4 ft.; large, 80 ft. by 6 ft. Principally used in commerce for the manufacture of butter-boxes, for which purpose it is much esteemed, large quantities being milled and sent abroad; also for building and inside fittings. A stave-pipe mill, at Hokitika, turns out

large quantities of white-pine piping, which is, after being tarred, used for the water-supply of Hokitika, and also for piping in connection with the Otira Tunnel. Branches used for firewood. M. D. F. Dennehey, an expert, is of opinion that this timber would suit admirably for the manufacture of pulp for paper-making. Saplings used as flag-staffs and scaffold-poles, shear-legs, props, &c., for temporary use. Used in coal-mines for much temporary work, where durability is not a consideration. As noted above, there are two varieties of white-pine—viz., "white heart" and "yellow heart." The former is wholly discarded; it rots quickly, and is now never used for inside fittings of houses, as the borer-grub rapidly destroys it; in Australia it is free from the grub, and is much esteemed. The "yellow heart," from mature well-grown trees, is much esteemed for its lasting qualities.

27. *Miro toromiro.*—Grows only on the low lands throughout the district. Never found as a distinct forest, but grows as single trees plentifully amongst other timber. Is extensively milled. Wood holds fair quantity of turpentine. Average diameter, 2 ft.; barrel, 20 ft.; maximum diameter, 3 ft. 6 in.; barrel, 35 ft. Used for inside fittings of houses; also the heart for repairs to small bridges. Exudes a gum plentifully, which is much used and esteemed by settlers, miners, and bushmen for cuts, bruises, and frost cracks; very cleansing. Fair firewood. Grows a large berry, which fattens the native pigeon. Makes first-class false keels for boats, as it does not scrub up, but preserves a smooth surface. Not reckoned a durable wood. Only used for firewood by settlers and miners.

28. *Tanekaha.*—Grows throughout the district. Usually found on skirts of and intermixed with silver-pine forest; also grows very plentifully as a seedling and sapling amongst young silver-pines in swampy ground. Has been found (stunted) on mountain spurs, 2,000 ft. up. It is full of tar, and is very tough wood. Average size, 6 in.; barrel, 15 ft.; maximum diameter, 1 ft.; barrel, 40 ft. It is good lasting wood, but is not much used. Makes good tool-handles; and the bark excellent for tanning fishing-nets, tents, &c.

30. *Mountain Toatoa.*—Cannot identify this timber as growing in Westland.

31. *Tawhai rauriki* (Mountain-beech).—A very infrequent timber in the Westland District, and only occurs in a few places on the Upper Grey, Ahaura, and Teremakau Valleys. Flourishes on dry gravelly soil on the valley-flats, where it is found of greater size; and again on the spurs and ridges, where it is dwarfed. It is essentially a mountain timber, and frequently grows right up to the "grass-line," 3,000 ft. and 4,000 ft. above sea-level. Large trees usually have short trunks, which divide into massive branches. It is often much intermixed with *Fagus Menziesii*. Range, from 1,800 ft. to 4,000 ft. above sea-level. Average size, 1 ft.; barrel, 20 ft.: maximum diameter, 2 ft.; barrel, 30 ft. It is principally used as firewood. It is a very poor-lasting wood.

32. *Tawhai* (Silver-beech).—Occurs on the Paparoa Range, and the mountain faces and valleys of the upper watersheds of the Grey, Ahaura, Crooked, and Teremakau Rivers, but not between the latter river and the Mahitahi; thence from this stream right down to Big Bay. Chiefly a mountain timber, which, over the areas noted, constitutes the main forest, and occupies the whole country right up to the "grass-line," about 3,500 ft. above sea-level, the exceptions being the timber on Jackson Head, Smoothwater, and Lower Arawata Valley, where very old mature forests exist. Very handsome trees when growing in the open. Seedlings very profuse if given air and sunshine. Average diameter, 3 ft.; barrel, 40 ft.: maximum diameter, 5 ft.; barrel, 30 ft. Used for rough stables, sheds, &c., and as fencing-posts; also as firewood. Not esteemed in Westland as a milling-timber. Wood easily worked. Very poor lasting qualities as an immature timber, but has an excellent character when taken from old trees.

34. *Hinau.*—Northern boundary down to Smoothwater River. Grows mainly adjacent to sea-coast, but odd trees also found a few miles inland. Only occurs as isolated trees. Plenty of seedlings and saplings. Average diameter, 3 ft.; barrel, 15 ft.: maximum diameter, 4 ft. 6 in.; barrel, 25 ft. Only milled in Westland for tramway rails, for which purpose it is well adapted, wearing smooth and lasting well. Settlers make little use of it. Good for dray-back pieces, as it does not chafe; and for timbering shafts and tunnels, as the caps made of it only bend, and do not break short. Have known tram-rails in position for fourteen years, and still sound.

38. *Titoki, Tokitoki.*—One or two stunted trees of this variety at Pakorari, in the extreme north of the district, but it does not occur elsewhere.

43. *Towhai, or Kamahi.*—This is found throughout the district, from the seaboard up to 2,500 ft. above sea-level, right into the heart of the mountains. It is intermixed with every other variety of timber growing below the 2,800 ft. level. The most widely distributed timber, and of the largest quantity, in Westland, becoming dwarfed as it ascends the mountains. Locally divided into two qualities—white and red. These refer to the colour of the wood; no difference in the leaf; the bark of the white is a thin bark, silvery in appearance, while that of the red is thicker, and of a dark-brown tint; the white grows taller and straighter than the red, but they are completely intermixed as to location; the white is much softer and more easily worked than the red, the latter is a tough strong timber, White-wooded variety: Average diameter, 1 ft. 6 in.; barrel, 30 ft.: Maximum diameter, 2 ft.; barrel, 40 ft. Red-wooded variety: Average diameter, 2 ft. 6 in.; barrel, 20 ft.: maximum diameter, 4 ft.; barrel, 20 ft. Never milled in Westland. Used for props for tunnels in mines, and fencing. Good firewood. Bark of the redwood extensively used for tanning. Red-wooded variety lasts better than the white, the latter not being in favour. Posts last six to seven years, and rot at ground-surface.

(Note.—The full height of these timbers are given.)

Horopito.—This variety of horopito is to be found throughout Westland. Grows chiefly in the low lands, but scattered strips are to be found inland up to 1,000 ft. above sea-level. Attains a height of 20 ft. Uusually scattered throughout the bush, but in many localities is met with by itself in considerable areas. Sometimes used for head-ache; the leaves taste intensely hot and pungent, but after swallowing the mouth becomes cool. Maoris chew the leaves, and apply the pulp as a poultice for

wounds. Locally known as "pepper-wood." Is grown and flourishes in gardens. Not used for any commercial purpose.

47. *Tarata.*—Is reported as only occurring South of Arawata River; fairly plentiful in Arawata and Cascade Valleys, and sparsely down to Big Bay. Does not grow on the high lands. Discarded by settlers, as it rots rapidly. The tree is from 20 ft. to 30 ft. high, with barrel 5 ft. to 8 ft. Not grown as a garden-shrub.

49. *Tawhiwhi.*—Occurs throughout the whole of the district; not found on the high lands, but is chiefly confined to swampy country; also grows on dry river-flats, where it attains a greater size than that on wet lands. Maximum height, 20 ft.; diameter, 8 in. Not commercially used. It is a very fine shelter-tree for gardens, and also grows into ornamental fences, which are very close, and stand trimming.

50. *Mahoe.*—Grows throughout the district. Is found on the low lands from the seaboard across to the mountains, and is frequently seen 1,000 ft. above sea-level. It is the chief feed for cattle, which fatten easily when placed in it. This scrub rapidly recovers after being fed off and trodden down if the cattle are kept out of the bush. It is grown in a few gardens as an ornamental shrub. Maximum size, 30 ft., and 1 ft. diameter. Settlers, miners, &c., never use this wood.

51. *Huoi, or Manatu.*—Found all over the district. There are two prominent varieties—the small-leaved kind grows usually on deep loamy country, is always an indication of good soil, and sends out a mass of small white flowers. The large-leaved sort (probably *Plagianthus Lyalli*) grows wholly on the mountains from near the base, generally up to within a short distance of the "grass line," and in some localities quite out on to the open high lands; is almost always found in damp shady hollows and on slips, where it is easily noted by the bright green of its foliage in spring, its masses of lovely white flowers in summer, and its yellow leaf tintage in autumn. Both varieties are deciduous. The mountain shrub makes a beautiful garden plant, and is extensively grown. Plenty of seedlings; transplants readily. Maximum size (low-country variety), 35 ft. high, with diameter of 2 ft.; odd trees, 35 ft. and 3 ft. through. Mountain variety—18 ft., and 8 in. in diameter; maximum, 25 ft. to 30 ft., and 9 in. through. Has been sawn into planks, and used for white-wood furniture, also for panelling; but is utterly useless for any outside purpose, as it decays very fast, and is only considered a fair timber for temporary use. It is reported that this wood and bark would make good paper.

52. *Wharangi.*—Found only on the limestone hills behind Greymouth and along the seaward faces of the hills between the Grey and Pororari Rivers; nowhere else in Westland.

53. *Kaikomako.*—Cannot positively identify this tree.

56. *Putaputa weta.*—Grows all over the lowlands; more plentiful along river-banks; not found inland, among the mountains. Size, 30 ft., and 1 ft. through. Very little used; not considered durable; cracks when drying; never used here for handles of any description. Would suit as a shelter-shrub for gardens.

57. *Kumarahou.*—Found from extreme north of district down to Cascade Valley; fairly plentiful on low lands and on outer spurs of inland mountains. Has been seen 30 ft. high and 12 in. in diameter. No use whatever made of it in Westland. Occurs amongst small bush and as undergrowth in main forest; also as a thick "second-growth" in clearings.

59. *Manuka, or Kahikatoa.*—Met with throughout Westland, but only in the low lands. Generally occurs as dense scrub which fringes the margins of shallow lagoons and swampy open lands where it has the needed air and sunlight, for it does not exist as an undergrowth. Comes up as a "second growth" in abandoned clearings in different places, but not invariably; no continuous broad areas occur. A bushman cleared about 2 acres of heavy scrub (20 ft. by 3 ft. 8 in.) on the margin of Okarito Lagoon for firewood, and on revisiting the place forty years afterwards found the new growths up to old size. Is not durable. Used for hammer, &c., handles, sheep-hurdles, fascines, and canoe-poles. Good firewood when at full growth.

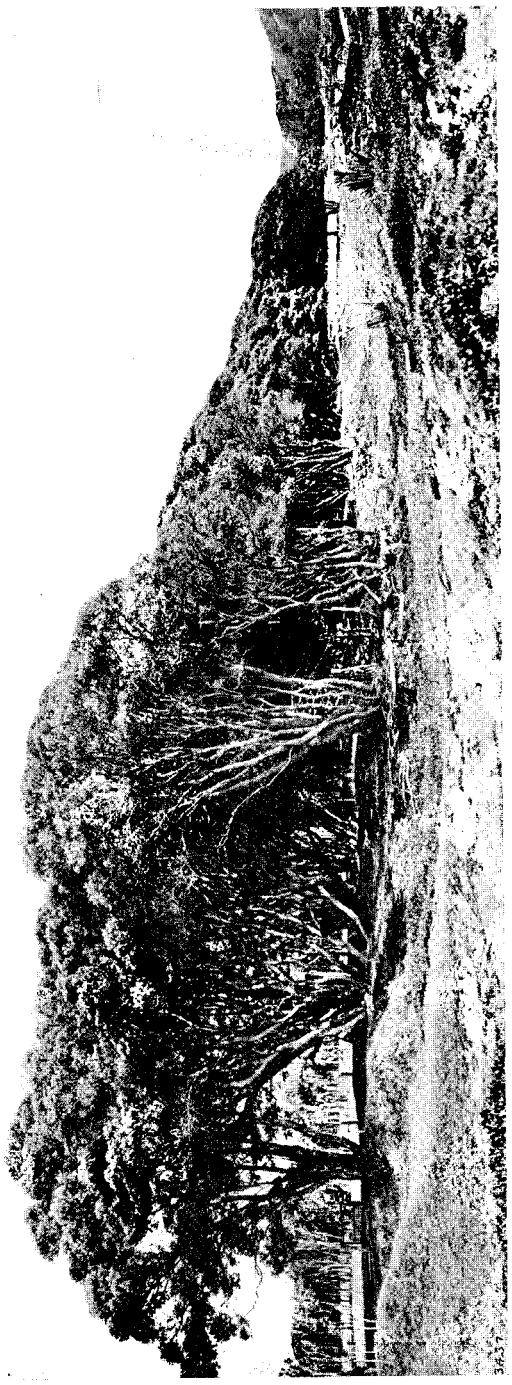
60. *Ramarama.*—Cannot positively identify this tree; but fairly certain of its occurrence in West land.

62. *Rohutu.*—Found throughout the low lands; usually amongst the bushes on shrub-covered lands in lower river-flats. Grows generally on good soil. Height, about 10 ft. Have never heard of any use being made of it. Horses and cattle crop the smaller branches and leaves in time of heavy frost. Is not esteemed as an ornamental shrub.

63. *Rohutu.*—Cannot positively identify this tree.

64. *Kotukutuku, or Kohutuhutu.*—This tree is found in all parts of Westland. Demands air and sunlight; hence generally growing on land-slides on mountain, hill, and terrace sides. Creeps up to 3,000 ft. on slips in beds of gullies. Frequently overhangs inland river-banks, where it stretches its main trunk and branches out laterally a few feet above the boulders which mark the flood-level. Deciduous, and usually intermixed with ribbon-wood. Streaks the higher mountain-faces with lovely autumn leafage. The bare russet branches and stems also beautiful in winter. Grows a nice luscious berry, which is much appreciated by birds and humans. Makes fine slippery skids for all kinds of bush-hauling or boat-landing. Very dense and sodden wood; would not burn green; have never seen it dry, except an old dead branch (of a living tree), fully exposed to sunshine. Some few settlers have used *Fuchsia* for house-piles and fencing-posts, with satisfactory results. Have met it 30 ft. high, and 1 ft. 6 in. through. Does not grow a straight stem, but is full of twists, bosses, and shapeless branches. Prefers stony ground, and drainage.

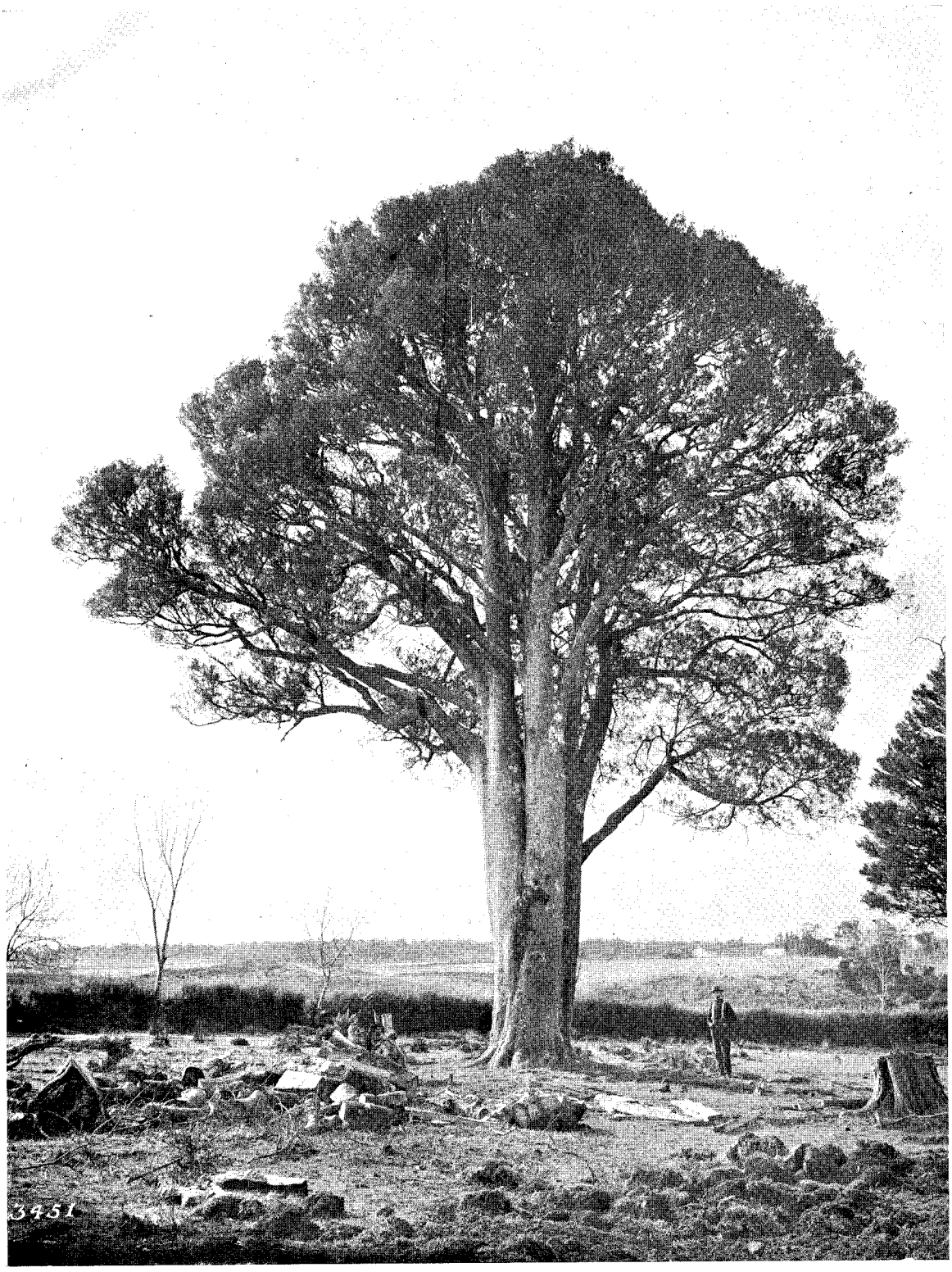
65. *Horoeka* (Lancewood).—Grows throughout Westland. Fairly plentiful, but for one mature tree there are quite forty younger ones in all stages of development. Mainly confined to low country or inland valley-floors. Utterly discarded by settlers and miners, who give it a bad name for durability. Sends up very clean straight stems, and is met 40 ft. high. The young trees make (while green) excellent fishing-rods, whip-handles, and sheep-hurdles,



POHUTUKAWA-TREES, NEAR WAIWERA.

[F. Whitney, photo.

Face p. 56.]



MATAI-TREE, SEAWARD FOREST.

[*W. Deverill, photo.*

66. *Toothed Lancewood.*—Have seen this tree in Westland, but much scattered, and not anywhere in quantity. The remarks upon horoeka (above) apply equally to this variety.

67. *Papauma.*—Occurs all over Westland, from the seaboard to the " grass-line " on the mountains. Trunk grows twisted and short. Not plentiful; only odd trees. 20 ft. and 30 ft. high. Good durable timber. Fine firewood; and used for ornamental cabinet-work.

68. *Puka.*—Found all throughout Westland and the low lands. Nice ornamental tree. Makes good garden shelter-fences, and is much grown for that purpose. Good cattle-feed.

70. *Yellow-wood.*—So far as this tree can be identified, it occurs throughout the low lands of Westland, and grows intermixed with other small bush, usually on good soil. Known locally as " yellow-wood." Very subject to a green moss, which covers the whole shrub, even at times on the leaves. Not used for any purpose whatever.

71. *Milk-tree.*—Cannot positively identify this tree, but a similar (isolated) tree is found throughout Westland which is never used by settlers, being soft, and not durable. Not even used for firewood.

72. *Large Milk-tree.*—The remarks attached to milk-tree (above) apply to this variety.

74. *Akeake.*—Grows throughout Westland, from the seaboard up to 2,000 ft. on the mountains. Does not occur as an undergrowth, but luxuriates on gravelly river-beds, slips, and similar locations; rarely intermixed with other shrubs. Attains a height of 20 ft. A very ornamental garden flowering-shrub. Grown sometimes as a fence; will stand clipping, and is easily propagated. In the absence of oats and chaff, has been often cut and used for feeding horses. Is a good winter feed for horses and cattle.

75. *Neinei.*—Only know of its occurrence along the seaward lower faces of the Paparoa Range, from Grey River northward. Makes a fine ornamental garden-shrub, but is difficult to strike.

76. *Mountain Neinei.*—Occurs at altitudes of 2,500 ft. up to 3,500 ft. all along the mountain faces, from the Nelson boundary down to the Mahitahi River, but not south of that valley. Very plentiful. Would make a fine garden-shrub.

77. *Inaka.*—Grows, principally intermixed with other high mountain shrubs, at altitude of 2,500 ft. to the " grass-line "—say, 3,000 ft. to 4,000 ft. above sea-level. Grows very thickly, and has an average of 9 ft., but dwarfing rapidly until, at the " grass-line," it is only 3 ft. to 4 ft. Good, fierce-burning wood, full of pitch, but leaves no coals.

78. *Toro.*—Grows all over the low lands in Westland. Good tree for shelter purposes, but not fit for anything else except firewood.

79. *Mapau.*—Grows all over the low lands in Westland. Good tree for shelter, but not fit for any other purpose except second-rate firewood.

82. *Ngaio.*—This tree only occurs on the limestone hills behind Greymouth, and thence northward on the sea-faces of the Paparoa Range. It is not found elsewhere in this district.

84. *Houhere.*—This is probably one of the " varieties " described under huoi (51); at any rate, cannot positively identify this tree otherwise.

85. *Makomako.*—Found all over the low lands of Westland; locally named " wine-berry." It usually grows along the seaboard and on the river-flats, partly as undergrowth, but prefers open sky. In most clearings, either of miner, settler, or sawmiller, it springs up vigorously, and is one of the few plants which flourish on old tailing-heaps and mounds of sawdust. Grows up to 30 ft. in height. Fine shelter-tree for small orchards, and is frequently planted for that purpose. It is not utilised in any other way in Westland.

86. *Tumatukuru.*—This shrub has only been found in one or two places in Westland, always as an isolated plant, and never in mass.

Holly.—Grows throughout Westland, but local; largest in inland country; plentiful locally on slips; requires good drainage; has been found along seaboard, and also up to 3,000 ft. on mountains. Accompanied often by young seedlings, which transplant easily, and in two years make a low garden shelter-fence, for which purpose it is well adapted, but is apt to become scraggy and open if not attended to. Leaves delicately scented. Have seen it 20 ft. high. Has heavy crowns of lovely white blossoms.

Koromiko.—This shrub occurs throughout Westland; flourishes from the sea-coast up to the " grass-line " on the mountains; numerous varieties; grows mainly along creeks, sea-coast, river-banks, open low lands, mountain slips, and high up on the edges and within the alpine grass lands, where it is much dwarfed, but has a profuse bloom. Demands sunshine. Cattle-feed, but not very much eaten except in winter. The leaves declared to be a sure cure for dysentery. Grown as a breakwind for gardens. The different varieties bloom (white and purple) heavily. Seedlings very common. Transplants very easily.

Tree-ferns.—These grow plentifully throughout Westland, and range from the sea-coast up to 1,600 ft. on inland hills; infrequent in inland valleys. A variety, locally called " mamakau " (20 ft. to 30 ft. high, and 1 ft. 3 in. to 1 ft. 6 in. through stem), sends out enormous fronds. Only grows on sea-coast slopes from Pakorari down to Teremakau, and from Paringa down to Cascade River. Prefers limestone formation. Plentiful in above localities only. Maoris reported to eat the pith when cooked. Grows well if carefully transplanted, and forms a very handsome garden-tree. " Ponga " (ordinary) is very beautiful; easily transplanted, and will grow readily even if cut off at ground; much used for garden-fences by planting stems side by side, when fronds grow vigorously; also used (split) for sides of rough sheds, stables, flooring for cow-bails, for paths, and bridle-roads. " Black wiry ponga " is also very common; has thick overlapping rows of fronds; gold-miners working in black sand for very fine gold saw this variety into slabs (4 ft. by 1 ft. by 1½ in.), and line their sluice-boxes, 4 ft. wide, with them, crosswise; the surface of this prepared " ponga " has a wire-brush appearance, and the particles of gold settle into the numerous interstices, and is there quite secure from the rush of water; afterwards the slabs are placed, upside down, in a tub of water, and, after being tapped smartly, the most

of the gold falls out, when they are replaced in the sluice-boxes; when they are worn out they are burnt, and the residue of the gold is recovered from the ashes. The black heart of any fern-tree, when thoroughly seasoned, makes beautiful picture-frames, and is often used for inlaying.

"*Incense*" *Plant.*—This small shrub is to be found mainly on old moraines; it grows in the Balfour, Fox, and Cook Valleys. Do not know of its actual occurrence elsewhere in Westland. It rarely attains more than 4 ft. in height, and has a delicate, soft perfume, especially when burnt. It would probably transplant readily.

Cordyline.—Found throughout Westland. Invariably grows on the *débris* and scars of land-slides, on sea bluffs, and the westward faces of the inland ranges. It rarely occurs within the great mountain valleys; in Upper Grey Basin it has been found near the main divide. Thirty-five years ago it was not often seen, but now this beautiful plant fringes the road-cuttings and spoil-heaps for miles, especially in the southern districts. It evidently requires air and sun. Known locally as the "bush cabbage-tree," or "indiarubber tree"; the leaves are somewhat elastic when stretched, but have no retractive powers. They are often handy in the absence of flax, being fibrous and strong.

Tutu.—This is not very common in Westland, and is mainly found skirting the waterways. A very beautiful tiny variety occurs about 2,500 ft. above sea-level, on the high lands.

Approximate Quantity of Milling-timber.

On Crown Lands and Reserves.	Sup. ft.
Rimu (red-pine)	3,677,800,000
Kahikatea (white-pine)	310,000,000
Totara	50,500,000
Matai (black-pine)	27,500,000
Birches	350,000,000
Miscellaneous	309,200,000
Total	4,725,000,000

On Private and Native Lands.	Sup. ft.
Rimu (red-pine)	786,000,000
Kahikatea (white-pine)	65,000,000
Totara	10,000,000
Matai (black-pine)	6,000,000
Birches	8,000,000
Miscellaneous	25,000,000
Total	900,000,000

G. J. Roberts,
Commissioner of Crown Lands.

CANTERBURY.

The Land District of Canterbury comprises the central portion of the South Island, and lies between the Conway River, Barefell Pass, and Mount Franklin on the northward; the Spenser Mountains, Travers Peak, Mount Barron, the Amuri, Hope, and Hurunui Passes, the summit of the Southern Alps, and the western watershed of the River Hopkins and Lake Ohau on the westward; the Rivers Ohau and Waitaki on the southward; and the South Pacific Ocean on the eastward. It lies between south latitudes 42° 5′ and 44° 55′, and east longitudes 169° 45′ and 173° 30′. The length of the district north-east and south-west is about 220 miles; the breadth W.N.W. and E.S.E., from the summit of the Alps to sea, averages seventy miles.

The remaining native forest in this district which is capable of utilisation as milling-timber is now of very limited extent; the estimated available quantities of milling-timber of the different kinds in the various localities are shown in the appended schedules, the total amount being 31,545,000 ft. Out of this total, about 26,000,000 estimated feet consist of beech (birch) timber, principally black-beech (tawhai), with a sprinkling of the red and brown varieties. Nearly 2,800,000 ft. of the remainder consist of kahikatea, or white-pine, the balance being made up of small quantities of totara, matai, rimu, and puka (broadleaf).

In addition to these there are in various inaccessible localities patches of forest varying in area from 10 acres to 5,000 acres, containing small-sized matai, rimu, kahikatea, totara, and tawhai (beech) trees, useful for posts and stakes for fencing lands in the vicinity, but comprising no milling-timber available for commercial purposes. Amongst these may be mentioned the following:—

In the upper watershed of the Waiau River and its tributaries there is an estimated aggregate of 60,000 acres, consisting principally of black and silver beech (tawhai), with scattered trees of matai, rimu, kahikatea, mountain totara, mahoe, &c., all of stunted scrubby character. Every dry season sees a reduction of this area by fire.

The upper watershed of the Hurunui River and its tributaries contains an estimated area of about 12,000 acres of forest-clad country of similar character.

In the upper watershed of the Waimakariri River and its feeders there is an estimated area of 60,000 acres of bush, the largest forest being included in the Bealey National Park Reserve. This is of

similar character to those previously mentioned, though there are patches of black and red tawhai, and some totara, which would form suitable milling-timber were they more accessibly situated.

At the head-waters of the Selwyn River lies what is known as the "Thirteen-mile Bush," comprising about 5,000 acres of tawhai timber, a small portion of which could, if more accessibly situated, be used for milling.

In the upper watershed of the Rakaia River and its tributaries—the Wilberforce, Avoca, and Harper Rivers—there are approximately 20,000 acres of scrubby tawhai forest, very inaccessibly situated; the only use to which it might be applied would be for props, fluming, &c., in the event of any mining operations being conducted in the locality.

Nearly all of these forests have been proclaimed State forests, but in almost every dry season some portion of the forest is destroyed by grass-fires, and a larger extent of shingle-slides is exposed. The pastoral occupation of the surrounding country renders it almost impossible to preserve isolated areas of forest, and no evidence as to the originators is forthcoming when any damage to the forest occurs.

At the head-waters of the Rangitata River and its tributaries there are some patches of inaccessible tawhai forest similar in character to those previously mentioned.

In South Canterbury there are three small blocks of bush situated at Raincliff, and near the head-waters of the Pareora and Hook Rivers; these are partly on Crown and partly on private lands, and comprise an estimated total of a little over 1,000,000 ft. of milling-timber, as shown in the schedules. The other scattered patches of bush in South Canterbury are too small to be of any value except from a scenic point of view, with the exception of a large tawhai forest in the vicinity of Lake Ohau and its feeders, the Hopkins and Dobson Rivers; this probably contains some millions of feet of milling-timber, but at present it is too remote from any means of communication to be available for use.

APPROXIMATE QUANTITY OF MILLING-TIMBER.

Locality.	Rimu.	Kahikatea.	Totara.	Matai.	Tawhai.	Miscellaneous.	Total.
			On Crown Lands.				
Near Waiau	Sup. ft. Scattered trees	Sup. ft. ..	Sup. ft. Scattered trees	Sup. ft. Scattered trees	Sup. ft. 1,000,000	Sup. ft. ..	Sup. ft. 1,000,000
Near Mount Grey	Ditto	..	..	Ditto	1,000,000	..	1,000,000
Near Mount Thomas and Glentui	300,000	50,000	..	50,000	11,000,000	..	11,400,000
Oxford Bush	200,000	75,000	50,000	Scattered trees	7,000,000	..	7,325,000
Kowai District	..	..	..	..	1,000,000	..	1,000,000
Banks Peninsula	50,000	50,000	100,000	50,000	..	30,000 (puka)	280,000
Alford Forest	..	100,000	..	..	800,000	..	900,000
Peel Forest	..	600,000	300,000	300,000	..	..	1,200,000
Raincliff, White Rock, and Hook Bushes	..	500,000	250,000	100,000	..	..	850,000
	550,000	1,375,000	700,000	500,000	21,800,000	30,000	24,955,000
			On Private Lands.				
Near Waiau	50,000	50,000	..	Scattered trees	1,000,000	..	1,100,000
Near Mount Thomas and Glentui	50,000	..	..	..	1,000,000	..	1,050,000
Kowai District	..	..	..	..	200,000	..	200,000
Alford Forest	..	10,000	..	..	2,000,000	..	2,010,000
Peel Forest	..	1,214,000	298,000	418,000	..	..	1,930,000
Raincliff, White Rock, and Hook Bushes	..	150,000	100,000	50,000	..	..	300,000
	100,000	1,424,000	398,000	468,000	4,200,000	..	6,590,000

E. C. GOLD SMITH,
Commissioner of Crown Lands.

VARIETIES OF TIMBER TREES, AND USES.

North Canterbury.

2. *Totara.*—Grows on Banks Peninsula and in the Oxford district. Prefers volcanic soil and moist alluvial situations. About 150,000 sup. ft. in district. Durability depends on age and where grown. Matured timber will last thirty years in proximity to the earth, and twenty years in salt water if the bark is left on the piles when driven. Used for house-blocks, studdings, and plates, piles and struts for bridges and wharves, fencing, furniture, railway-sleepers, and telegraph-poles. Value, £1 7s. 6d. per 100 sup. ft. From observation, South Island totara does not appear to have the stability of that grown in the North Island; the tensile strength seems even less. The totara can be easily grown on volcanic land.

Alpine Totara.—Grows in mountain forest, North Canterbury. Used for fencing where other timber not available. Not procurable in market. Is of stunted growth.

4. *Black-pine* (Matai).—Grows on lower altitudes of remaining forest in Oxford, Ashley, and Waiau districts, and Banks Peninsula. About 100,000 sup. ft. in district. Free of sap and of mature age, one of the best timbers (native) for flooring, framing, decking, and all studdings. In exposed situations, twenty years' life; under cover, fifty years. The sap is only fit for boxes and packing-cases. Used

for buildings and deckings, fencing, furniture, and small bridges. The sap is used for house lining and flooring. Value, £1 4s. per 100 sup. ft. Most of the trees that are left are to be found on Banks Peninsula; all used in Christchurch is imported from Havelock and West Coast. Miro is often sold as matai; the former is not such a good timber, and matai gets blamed for miro deficiencies.

12. *Brown-birch* (Beech, Tawhai raunui).—Grows on Banks Peninsula, Upper Waimakariri valleys, and in isolated places through the remaining forests. Cannot estimate quantity, probably 2,000,000 sup. ft. The same remarks apply as those in connection with the black or smooth-leaved variety, only I do not think it is such a durable timber. The acid in this wood renders the cutting of it tedious. Used for bridges (rough in mountain districts) and buildings.

13. *Black-birch* (Beech, Tawhai rauriki).—This timber forms the bulk of all forest in Canterbury. In accessible forest the quantity available as milling-timber is estimated at 23,000,000 sup. ft. In remote bush (only patches are suitable for cutting into milling sizes, the greater area being poles and scrubby trees) cannot estimate. A useful lasting timber if cut from matured trees and seasoned in the balk, otherwise it winds. I have seen black-beech which has been in the ground as house-blocks for sixty years at Port Underwood, Marlborough. Ordinary timber will last thirty years exposed, and indefinitely if covered. Used for bridge-timbers, fencing, buildings, heart railway-sleepers, and scaffolding-poles. Value, 15s. per 100 sup. ft. Only procurable from country mills. Not stocked as sawn timber by Christchurch timber-merchants.

25. *Red-pine* (Rimu).—Grows on lower altitudes of the Oxford and Glentui Forests, Banks Peninsula, and scattered clumps of bush throughout the district. About 650,000 sup. ft. in district. Durability depends mostly on the situation of the tree and its age. When grown on dry land its life of utility is double that of the timber grown in damp places. As weatherboards, thirty years' life. Sound timber under cover, fifty years. Used for building generally, and furniture. Value, 18s. per 100 sup. ft. The remaining rimu in this district is so much scattered that very little is now cut. The most of what is used here is imported from other districts.

26. *White-pine* (Kahikatea).—Grows on lower altitudes in the remaining forests in the Waiau, Ashley, Oxford, and Peninsula districts. About 225,000 sup. ft. in district. Durable for fifteen years in dry situations. Used for buildings, such as barns, sheds, &c.; butter-boxes, packing-cases. Value, 15s. per 100 sup. ft. Not a desirable timber for houses, on account of its liability to dry-rot; all used in this district imported from other parts of New Zealand.

32. *Red-birch* (Beech, Silver-beech, Tawhai).—Grows in Upper Waimakariri valleys, Amuri County, and Banks Peninsula. Will last thirty years if protected by cover, but will not stand in proximity to soil; will last well in water. This timber, if seasoned, should be excellent for the finer parts of cabinet-work. Used for coachbuilding, furniture, frames, &c., and fencing in the backblocks. Users import from other places. Worth probably as much as totara.

31. *Mountain Birch* (Beech, Tawhai rauriki).—In back mountain ranges. Used for fencing in the high country.

22. *Manuka rauriki.*—Banks Peninsula, and in clumps of bush occasionally met with along the coast. 100,000 sup. ft. (very approximate) in district. Very durable in water for piles; is not liable to attack from the teredo. Makes good tool-handles and fencing-rails. Used for frames for rough buildings, hop-poles, and fencing in swamps. Pieces suitable for wharf or bridge piles—say, 8 in. by 8 in., taper from 12 in. by 12 in., length 25 ft.; probably cost 3s. per lineal foot. For bridge-piles across salt-water estuaries I think it is the best timber we have in New Zealand.

24. *Kowhai* (New Zealand Laburnum).—Banks Peninsula, and along river-banks generally. A very durable but slow-growing timber; will last as posts and house-blocks for thirty to thirty-five years. Should be excellent for cabinet-work, on account of closeness of grain and readiness to take a polish. Used for fencing-posts, bridge-building, sleepers. Value of posts, 2s. 6d. each, and £2 per 100 sup. ft.

64. *Kotukutuku.*—Oxford, Ashley, Amuri, Banks Peninsula; generally in low moist situations. Very durable in proximity to soil; will last as fencing-posts twenty years if from matured trees. Used for fencing and house-piles. Value: Straining-posts, 3s. each; ordinary posts, 1s. each. The trees grow easily in damp places, and the timber is excellent for fencing. I think it should receive more attention. It also affords a fine protection (from fire) to other more delicate growing trees. This and the plant known as "wine-berry" (*Aristotelia racemosa*), I think, afford the best means of checking fire around growing forest. These two shrubs might be planted in all fire-belts to advantage.

68. *Broadleaf* (Puka).—Banks Peninsula, and scattered through other forests. 30,000 sup. ft. (small dimensions) in district. Very durable; matured timber will last thirty-five years in proximity to soil. Should be suitable for furniture. Used for fencing and house-piles. Posts are worth from £5 to £7 per 100 locally. The tree is generally very crooked, so much so as to prevent its usage for many purposes for which otherwise it could be adapted. It is easily grown, and should be cultivated for its durability.

W. B. Buckhurst,
Crown Lands Ranger.

Alford Forest District.

20. *Southern Rata.*—Found throughout New Zealand under different conditions, in both high and low altitudes, and on both dry and swampy ground. Hard wood, adapted for fencing, bullock-yokes, and firewood. All in standing bush. There is a small quantity of rata, fit for stakes and firewood.

26. *White-pine* (Kahikatea).—Found mostly in low country, and also at higher altitudes, in the gullies. 10,000 sup. ft. on freehold, and 100,000 sup. ft. on Crown land. Soft wood; used principally

for lining houses and making butter-boxes. Sometimes infested by an insect commonly known as the "borer," which militates against its durability. One mill at work on freehold timber; Crown land timber untouched. Value, 10s. per 100 sup. ft., sawn at mill. Chiefly used in the district.

31. *Black-birch* (Beech, Tawhai rauriki).—Found mostly in hilly country. 800,000 sup. ft. on Crown lands; 2,000,000 sup. ft. on freehold. Hard durable timber, well adapted for bridge-building. Crown land bush untouched; one mill at work on freehold timber. Value, 11s. per 100 sup. ft., sawn at mill. Chiefly used in the district for building houses and bridges. Bush on Crown land very inaccessible.

68. *Broadleaf* (Puka).—Found both on hilly and flat land. Hard wood; very durable for fencing. All in standing bush. There is a small quantity of broadleaf fit for fencing material. Value of stakes at the bush, £1 per 100.

Peel Forest.

2. *Totara.*—Found in most bushes of the South Island. 300,000 sup. ft. on Crown land; 298,000 sup. ft. on freehold. Hard lasting timber; used for constructing bridges, telegraph-posts, sleepers, &c. On Crown land bush is untouched; sawmill on freehold cuts it occasionally for local use. Value, £1 per 100 sup. ft.

4. *Black-pine* (Matai).—Found in most bushes of the South Island. 300,000 sup. ft. on Crown land; 418,000 sup. ft. on freehold. Not much used for house-building; suitable for sleepers, bridges, piles, &c. A hard durable wood. On Crown land it is standing bush; on freehold, used by settlers. Value, 16s. per 100 sup. ft. Chiefly used in the district.

26. *White-pine* (Kahikatea).—Found principally in low country, but also at higher altitudes, in the gullies. 600,000 sup. ft. on Crown land; 1,214,000 sup. ft. on freehold. Soft wood; used mostly for lining houses and making butter-boxes. Sometimes infested by an insect known as the "borer," which militates against its durability. On Crown land it is standing bush; on freehold, used by settlers for building. Value, 10s. per 100 sup. ft. Chiefly used in the district.

20. *Southern Rata.*—Small quantity on both Crown and freehold land. Hard wood; adapted for fencing, bullock-yokes, and firewood. All in standing bush. So small a quantity is procurable that no fixed value obtains.

59. *Manuka, or Kahikatoa.*—Principally grows in swampy ground, but also grows on hill-sides. About 20,000 stakes on Crown land, and about 20,000 on freehold. Makes good rails and stakes; used largely for firewood. Value of stakes at the bush, 16s. per 100.

68. *Broadleaf* (Puka).—Found on both hilly and flat country. 25,000 stakes on Crown land, and 20,000 on freehold. Hard and very durable for fencing. On Crown land bush is untouched; but it is used by settlers for stakes. Value of stakes at the bush, £1 per 100.

JOHN FORRESTER,
Crown Lands Ranger.

South Canterbury.

2. *Totara.*—350,000 sup. ft. Extremely durable. Largely employed for building purposes, bridges, wharves, telegraph-posts, &c. Value, £1 10s. per 100 sup. ft.

4. *Black-pine* (Matai).—150,000 sup. ft. Very durable. Used for verandah-flooring, bridges, strainers, &c. Value, £1 5s. per 100 sup. ft.

26. *White-pine* (Kahikatea).—650,000 sup. ft. Not very durable. Extensively used for cheap furniture, butter-boxes, &c. Value, 14s. 6d. per 100 sup. ft.

In this district the timber on Crown land is reserved, while that on private lands is not being cut at present. Over two-thirds of the timber is on Crown land, and the separate localities where it is to be found are as under: Dairy Bush, Raincliff; Hook Bush, Waimate; White Rock, Nimrod.

In addition to the timber mentioned, there is a very fine birch forest in the vicinity of Glenlyon Station and Lake Ohau, which contains millions of feet of milling-timber; but this is not being used at present, on account of the distance from the railway.

D. NIMMO SCOTT,
Crown Lands Ranger.

OTAGO.

The principal timber area in Otago is that known generally as Catlin's, comprising the Survey Districts of Catlin's, Glenomaru, Woodland, Tautuku, Rimu, and parts of Warepa and South Molyneux. There are areas of bush in the Waipori River in Waipori and Mangatua Survey Districts, on Blue Mountains in Rankleburn Survey District, at Lake Wakatipu, and at Lakes Hawea and Wanaka. The Waipori Bush consists chiefly of birch of rather inferior quality, with occasional kowhai and broadleaf trees. It is situated on very steep country, and is not likely to be of any use as far as sawmilling or other industry is concerned. This bush appears to have originally contained a fair amount of kowhai, black-pine, totara, and red-pine, but the most accessible and the most valuable of this timber was taken out many years ago by the adjoining settlers. Some small detached areas that were cleared and afterwards partly burned are now producing young birches that will eventually grow into value, but attention is not likely to turn to Waipori Bush until all the more accessible country is worked out.

The Blue Mountain Bush, near Tapanui, is the remains of what once appears to have been a large forest. It consists chiefly of birch, and it occupies a number of steep narrow gullies on the west side

of Blue Mountain, and a number of flat spurs on the eastern side. Formerly the bush extended over a large area of flat where the Township of Tapanui now stands. This flat carried some magnificent timber, but it was all taken out by sawmillers, leaving now only the less valuable and more inaccessible portions. On the eastern side of Blue Mountain there is a fairly large area of practically virgin forest, consisting solely of birch. A sawmill started there last year on a licensed area, but, as there is considerable difficulty in getting away the timber, owing to bad roads, it is yet somewhat doubtful as to whether or not the venture will be successful.

The forest around the lakes consists chiefly of birch; and large quantities of timber, posts, and firewood have been taken from it in the past. The country generally is rough and steep, and systematic milling is not now being carried on to any extent.

The Catlin's Forest covers a very large area, and the bush is of a varied description all through. Sawmilling has been carried on for some thirty to thirty-five years, and at the present day the Catlin's district is producing large quantities of rimu, matai, kahikatea, &c., for building purposes; kowhai, broadfeaf, and totara, for fencing; and manuka, matai, &c., for firewood. There are not any extensive areas of any particular species of timber except kamahi. On some areas all kinds may be found in equal proportions; some produce larger quantities of rimu, with other timbers in smaller proportion; some, again, may contain a majority of matais, and so on: but no areas have been found to contain exclusively rimu, or matai, or totara, &c. Kamahi, however, is found exclusively on some fairly large areas.

VARIETIES OF TIMBER-TREES.

1. *Kauri* is not found in Otago.

2. *Totara* was originally found in fairly large quantities in Catlin's and Glenomaru Survey Districts, and in smaller quantities throughout the remainder of the Catlin's Forest, in Waipori Bush, and in the lakes districts. It was extensively used for building both houses and bridges, and also largely used for telegraph-poles and railway-sleepers until the supply began to run short. At the present time it is rather difficult to get in anything like large quantities, and is consequently very dear. It is still used to some extent for building, particularly in window-sills, door-frames, &c., and also in building bridges. All that can be obtained can be used in building—in fact, the d and for that purpose is quite equal to the supply.

4. *Matai* is to be obtained in large quantities throughout the whole of Catlin's Forest, but it does not exist to any extent in any other part of Otago. It is largely used in house-building as studs, flooring, &c., and to some extent in bridge-building. The trunks and limbs unfit for sawing are split into posts for fencing, and the still smaller parts make splendid firewood. The matai grows to a very fair girth, but as a rule the tree becomes branchy at a short distance from the ground, making it difficult to get logs of any great length. The wood is hard and durable, and, when used for fencing in anything of a dry soil, it has been known to last for many years. A well-developed matai is really a handsome tree. Breaking out from a main trunk at 16 ft. to 20 ft. from the ground, its wide-spreading branches and close green foliage give it a very commanding appearance. It is generally recognised that where matai is plentiful the land is of good quality, and intending selectors are often guided by it in making their selections. It is only a matter of a short time when all the matai will be used for fencing and building, and to introduce any other means of using it would be to hasten the end of a timber that is now most valuable for the purposes previously mentioned. (*Vide* photograph opposite page 57.)

8. *Southern Manoao* is generally known in Otago as "bog-pine." It is very scarce, and does not appear at all in the Catlin's Bush. There are a few trees in a small bush at Mount Cargill, near Dunedin, and the only use it is put to is as fire-wood.

12. *Tawhai raunui* (Red-beech) is found only in the lakes district, in Otago, where is grows to a great size. Its wood is hard and durable, and it is used chiefly for fencing. Owing to its durability it has proved itself to have great lasting-power as fencing-posts. When the lake forests were more accessible, and the trees larger and more plentiful, large quantities were sawn; but sawmilling has now become more or less a thing of the past, and the small quantity of timber left is of great value to the local people as a means of supply of fencing-material.

20. *The Southern Rata* grows freely in the Catlin's Forest, but it is not found to any extent in any other part of Otago. It is really the beauty tree of the Otago forest—its beautiful red flowers, so plentiful, and so striking in appearance, are a slight worth going far to see. It is in full bloom in ordinary years about the month of January. The rata attains great size, but the trunk is usually very gnarled and twisted. The branches strike out from near the ground, and often extend to a great distance, causing a full-grown tree to occupy a considerable space. It is sometimes known locally as the New Zealand ironwood, owing to its extreme hardness. It is used for making fencing-droppers, hand-mauls for pile-driving, and other uses requiring extra hard timber; but, though I have heard of its having been used for making wheels, I have never seen wheels made of it. Experiment would probably prove that it would be an excellent wood for making heavy wheels and also for making ribs for boats. There is a fairly large quantity of this timber in the Catlin's Forest; but, as the trees consist chiefly of very short trunks and very long and numerous limbs, it is difficult to convey any idea of its quantity in superficial feet.

24. *Kowhai* does not grow to so large a size as many other of the timber-trees—25 ft. to 40 ft. being its average height, with a trunk varying from 1½ ft. to 2½ ft. through. It is also an exceedingly hard wood, and it is very durable. Standing alone or in groups detached from the forest it is very handsome, and in early spring when its yellow flowers are in full bloom it presents a handsome picture. It is becoming a great favourate as a garden or ornamental tree, and many fine specimens are to be seen in some gardens in Otago. Isolated trees are to be met with even in places that are miles from a forest, and it appears to thrive to best advantage on a sharp soil. In the forest it is generally supposed to indicate good sharp land, and selectors usually accept it as a sign of good soil. Its principal use is posts for

fencing, boat-ribs, blocks for tackle, and bearings. It is unfortunately getting very scarce, as all the more accessible trees were removed by the earlier settlers for fencing and house-piles. It splits very straight, and it is very tough, hence light posts of kowhai, which were easily handled and carted, were preferred to heavier and more twisted timbers.

25. *Rimu* (Red-pine) is probably the most plentiful and most widely distributed of Otago's timber-trees. When young it is a very handsome tree, with its drooping foliage and cone-shaped outline, but the old trees bear a broken, scraggy appearance. It grows to a height of from 80 ft. to 90 ft., with a diameter as high as 4½ ft. In the dense forest the desire for sunlight appears to have caused the rimu to outstrip its neighbours, for it may be seen in many instances towering high above the surrounding bush. Numerous very fine specimens from the sawmiller's point of view are to be found. With trunks running up to 50 ft. or 60 ft. without a branch, and with very little taper, they are ideal food for the saw, and the grain is so straight, and the newly felled wood so sappy, that no difficulty is found in ripping them into various sizes for commercial use. From a building point of view this must be looked upon as the most valuable timber our native forest contains. With the exception of the piles, for which the wood is altogether unsuitable, a whole house may be built with it, and a good, substantial, and handsome job made. For the rough work it is strong and easily worked, and for ornamentation nothing better or prettier could be desired. Practically all the output of the Otago mills is used for building, though a quantity is used in making railway-carriages, &c. There may be other uses to which rimu could be put, but, since it is of such value for building, and its end is so nearly in sight, it would seem a pity to look for other means to run away with the already limited supply.

26. *Kahikatea* (White-pine) grows chiefly in swampy, low-lying land, and it is not generally looked upon as being a good indication as to soil. It grows to a much greater height than any other of the trees in the Otago bush, and as a rule it is not by any means a handsome tree. The trunk is usually tall and straight, reaching as high as 80 ft., with a diameter of from 2 ft. to 3½ ft. The sawn timber is clean, straight-grained, and easily worked. During the earlier settlement it seems to have been a great favourite for building purposes, probably because it was easily sawn and easily worked, and also because there was no difficulty in making a neat and a sound building. Later, however, it was found that white-pine was subject to the attack of the weevil or borer—a small black or dark-brown beetle that bores the whole inside out of the wood. The destruction caused by this insect is very great, and many thousands of pounds' worth of houses are either wholly or partly destroyed by it. Unfortunately, its attentions are not confined to white-pine alone, for many instances are to hand of rimu and other native timbers being operated on by it, and even pianos and other articles of imported timbers have been utterly destroyed by this industrious mite. No means have yet been found of destroying the insect or of checking its progress, and this is a great pity, seeing that the result of its depredations runs into such an alarming amount. Since the first notice of the borer, white-pine has been discarded for building purposes, and it is now used principally for making cheese and butter cases. For these purposes it is eminently suitable, being clean, white, and tasteless, and all the available supply will be readily absorbed by the cheese and butter industries.

27. *Miro toromiro*, generally known as " miro," is fairly common in the Catlin's Bush. It usually grows to a height of from 40 ft. to 60 ft., with a diameter of 1½ ft. to 2½ ft. The trunk is usually clean and straight, with the foliage near the top of the tree. The wood is somewhat like matai in colour and general appearance, but it is not looked upon with much favour by builders. The grain is straight, but when properly seasoned it is hard and brittle, and difficult to drive nails in without splitting. Otherwise it is fairly durable, and answers well for making studs, rafters, &c., in building.

31. *Tawhai rauriki* (Mountain-beech).—There is a fairly large area of this timber on the eastern slopes of the Blue Mountains near the headwaters of the Blackclough and Rankleburn Creeks, which are tributaries of the Molyneaux River. The trees grow to a height of 30 ft. to 50 ft., with a trunk of 1½ ft. to 3½ ft. through. Very little of it has yet been used for any purpose, as it has been somewhat inaccessible. Of more recent years, however, attention has been turned towards it, and some twelve or eighteen months ago a sawmill was started near the head of Blackclough Creek. The timber has a nice appearance, and is being used for building purposes. From all appearances it will be a durable and a useful timber. The large increase of settlement on Greenfield and Clydevale Estates has opened up a new market for timber, and probably all that can be produced from this forest during the next few years will be taken locally. As a means of supplying a serviceable timber at a reasonable rate, this bush is of considerable value locally, and, as it is of limited size, it would seem inadvisable to look for further means of using it. It does not appear to have been ever tried for any other purpose.

32. *Tawhai* (Silver-beech), which grows in large quantities in the more swampy parts and about the creek-beds of Catlin's Forest, and also in Waipori Bush, has been hitherto looked upon as more or less having no value. During the past year or so, however, fairly large quantities have been placed in Dunedin for furniture-making; it has also been largely used recently for planks on railway and road works. It is not of great durability, hence it has been looked upon as of little value for building purposes. The trees grow to a height of 60 ft. or 70 ft., with a trunk of 2½ ft. to 4 ft. through, and under favourable circumstances they are very handsome. Many of them are unsound in the hearts, and it is very difficult to burn the useless trunks and branches, as the wood does not burn readily. It might be used in cooper's work, such as making barrels, buckets, &c., and experiment might prove that it could be used for paper-making. There is a considerable quantity of this class of timber in the localities mentioned, and if it could be used for papermaking a good supply could be obtained within easy distance of the Catlin's Branch Railway.

35. *Pokaka* appears to be found of two different kinds. One has a dark wood, which is very hard and durable, and is sometimes used as studs in building sheds. This species, if it is a pokaka, properly speaking, is rare. The other kind grows to a height of 30 ft. to 40 ft., with a diameter of 1½ ft. to 2 ft.

The trunk is usually clear and straight, and the wood soft, with an even grain. It is not by any means plentiful, and it is very little used. The timber is white in colour, and is sometimes used for shelving, boxmaking, &c. It is not supposed to be durable, and it is hardly plentiful enough to provide material for further uses.

43. *Towhai, or Kamahi, or Kamai* is exceedingly plentiful in the Catlin's Forest, where it is looked upon with much disfavour by settler and sawmiller alike. It grows to a height of 40 ft. to 60 ft., and, though the younger trees have a nice appearance, the older ones are very often gnarled and crooked. The wood is looked upon as valueless, except for mining-props or other uses that keep it away from the sun. When cut, the roots exude a dark liquid that poisons any adjacent vegetation, which gives one the impression that it might be used for tanning purposes. Towhai is difficult to burn, and hence it is an obstruction to settlers in making their clearings. If left standing during bushfalling, it is killed by the subsequent fire. It may then stand for a year or two, during which time it rots, and is blown to the ground by the heavy wind. Standing, it is a continual menace to stock, for it may fall at any time; and, fallen, it is a nusiance to the settler, as it will not burn. There is a large quantity of this timber in Catlin's—in fact, there are extensive areas containing nothing but towhai or kamai. The amount used as mining-props is comparatively small, and, if any other possible use could be found for it, there is any amount of material to work on. It might be well worth while to try it for papermaking, and, if it proved suitable, large quantities could be got within easy reach of a railway.

46. *Horopito* (Pepper-tree) is very plentiful in Otago, and is generally found on the outskirts of the forest or on the edge of a bush clearing. It rarely attains a greater height than 10 ft. to 12 ft., with a diameter of 3 in. to 4 in. The bark is dark or black in colour, and the wood of a reddish colour. No particular use is made of the wood, though it would appear to be suitable for inlaying in ornamental work. Its leaves have a hot and rather bitter taste, and it is often used as an ornamental shrub.

47. *Tarata* (known generally here as "turpentine") cannot be said to be plentiful, though there are a fair number in the Otago bush. It has a very handsome foliage, but the trunk is usually crooked and branchy. The bark contains a resinous liquid which emits a very pleasant odour, and the leaves are of a light, soft green. It does not grow large enough to be of any use to the sawmiller. The wood is tough and elastic, and it might be used to a small extent for making tool-handles.

49. *Tawhiwhi* (Black-maple) grows sometimes to a height of 20 ft. to 25 ft., though it is rarely found of this height. The wood is strong and elastic, but it is not supposed to be very durable. It is used chiefly for fencing-rails. It is not by any means plentiful.

50. *Mahoe, or Hinahina* usually grows in areas that do not contain any other timber. Its foliage is of a pale green, and the trees are branchy, and not high. The wood is nearly white in colour, and the leaves are relished as feed by cattle. This tree is looked upon as an indication of good sharp soil. It is not sufficiently plentiful to be of any commercial use.

51. *Huoi, or Manatu* grows in the different forests of Otago. Under favourable circumstances it is a handsome tree, occasionally reaching 30 ft. to 40 ft. in height. The wood is white, tough, and springy, but is not looked upon as durable. Some species produce a mottled wood that can be used for inlaying-work. It is not sufficiently plentiful to be of much commercial value.

56. *Putaputa weta* (White-maple) is not very common in Otago, except in the vicinity of Dunedin. It grows to a height of 20 ft., but might be classed more as a shrub than a tree. The wood is not durable, but is elastic and strong. It is sometimes used for making tool-handles or light rails.

59. *Manuka, or Kahikatoa.*—Manuka scrub is very prevalent in many parts of Otago. It does not usually grow to a size that would be useful for any purpose whatever. It comes up very densely, and spreads quickly if unchecked by fire or cultivation. This useless scrub is destroying many acres of pastoral land in Otago—land that would successfully graze sheep well, but that is not quite valuable enough to warrant its being cleared. Kahikatoa is not used for any purpose, but might prove suitable for papermaking.

64. *Kotukutuku* grows to a height of 20 ft. to 25 ft., and occasionally attains a diameter of 2 ft. The wood is very sappy, and takes a very considerable time to dry. It is very hard or nearly impossible to burn it, owing to the length of time it retains the sap. Fuchsia, though for some time looked upon as being absolutely useless, has proved itself to be very lasting in the ground, and it is therefore much used in bush fencing. It is difficult to get it anything like straight, as the trunk has a strong tendency to grow crooked and gnarled. It is not very plentiful, and, with the exception of material for fencing, it does not appear to have any other use.

65. *Horoeka* (Lance-wood) has a very striking appearance. In its younger growth it consists of a straight slender stem with a few leaves growing at the top. These leaves grow downwards, and they are 18 in. to 2 ft. in length, with a breadth of ½ in. to ¾ in. As the tree or shrub grows older its leaves turn upwards. When maturity is reached, the trunk measures up to 6 in. in diameter. The timber is tough and elastic, but is rarely used for any other purpose than making fencing-rails or walking-sticks.

67. *Papauma* (Broadleaf) is very common in the various bush lands of Otago. It grows to a height of sometimes 40 ft. to 45 ft., but as a rule it is low and branchy. The trunks are crooked, gnarled, and hollow; but the wood is very durable. From the settlers' point of view broadleaf is one of the most valuable of our timbers for fencing, and all the available supply will be used in time for this purpose. The wood retains the sap for a very long time, and hence it is very difficult to burn.

70. *Mikimiki* (Yellow-wood) is not very common, except on the outskirts of the bush. The wood is yellow in colour, and is very tough and elastic. It is used for making tool-handles, and also for making the cross-pieces of light sheep-gates.

77. *Inaka*, generally known here as the grass-tree, is not at all common, and it is more of a shrub than a tree. It has rather a peculiar appearance, owing to its long spiked leaves. It is too small to be of any use either as timber or fencing-material.

82. *Ngaio* might also be better described as a shrub than as a tree. It is found chiefly on the edges of the bush, and does not grow to a sufficient size to be of any value.

85. *Makomako* is generally found along the edges of the bush or in clearings after the bush has been felled and burned. It grows very rapidly to a height of sometimes 30 ft. The wood is white and very soft, and is used occasionally for rails in fencing. It is not durable, and it is very difficult to burn, hence it is looked upon with disfavour by bush settlers. The wood might be used for making charcoal.

86. *Tumatukuru* is prevalent all over Otago. It does not grow to a great height, and it is generally gnarled and branchy. It is a very slow grower, and the wood is hard, but not sufficiently large to be of use for anything but firewood. Being the most common of the few bushes or shrubs that grow in Central Otago, it proved a great boon to the early settlers, who used it for firewood. It burns readily, and produces a great heat. The larger bushes have disappeared before the cultivator, though the smaller bushes are still common on the uncultivable land.

A number of the trees and shrubs have been omitted from this report, chiefly because they are not known here. Many of the Maori names mentioned are not in common use in Otago, the trees being known by other names.

SCHEDULE SHOWING AREAS OF FORESTS, WITH APPROXIMATE QUANTITIES OF EACH VARIETY OF TIMBER THEREIN.

District.	Approx. Area in Acres.	Rimu.	Matai.	Kahikatea.	Totara.	Birches.	Miscellaneous.	Totals.
				Crown Lands.				
		Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.
Tautuku	23,420	93,680,000	5,850,000	250,000	250,000	2,342,000	187,728,000	290,100,000
Rimu	42,420	169,680,000	16,968,000	..	500,000	..	191,920,000	379,068,000
Woodland	8,000	36,000,000	4,000,000	450,000	150,000	900,000	58,800,000	100,300,000
Catlin's	6,820	23,870,000	6,820,000	682,000	90,000	2,046,000	27,912,000	61,420,000
Glenomaru	2,200	4,400,000	1,000,000	132,000	20,000	..	11,022,000	16,574,000
Waipori	1,000	..	10,000	..	10,000	1,000,000	80,000	1,100,000
Rankleburn ..	7,000	..	..	..	..	18,200,000	..	18,200,000
Lake Wakatipu and Martin's Bay	95,000	10,000,000	9,000,000	11,000,000	2,000,000	9,000,000	8,000,000	49,000,000
Hawea and Wanaka..	28,000	..	50,000	50,000	1,000,000	11,000,000	..	12,100,000
	213,860	337,630,000	43,698,000	12,564,000	4,020,000	44,488,000	485,462,000	927,862,000
				Crown Leases.				
Tautuku	2,100	8,400,000	2,100,000	210,000	21,000	..	10,826,000	21,557,000
Rimu	2,620	7,860,000	2,096,000	260,000	262,000	50,000	8,938,000	19,466,000
Woodland	12,400	19,840,000	4,960,000	496,000	124,000	7,500,000	38,936,000	71,856,000
Catlin's	5,890	5,890,000	2,945,000	589,000	590,000	2,000,000	15,725,800	27,739,800
Glenomaru	3,680	4,400,000	1,840,000	184,000	1,475,000	..	10,169,600	18,068,600
Warepa	400	400,000	40,000	..	..	..	604,000	1,044,000
	27,090	46,790,000	13,981,000	1,739,000	2,472,000	9,550,000	85,199,400	159,731,400
				Freeholds.				
Tautuku	1,670	6,680,000	1,670,000	167,000	16,700	..	7,065,000	15,598,700
Rimu	1,110	4,440,000	500,000	25,000	11,100	..	4,866,000	9,842,100
Woodland	4,300	6,450,000	1,750,000	129,000	43,000	2,500,000	15,803,000	26,675,000
Catlin's	2,800	2,800,000	1,400,000	84,000	56,000	850,000	7,644,000	12,834,000
Glenomaru	5,000	6,000,000	2,500,000	150,000	1,500,000	..	7,650,000	17,800,000
Warepa	200	200,000	60,000	..	..	..	282,000	542,000
South Molyneux ..	900	900,000	270,000	..	..	..	927,000	2,097,000
	15,980	27,470,000	8,150,000	555,000	1,626,800	3,350,000	44,237,000	85,388,800
				Native Reserves.				
Tautuku	8,290	16,580,000	4,145,000	829,000	..	..	20,955,800	42,509,800
Glenomaru	750	1,125,000	225,000	100,000	..	..	1,565,000	3,015,000
	9,040	17,705,000	4,370,000	929,000	..	..	22,520,800	45,524,800
				Grand Totals.				
Crown lands ..	213,860	337,630,000	43,698,000	12,564,000	4,020,000	44,488,000	485,462,000	927,862,000
Crown leases ..	27,090	46,790,000	13,981,000	1,739,000	2,472,000	9,550,000	85,199,400	159,731,400
Freeholds	15,980	27,470,000	8,150,000	555,000	1,626,800	3,350,000	44,237,000	85,388,800
Native reserves ..	9,040	17,705,000	4,370,000	929,000	..	..	22,520,800	45,524,800
	265,970	429,595,000	70,199,000	15,787,000	8,118,800	57,388,000	637,419,200	1,218,507,000

NOTE.—Total areas do not include bush already milled or bush without milling-timber. Totals under "Miscellaneous" include towhai, which was not included in former returns. "Miscellaneous" includes miro, papauma, towhai (kamai), kowhai, pokaka, and rata.

DAVID BARRON,
Commissioner of Crown Lands.
EDWARD O'NEILL,
Crown Lands Ranger.

SOUTHLAND.

The Southland District may be stated to comprise the Counties of Fiord, Stewart Island, Southland, Wallace, and part of Lake, and is bounded on the north and east by the Otago District, and on the south and west by the Tasman Sea, and may be said to lie between south latitudes 45° and 47° and east longitudes 166° 15′ and 169° 15′. For administrative purposes, however, the Snares, Auckland, Enderby, Campbell, Antipodes, Bounty, and all other islands within the limits of the Dominion south of the 47° parallel of south latitude are included in it.

The total area of the district, including Stewart Island, but exclusive of Solander, Ruapuke, and the other small islands enumerated above, is 7,583,892 acres, of which 2,405,040 are covered with bush. A considerable area in the Fiord County consists of wild alpine country with scrubby bush reaching to the snow-line. This little-known country extends to the western sea, and there presents the remarkable indentations of the coast-line known as the West Coast Sounds. The whole region is a paradise for the artist, and, indeed, for all enthusiastic lovers of nature, but has little attraction for the agriculturist or pastoralist. The bush land suitable for timber lies in the neighbourhood of Forest Hill, Longwood, Hokonui, Waikawa, and on Stewart Island. The timbers of commercial value are totara, rimu, miro, matai, kahikatea, rata, towhai, and kamahi, in mixed bushes; but *Fagus Menziesii* and other beeches predominate on the high lands.

For many years the active efforts of the sawmiller have proved a source of considerable wealth. No less than sixty-two sawmills are now at work off and on within the timber-areas of Southland, and although the quantity of timber sawn during 1908—viz., 49,000,000 sup. ft.—has exceeded that produced in former years, there can be no doubt that the industry will be very considerably reduced in the near future.

The total estimated quantity of timber is 2,667,933,000 sup. ft., only 1,294,580,000 sup. ft. of which is suitable for milling; but as the timbered land in Southland is very patchy, and extends over large areas, it may well be that this estimate falls considerably short of the actual quantity.

Varieties of Timber Trees, and Uses.

Black-mapau (*Pittosporum tenuifolium*), white-mapau (*Pittosporum Eugenioides*), red-mapau (*Myrsine Urvillei*), milk-wood, ribbon-wood (*Plagianthus betulinus*), fuchsia, or kohutuhutu (*Fuchsia excorticata*), kowhai (*Sophora tetraptera*), horoeka, or lancewood (*Pseudopanax crassifolium*), stink-wood, or pipipiro (*Coprosma fœtidissima*), makomako (*Aristotelia racemosa* and *Aristotelia fruticosa*), mikimiki (*Coprosma linariifolia*), and *Carpodetus serratus* are to be found, in addition to the following:—

4. *Black-pine* (Matai).—This is a hard wood, at one time extensively used for railway-sleepers; but it appears that the Railway Department found it faulty, and it is now no longer used for that purpose. It is still used in small quantities for foundations of buildings, but at the present time its chief use is for fencing. In the North Island it is converted into weatherboards and flooring, and, next to red-pine, it is the most suitable timber we have for that purpose. (*Vide* photograph opposite page 57.)

2. *Totara.*—This is one of the most useful hardwoods in the Dominion. It is not by any means plentiful. Its chief use is for railway-sleepers, piles and foundations, bottom plates, and window-sills for buildings. It has a peculiar oily nature, and takes paint badly, but otherwise it is a very fine timber for general joinery. It is also used and is suitable for bridge-construction, fencing-posts, telegraph-poles, &c. It is, however, not suitable for bridge-decking, where much heavy traffic passes, as it wears quickly, and has a low transverse strength. Totara knots, especially those of what is known in Southland as "white-totara," are used in cabinet-work, usually in the form of veneers, which are very handsome.

25. *Red-pine* (Rimu).—This timber is chiefly used for building purposes. It may safely be said that 80 per cent. of the timber used in buildings is red-pine, which is eminently suitable for the purpose, being tough and durable, besides being a handsome wood for inside finishing. It is also extensively used for cabinet-work, as it takes polish or oil finish excedingly well; indeed, heart-figure red-pine takes a leading place amongst the handsomest timbers of the world. When grown on ridges and high country, the heartwood appears to last quite as long as totara for fencing purposes, and it is worth using in bridge-work at its present price.

26. *White-pine* (Kahikatea).—This is a most useful timber for boxes and cases of all kinds, being free to work, and very clean in appearance. It is largely used throughout Australasia for butter-boxes, as, in addition to its clean white apearance, it has the great advantage of not tainting the butter in the slightest degree. It is also largely used for cheese-cases, boxes for confectionery and stationery, cases for fruit, frozen rabbits, poultry, &c., and staves for casks. As a building-timber it is not in favour, as it is subject to destruction by an insect known here as "white-pine grub," or "borer."

27. *Miro.*—This is a good timber for studs, rafters, &c., and flooring of buildings, and is generally used for these purposes. It stands well under heavy traffic, and is therefore very suitable for bridge-decking and flooring of stores. It is unsuitable for furnishing and cabinetmaking.

Birch.—As in the case of pines, there are several varieties of this timber. The variety most commonly met with in this district is the brown birch.

12. *Red-birch.*—This is a superior class of timber, and much more durable than the brown or white. It is not so plentiful, and is much more difficult of access, consequently its chief use is for fencing purposes. The *Fagus fusca* obtained in the Cold Lakes District has been found very suitable for bridge-work, as it is very durable, and will stand a high transverse strain.

13. *White-birch.*—This is rather an inferior kind of wood, decay setting in very quickly. It is only suitable for case-making. When put in while green, as props in a wet mine, it will last a long time, and is suitable for log-culverts in wet places.

31. *Black-birch.*—This timber is not plentiful in Southland. It lasts well in fencing, and is suitable for rough buildings, but twists badly when sawn and exposed to the weather.

32. *Brown-birch.*—It is now being introduced into the market by sawmillers, and has been used for all purposes in buildings, and, so far, there has been little or no complaint. It is now used both in Invercargill and Dunedin for cabinet-work, and, as it is cheaper than rimu, it is being used to some extent as a substitute for that timber in this class of work. It looks well when stained and polished, and can be got up to closely resemble walnut.

43. *Kamahi.*—This timber is generally called birch in Southland, and it resembles black-birch, inasmuch as it twists and splits when sawn and exposed to the weather. It was used at one time for railway-sleepers, but was found to be not durable enough for that purpose. It is suitable for fencing, but it is not so durable as black-birch or black-pine. It makes excellent firewood.

67. *Broadleaf* (Papauma).—This timber is becoming scarce. It is very durable, and is most valuable as a fencing-timber, for which purpose it is nearly as much sought after as kowhai. It is also good firewood. It splits readily, though very crookedly. It will sometimes shoot and take root when put into the ground. It also will stand trimming in the shape of hedges.

37. *Pokaka.*—This is an inferior kind of timber, decay setting in at an early stage of its growth; consequently, a sound tree over 2 ft. in diameter is rare. The timber is sometimes used for studs and joists of buildings, but it is mostly used by sawmillers for tramway purposes.

59. *Manuka.*—This tree seldom grows over 1 ft. or 1 ft. 2 in. in diameter in Southland. It is sometimes used for fencing-rails, but its chief use is for firewood, for which it is very suitable. It is very tough, however, and will stand a heavy twist or transverse strain, and should be suitable for spokes.

10. *Rata, or Ironwood.*—This is a very strong and durable timber. It has been used in a few instances for props and beams in large stores, and occasionally for spokes of dray-wheels, but its chief use is for firewood, and as such it commands a high price.

24. *Kowhai.*—This may almost be classed as a dead timber, as there are few growing trees in Southland. It is said that some forty-five years ago an insect attacked and killed practically all the trees in Southland. There are a few small trees or shrubs growing along the banks of creeks and rivers. The heart-wood which is now left on the ground is very durable, and commands a high price for fencing material, for which purpose it is solely used. It is one of the best lasting trees in the South Island, unless split too small, in which case the coating of dry-rot which invariably accumulates round it after lengthy exposure to the weather is apt to penetrate too far, and so impair its strength. The large trees (dead), which rarely exceed 2 ft. in diameter, are generally hollow, or have at least one big longitudinal shake. The timber is very hard and heavy, and of great transverse strength, though it splits freely. It steams readily, and is suitable for ribs for boats, and for any bent-wood work.

51. *Houi, or Houhere* (Ribbon-wood).—This is a deciduous tree in Southland. The timber is white, with a mottled grain, somewhat like honeysuckle. It is very easy and even to work, and, though it shrinks, does not appear to crack or split unduly. It could doubtless be devoted to some practical or ornamental use. The tree will survive when the underscrub is cleared away, and is a very ornamental one.

The other shrubs mentioned, such as black, red, and white mapau, milk-wood, fuchsia, makomako, horse-chestnut, &c., are only used in Southland for firewood and temporary fencing. The wood of a large number of the smaller timbers—such as pepper-tree, honeysuckle, mapou, and others—is very ornamental when used in the shape of veneer for cabinet-work.

SCHEDULE OF ESTIMATED AREAS AND QUANTITIES OF TIMBER.

Number on Plan.	Area.	Red-pine.	White-pine.	Black-pine.	Miro.	Totara.	Birch.	Total.
				On Crown Lands (including Reserves).				
	Acres.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.	Sup. ft.
2	261,000	..	..	..	..	..	42,000,000	42,000,000
3	494,140	76,700,000	11,400,000	7,650,000	23,050,000	3,270,000	50,165,000	172,235,000
4	88,400	54,475,000	33,892,000	5,210,000	10,150,000	1,490,000	10,030,000	115,247,000
5	370,000	11,000,000	2,000,000	..	1,500,000	100,000	10,400,000	25,000,000
Total ..	1,213,540	142,175,000	47,292,000	12,860,000	34,700,000	4,860,000	112,595,000	354,482,000
				Timber within Sounds National Park.				
1	800,000	203,000,000	43,000,000	10,150,000	17,000,000	2,750,000	334,100,000	610,000,000
				On Private and Native Lands.				
1	..	..	..	..	..	..	25,000,000	25,000,000
2	18,200	..	..	..	..	..	..	..
3	154,600	39,900,000	17,100,000	9,000,000	13,000,000	4,000,000	52,000,000	134,100,000
4	186,900	94,000,000	17,000,000	5,213,000	20,985,000	2,500,000	15,000,000	154,698,000
5	31,200	11,000,000	1,000,000	50,000	2,500,000	150,000	1,600,000	16,300,000
Total ..	390,900	144,000,000	35,100,000	14,263,000	36,485,000	6,650,000	93,600,000	330,098,000

NOTE.—In addition to the above there are estimated to be 1,397,400,000 sup. ft. of timber which is not suitable for milling.

E. H. WILMOT,
Commissioner of Crown Lands.

JAS. COLLINS,
Crown Lands Ranger.

(C.) TIMBERS SUITABLE FOR COACHBUILDING AND WHEELWRIGHTING.

Kauri.—A most useful timber for panelling, more especially the white variety. When cut on the quarter, can be readily bent for curved panels, wing-boards, &c. Have found that timber felled during the winter months gives the best results. (*Vide* photographs opposite pages 16 and 17.)

Rimu.—Have used this timber for inside work on tram-cars, &c., with good results. When used in roof-linings and dados, alternated with kauri, when varnished, the effect is very pleasing.

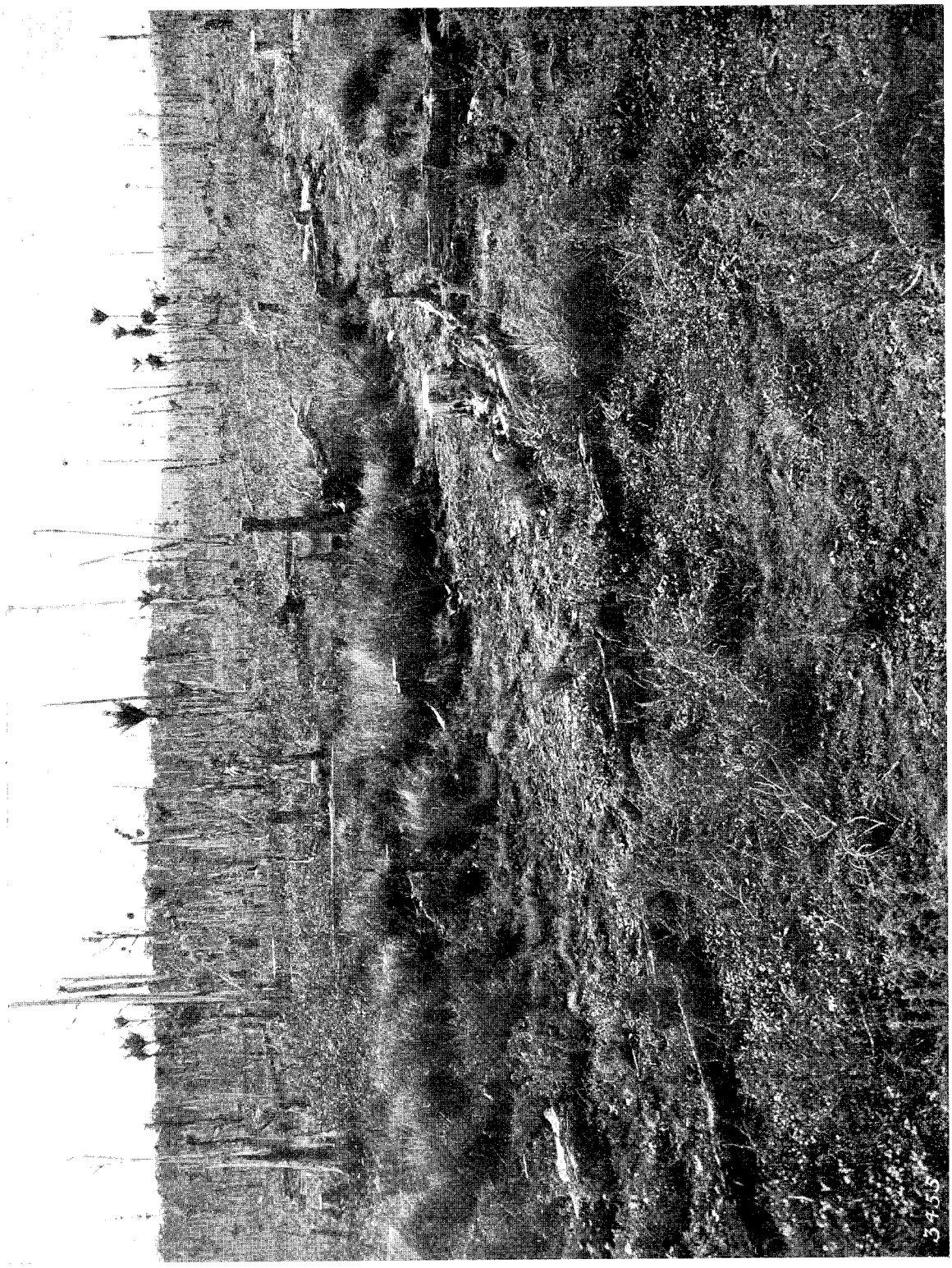
Pohutukawa.—One of the finest timbers for wheelwright's work. Makes first-class hubs and felloes. Requires to be cut between May and July to get the best results. That grown in sheltered positions is much better than that grown in exposed places, as it is more uniform and the heart is nearer the centre of the tree. When required for hubs it should be cut into suitable lengths, and a hole put through the centre. This enables it to season without splitting. Seasoning in a dark place also prevents splitting. It is beneficial to get the tree as near to the size of the hub required as possible, as it is hardest nearest to the outside. (*Vide* photograph opposite page 56.)

Manuka, or White Tea-tree.—Another useful timber for making spokes. It is a timber easily worked, and a good finish can be got on it without a great deal of labour. If the right class of timber is selected, cut at the proper time, and seasoned, first-class results will be obtained. During the past twenty-five years, have obtained good results from it, and for some classes of work prefer it to imported timber. It also makes good light cart-shafts, where pliability is required. Also useful for pick-handles. (*See* photograph of manuka opposite page 48.)

Yellow Kowhai.—A very useful timber for bending purposes, and makes first-class rims for wheels, equal to anything imported. Is not procurable in any quantity in this part of the Dominion, which is unfortunate, as it could largely take the place of imported hickory. Have seen it used in wheels with most satisfactory results. (*Vide* photograph opposite page 49.)

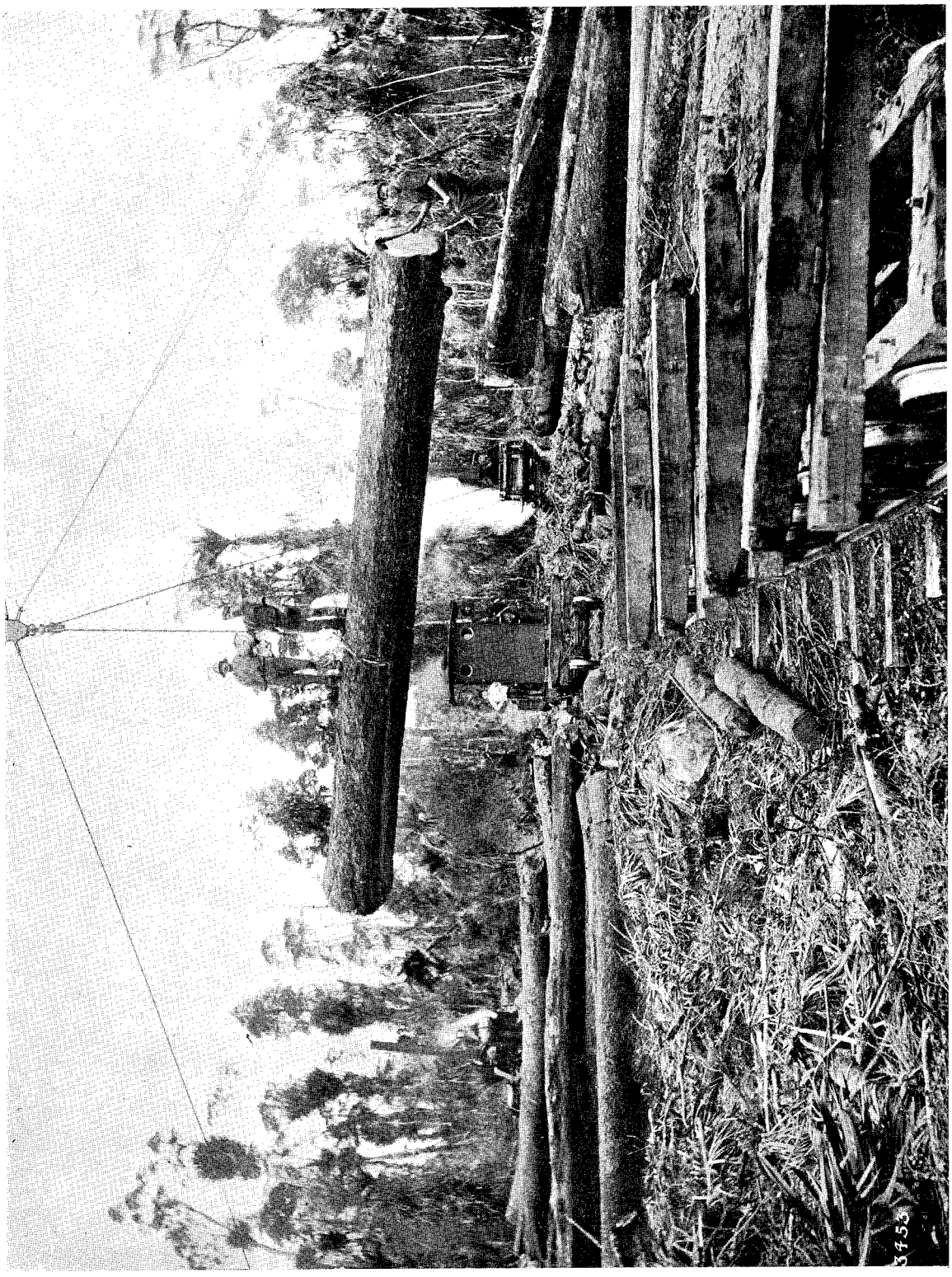
Mangeao.—A very useful timber for inside work in buses, trams, and railway-carriages, some of it being very beautifully figured. Requires to be cut at the proper season, otherwise it is useless. If cut when the sap is up it will rot very quickly, and if cut into boards it will go black and decay when each fillet is placed between the boards whilst being seasoned. When cut at the proper season this trouble does not appear. Have seen this timber used with good results in violin-making. It produces a good clear tone.

H. J. Cousins,
Auckland.



KAHIKATEA-FOREST LAND WHEN CLEARED BY SAWMILLER.

Face p. 68.]



LOADING LOGS ON TO TRUCKS, NAUMAI MILL.

PART II.—FOREST-UTILISATION.

CONTENTS.

	Page
(A.) Sawmilling Methods,—	
(1.) In the Kaipara district	69
(2.) In the Waimarino	70
(3.) In Westland	72
(4.) In Southland	74
(B.) Medicinal Properties of Trees and Shrubs	76
(C.) Various Processes of Seasoning Timber,—	
(1.) General description of methods	76
(2.) The Rueping process of creasoting	78
(3.) The Powell wood process	80
(D.) Miscellaneous Methods of Utilisation,—	
(1.) The wood-pulp industry	81
(2.) Secondary forest-products	83

(A.) SAWMILLING METHODS.

(1.) Kaipara District.

The White-pine Company of New Zealand (Limited), at Naumai, Kaipara, have a bush extending over some 4,000 acres. The timber is practically all kahikatea; some little rimu and kauri being found in isolated patches.

The small margin between the cost of production and the selling-price of kahikatea has made it essential that only the most economical methods of handling the log and timber can be used. In order that this handling may be done in an expeditious and cheap manner, machinery has been introduced to take the place of the bullocks and timber-jacks in the bush and much of the slow and laborious manual handling in the mill. From the time the trees are felled, machinery does practically the whole of the work. A 15-horse-power boiler, coupled to a winch with two 8 in. cylinders, the barrel carrying up to 20 chains of 2¾ in. wire hauling-rope, and a smaller barrel with double that length of 1⅜ in. return rope, is employed. A block is placed at the end of the hauling-track, through which the return rope runs, and is then brought back and hooked on to the hauling-rope on the main barrel. Starting the winch winding up the return rope, the hauling-rope is carried out far enough to reach the log to be hauled. The hauling-rope is made fast to the log by means of grips, and the signal is given to the winchman to go ahead. The log, in lengths varying from 30 ft. to 120 ft., averaging about 60 ft., is hauled in to the tram-line, where it is to be loaded on to trucks. The loading-winch now takes hold. The fall from this winch passes through a block slung immediately over the track, on a wire strained at a height of about 40 ft. from the ground between two trees, on either side of the tram. A wire strop is placed around the log at the balancing-point, and it is lifted into the air and lowered quietly on to the truck. The trucks, being loaded, are coupled to the locomotive and conveyed to the mill, some two and a half miles away. On arriving at the mill the logs are rolled or parbuckled by means of a steam-winch on to the unloading-skids adjoining the log-slip. A wire rope from the mill log-winch is brought down, and the log hauled up to the entrance of the mill, where, after being measured, the man in charge of the steam crosscut saw proceeds to cut it into suitable lengths for the mill. Each length is in turn hauled along until opposite the band-saw skids; a crank operated by friction-gear lifts the arms of the log-cant, and the log rolls down the skids until brought up by the steam log-stop. The log-stop is a shaft on which is fastened three arms standing about 16 in. above the skids. The end arm by means of a short crank and connecting-rod is operated by a steam piston which is worked by the band-sawyer from his position at the saw-levers. When the steam is opened the arms and shaft revolve, throwing the log over towards the band-saw carriage and within reach of the steam nigger. The nigger is a spear about 6 ft. long and 6 in. square, connected to two pistons working in oscillating cylinders 8 in. and 10 in. diameter. The steam of this is also controlled by the sawyer, and he can lift, lower, throw forward or backward, the spear by means of which the logs are put on the carriage and turned into position for cutting in as many seconds as the old laborious method with jacks took minutes. For heavy logs an overhead winch assists in turning the logs. As soon as the log is in position the carriage-man dogs down, and the carriage, operated by steam, is started forward towards the band-saw. As the slabs and boards are turned off, they fall on to live rolls worked by friction gear, and pass along to the drag and edger saws. When a flitch is cut it passes along the rolls until opposite the deal-frame skids. Here a cant-flip, operated by a belt, throws the flitch down the skids within reach of the man at the deal-frame. The bark-edged and shaky

boards turned off by the band-saw are put through the edger, which has one fixed and two movable saws, by means of which three boards of varying widths may be cut at the one operation. The slabs go to the drag saw, are sized, and cut into the required dimensions. The refuse slabs and edgings are passed down a shoot to the "hog," or edging-grinder. This machine will take a slab up to 6 in. in thickness and in a few seconds convert it into chips about 1 in. in thickness, according to the setting of the knives. These chips, or "hoggings," drop into a conveyer shoot in which runs an endless chain. The sawdust from the saws is also conveyed by creepers into this shoot, and, mingling with the hoggings, is carried to the stokehold and deposited as required on the tops of the furnaces. From here by gravitation it drops through hoppers into the fire. The furnaces are specially constructed to burn this fuel. A fan or blower is attached to give the forced draught necessary to burn the green kahikatea sawdust, which contains about 50 per cent. of moisture. Any sawdust in excess of that necessary for fuel is carried by an extension of the conveyer past the stokehold, and falls into a large box truck, and is taken on the return trip of the locomotive to the bush, where it is used to pack the sleepers in the bush tram. The amount so used is not great—in fact, contrary to the usual state of affairs at a sawmill, the quantity of fuel is barely sufficient for the furnaces.

The power is derived from three longitudinal boilers, 14 ft. tubes, carrying 120 lb. pressure. The engine is a twin-cylinder, 16-in. diameter, 20-in. stroke, 100-horse power. A small compound engine, 37-horse power is used to drive the deal-frame.

The saw-shop is equipped with an automatic grinder, saw-stretching rollers, brazing-bench, and lap grinder for the band-saws, and other emery wheels for the deal-frame and circular saws.

The trade is wholly export, the bulk of the timber going to Australia. Some shipments have been made to the United Kingdom. Steamers of 1,000 to 1,800 tons are frequently loaded: on one occasion a steamer of 2,600 tons loaded for Australia. Sailing-vessels of from 200 to 700 tons are also employed. Vessels of 20 ft. draught can load with safety.

J. Allman Marchant,
Naumai, Kaipara.

(2.) Waimarino District.

In going through a New Zealand forest one is always impressed by its density, but of the many varieties of trees composing it there are generally not more than two or three kinds that are at present of commercial value; and of these two or three kinds there are probably not more than 75 per cent. of them that are of sufficient size or of good-enough quality for milling purposes. In some localities the red-pine (rimu) are to a great extent bark-galled, twisted, or the barrels bifurcated; and in some localities the totara is largely affected by dry-rot; so that there is a very small proportion of the sawn timber that can be disposed of as best heart. I have heard no satisfactory explanation of the causes that are responsible for these defects, nor have I any explanation of my own that is applicable to all cases. This, however, I have observed: that rimu growing in a locality where mountain-cedar is the dominant tree is nearly always more or less dwarfed or twisted and often bifurcated; and, as the cedar predominates only on very poor soils at high altitudes, it would appear that these two conditions are mainly responsible for the defects of the rimu.

In working a milling-bush the first thing after the selection of a suitable site for the milling-plant is the selection of tram-routes that entail as little expense as possible for formation, yet at the same time tap localities where the trees are most plentiful, and give good grades for hauling. At the terminus of the tram-line it is usual in easy country to have a small stationary engine, which, by means of a long steel-wire rope, hauls the logs down rough tracks to the trucks that are waiting to run them down to the mill-yard. From the yard the logs are hauled by machinery on to a platform, and then jacked on to a large travelling bench which conveys them to the breaking-down saw; the flitches are then slid to smaller saws which cut them into studs, weatherboards, flooring-boards, &c.; these small timbers are then stacked in the yards according to their quality—heart, O.B. or seconds—to be in readiness for the orders of city timber-merchants.

There does not appear to be any season recognised in New Zealand for the felling of trees for milling. When business is good men are kept cutting, and when business is dull the mill works half-time. Some authorities assert that it is this indiscriminate cutting of trees that gives some of our timbers bad reputations. For example I have heard one of the most experienced architects in New Zealand say that when kahikatea (white-pine) is cut in winter, before the sap rises, the timber is as durable as red-pine. However this may be, it is well known that in older countries the trees are always cut when the sap is down.

The yield of timber per acre, of course, differs largely in different localities. In the forest recently opened up by the North Island Main Trunk Railway the yield is as high as 40,000 ft. (superficial) to the acre. The average of the milling-bushes at present being worked in this district would probably be about 25,000 sup. feet. As a rule it does not pay here to work a bush that gives under 10,000 feet to the acre.

The felling of the trees is done by axe and saw: a "scarf" is cut with the axe on the side facing the direction in which the tree is wanted to fall; then a long two-handled saw is brought into operation on the opposite side, and, to guard against the tree balancing over to the reverse direction to that required, the saw-cut is made about 2 in. higher up than the "scarf." Two men will cut down an average tree (2 ft. 9 in. in diameter) in about thirty minutes. Very great care and skill are required in felling trees for milling, as, if they fall over logs or stumps, their barrels are liable to be shattered and rendered worthless. The felled trees are then sawn into suitable lengths (from 14 ft. to 15 ft. being generally required) and then hauled out either by bullocks or by steel-wire rope and steam log-hauler to the bush skids, where they are jacked on to the trucks and hauled either by a team of heavy draught horses or steam locomotive along the bush tram to the mill.

A mill with a capacity of two million feet employs four men felling, and these men will cut down thirty trees, equalling about 10,000 sup. ft. in eight hours. In one year a mill of about this capacity would cut out about 100 acres of milling-bush.

Before starting milling operations a large outlay of capital is required for the erection of buildings and machinery, construction of tramways, water-race, locomotive or horses, bush hauler or bullocks, wire ropes and blocks, stationary engine and boiler, saws, planing-machines, &c., men's cottages, railway-siding, clearing site for mill, and numerous other smaller items. There is also the purchase of the milling-bush or the right to cut timber. A mill with a two-million-feet capacity will require an outlay of from £7,000 to £8,000, exclusive of the purchase of the milling-bush or timber rights, which alone reach as high as £8 an acre for rimu and matai bush. The cost of some of the items in the expenditure are—stationary engine and boiler, £600; planing-machine, £170; saws, spindles, rollers, belting, and small interior machinery, £400 (breaking-down twin-saw costs £20, and breast-bench saws cost £6 each); a 12-horse-power log-hauler costs £450; wire ropes and blocks cost £70; and if a locomotive be used on tram-line it will cost £1,500; the tram-line will cost from £160 to £1,000 a mile, according as to whether steel or wooden rails are used and the kind of country it has to be constructed in; then, if horses or bullocks are used instead of a locomotive or steam hauler, there will be required of the former not less than eight at £45 each, and of the latter not less than forty at £10 apiece; the feed of the horses all the year round will not be less than £250, and of the bullocks £240. If a railway-siding be obtained it will cost some £700. In most mills, also, it is now usual to bring in water by a race to wash away shavings and sawdust, thus saving the labour of one man.

A mill with a capacity of about six million feet would employ about seventy hands at the bush and mill. A mill with a capacity of about two million feet would employ about twenty-one hands. Of these there would be thirteen at the mill itself, and eight on the outside work. Of those working inside the most important are the men looking after the boiler and engine, the two men at the breaking-down saw, the two men at the breast-bench saws, and the one at the planing-machine; the others are employed at the less responsible jobs of skidding, slabbing, truck-loading, &c.

At the outside work there are four men felling, two "bullockies" hauling logs to the bush skids, one man at the skids to help load trucks, and one man working the truck-horses between the bush skids and mill. The average wage earned is 12s. for a day of eight hours. A benchman gets as much as 14s. a day, a planer gets 12s. a day, axemen get 12s. a day, and at the less skilled jobs the wage is from 10s. to 11s. a day. In the larger mills a man is kept solely to keep the saws in order; he bears the serious title of "doctor," and gets as much as 15s. 6d. a day, which is perhaps more than some medical doctors clear.

From the tree to the saw-bench the timber costs 3s. 3d. per 100 sup. ft., and from the saw-bench to the railway-truck 1s. 3d. for labour only; royalties, insurance, interest on capital, depreciation, &c., add 1s. 3d.; and the freight by rail to Wellington would be about 3s. 9d., bringing the total cost to 9s. 6d. landed in Wellington.

The insurances are heavy items, that on the labourers amounting to 3 per cent. on the total wages paid, and that on the plant to 5 per cent. on the cost—in fact, it is only a few of the insurance companies that will insure bush mills. The forests are quite uninsurable, and may be destroyed any time.

The mill itself consists merely of one or more large sheds roofed with galvanised iron; under these are disposed the breaking-down saw, the breast-bench saws, and planing-machines, all in such positions that the timbers can be conveniently passed from one to the other.

Trees with as small a diameter as 12 in. are cut; so, as will be seen in the photograph opposite page 68, after a miller has finished with a bush, there is little left standing beyond saplings, useless-timber trees, and the usual undergrowth of shrubs and ferns, all shattered and torn by the trees that have fallen. Even this shattered remainder is probably doomed to destruction, as the worked-out bush, containing as it does all the boughs and leaves of the used timber, generally catches fire accidentally, or is purposely burned to insure the safety of other uncut timber, the mill-yard, and workmen's cottages. Even were this not the usual fate of the worked-out bush it would not be advisable to preserve it, as our marketable pines are of remarkably slow growth; so it would not pay to await their development to mature trees. Consequently, the only plan when dealing with Crown lands that have been milled seems to be to throw them open for settlement, if of good-enough quality and accessible; and where of poor quality and broken they might be left further untouched as protection to the hill-slopes; or they might in some instances be replanted with quick-growing foreign trees suitable to the climate.

Of the log-measurement there generally is lost from one-quarter to one-third as slabs and sawdust. The proportion of heart, ordinary building-timber, and seconds naturally differs with various timbers, localities, and mills. One of the most successful managers in the Waimarino district gets from every hundred superficial feet of sawn red-pine 22 per cent. of heart, 56 per cent. of O.B., and 22 per cent. of seconds. The manager of another prosperous mill in a locality where totara is the chief timber converted, from 181,000 sup. ft. of logs gets 31,300 ft. of best heart, 2,200 ft. of rough heart, 44,500 ft. of O.B., and 57,000 ft. of seconds, or a total of 135,000 ft. of sawn timber; which, again, is equal to 23 per cent. of best heart, $1\frac{3}{4}$ per cent. of rough heart, 33 per cent. of O.B., and $42\frac{1}{4}$ per cent. of seconds. The difference in measurement between the log and sawn timber shows that about one-third has been lost in sawdust and slabs. Another mill with a large cutting-area of heavy rimu bush finds the trees so defective with "shakes" and bark-galls that, on an average, only one-fifth of the timber converted turns out heart, the balance being classed as O.B.

So far, nothing has been done in New Zealand to utilise what might be termed the by-products of milling operations. The leaves, bark, and branches are left in the bush either to rot or be burnt; the sawdust and slabs are conveyed a short distance from the mill, and left in huge heaps to rot. This all seems lamentable waste, as turpentine, wood-spirit (which is now in Europe being much used as a

motive power), pine-oil, tar, resin, dyes, tannin, &c., might be obtained from these waste products; and, finally, the wood-pulp industry might well be carried on in conjunction with timber-milling.

At the present time the only timbers that are milled are kauri, totara, rimu (or red-pine), kahikatea (or white-pine), matai (or black-pine), miro (in some places it is cut up, and the boards dispersed and sold with other timbers), and to a small extent silver-pine.

There are many other of our forest-trees (now neglected) which would be of value were the industries for which they are useful well established in the country. The mountain-cedar (*Libocedrus Bidwillii*), which grows in great quantity in the Waimarino forests, could be used for all purposes for which Australian and Asiatic cedar are used; so, also could the other cedar, the kohekohe (*Dysoxylum spectabile*), which is plentiful in Auckland forests; the pukatea (*Laurelia novæ-zealandiæ*), the kamahi (*Weinmannia racemosa*), the mangeao (*Litsea calicaris*), the titoki (*Alectryon excelsum*), and the hinau (*Elæocarpus dentatus*) are all valuable for furniture, coachbuilding, and like purposes; maire (*Olea Cunninghamii* and *lanceolata*) are equal to lignum vitæ; and the different kinds of *Fagus* in other countries would all be used. In this country, however, all these trees are being cut down by the pioneer, their charred barrels remaining as an encumbrance to the land till years of exposure have finally caused their decay.

E. Phillips Turner,
Inspector of Scenic Reserves, &c.

(3.) Westland District.

This report deals specially with the Arnold Valley timber areas, Mawheranui, Hohonu, and Brunner Survey Districts, hitherto the most prolific source of supply of timber in Westland.

To work forests on this coast profitably at present prices, it is necessary that the sawmill should be on, or of easy access to, a railway, with speedy delivery to a port capable of fair-sized vessels. The milling-bush must be close to the mill, in order that there shall not be the outlay on, and the upkeep of, a long distance of dead tram; though, once established, the mill may extend its workings to a distance of eight or ten miles. The country must be generally flat or lightly undulating.

In the Arnold Valley, from Stillwater Junction to Lake Brunner, are nine mills cutting almost exclusively on Crown land, and four cutting almost entirely on alienated land (Midland Railway land grants). These mills each cut an average of 8,500 sup. ft. of red-pine and white-pine per day, and reckoning 275 working-days in the year, the total output of the whole of the above mills aggregates to over 30,000,000 ft. per annum.

The amount of marketable timber per acre of milling-forest in the district varies from 10,000 sup. ft. to as high as 60,000 sup. ft.

At an estimate of 20,000 ft. to the acre, the output above mentioned means the denudation of 1,500 acres annually, and, as this excludes all silver-pine workings and blank places, a much larger area is worked over every year by these mills alone.

It is beyond the power of the writer to give more than a nebulous forecast as to the duration of the supply for these mills, but he considers that the profitable possible supply of red-pine, white-pine, or even miro will cease for at least one mill in five years, and the life of even that mill which has the best supply cannot exceed twenty-five years, although the owner considers he has thirty years' cutting. At present rates of cutting, all pine accessible to present railways in this district will be cut out in about twenty years, and the future source depends on the extension of railway southward from the Mikonui River.

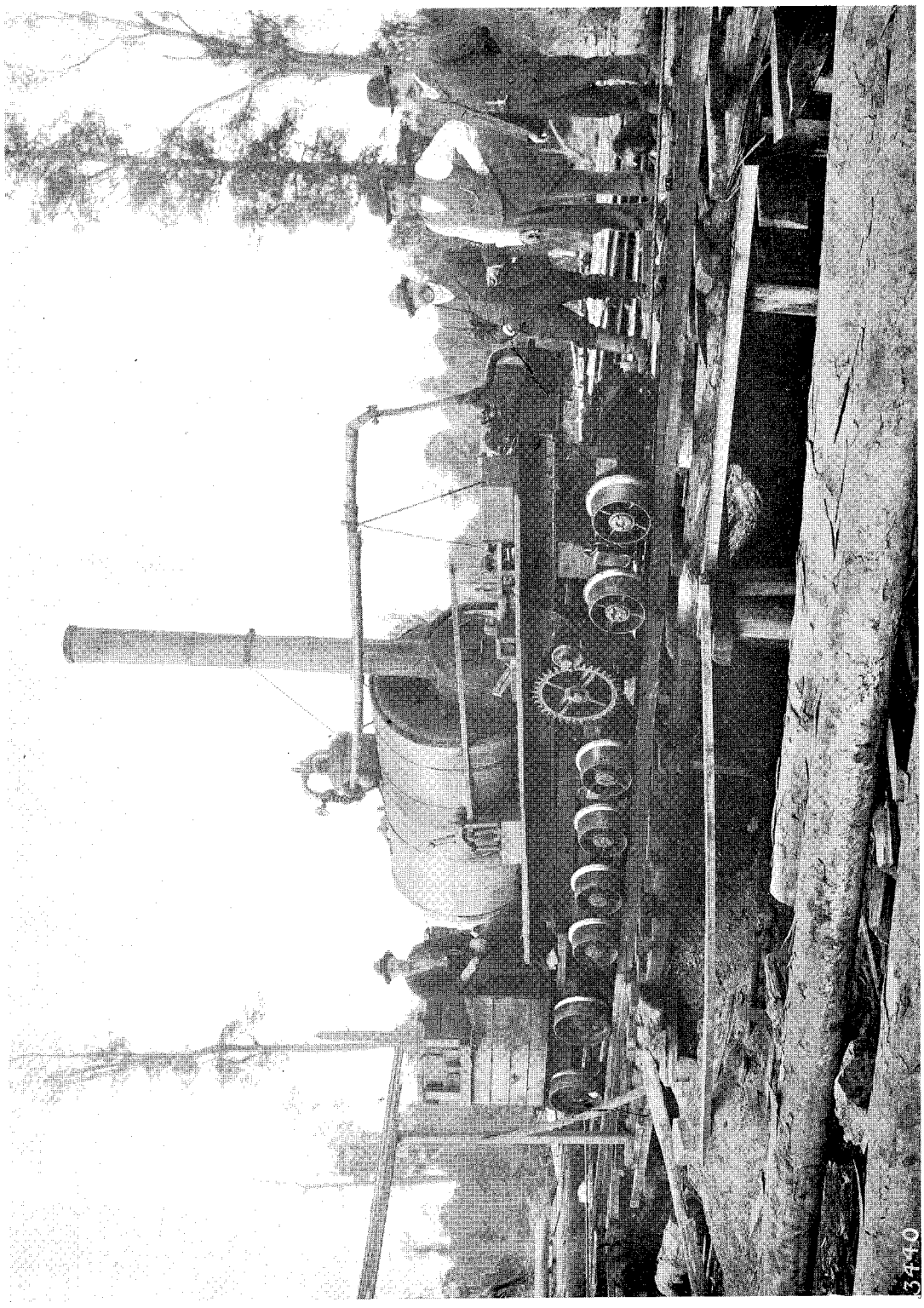
Of the various "birches," *Nothofagus Solandri*, *fusca*, *Menziesii*, &c., and *Weinmannia racemosa*, there is abundance for many years; but these timbers will never be used by builders while material more easily worked can be obtained.

Waste.—Much timber is needlessly wasted by the sawmillers, and it is safe to say that only 60 or 70 per cent. of the timber cut, or available, in the workings in the forest ever reaches the market. The millers declare with truth that, if the east-coast market continue to demand nothing but absolutely clean timber, they will have to waste fully another 10 per cent. of the available timber. It will therefore be impossible to demand from any one miller that his bush shall be worked clean unless this is rigorously required of all alike. Then each mill will arrange for a market for its rougher timber, which, by the way, is the stronger by far and more durable than the clean immature sapwood in request by the builders.

Tenure.—In this district all timber-areas are considered as mining rights, and are under the control of the Warden.

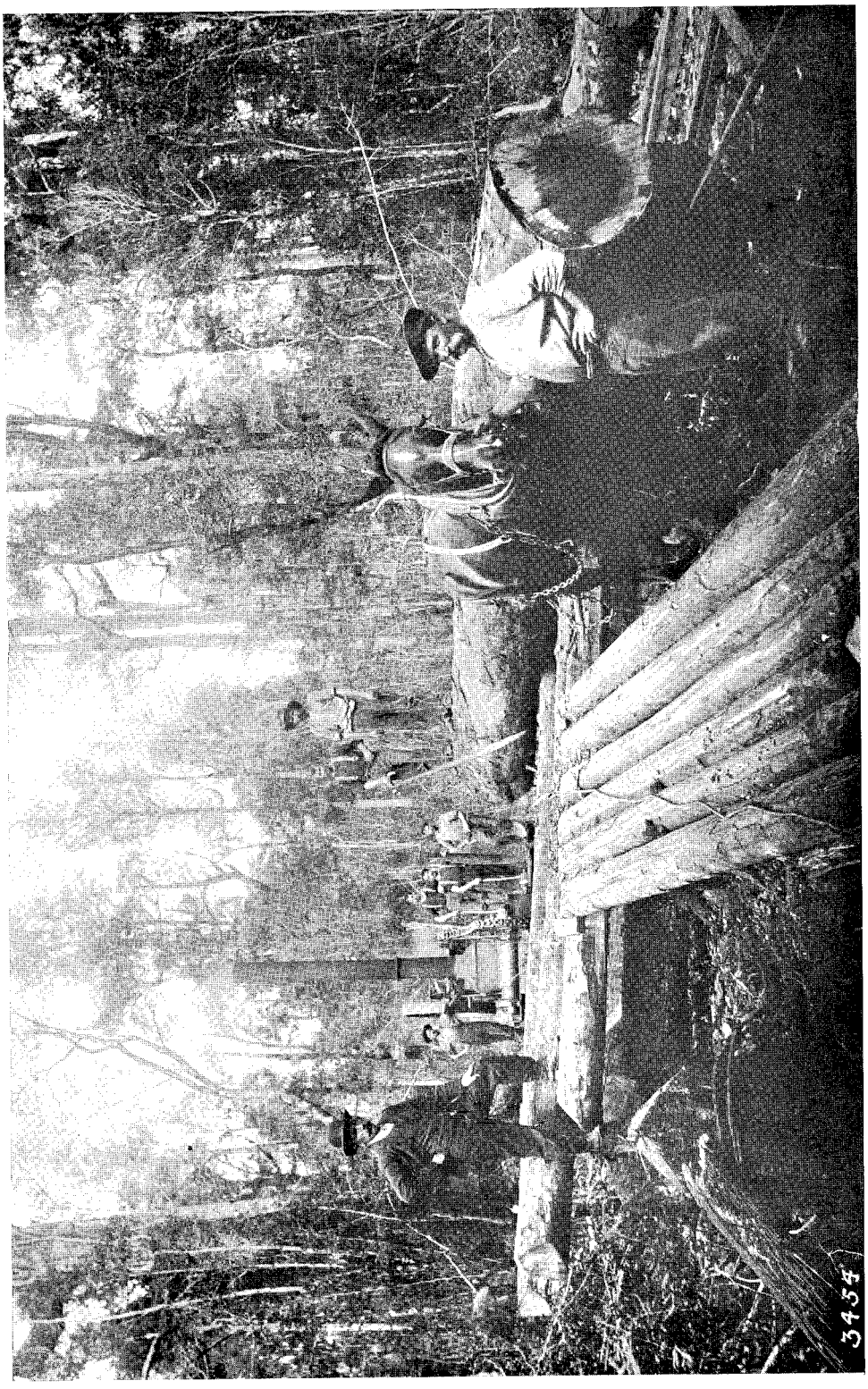
Conversion.—A very abridged description of the method of working the forest in this district will render more comprehensible the detailed cost of production given below. The tree is felled by axe and saw, the barrel sawn off by hand, when a wire rope up to 18 chains in length is secured to the barrel by iron dogs, and the log is hauled along the ground by a steam-winch of about 8 brake horse-power to the loading-bank near the tram. The log is not snouted, an iron shoe plate serving the purpose more efficiently.

The log is then rolled on to trucks, and a rake of trucks carrying perhaps ten logs containing 5,000 ft. of marketable timber, plus waste, is drawn by a simple but effective locomotive along a wooden- or iron-railed tram, it may be eight or nine miles to the mill. (One of these locomotives, chain-geared, on eight wheels, can work grades up to 1 in 7 on wooden rails, and 1 in 10 or 12 is easily surmounted.) When the log arrives at the mill, it is rolled off the trucks on to skids, crosscut, hauled on to the travelling bench, and sawn into flitches by twin circular saws, when the flitches are rolled to the breast bench to be cut into the required sizes of building-timber, and straightway loaded by hand on to railway wagons (U's and UB's) for shipment. It is therefore quite usual that the timber beng used in any building was growing green in the forest the previous week. The falling of the timber is carried on continuously throughout the year, irrespective of season.



LOG-HAULER AT KAIMATA MILL, WESTLAND.

Face p. 72.]



Log-hauling at Arnold Mill, showing Wire Rope.

The net cost of production of one typical mill turning out 10,000 ft. per day is detailed hereunder:—

	s.	*Labour, per Day.*
3 bushmen	34	Fall and crosscut fifteen or sixteen fair-sized trees per day.
1 winchman ..	11	Drives and cuts fuel for hauler that pulls logs from stump to tram.
2 sniggers	22	Cut tracks and superintend the passage of logs from stump to tram.
2 on locomotive ..	21	Driver and brakeman. Both load and unload.
4 laying tram ..	42	Tram costs about £1 10s. per chain, labour only.
1 sawyer	16	£4 10s. to £5 per week. Has to "keep" saws.
1 tailer-out	12	Assists sawyer at breast-bench.
2 breakers-down ..	23	Cut log into flitches on travelling bench.
1 crosscut	10	The "fiddley." Cuts logs into shorter lengths at mill.
1 slab-carrier ..	10	Removes waste from breast bench, pushes it along tram, and burns it.
1 mill-engine driver ..	12	Engine 10 to 20 brake horse-power, usually wood-fired.
1 blacksmith ..	11	Repair-work and shoes.
1 docker	9	Not in all mills. Cuts ends of sawn timber.
1 trollyman	10	Drives horse hauling sawn timber, mill to siding.
3 yardmen	30	Load and tally timber, &c., at siding.
	273	
Insurance—		
W.C.A.A., 3% ..	8	
Total ..	281	Cost of labour on 10,000 ft. = 2s. 10d. per hundred, nearly.

Plant Charges.

	s.	
Upkeep of mill, winches, and locomotive; material for trams, &c. ..	50	Very difficult to estimate. Includes depreciation.
Three horses	20	
Interest, rent, insurance, &c. ..	15	Capital value, £3,000.
Contingencies	5	
Total	90	Plant charges on 10,000 ft. = 11d. per hundred, nearly.

	s.	d.	s.	d.
Cost on timber-trucks at siding, per hundred (labour 2s. 10d., plant-charge 11d.) ..	3	9		
Freight, twenty miles	1	3		
Royalty	0	6		
Agency	0	1		
Shortages, &c.	0	2		
F.O.B. Grey Wharf, per hundred			5	9
60 per cent. of this timber must be classed as "rough," for which 6s. 9d. per hundred is obtained = ...	4	0		
40 per cent. clean timber at 8s. = ...	3	2		
Price obtained by miller			7	2
Profit to miller, including his services as superintendent and director, per hundred			1	5

The above cost may vary slightly for various mills, owing to differences in quality and accessibility of bush, and in skill in management.

If a mill be worked by contractor, the contractor may get 4s. to 4s. 6d. per hundred on trucks at siding.

Timbers other than red, white, or black pine, that could be profitably exploited:—

Silver-pine, *Dacrydium westlandicum*, is now used almost solely for sleepers, except for a limited local consumption. It is cut very wastefully, hundreds of trees being cut for sleeper sizes only, the remainder being left in the forest to be burnt by the inevitable fire. This timber is soft, close-grained, oily, of medium strength, rather brittle, of great durability, and impervious to grubs. It is superior to totara, and is well suited for house-blocks, fences, sills, and outside work generally. It rarely attains a large size, but is usually from 12 in. diameter upwards. Special freights for fence-posts, &c., would enable much of this timber that is now wasted to be used on the east coast.

Kaikawaka, *Libocedrus Bidwillii:* A straight-grained, durable timber, porous in composition, and very light in weight; very well suited for boat-building, furniture, venetian blinds, &c. Moderately plentiful through the district, occurring in patches. At present hardly used. Certain specimens prove very durable when converted into fence-posts, others decay near the ground. This is probably dependent on the season in which it is cut.

Nothofagus fusca, Solandri, &c.: Of great size, strength, and good durability; liable to warp in drying; decays in contact with iron. Used only for mine-timbers in this district. The bark of all this genus, as well as of tanekaha (*Phyllocladus alpinus*) contains a high percentage of tannin. *Nothofagus Menziesii* is to be used for the wood-pulp industry. For this purpose it would seem that mako-mako, *Aristotelia racemosa*, would have been suitable.

Miro, *Podocarpus ferruginea*, is frequently cut and sold as red-pine, from which it may hardly be distinguished when sawn and stacked. This timber takes the borer readily.

The common supplejack (*kareao*) was formerly cut in the North Island for basketwork, the cutter receiving 8d. per 100 canes, 10 ft. in length.

Fancy-figured timbers can be frequently obtained from nearly every variety of tree.

WALTER FRANCIS ROBINSON,
Assistant Surveyor.

(4.) SOUTHLAND DISTRICT.

A sawmiller's first object is to secure, within a reasonable distance of a railway or water-way, an area of forest land or bush, carrying sufficient timber to warrant the erection of a mill. This area varies very much in different parts of the Dominion, but an 800-acre block is usually considered an average, though in the south of this Island and in Stewart Island, it is sometimes not extensive enough owing to the land being so sparsely timbered. The selection of a mill-site is most important, as it must suit the best tramway-grade for working out all the timber in the bush, and for conveying it to the railway-siding or shipping port, and it must also be in a position to command a constant supply of water. A plan and specification of the contemplated mill should then be made, the power and extensiveness of which must necessarily depend on the quantity of timber already secured, the size of trees to be operated on, and the class of trade expected to be done during the working of the mill. The site, if in the bush, must then be cleared of all trees, stumps, &c., and the foundations for machinery and buildings laid out; also tramway routes marked ready for construction. The cost of erecting a mill and constructing the necessary tramways may vary from £1,000 to £4,000, according to the output required, the nature of the country through which the tramways must go, &c. In erecting a mill, a sawmiller should bear in mind that solid foundation, good substantial material, up-to-date machinery, ample power, and the best mechanical skill procurable are all indispensable commodities for the successful carrying-out of the industry. If the timber-distribution be by a railway, a siding must be secured. Usually this has to be constructed specially for the miller: the Railway Department does the work at the sawmiller's expense. The cost runs from £200 up to £700, according to length of siding and nature of the ground. The miller must also construct a timber stage or yard where the timber may be stored ready for loading into railway-trucks. If the distribution be by water, a wharf has to be built where the timber may be stored ready for loading into vessels. The cost of constructing a wharf runs from £350 up to £3,000, according to the dimensions of wharf and class of harbour. If the harbour be well sheltered, and deep water close inshore, the expense of construction is low; but if it be badly sheltered and deep water a distance from the shore, the wharf must be costly. Tramways must then be constructed from railway-siding or wharf, as the case may be, to the mill, for the conveyance of sawn timber, and from mill to bush for conveyance of logs to mill. In cases where the bush-area is a long distance—say, four miles or over—from a railway-siding or wharf, iron rails are used in construction, and very probably a locomotive engine for hauling; but if under that distance horses and wooden rails are generally used. The cost of constructing tramways varies according to the nature of the country to be worked and the class of trawmay required. Iron-railed locomotive tramways cost from £5 to £20 per chain, and wooden horse-trams from £1 5s. to £8 per chain.

The cost of constructing a sawmill is rather difficult to define; but, take an area of 800 acres, carrying 15,000 ft. of sawmilling-timber per acre, situated four miles from a railway, the following mill with all appurtenances would work this bush to the best advantage, and deal direct with the builders:—

	£
1 mill-engine, 30-horse power nominal	650
1 planer, to areas 24 in. wide	185
1 moulder, to areas 5 in. by 5 in.	125
1 breaking-down bench, with feed gear	140
2 rip benches, with feed gear	40
Intermediate shafting, with pulleys and bearings complete	110
3 60 in., 3 42 in. saws	78
2 30 in. crosscut saws and frame	7
4 saw-spindles with pulleys and bearings	30
Belting	45
Cost of erecting machinery and mill-shed, including material	300
	1,710
4 miles wooden horse-tram	640
Loading-bank at railway-siding, including all material	40
Railway-siding	300
6 horses, and harness	230
7 trolleys, complete	70
	2,990
1 hauling-engine, with blocks and ropes complete	400
Men's huts	60
Stable and store	40
	3,490

A mill of this class will produce about 1,500,000 feet superficial per annum, and will require twenty-six men to work it, the daily cost of running it being shown in the following table :—

	£	s.	d.
Bush.			
4 bushmen, at 9s. per day	1	16	0
1 tracker, at 9s. per day	0	9	0
1 shoe-man, at 11s. per day	0	11	0
1 winch-man, at 9s. per day	0	9	0
2 trolly-men, at 9s. per day	0	18	0
2 tram-layers, at 9s. per day	0	18	0
Mill.			
2 sawyers, at 12s. and 10s. per day	1	2	0
2 tailers-out, at 10s. and 9s. per day	0	19	0
2 slab-men, at 9s. per day	0	18	0
1 machinist, at 12s. per day	0	12	0
1 assistant machinist, at 8s. per day	0	8	0
1 engine-driver, at 10s. per day	0	10	0
1 labourer, at 9s. per day	0	9	0
Yard.			
3 yardmen, at 9s. per day	1	7	0
1 clerk and manager, at 14s. per day	0	14	0
1 blacksmith, &c., at 12s. per day	0	12	0
	12	12	0
Horse-feed	0	10	0
Oil, files, coal, iron, &c.	0	15	0
	13	17	0
Additional.			
This return shows a cost per 100 ft. of	0	3	10½
Royalty	0	0	6
Wear-and-tear, ropes, blocks, belting, &c.	0	0	6
Insurances, fire and accident	0	0	6
Travelling-expenses	0	0	6
Rents and taxes	0	0	1
Interest on capital	0	0	4½
Depreciation	0	0	4
Discounts and allowances, and bad debts	0	0	3
	0	6	11

This mill, as already mentioned, should produce 1,500,000 ft. of timber per annum, and manufacture close on 50 per cent.

The method adopted for working sawmills differs very little throughout New Zealand, with the exception of the rafting kauri-mills in the North Island. The canvasser forwards orders from the builder or other customer to the mill-clerk or manager, who posts the portions not already in the timber-yard on a blackboard in the mill, to direct the sawyers and machinist, and if necessary he sends a list to the leading bushman. This bushman has usually a standing order for certain lengths, and only receives instructions when some extraordinary length or class of timber is required.

When the bushmen start to work a new piece of bush, a loading-bank is built adjacent to the tram, and the hauler or winch set in position for work. A main track for log-hauling is cleared from the loading-bank to the far end of the block of bush to be worked—a distance of perhaps 15 chains—the back rope is then hauled from the winch to the end of this track, passed through a block or pulley, and hauled right back again to the winch, where it is made fast to the hauling or big rope ; by this means the winch not only hauls in the logs, but takes the hauling-rope back for the next pull of logs. If the track is not straight, a block is placed at each bend, and the rope passed through in order to fetch the logs round the corner. The bushmen fell all trees to suit the hauler. The tree is scarfed or notched on the side on which it is required to fall ; then two men, with an ordinary crosscut, saw on the opposite side of the tree, and by this means, with the assistance of a maul and wedge, the tree is felled. It is then crosscut into suitable lengths, and the logs, made fast to the hauling-rope by means of a dog or spike, are hauled on to the log-bank, which is slightly higher than the trollies, so that the logs may be easily loaded.

The logs are conveyed by means of trollies hauled by horses from the bush bank to the mill-skids, where the sawyer commences his operations. The logs are rolled by hand or lifted by a crane on to the breaking-down bench, which consists of two ½ in. iron plates, 1¼ in. apart, coupled at one end, and travelling on cast-iron rollers. The slit between the plates of the bench allows the saw to work freely while the bench travels past, carrying the log which is being operated on. The saws used are 60 in. twin saws, one revolving over the other. A bench of this class can flitch logs up to 60 in. in diameter, and suits all mills in this island ; but in the North, where logs 6 ft. in diameter are common, a vertical saw has to be used to break down before the circular saws can operate. The ripping-bench saws up into boards,

scantling, or other sizes which may be in order the flitches or balks from the breaking-down bench; the rough timber is loaded on to a trolly by the tailer-out, and timber for dressing is stored near the planer or moulder. The timber is conveyed from mill to yard on trollies, and there classed and stacked ready for delivery to customers.

The waste in connection with sawmilling is very great, especially in Southland, where the trees are small and rather stunted. Compared with kauri bush, I should say the waste in Southland is double. I estimate the waste in Southland as follows: All limbs, tops, &c., left in bush, 30 per cent.; sawdust, 10 per cent.; slabs, 20 per cent.: total, 60 per cent.

Suggestions re *Waste.*—Many suggestions may be made for utilising waste products of sawmills, such as wood-pulp, a mixture of tar and sand with sawdust for street-paving blocks, &c. A large pit built near the mill where all waste could be burnt, and the ashes converted into potash, which is a very simple and practically inexpensive process, would pay sawmillers who cannot sell slabs to householders for firewood. Another suggestion is that all timber should be ringed during the months of June, July, and August. By this means all sap is prevented from ascending to nourish the tree, and consequently it must increase the durability of the timber. Of course, the wood in those trees will commence to decay unless cut up within eighteen months.

J. W. Collins,
Crown Lands Ranger.

B.) MEDICINAL PROPERTIES OF TREES AND SHRUBS, AS STATED BY OLD MAORIS.

Flax.—Juice of roots and thick ends of leaves, in large doses an emetic, small doses daily when suffering from boils. The red portion of flax-roots boiled—the extract therefrom is used as a purgative. Flax-gum is also used for dressing open wounds.

Kareao (*Supplejack*).—A decoction from the roots given in cases of weakness or general debility; used in the same manner as sarsaparilla.

Kawakawa.—Pulp of leaves and fruit retained in the mouth to relieve toothache. An infusion of the leaves used to prevent swelling, and taken internally for stomach-ache. The leaves burnt in a room kill mosquitoes, and will also render human beings insensible. Kawakawa is sometimes used as a substitute for tea.

Koromiko.—The tender shoots are masticated and swallowed for diarrhœa and dysentery. It relieves the pain of stomach-ache very quickly.

Kohekohe.—Used as a tonic. A kind of bitter beer made from its leaves is used as a stomachic.

Kahikatoa.—Berries masticated and saliva swallowed to allay pains in the stomach, and cures diarrhœa. A weak infusion of leaves given in fever cases.

Ngaio.—The tender shoots rubbed on insect-bites allay irritation. Also it cures toothache.

Nikau.—When cooked, used by Native women for medicinal purposes.

Rimu.—Gum used in dressing severe wounds.

Tipau.—Tender shoots masticated and swallowed in cases of costiveness.

Titoki.—An oil is expressed from the nuts and used for earache, weak eyes, sores, bruises, sprains, &c.

Tupaki, or Tutu.—The juice from the berries made a sort of wine, which the old Maoris were very fond of. It is rather laxative, and is said to counteract the costive effects of such foods as fern-root and karaka-nuts.

Tataramoa (*Bush-lawyer*).—A very good remedy for toothache.

Kohukohu (*Tree-moss and Lichens*).—Reduced to fine dust and mixed with *hinu-kohia*, is a specific for *hakihaki* (itch) and other skin-diseases. *Hinu-kohia* is oil from the kohia-seeds.

Raurekau, or New Zealand Coffee-tree.—Infusion of inner bark used to reduce swellings, sprains, &c.

Rata Vine.—The inner portion of the bark cut into strips and boiled until it becomes black—the extract is used for the cure of all open wounds, with very good results.

Native Trees containing Properties suitable for Tanning Purposes, also utilised for dyeing by the Maoris.

Tanekaha.—Bark used for tanning.

Toatoa.—Bark used for tanning.

Tawhai.—Bark used for tanning.

Hinau.—Bark used for tanning; also used by the Natives as a black dye.

Tutu.—The berries of this shrub are highly poisonous. The juice make a deep-purple dye.

Dyes.—Hinau-bark—Brown; mixed with iron, black. Towai-bark—Red; mixed with iron, black. Puriri-bark—Brown; mixed with tanekaha, yellow. Makomako-bark—Good black. Whawhakou—Blue. Tanekaha—Pinkish red. Toatoa—Brownish red. Kakariki—Blood-red. Tupaki—Blood-red.

(C.) THE VARIOUS PROCESSES OF SEASONING TIMBER.

(1.) General Description.

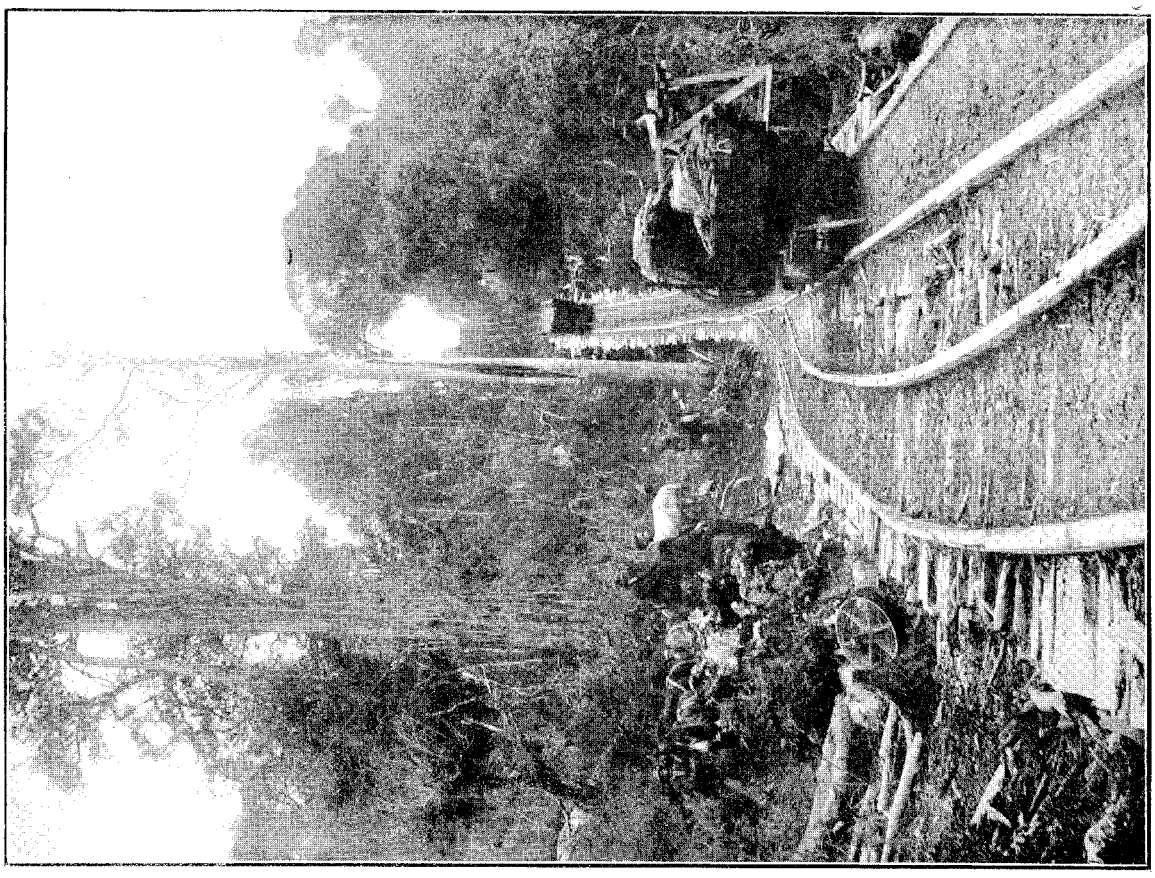
[Extracts from a paper by Mr. G. A. Julius, B.Sc., M.E., 20th July, 1907.]

Enormous quantities of timber are used yearly in the supply of railroad sleepers in every country, the United States railways alone requiring over ninety millions of new ties per annum. It may be argued that these will ultimately be replaced by steel sleepers, and such a substitution will have to be made in the near future unless the most rigid economies are practised in the use of the present

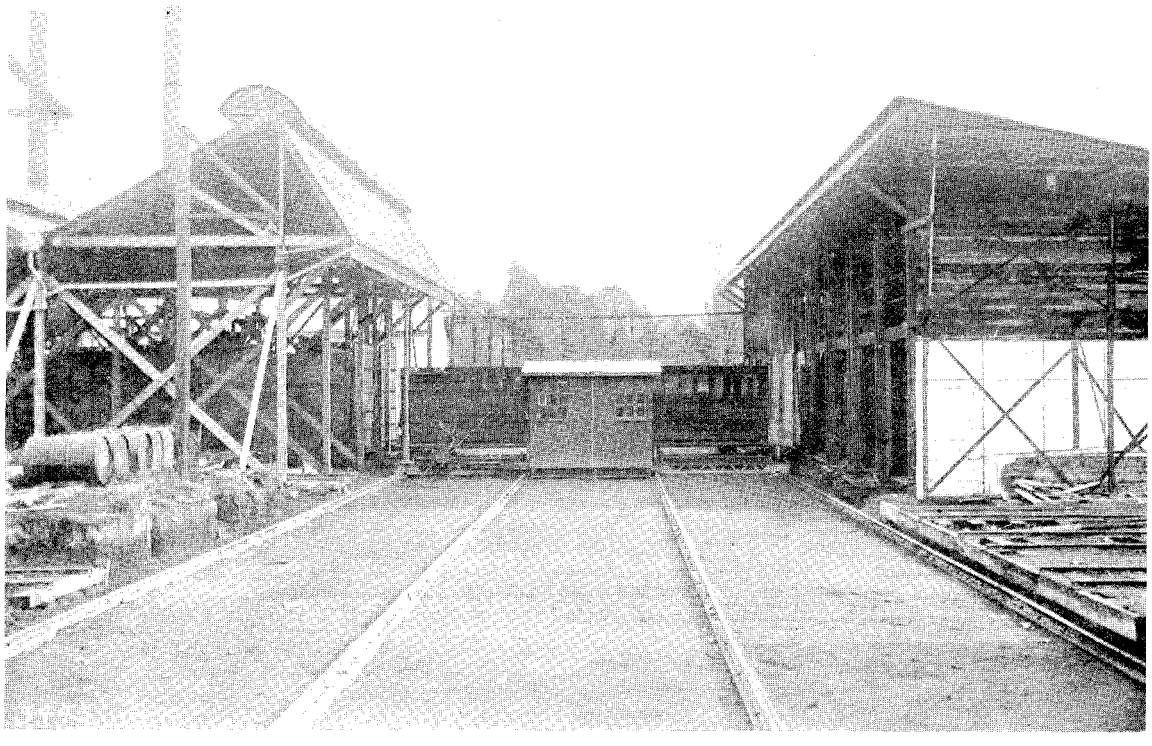


HAULING LOGS OUT OF FOREST.

Face p. 76.]



Hauling Timber up Incline, Otanga Bush.



Electric Traverser and Binns, Powell Wood Process Works, Rangataua.

supplies of timber; but in those countries that have been using steel ties, notably Germany, the rate of increase in the percentage of metal sleepers has been very small, and there appears to be no tendency to further replace wood by steel, unless unavoidable, since the wooden tie has proved to be the best. In many other fields the special suitability of timber is well known to all, and it is apparent, therefore, that wood is required in increasing quantities for those purposes for which it has been used in the past, and also to meet ever-increasing new uses, whilst at the same time it must be well realised that the available supplies are being rapidly and prodigally depleted.

Amongst the most valuable of the world's timbers are the hardwoods of Australasia, chiefly consisting of various members of the Eucalyptus family.

The late Mr. Ednie Brown has estimated the total forest-area in Australasia to be about forty-five million acres, of which nearly half lies in Western Australia—calculating only those areas upon which the timber is matured and ready for cutting. Of this amount many million acres are at present leased for timber-getting, but a very large percentage is still untouched.

Many timber-users believe that timber is always better and stronger with the sap in it. Their usual manner of expressing it is that "the nature" is gone from the wood after the sap is removed. It is also frequently stated that timber decays more rapidly when dry than when green. Both these beliefs are entirely erroneous. Timber when seasoned is stronger, stiffer, more resilient, and much less likely to decay when green or partly seasoned.

Reverting to the construction of wood itself, and first considering internal agencies, it has been definitely determined that the pure lignified cellulose of seasoned timber is practically imperishable. Neither air nor moisture have of themselves any effect upon it. It is, however, liable to be redissolved or digested by the fermentative action of the natural solvent contained within the cells. This fermentable nitrogenous matter in the green or partly seasoned timber is contained in the sap, and in order to eliminate the possibility of decay from this source it is absolutely essential to, as far as possible, remove the sap, or render it chemically inert. The removal of the sap without replacement, or, in other words, the process of natural seasoning, may not of itself be sufficient, for if such seasoned timber is used in unventilated positions, or in damp places, the same fermentative action and consequent decay may still take place through the action of some other plant, such as fungus or mould, or through the cellulose bacteria of the soil. Some woods rich in gums and resins, such as the heartwood of many coniferous timbers, and of some of our eucalypti, such as ironbark and jarrah, contain in these gums and resins ingredients of an antiseptic nature which will for long periods resist decay.

Australia undoubtedly possesses many varieties of hardwood which equal in strength and durability anything procurable in other parts of the world, and which would therefore be so treated as to give them the longest possible life. A few of these timbers will resist decay for long periods, whereas others, whilst possessing great strength, are peculiarly liable to attack by dry-rot and other diseases, and are also attacked by the majority of the insect pests. The strength of all the timbers is in every way greatly increased by seasoning, the increase in some cases being considerably over 100 per cent.

The natural or artificial seasoning of timber, whilst increasing the strength, will not of itself prevent decay, nor is it in any way a protection against the attacks of insects. It appears, therefore, that some artificial means must be adopted to satisfy the required conditions. The various processes at present in use may now be briefly considered, to determine their relative efficiencies in lengthening the life of timbers.

1. *Water seasoning* consists in its best form in entirely immersing the logs of timber in running water, with their butt end up stream. With soft woods, in about a month or six weeks the sap is more or less washed out, being replaced by pure water. The timber can then be fairly easily seasoned by natural or hot-air processes. Timber treated in this way gives fairly satisfactory results, being much less likely to be attacked by dry-rot and other similar forms of decay. It is, however, in no wise protected against the ravages of insects, and the process would be an extremely lengthy one when applied to the eucalyptus.

2. *Kyanising* was patented by Mr. Kyan in 1832, and consists in steeping the timber in a solution of corrosive sublimate (1 part of bichloride of mercury to 15 parts of water). The immersion is continued for at least seven days, or until the solution has thoroughly penetrated to all parts, the timber being then removed and dried. The results obtained have been somewhat contradictory, the wood in some cases resisting decay, whilst in others the subsequent rotting has been apparently expedited. The ingredient used is in no wise incorporated into the structure of the timber, and is washed out in time.

3. *Creosoting* was a system patented by Mr. John Bethell in 1838, and has been and is being very successfully used on various classes of wood in different parts of the world. Up to recent years the process was conducted as follows: The timber to be treated is naturally seasoned to as great an extent as conditions will allow, and is also further artificially dried for at least thirty-six hours. It is then placed in a cylinder, which in the larger plants frequently has a diameter from 8 ft. to 10 ft., and a length anything between 100 ft. and 200 ft. This cylinder is then sealed, steam at a high pressure is admitted, and the pressure maintained for some hours. This softens and "opens" the timber, and, when complete, the pressure is cut off, and a vacuum created in the cylinder, thus drawing off air and moisture from the softened timber. Of recent years certain modifications of this process, notably the "Rueping" and "open-tank creosoting" have been introduced. (Note: *Vide* special article by Mr. H. Lightband on page 78.)

4. *Burnettising* was invented by Sir William Burnett in 1840, and consists of the injection of a solution of chloride of zinc into timber at a pressure of about 150 lb. per square inch. The series of operations very closely agrees with that of creosoting, but the cost is considerably less, being about 9d. to 1s. per sleeper. It is not so efficacious as creosote.

5. *The Boucherie system*, also first brought forward in the year 1840, consists in pressing a 10-per-cent. solution of copper-sulphate into the butts of poles and logs at a pressure of 10 lb. to 12 lb. per square inch, and immediately after the timber is felled. The process is continued until the solution runs out at the top end of the log, after which the bark is removed and the poles or logs left to season for some time before use. This system has been largely used for treating telegraph-poles, &c., but its application would be practically impossible with our hardwoods.

6. *Powellising.*—The essential part of the process consists in boiling wood in a saccharine solution, after which it is artificially dried. No mechanical force, either pressure or vacuum, is used throughout the process, nor is the timber at any time subjected to the action of steam at a temperature higher than a few degrees above the normal boiling-point of water at atmospheric pressure. The treatment is, therefore, of the simplest and cheapest description, and in this respect satisfies the first condition laid down for an ideal process. (*Vide* special article by Mr. F. W. T. Saunders, on page 80.)

The wood as it is received, and preferably as green as possible, is placed in the cold solution, and the temperature of the whole is then gradually raised to boiling-point, and maintained at that temperature for some hours, the length of time depending upon the size and nature of the timber being treated. In raising the temperature, the air in the wood expands, and a large proportion forces itself out, and escapes into the solution in a series of bubbles. The boiling-point of the saccharine solution is two or three degrees above that of water, and the moisture in the wood is thus converted into steam, which escapes with the air, carrying with it much of the colouring and other matter in the sap. When the evolution of air and steam ceases, as shown by the cessation of rising bubbles, the boiling is stopped and the solution allowed to cool slowly, and in this process it is absorbed into the wood, penetrating every portion of it, and thus replacing the previously expelled sap and air. The timber is removed when the solution is cold, and, if it is required to be seasoned, is placed in special drying-chambers, where its moisture-contents can be reduced if required to less than 1 per cent. of the dry weight of the wood-substance proper. First of all, with regard to the degree of penetration: Although soft woods and moderately hard woods that have been treated in England have shown on test that the solution penetrated to the very centre of the timbers, even in the case of such resinous woods as pitch-pine, balks of which, 24 in. square by many feet in length, have been treated, yet, to determine this point definitely with respect to our hardwoods, a number of large sections of our hardest and densest timbers were treated, some green and some dry, amongst them being 5 ft. lengths of 12 in. by 12 in. ironbark. Upon cutting sections from the centre of these timbers, after boiling, chemical tests showed the presence of the saccharine matter, and of the other chemicals carried in with it, at the very centre of these sections. Conclusive evidence was thus obtained as to the thorough permeation of the solution throughout the whole of the treated timber, thus satisfying the second of the conditions laid down for the ideal process.

The next consideration is the permanency and stability of the impregnated material. This point was thoroughly tested by Professor Boulger, of the City of London College. As a result of his examination and tests, extending over a period of two years, he reported that some of the sugar is indisputably so absorbed by the tissues as not to be readily parted from them. The sugar is not visible under the microscope, either as crystals or drops of syrup, and it is probably in some loose combination with the walls of the histological elements of the wood. The wood, in being subsequently seasoned, either naturally or artificially, parts with the water taken in with the saccharine matter, but retains the latter incorporated in the material of the cells themselves.

In experiments carried out in India, Western Australia, and elsewhere, treated samples were examined after being subjected to steaming, excessive temperature-conditions, saturation with water, &c., and in every case both the molasses and the chemicals with which the timber had been initially impregnated were still present.

With regard to the subsequent seasoning of the timber, it has been found in practice that within fourteen days the moisture-contents of our hardwoods, after treatment, can be and have been reduced from 60 per cent. to 3 per cent. of the dry weight of the wood itself; not that such a low moisture-percentage is either requisite or desirable.

[Note.—Professor Henry, of the French National School of Forestry, published in 1907 the results of his experiments with several timber-preservatives, and found that:—

(*a.*) Of the specimens left in the open *without any preservative*, the fir was the best preserved, and after it the Aleppo pine. Oak, beech, and poplar, not treated, were at the end of three years so decomposed that their replacement would be necessary in actual use.

(*b.*) The specimens of oak, Aleppo pine, beech, poplar, and fir, treated with either of the brands of *carbolineum*, with *coal-tar*, or with *microsol*, remained unaltered, and were as serviceable as at the outset of the experiment.

(*c.*) The value of the experiments emphasized the value of carbolineum and of microsol. The former imparts a persistent odour to the timber treated with it, which microsol does not.]

(2.) The Rueping Process.

[By H. Lightband.]

Necessity for preserving Wood.

This has now reached a point beyond the region of debate, and it only need be said that amongst the materials used for constructing purposes wood holds a very important position, from which it is not likely to be displaced for some considerable time, although the growing of timber for many years past has not kept pace with its consumption. It is therefore most important that wood used for construction should be rendered capable of resisting destruction from decay as long as possible, because this material contains the germs of a comparatively rapid decay in itself.

Recognised Preservative Agents.

There are several preservative agents used for this purpose, such as copper-vitriol, the chlorides of mercury and zinc, or, best of all, *heavy oil of tar.*

The ideal preservative is the one which not only destroys the putrefactive organisms, but renders even the conditions of their existence impossible, by preventing the access of air and water; and the only one that can effectively do this is *heavy oil of coal-tar*, also called "creosote."

Why Creosote takes Precedence.

The superiority of creosote as a preservative has long been recognised, its use in more or less crude form dating back over seven hundred years. This is instanced in a striking manner by the fact that many churches and similar buildings are standing to-day in Norway, thoroughly sound in condition after exposure to the wet and rigorous winters of seven hundred years, their marvellous preservation being due entirely to periodical applications of tar, as a surface dressing, to their outer walls. Within the last seventy to eighty years European engineers have continued to use creosoted timber, notwithstanding its comparatively high cost, in preference to timber treated with salt-solutions, &c., for railway timbers, bridges, wood paving, marine piles, &c.; but its universal use has now been made possible by the invention and adoption of the Rueping process.,

The preserving quality of creosote is further demonstrated by the many officially recorded successes achieved in England and France. On one railway-track in France, within a space of twenty-one years, only 6 per cent. out of all beechwood sleepers which had been treated with creosote had to be exchanged.

In the United States over ten millions of railway-sleepers, besides large quantities of other constructional timbers, are being creosoted annually for and by the great railroad companies, under the Rueping process, and it is needless to say this huge business has not grown within the last four or five years other than as the result of most exhaustive trials by the railroad companies themselves as well as by the Forest Service Branch of the United States Department of Agriculture, whose work in regard to timber and forestry is recognised as authoritative in the highest degree.

Professor C. Baron von Tubeuf, University Professor of Munich, a well-known European authority on matters pertaining to wood-preservation, in a report, dated December, 1906, on creosoting by the Rueping process, says, "Creosote oil is a superior preservation against wood-destroying fungi, which, for instance, cannot be said of creosole or copper-salts. I mention as important the fact that timber treated with creosote by the Rueping process does not absorb water, and that therefore the preservative cannot *leach* out, as is the case with timber treated with salts." It must be noted here that under the same category must be included all those chemicals which are injected into the timber-cells with water as the conveying agent.

The Rueping Process.

The distinctive feature of the Rueping process, and the economy and thorough impregnation effected thereby, will be noted from the following brief comparative description of this and the usual method:—

In the usual method impregnation is obtained by first submitting to a *vacuum*, the timber being treated, thereby removing the air from the cells of the wood, after which, whilst still in vacuum, the impregnating fluid is forced into the wood by a pressure of from 75 lb. to 100 lb. The unabsorbed creosote remaining in the cylinder is then removed, and the process is completed. Result: An unnecessarily large quantity of creosote—about 12 lb. per cubic foot—is left in the wood, while the condition of the wood for handling is the reverse of desirable, it being soggy, heavy, and dirty.

In the Rueping process the timber is first subjected to a *pressure* of 60 lb. to 65 lb., instead of to a vacuum as in the former case, the air being thus compressed into the interior cells of the wood. Whilst still under this pressure the warm impregnating fluid is admitted into the cylinder until the timber is quite immersed; the pressure is then increased to 105 lb. to 225 lb. according to the dimensions and qualities of the timber. Under this increased pressure the impregnating fluid will penetrate into the cells of the wood. Owing to the high pressure, the creosote, in consequence of the capillary nature of wood, and its adhesive properties, moves along the cell-walls into the innermost parts of the wood, soaking them entirely, by which the compressed air in the cells will be still more compressed, and at the same time entirely kept in suspension and enclosed by the advancing creosote. When the material is sufficiently impregnated, the pressure, with great energy, through its expansion, will force as much of the impregnating fluid out of the wood as does not adhere to the cell-walls, and this surplus is thus made to flow back into the creosote-tank. Result: A much more thorough impregnation; only as much creosote as is necessary for effective preservation left in the wood; and the timber treated left in such condition as to render it fit for handling, painting if desired, and practically any purpose except the inside of buildings, where treated timber is not required.

Cost of Creosoting by the Rueping Process.

Creosote, of approved quality, is at present quoted in Europe at 2¾d. to 3d. per gallon naked, the estimated outside cost landed in New Zealand in bulk or barrels being 5d. per gallon. At this price for creosote, based on extensive experience of treating timber by the Rueping process in America, the cost of treating a standard-size New Zealand railway-sleeper would be approximately as follows: 1 gallon of creosote, 5d.; mechanical part of impregnation, wages, &c., at most, 2d.: total, 7d. per sleeper —equal to about 3¼d. per cubic foot for material and labour. Based on the consumption of creosoted

sleepers by the New Zealand Government in 1905, stated as being 120,000 annually, absorbing 2½ gallons of creosote each, equal to 300,000 gallons, treated by the existing plant, a saving of 180,000 gallons per annum would be effected by using the Rueping process, equal to £5,625 per annum in cost of creosote alone, reckoning the cost of creosote at the price at which the Department was then landing it—viz., 7½d. per gallon. Added to this very substantial saving, a much better penetration, with necessarily better lasting results, would be obtained by the adoption of the Rueping process.

Effect on Mechanical Strength of Timber.

In a report of mechanical tests made on specimens cut from loblolly-pine sleepers treated by the Rueping process, by Mr. E. O. Faulkner, issued by the Bureau of Forestry, United States Government Department of Agriculture, December, 1904, it is set down that an average increased strength equal to 15 per cent. was discovered in the treated specimens as against specimens of the same natural wood.

Machinery necessary for the Rueping Process.

The impregnating-works consist principally of (1) impregnating-cylinders strong enough for a pressure of from seven to fifteen atmospheres, equal to 102 lb. to 226 lb.; (2) a creosote-tank capable of a pressure of 75 lb. to 120 lb.; (3) an air-compressor, which at the same time may serve as a vacuum-pump; (4) a pressure-pump; (5) a steam-boiler; (6) trollies for running timber through cylinders.

The cost of constructing such impregnating-works would be largely controlled by the capacity required, as well as the local prices for boilers and machinery.

Suitability of New Zealand Timbers for Treatment by the Rueping Process.

Specimens of birch, rimu, white-pine, and other native timbers have been treated, and found readily adapted to the process in every way.

In conclusion it may be stated that timber properly treated with creosote is absolutely and permanently impervious to destruction from insect-life of any species, whether termite, white ant, or teredo. In marine piling the latter pest has been always especially troublesome, and an instance of the effectiveness of creosote, officially given, is before us, where 1,100 piles driven at Leith, Scotland, in 1848, were reported by the engineer in charge as perfectly sound in 1882, having been treated with 10 lb. of creosote per cubic foot. (*Vide* American Society of Civil Engineers' Report on the Preservation of Timber, 25th June, 1885, p. 340.)

(3.) Powell Wood Process.

As the name implies, the process is the discovery of Mr. Powell, and it is patented the world over.

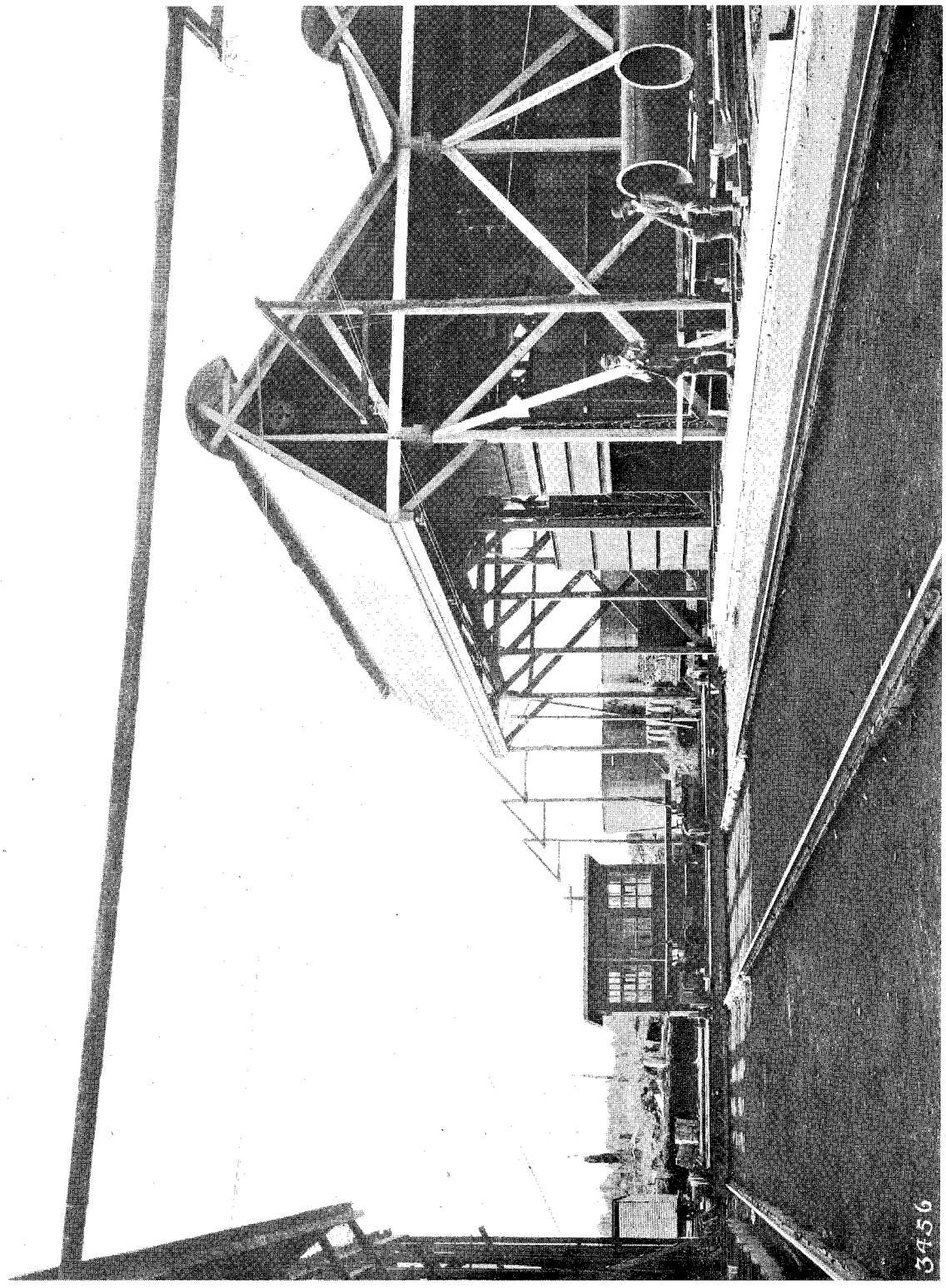
The process, from its initial stage, has been subjected to some very severe tests by several scientists and experts, as to the lasting properties and other virtues of Powellised wood; and the process is concisely described in the book "Wood," by Professor G. S. Boulger, F.L.S., F.G.S., &c., Lecturer on Botany, Geology, and Forestry in the City of London College:—

"Powellising consists in boiling the wood in a saccharine solution without pressure, so as to expel air and moisture, and coagulate the albumen, and then drying it at a high temperature. Green wood; and some species, such as spruce, which cannot readily be creosoted, can be treated by this process, and the wood is not only seasoned within a few days of being felled, but small cracks are closed up, the porosity of the wood is much diminished—a very important point in connection with wood paving—and its strength, toughness, resiliency, and durability are enhanced. The process need not discolour the wood, but may be made to bring out figure, and thus, in more ways than one, to render it possible to substitute a lower-grade timber for the more expensive grades now in use. The processed wood will take paint or varnish, and is completly immune to the attacks of dry-rot. Having no unpleasant odour, Powellised wood is adapted for furniture as well as for paving or railway-sleepers; whilst a slight modification of the treatment protects it from the attacks of termites."

Professor Boulger also states, "Effective wood-preservation—certainly if it is to be expeditious, and so obviate the prolonged locking-up of capital—must be accomplished by some impregnation method. It might not seem *a priori* probable that sugar would answer the purpose, but the Powell process has demonstrated that it does so. Sugar, especially beet-sugar, is a simple, stable carbo-hydrate, incapable, in the absence of soluble nitrogenous matter, of nourishing septic organisms, while in solution it has a high boiling-point, and has been shown experimentally to have a greater power of diffusion through the wood than water has."

The following statement by Dr. Morris Travers, Director of the Indian Institute of Science, Bangalore, explains the reason of sugar being so readily accepted by the timber when submitted to its treatment: "Sugar-solution, being an amorphous form of wood, is readily taken in by the wood-fibres, and actually becomes part of the wood itself, and is not held in a merely mechanical position."

Past experience has proved that in Powellising timber the following results are obtained: (1.) It enables timber to be rapidly and thoroughly seasoned. (2.) It renders all woods immune to the attacks of insects, such as white ants, the borer, and the *Teredo navalis*. (3.) The treated timber is absolutely immune to attacks from dry-rot. (4.) Timber so treated is very much lighter and stronger than the untreated green wood. (5.) It renders timber more close and impermeable, lessening its porosity, and reducing its tendency to absorb moisture. (6.) It brings out the grain and markings of figured wood, improving its appearance. (7.) In painting Powellised timber, owing to its relatively non-absorbent nature, from 20 to 40 per cent. less paint is required.



ELECTRIC TRAVERSER, RANGATAUA, IN POWELL WOOD PROCESS WORKS.

Face p. 80.]

Prominent Characteristics of the Process.

The sap and fermentative matter is removed, and replaced by a solid antiseptic material of which the timber has a natural craving; consequently there is no subsequent decay, such as dry-rot, &c.

No pressure of any kind is used in the Powell process to induce absorption, owing to the affinity of sugar for the wood enabling other ingredients to be conveyed into the wood to render it immune to attacks by insects.

Seasoning.—The wood, after being boiled, is placed in drying-chambers, and there seasoned from one week to six, depending on the size of the timber.

Dry-rot.—Numerous attempts have been made by experts to create dry-rot (*Merulius lacrymans*) in the processed wood; but the disease has never developed.

Mr. G. A. Julius, B.Sc., M.E., consulting engineer, Sydney, was privileged to carry out a number of comparative tests of Powellised woods and untreated wood on behalf of the Western Australian Government, and extracts from his article on the results achieved precede these notes.

Powellising Works at Rangataua.

The New Zealand Powell Wood Process (Limited) have erected extensive works at Rangataua, in the Waimarino, where about a dozen sawmills are located, so that supplies will be readily available. A railway-siding, 16 chains long, connects the works with the Main Trunk Railway.

Special roller-bearing trucks, 36 ft. long, and capable of accommodating 15,000 sup. ft. in one load, are provided for stacking the timber which is conveyed to the boiling-vat by a submerged electrical traverser, and the truck and contents are hauled into the vat, which is 36 ft. long, 10 ft. deep, and 10 ft. wide; an iron door, weighing 15 cwt., is then lowered, and made watertight by a number of readily adjustable wing-nuts. The saccharine solution is then run through a 5 in. pipe into the boiling-vats, after which the timber is submitted to a process of boiling for a few hours, the liquor being boiled by steam-coils placed in the bottom of the vats. The steam is "trapped," and the feed-water is returned to the boilers at a high temperature. The electric pump then redelivers the liquor into elevated tanks, to be used over again. The heavy door is unfastened, and is hoisted into the roof by a compensating weight, and the electric traverser hauls the truck out to the drying-room. The room is then hermetically sealed, and electrically driven fans deliver heated air into the room; the timber is thus robbed of its moisture, and thoroughly seasoned. The electric traverser is again requisitioned to remove the truck with its load, and every stick of timber is then branded on the end with the company's registered brand, "Powellite," and loaded direct into railway-trucks for despatch. (*Vide* photographs opposite pages 77 and 80.)

What it does.

1. It enables timbers to be rapidly and thoroughly seasoned without cracking, twisting, or splitting.
2. It renders all woods immune to the attacks of insects, either land or marine, such as the white ant, the borer, and the *Teredo navalis*.
3. The treated timber is absolutely immune to attack from dry-rot, and from all fungoid growths.
4. It renders wood less liable to the penetration of disease-germs, and therefore makes it hygienic.
5. Timber so treated is on the average 25 per cent. lighter and 40 per cent. stronger than the untreated green wood.
6. It renders timber more close and dense, lessening its porosity, and reducing its tendency to absorb moisture, thus eliminating the risk of subsequent twisting and warping.
7. The resilience and elasticity of timber are materially increased by the process.
8. It brings out the grain and markings of figured woods, improving their appearance, and in no way interfering with the subsequent polishing, staining, and painting.
9. The removal of sap and other matter by the process prevents the subsequent exudations which are found in practice to so frequently destroy polished timber-work.
10. In painting Powellised timber, owing to its relatively non-absorbent nature, from 20 to 40 per cent. less paint is required than is necessary to produce the same result upon untreated timber.

F. W. T. Saunders,
A.M.Inst.C.E., A.M.I.Mech.E.

(D.) MISCELLANEOUS METHODS OF UTILISATION.

(1.) The Wood-pulp Industry.

The fact that this industry has attained such an important position in Canada and United States of America should indicate that it is also worthy of attention in any other country that may possess the necessary raw material, the means of manufacture, and prospective available markets. As this Dominion embraces the above qualifications, and as the industry is practically unknown here, the following information may be of interest.

The method of manufacture most extensively used in Canada is what is known as the "mechanical" or "grinding" process. The kinds of woods principally used are fir, balsam, and spruce, mostly the latter, no doubt because it is the most abundant of the suitable woods. White spruce makes the whitest pulp, but the black variety makes the toughest fibre. Poplar makes a very fine-grade pulp—soft and white—but is not considered so strong as spruce. The best pulp comes from the wood having the longest and toughest fibre. Sometimes different kinds of woods are mixed for the purpose of blending toughness and whiteness. The power used for the grinding operation is

generally water-power, chiefly because power is such a big factor in the process. One grinder, having a capacity of, say, 5 tons of dry pulp per day (by "dry pulp" is meant pulp that has been dried out after grinding) would require about 300-horse power to operate it. A complete mill having a daily capacity of 25 tons of dry pulp would be considered a very moderate mill in Canada, and would require 2,000- to 2,500-horse power. It is commonly figured that it takes about 100-horse power for each ton of ground pulp produced per day of twenty-four hours. This would be sufficient to drive all the gear that is comprised in a complete outfit.

The logs to be pulped are all floatable, and are usually brought to the mills by water, being "driven" or rafted from the streams which are invariably available to the forests. They are collected in the log-pond, which in some instances also forms the mill-dam, from which the water for power purposes is taken.

From the log-pond the logs are conveyed into the mill by an ordinary "haul-up" or "bull-chain." This consists of an endless chain, having spikes at intervals projecting upwards, which traverses in one direction an inclined trough leading from the pond to the mill. The logs are thus drawn up the trough, partly resting on the chain. They are then usually cut into 16 in. or 24 in. lengths by means of a circular saw, being fed endwise automatically by live rollers.

From the "crosscut" the billets are conveyed to the barker. This consists of a cast-iron disc about 5 ft. or 6 ft. in diameter, with about six knives bolted to it in such a manner that the edges project from the face of the disc about $\frac{1}{2}$ in. They are set in radial lines, and are a few inches longer than the billet to be operated upon. The billet is placed horizontally on a rest in front of the revolving disc, and each knife as it passes takes off a strip of bark the full length of the billet. By revolving the wood slowly the whole of the bark, knots, and bad places in the wood are completely removed. The chips and bark pass through the disc and are thrown by fans attached to the disc through the outlet, and piped away as refuse. It is necessary to clean the wood as above, to insure a saleable quality of pulp. It is this part of the process that calls for straight timber, and in this respect the coniferous trees are *par excellence*—lending themselves as they do so readily to mechanical manipulation. Where wood larger than, say, 12 in. diameter is used it is split, after barking, by a power splitter.

Now for the "grinders." These are very strongly built. The framing is of cast-ironi, the shaft of steel 7 in. or 8 in. diameter, upon which is fixed a grindstone, held in place by screwed flanges. If 16 in. wood is to be ground, the stone would be about 18 in. wide, and, say, 54 in. diameter, and for 24 in. wood a 26 in. stone would be used. Generally Scotch stone is used. Each grinder has three hydraulic cylinders and three pockets for wood placed in an inverted position above the stone, the centre set being vertical and the others at angles of 45°. The size of these cylinders is such as to suit the pressure of water used, and is figured on a basis of 100 lb. pressure per square inch on a 10-in.-diameter cylinder. The wood is placed in the pockets flatwise, with the grain across the direction in which the stone revolves, and the application of the hydraulic pressure forces the wood against the stone. Water is constantly applied, and the stone runs about 200 revolutions per minute. The quality of the pulp is influenced a good deal by the speed of the stone, the pressure applied, and the sharpness or texture of the stone. If the stone runs too fast, there is, besides the danger of its bursting, a greater tendency to heat and gloss it, thus affecting its cutting. With a slower speed a longer fibre is produced.

After being roughly screened to remove chips and splinters, the pulp is pumped into the "screen-tank." The screen-plates are about 12 in. by 36 in., made of brass, with slits $\frac{10}{1000}$ in. or $\frac{12}{1000}$ in. wide. A rubber diaphragm is placed under each two plates, and is operated by a cam, which on its upward throw agitates the mixture and blows the slits clear, and on its downward throw draws the finer particles through the screen. The stuff is then pumped to the "wet machine," and is discharged into a tank in which revolves horizontally the "cylinder mould." This is made of brass, to prevent its rusting and so discolouring the pulp. It is usually 30 in. or 36 in. diameter, and 72 in. long, covered with two fine brass cloths, the outer covering having sixty meshes to the inch. As the water is pumped from the inside of this cylinder a film of pulp adheres to the outside, to be taken off by an endless felt band, which comes into contact with it on the upper or unimmersed part of the cylinder. The felt is carried through press-rolls, and the pulp, now in a condition containing 60 per cent. of water, is collected on a wooden roller in successive layers until it attains a thickness of about $\frac{1}{2}$ in. The operator then makes a cut lengthwise of the roll, and the wad thus formed is delivered at the next revolution on to the table. It is then baled for delivery to the paper-mills.

The buyer usually specifies that the pulp shall be not more than 40 per cent. dry—*i.e.*, 40 per cent. pulp and 60 per cent. water. This is to facilitate working up into a liquid state again preparatory to making paper. The pulp is, however, paid for as dry, and tests are made of each consignment to determine the quantity of water. If upon testing it proves drier than specified, a re-draw is made on the supplier to cover extra cost in working up. The fact that the supplier pays freight per 100 lb. explains the need for such stipulations.

In Canada it is usually estimated that the cost of a first-class mill with brick or stone buildings, slate roof, and iron interior will be about £1,000 per ton per day capacity. Cheaper mills can be built to cost not more than £200 to £300 per ton-day.

In the "sulphite" or "chemical" process, the wood, instead of being ground, is reduced to chips, and then placed in large tanks or digestors, and treated chemically. In most other respects the process is similar to that already described. It is, however, much more costly, and the plant is more expensive.

The quantity of wood to produce 1 ton of pulp is about 1 cord for mechanical pulp, and 2 cords for chemical pulp. The relative values are about 1 to 4 or 5. The mechanical process produces pulp of a sufficiently fine quality for newspaper and a good deal of similar work. The chemical pulp is used for better-class work and to mix with mechanical pulp for the medium qualities of paper.

N.Z. GOVERNMENT
LIBRARY.
DEPT. OF LABOUR.

The growth of the industry in Canada has been very great, and the demand is more likely to increase than otherwise, as wood-pulp will undoubtedly continue to be used in the manufacture of paper, particularly in the coarser grades, and for many other purposes. As an instance of the growth of this industry it may be mentioned that in 1881 there were but five mills in Canada, with an invested capital of less than £13,000; in 1891 the figures were twenty-four mills, and £600,000; in 1901 there were thirty-six mills, and £4,000,000 was invested or appropriated for expenditure.

If there are any industries in which New Zealand can hope to excel it will be such as will utilise the natural sources of power with which she is so bounteously endowed. Wood-pulping calls for such cheap power. If, for climatic purposes, it is advisable to afforest our watersheds and poor land, such afforestation could also be made commercially profitable if suitable pulping-woods were planted. Early maturity and a continuity of forest-growth for industrial and climatic purposes would be secured. There are, doubtless, many instances where it would also pay to pulp the native sapling-growth which is at present destroyed during felling for sawmilling or when clearing for pastoral purposes.

William Butler,
Ruatapu, Hokitika.

(2.) Secondary Forest-products.

In a report entitled "New Zealand Timbers, Bark, and Secondary Forest-products," by T. Kirk, F.L.S., published in 1886, the following particulars are given relating to possible utilisation of forest-products at present almost entirely disregarded:—

Tar.

Tar may be extracted from many of our native trees, especially from the pines, kauri, totara, kahikatea, rimu, miro, matai, tanekaha, &c., also from the tooth-leaved and other beeches, and in all probability from the large kinds of rata and tea-tree. The waste tops and branches of trees felled for timber, crooked pieces, knots, roots, &c., can be used for this purpose, so that the manufacture of tar and allied products would not only afford a profitable outlet for labour, but would remove a great source of danger and materially reduce the serious loss arising from forest-fires.

In the forests of the White Sea and the Baltic tar is extracted from the Scotch fir and Baltic spruce fir, the wood and roots being cut into short billets and then subjected to a process of slow combustion. A funnel-shaped cavity of any convenient size is excavated in the side of a sloping bank; an iron pan is fitted tightly into the bottom of the hole, and communicates with the exterior by a pipe or tube which passes through the side of the bank, and allows the tar to be drawn off as fast as it is extracted. The billets are now tightly packed in the cavity, ends downwards, until it is completely filled, when the surface is covered with turf, which is compactly beaten down by two men, one of whom uses a wooden stamper, the other a wooden mallet, so that the outer surface is sufficiently firm to prevent the escape of the volatile product. A small portion of the turf is now removed, and fire applied to the stack; as soon as it is kindled the turf is replaced. The exuded tar is received into the pan at the bottom of the hole, and is discharged by the spout into casks, which are at once bunged and made ready for shipment.

Pitch.

This is obtained by boiling wood-tar until nearly one-half of its bulk has evaporated, when the remainder is allowed to cool and harden into pitch. The process is usually effected in copper boilers set into brickwork, to diminish the risk of accident.

Lampblack.

This is merely the soot given off during the manufacture of tar or charcoal. It is deposited on the sods which cover the billets, and must be scraped off. If closed ovens were used, instead of the rough process indicated above, the lampblack would be deposited on the roof.

Resin.

Resin from kauri-gum is well known, and needs no description; but, although a "shake" or fissure of any kind in the trunk of the rimu or kahikatea is always found to be compactly filled with resin, no attempt has been made to collect it for commercial purposes. In Southern Europe resin is largely collected from the pine-trees.

Turpentine.

This may be regarded as resin held in solution in a volatile oil. It is produced by numerous pines and other trees. Actual experiments are necessary to determine to what extent the pines of New Zealand can furnish a substitute for the turpentine of Europe and North America; but there can be little doubt that large quantities can be obtained from the kauri, rimu, kahikatea, and others, by incision of the outer bark in a similar manner to that practiced in the United States. Common turpentine is extracted from the Scotch fir, Baltic spruce, larch, pinaster, and silver-fir; in North America from the loblolly pine and the Georgian pine (*Pinus australis*).

Potash.

This is extensively prepared from wood-ashes in Europe, Canada, and the United States, where it enables the settler to defray a large portion of the heavy cost of clearing forest land. Potash-salts are found in varying proportions in all plants, and are most abundant in the young branches and leaves.

The process of extraction is simple and inexpensive. All parts of the plant, including the leaves, are burnt in dry pits dug in the earth from 3 ft. to 5 ft. in depth, and of any convenient size. The ashes are placed in tubs or vats, each having an orifice near the bottom secured by a plug, and a false bottom covered with straw or rushes. The ashes are saturated with water, and after standing about twelve hours the potash-liquor is drawn off and taken to the evaporating-pans, usually shallow iron vessels, sometimes with corrugated-iron bottoms. It is now kept in a boiling condition and constantly stirred, fresh liquor being added from time to time as required until the whole becomes of a pasty consistence, when the heat is gradually reduced and the dry residuum allowed to cool. The crude potash thus obtained requires to undergo a process of calcination to free it from certain organic matter before it becomes the potash of commerce.

Charcoal.

There is always a certain demand for this product, which requires great care and attention in manufacture, though the ordinary process is extremely simple. Particulars as to the manufacture are readily obtainable.

Bark.

Large quantities of the bark of the kamai, tawhero, and tooth-leaved beech were used by local tanners in past years; but since the importation of mimosa-back from Australia the use of indigenous barks has been neglected. The bark of the tanekaha was discovered to possess a special value as an organic mordant in the preparation of basils, and at one time realised from £30 to £50 per ton in London. Both the hinau and rata afford tanning-bark of high-value, and it may be fairly assumed that bark yielding from 18 to 22 per cent. of tannin would realise £6 per ton at the local tanyards. Settlers clearing their land would find it profitable to peel these trees after felling, and sell the bark to the nearest tanner. Rimu-bark only contains 4 per cent. of tannin, and is practically valueless. The same difficulty in a reduced degree occurs with regard to beech, containing 7 per cent. of tannin; pokaka, 9 per cent.; and kamai, 12 per cent.; although the latter might compete successfully with wattle. In the United States extract of hemlock is made from bark containing only 9 per cent. of tannin, so that it is evident that much of our local trees could be utilised in some such manner.

PART III.—FOREST-PRESERVATION.

CONTENTS.

	Page.
General remarks	85
(A.) The necessity for forest-conservation	85
(B.) Deforestation and its consequence	93

GENERAL REMARKS.

It is generally supposed that a very large proportion of the forest-area of New Zealand has been permanently reserved for all time. Although the total area of land reserved for public purposes is fairly large, amounting to perhaps eight million acres, yet a great proportion of these lands are not covered with forest, but are utilised for settlement and other purposes. For example, the endowments made for education, university, harbour, and municipal purposes comprise very large areas, whilst railway, gravel, Native, and other reserves are included in the total.

Moreover, even all the lands now covered with forest, or which have been set apart as forest reserves, will not eventually remain in that state. An area of two and three-quarters million acres have been reserved for National Parks, of which two and a quarter million acres are absorbed by the Sounds National Park, mostly consisting of rugged mountain country and fiords, with here and there narrow valleys giving access to the various parts of the country. The Tongariro National Park, of 62,000 acres, does not contain one single acre of forest land, whilst the Tasman and Arthur's Pass Parks contain hardly any timber suitable for milling; and when the reserves which are clothed with good timber are analysed, it will be found that they are mostly ill adapted for settlement, and are better fitted for reservation than for any other purpose.

Although an area of 2,117,215 acres has been reserved under the State Forests Act, yet here, again, it has to be pointed out that this will not insure the permanent retention of the forest land included therein, and that it may all be used for sawmilling purposes under the State Forests Act and Regulations. Practically speaking, State forests are reserves for future sawmilling, and cannot be considered as permanent forests.

As the result of inquiry, it is found that the total area of land covered with forest in New Zealand that may, by virtue of statutory enactments under which it was set aside, remain in a state of nature for all time is about 2,100,717 acres, or only 3·1 per cent. of the area of the Dominion; and this is made up of the Waipoua State Forest (near Hokianga) which is an absolutely unique specimen of a typical kauri forest, containing 22,000 acres; various scenic reserves amounting to about 80,000 acres; timber and forest reserves under the Land Act; reserves for the conservation of the water-supply; climatic reserves; and a portion of the great Sounds National Park (West Coast), estimated to contain about 800,000 acres. In the whole of the North Island only about 290,000 acres may be classed as permanent forests, and in the South Island as 800,000 acres (just mentioned) are in the West Coast Sounds, and 700,000 acres on the slopes of the Westland ranges, the present reservations cannot be regarded as in excess of urgent requirements. Whilst it is not desired that forest land suitable for settlement should be locked up in this manner, yet it is strongly represented that judicious selections of forest land should continue to be made and set apart for the protection of our water-supply, climatic equilibrium, and protection of streams and mountain-sides. Most of the land required for these purposes would only support a scanty population, is not considered agricultural land, and is much more valuable to the State in its present condition than if denuded of vegetation and exposed to the disastrous effects of heavy rainfall and other climatic influences. The following articles by Dr. Cockayne and Mr. Grossman indicate the evil effects of unwise deforestation.

(A.) THE NECESSITY FOR FOREST-CONSERVATION.

[By L. Cockayne, Ph.D.]

The climate of New Zealand as a whole is admirably suited for the well-being of trees. This is evidenced not only by the native forests, but by the ease with which almost any species of the cold or warmer temperate regions can be cultivated throughout the Dominion.

At the time of early colonisation a more or less continuous forest clothed the land, unbroken except where certain conditions of soil or climate (especially excessive wind and high altitude) were antagonistic. At the present time detached portions or fragments of this great tree-community alone remain, which, although collectively of considerable area, are but in many districts a fraction of the original. This state of affairs has come about chiefly from the land being required for farming purposes, though at the same time much needless destruction has taken place from wasteful methods in dealing with the timber, or from careless or wanton damage through fire.

The original forests appeared to the pioneer settlers as inexhaustible, and so no proper means were taken for their conservation, forest areas having constantly been burnt for purposes of settlement without first utilising the trees of commercial value. Such waste has been a common experience not only in New Zealand but in all colonisation.

The gradual extinction of the forests has now reached a point when, at the present rate of consumption, the end of the timber-supply will be in no very distant future, and the question as to the value to the Dominion of the forests as they stand and their future treatment daily becomes one of more importance.

2. CHARACTER OF THE NATIVE FORESTS.

The tree-communities of New Zealand belong to that class designated by plant-geographers "rain-forest." Such is specially characteristic of the tropics, but is rarely met with in the Temperate Zone, being quite absent in Europe and the extra-tropical parts of Asia, and North America—those regions which furnish the greater part of the timber-supply of the world.

The presence of rain-forests is due to an equable climate with the rainfall spread over *all* the months of the year, and not confined to some particular season. Such regularity of the downpour is not at all an essential for the growth of trees, the deep-rooting habit of many species allowing them to utilise the ground-water at a considerable depth, and to actually occupy situations where meadow-grasses cannot thrive. Nor does it matter at what season of the year the rain falls which keeps up the subterranean supply, or even whether such is dependent upon the snowfall. Also, intense cold is not inhibitory, as witness the forests of northern Asia and America.*

A typical New Zealand rain-forest resembles in many ways one in the tropics, and is altogether different from the timber-forests of Europe and North America, a matter of considerable influence on its economic value. Thus the trees are of various sizes and of many species, while, with a very few exceptions, they are evergreen. There is a close undergrowth of small trees, tall shrubs, and tree-ferns, a second of smaller shrubs, and a third of ferns in abundance, sedges, and a few other herbaceous plants. Certain of the trees have plank-buttresses at their bases, and a few bear flowers on the trunks or thick branches. Mosses are usually very plentiful, forming mats or even cushions on the forest-floor and growing in profusion on the trees themselves. Woody climbing-plants and epiphytes are extremely common. Generally speaking, the trees have far-spreading but not deeply-descending roots, so that they are dependent for their water-supply rather on the frequent rain than upon the ground-water, the quantity of which in consequence they reduce but slightly. Such shallow rooting also leads to their being easily uprooted by the wind. The mosses play an important part as water-storers, and are aided by the leafy shelter of the close undergrowth of shrubs. It can also be seen that the moist forest-interior is very favourable for the production of humus.

Such a New Zealand rain-forest depends for its well-being not only on the climate, but on its composition and the arrangement of its members. The trees, which form with their crowns its roof, are provided with more or less drought-resisting leaves, partly in harmony with their evergreen nature and partly because such are wind-tolerating. The close canopy serves to keep out the wind and to restrain evaporation from the ground, so that within the interior there is always a moist atmosphere, a fact demonstrated by the numerous filmy ferns whose leaf-structure resembles that of water-plants.

It can be readily seen that such a forest as the above cannot tolerate being interfered with. Any cause which can let in more light, or wind, changes the environment of the plants and leads to damage. Many of the trees are so dependent on the forest mode of life that they will not thrive when growing isolated; in fact, it is quite impossible in many places to cultivate certain indigenous trees in the open, even in exactly the same climate which regulates the association as a whole.

The forest is not uniform, either as to species or their relative abundance, throughout New Zealand. There are two main classes—*the mixed*, where the trees are of many species, even though one or other may dominate, and *the pure*, where one species of tall tree is alone present.

The mixed forest occupies the lower country and the better land. Its most important timber-trees are various species of pine. These pine-trees are not closely related to those of the Old World: one, the kauri (*Agathis australis*) is allied to the araucarias (monkey-puzzle tree, Norfolk Island pine, &c.), and the remainder belong to a family, the *Taxaceae*, of which the yew of Europe is a well-known member. The terms "white-," "black-," and "red-pine" are therefore somewhat misleading.† The species decrease in number from north to south of New Zealand, but there are many common to all the mixed forests.

The pure forests are either made up of the kahikatea (*Podocarpus dacrydioides*) as the sole tall tree, or the various species of the southern beech (*Nothofagus*).‡ In the former case they occupy swampy ground in the lowlands, and in the latter are chiefly on the mountain-slopes, or if at low levels, then on the poorer ground unsuitable for the mixed forest. Both classes of pure forest contain more or less small trees, shrubs, and ferns—indeed, frequently the number of species present is considerable. Between beech and mixed taxad forests are transitions where both *Nothofagus* and various species of pine occur in the same plant-society, as in the fiord country of Otago.

---

* Wind is the factor which prohibits the growth of trees in the Arctic, owing to its effect in causing transpiration at a time when the roots cannot function on account of the frozen ground.

† *Pinus Strobus* is known as "white-pine" in North America.

‡ The incorrect term "birch" is still almost universally used by sawmillers, and even yet to some extent in official reports. This error would not matter if the names of the various so-called "birches" were uniform for the whole Dominion, but quite the contrary is the case—*e.g.*, the red or toothed-leaved beech (*Nothofagus fusca*) = red-birch in Wellington, black-birch in Auckland, brown-birch in Nelson. The silver-beech (*N. Menziesii*) = red-birch, silver-birch, black-birch, and brown-birch according to the district and the fancy of the bushman. The entire-leaved beech (*N. Solandri*) = black-birch, white-birch, brown-birch, red-heart-birch. Even the kamahi (*Weinmannia racemosa*), which, of course, is neither a beech nor a birch, is frequently called "red-birch," "brown-birch," and "white-birch."

The forests of New Zealand are in part owned by the Crown and in part freehold or Maori land. It is customary in official reports to refer only to the first-named, but this is misleading, since the two latter are equally of national importance, whether as a timber-supply or for climatic purposes. (The maps at the end of this report show the forest areas of the Dominion.)

3. DISTRIBUTION OF THE FORESTS.

Proceeding from the north coast of the North Island to the latitude of Auckland City there is even yet much forest, the greater part more or less "cut out," but still fairly dense; while on the flanks of the higher hills in the west and near the Hokianga and Whangape Estuaries, north and south, is virgin kauri forest. Along the shores of the Northern Wairoa and its affluents is much kahikatea forest, and on the high plateau south of Hokianga there is a great deal of rimu (*Dacrydium cupressinum*). Forest extends from the Little Barrier Island by way of the Great Barrier to the Thames mountains, and thence almost to Rotorua, nearly meeting the great tree-mass which covers the whole East Cape region, extending thence along the main mountain-chain of the North Island on both sides to Cook Strait. North of Lake Taupo is a fine forest of totara, which extends, more or less broken, westwards, joining west of the volcanic plateau the great Waimarino Forest. This latter is one of the mixed taxad type with abundance of rimu, matai, miro, and totara, but differing in its composition at different altitudes. On Ruapehu on the west and south are extensive beech forests. Much of Taranaki is still forest-clad, with taxad forest on the lower ground and beech on the ridges, except on Mount Egmont, where the latter is absent. Virgin forest still exists in plenty at the head-waters of the Rangitikei.

With regard to the South Island, the whole of the western slopes of the dividing range from north to south up to 3,000 ft. altitude or more, and the coastal plain, are covered with forest, which, except in the settled districts, is virtually virgin. Patches of forest occur in the mountains of north-east Nelson and Marlborough. The Seaward Kaikouras are forest-clad on the east, and the coast ranges to the south have usually their gullies full of trees. The eastern Southern Alps contain many larger or smaller pieces of forest—beech for the most part—but large areas are practically treeless. The Canterbury Plain, Banks Peninsula, the upper river-valleys in many parts of the Southern Alps, and Central Otago are also almost treeless, so far as native species are concerned.* Small patches of forest occur in eastern Otago, but southern Otago contains still large areas (Catlin's, Seaward Bush, Longwood Forest), which join those of the west. Stewart Island is almost all forest up to 1,000 ft. or more. There are many pieces, large and small, in Chatham Island, and the coast-line of the Aucklands, where sheltered, is fringed with low forest.

4. ECONOMIC VALUE OF THE FORESTS.

(*a.*) Timbers.

Ever since the early days of settlement the forests have supplied timber for many purposes. Their great extent, original proximity to centres of population, and excellent timbers have led to their furnishing abundant material for house-building, furniture-making, fencing, mining-timbers, railway-sleepers, and other purposes, and have assisted very materially in the development of the country. But notwithstanding the opening-up of the land by means of roads and railways, the timber which yet remains is not nearly so easy of access as formerly, while great areas, as in southern Westland, are as yet quite too far afield for sawmilling. But settlement frequently precedes the proper opening-up of the country, and in that case forests which would some day yield a valuable return are destroyed.† Cases such as this certainly suggest that very careful consideration should be given before opening up forest lands for purposes of settlement.

Although the New Zealand forests contain more than a hundred species of trees, only about ten are converted in the sawmills at the present time. These are kauri (*Agathis australis*), kahikatea (*Podocarpus dacrydioides*), rimu (*Dacrydium cupressinum*), matai (*Podocarpus spicatus*), miro‡ (*Podocarpus ferrugineus*), totara (*Podocarpus totara* and *P. Hallii*), silver-pine (*Dacrydium Colensoi*),§ yellow-pine (*D. intermedium*), tooth-leaved beech (*Nothofagus fusca*), the silver-beech (*N. Menziesii*), and a little entire-leaved beech (*N. Solandri*). The uses of these different timbers are too well known to require mention here. It may merely be pointed out that the toothed-leaved and silver beeches are growing in importance for certain classes of furniture, and therefore these forests, hitherto considered of little moment, may become of considerable monetary value.

Many other woods have been used for different purposes, but details are given in the "Forest Flora" and in the body of the present report. Such are the rewarewa (*Knightia excelsa*), the puriri (*Vitex lucens*), the kowhai (*Sophora tetraptera*), the northern rata (*Metrosideros robusta*), the tawa (*Beilschmiedia tawa*), and others. With the exception of those employed for fencing-posts and for mining, &c., and which are therefore of value even in remote districts, the minor timbers are not generally commercially valuable under present conditions, and the trees are cut down and burned in order to fit the land for grass. That such a procedure is in all cases a wise one or profitable for the Dominion is more than doubtful. Certainly much forest has been felled in the past which might far more profitably have been left standing. Nor can any one say, because a certain tree is not now useful, change of circumstances may not in the future bring it into demand.

---

* Banks Peninsula was originally clothed with magnificent forest.

† Forest areas have been taken up, the trees burned, and then the land, not being good enough for farming, has been abandoned.

‡ Miro is frequently sold as rimu.

§ This is frequently known as *Dacrydium westlandicum*, but *D. Colensoi* has many years' priority.

(*b.*) Neglected Forest-products.

Besides the value of trees for timber purposes there are various other uses for certain of them, and it is more than possible that in the near future forests now thought valueless may become profitable. The wood-pulp industry is a case in point. This has attained enormous proportions in Scandinavia, Germany, and the United States. The chief trees used are spruces, pines, and poplars. Trees of medium age are employed. Experiment would be needed to find out which of our trees were suitable, and if those now quite neglected—such as the taraire in the north, the various species of beech, and especially the smaller trees, species of *Pittosporum*, the wineberry (*Aristotelia racemosa*), *Carpodetus serratus*, and others—proved suitable, and they could be used at an early stage of growth, then the supply would be indeed great. The dry distillation of wood also suggests itself as a profitable undertaking. For this purpose hard woods such as oak, elm, beech, and chestnut; soft, such as pine, fir, poplar, and willow; and intermediate, as birch, maple, ash, larch, and alder, are used in Europe. Wood-spirit, pyroligneous acid, acetic acid, are some of the important products. Doubtless a considerable percentage of our woods could be so utilised. Then, there are methods of treating timbers so that they will become very durable, and in this way certain of our trees, now neglected merely on account of their non-durability, may become of value. Also, there are many uses of wood for woodware of various kinds, most of which is now imported, ornamental woods for veneering, &c. It seems very probable indeed that in our neglected forest-trees is a good deal of latent wealth, and it does not seem a wise policy to turn them into smoke and ashes before fully testing their capabilities and educating the public as to the same.

(*c.*) Regeneration of Forests.

The forests of New Zealand, as was explained earlier on, differ altogether from those of Europe and America where forestry operations are being carried on. It is quite true that those of Europe are for the most part artificial, but that fact does not alter the case. A European or American forest consists of trees nearly all of which are available for timber, whereas in that of this country often three-fourths of the ground is occupied by unprofitable growths. The foreign forests whence come "Baltic," "Oregon," and other pines or hardwoods can by the methods of scientific forestry—*i.e.*, cutting out only trees of a certain size and at fixed seasons, replanting, and so on—be made to yield a continuous crop. This is quite out of the question in a New Zealand taxad or kauri forest. The trees are of too slow a growth to allow a profitable reinstatement; the difficulties of planting within the forest, owing to the multitude of shrubs, the tangle of roots on the ground, and the fallen and rotting trees, are very great, while for the reproduction of certain trees—the kauri, *e.g.*—the light of the forest-interior is not generally sufficient. Even were saplings left to replace the felled trees, the length of time required before they were of "millable" size would be altogether too great to profitably allow the regenerating forest to occupy *good* ground.

At the same time, where the ground is unsuitable for settlement, or where there would be no special benefit in opening up for farming purposes that particular area, it certainly should be preserved, especially as no one can tell but that many of the neglected species may be of value. Also, undoubtedly, the present methods of dealing with our timber forests are far from perfect. Trees are cut at all seasons of the year, there is little supervision as to what trees should be cut, much damage is done to the standing timber, and, finally, there is a lamentable amount of waste. Undoubtedly, more supervision and less wasteful and more careful methods would materally assist in conserving the present timber-supply.

Furthermore, those areas which have been burned, if cattle, &c., be kept away, where the climate is wet, will again be covered with trees or shrubs; but at first, at any rate, the valuable timber-trees will be absent, and a quite different growth to the original will for many years occupy the ground, nor is it known what would be the final outcome*. Kauri and beech forests are an exception, the dominant trees in both cases coming up by thousands when the larger timber has been removed. In Stewart Island, too, owing to the cloudy skies and large number of rainy days, even the rimu, that most difficult of trees to grow in the open, is reproduced thickly by thousands even where the forest has been altogether removed. But these exceptional cases are of little moment from the timber standpoint, and it may be assumed that when once a New Zealand forest has had its large trees cut out it is practically worthless for any future growing of timber that could compete with artificial forests made of foreign pines or hardwoods.

Certain of the native trees will grow under artificial conditions, and it might pay to cultivate them: such are the totara, kowhai, and puriri.† Beech forests could be produced artificially, and will regenerate, as noted above, if cattle, &c., are kept out of them, but in the latter case the timber would not equal that of foreign trees much more easily raised and quicker to mature.

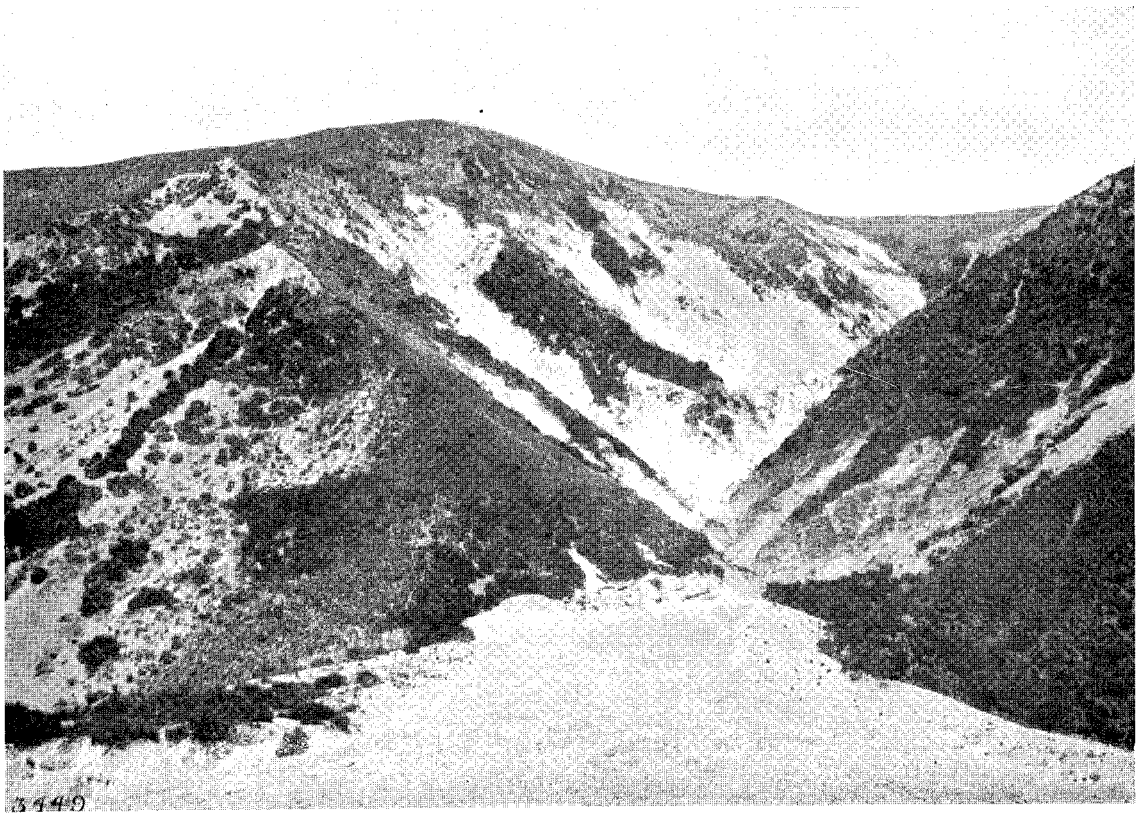
(*d.*) Forests and Climate.

Apart altogether from the importance of woodlands as yielding timber, &c.—and which, so far as New Zealand is concerned, leads to their destruction—they are in many places a most valuable asset as they stand, and if cut down would probably have to be reinstated at great expense by some future generation. The indirect importance of the forest, which may be called "climatic," was in the early colonial days a matter of little interest, and even at the present time is not generally recognised. The settler who on clearing his land leaves a few acres of "bush" upon his property is exceptional, and where small pieces still exist in gullies upon private holdings they are rather the result of it not

---

* Accurate observations on this head would be a very valuable contribution to scientific forestry.

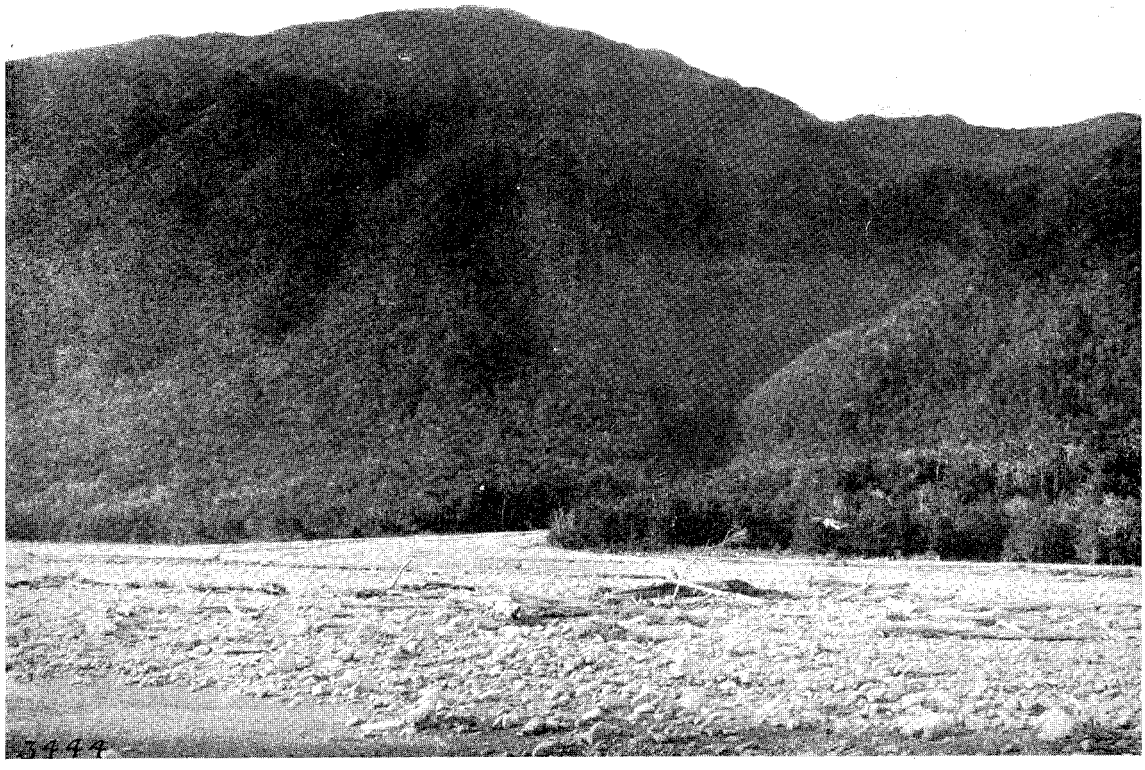
† Details as to rapidity of growth under various conditions in different parts of New Zealand should be collected.



EROSION ON A MOUNTAIN-SIDE DESTITUTE OF TREES.

Fan of *débris* in foreground. Note how the dark patches of scrub protect the surface.

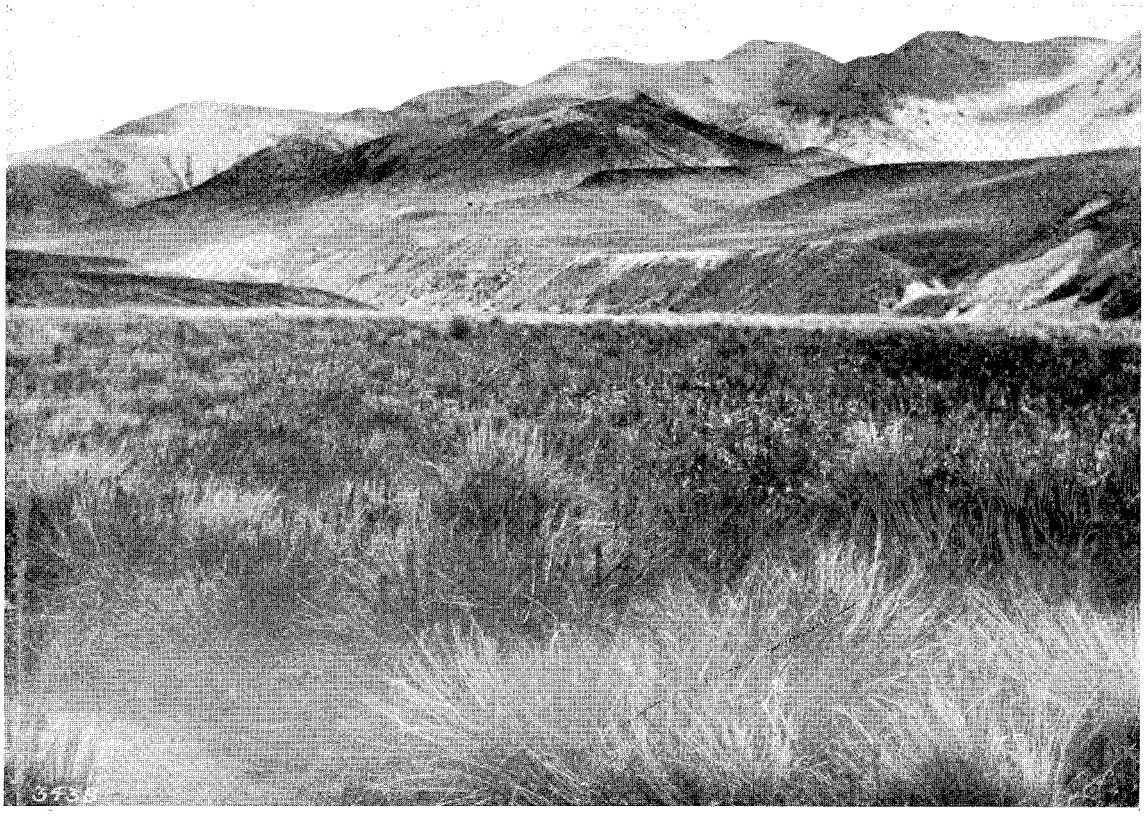
[*L. Cockayne, photo.*



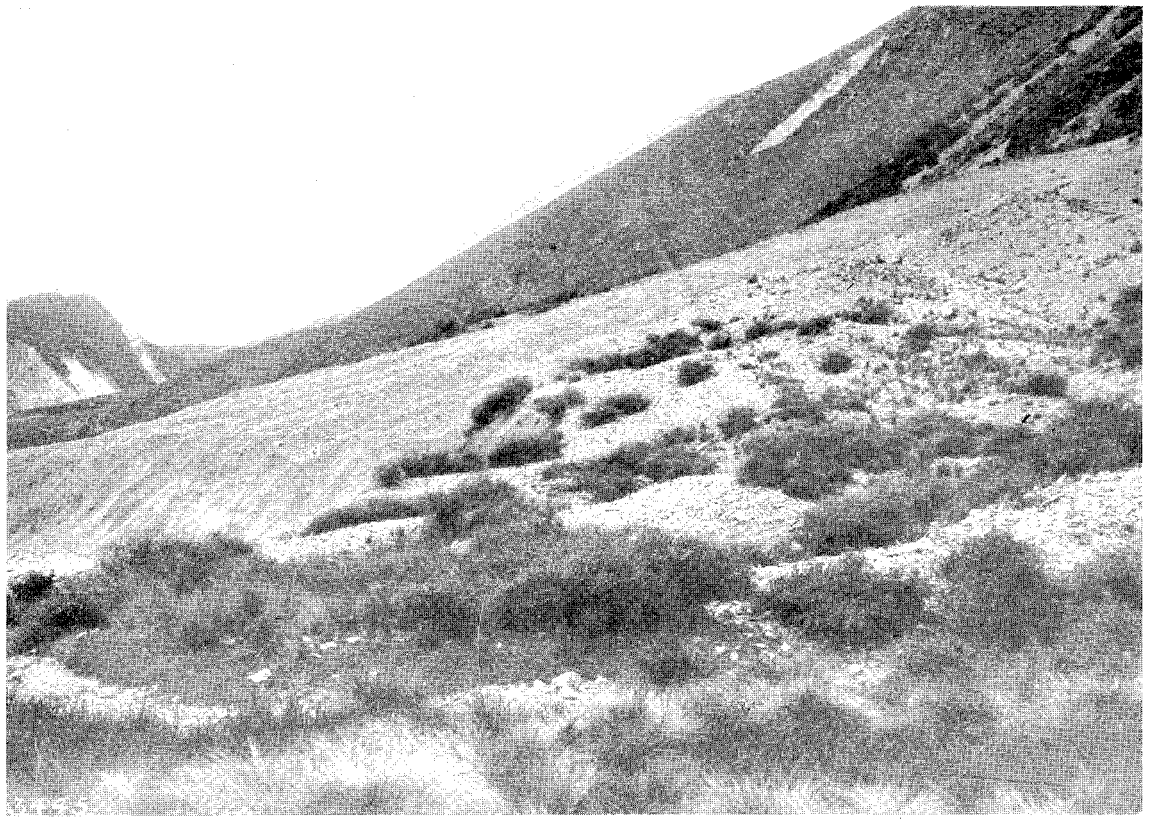
JUNCTION HILL, VALLEY OF RIVER POULTER, WAIMAKARIRI NATIONAL PARK.

Densely covered with beech forest. The mountain-slopes, although very steep, are quite protected.

Face p. 88.] [*L. Cockayne, photo.*



View of the Craigieburn Mountains.
The summits average about 6,000 ft. altitude. Shingle-slips extend from base to summit.
[*L. Cockayne, photo.*



Heap of Debris brought into River Porter by a Torrent from Mount Torlesse.
On right the surface is getting fixed naturally by drought-resisting shrubs.
[*L. Cockayne, photo*

paying to remove them than of their being considered of any moment.* Yet, paradoxical as it may appear, almost the first act of the settler after destroying the entire forest covering is to plant certain Californian pines for shelter purposes† (*Pinus insignis*, *P. muricata*, *Cupressus macrocarpa*).

(1.) *Effect on Rainfall.*

It is a matter of very general belief that a tree-covering increases the rainfall of a country very considerably, and that if such be removed the land would become a desert. Before dealing briefly with this important question it must be pointed out that in estimating changes of climate individual experience based on memory is of no moment whatever, since meteorological facts can only be secured by accurate instruments in the hands of a careful observer during a long period of years.

That forests cause increased precipitation seems at first glance, on comparing the rainfall of treeless and forest-clad districts, to be indisputable. But a moment's thought shows that without sufficient rain such a forest as that of New Zealand could not exist at all, and that it is not a *cause* of the rain but a direct *result*. Reduce the downpour beyond a certain limit and the rain-forest will be no longer present. Thus in Canterbury-Westland, everywhere within the region of the western rainfall up to a certain altitude is a vast forest, but on the eastern side beyond the average point reached by the above rain the forest as a continuous covering ceases, being confined to sheltered gullies or slopes, or to places where sufficient ground-water is available. So marked is this effect of change in harmony with the average rainfall and number of rainy days that the two very closely related species of mountain ribbonwood, *Gaya Lyallii* and *G. ribifolia*, approach within less than a mile of one another, but do not intermingle, the former being confined to the wetter and the latter to the drier district.‡

The relation of forests to rainfall is in fact very little understood as yet: the evidence is conflicting, and there is no unanimity amongst scientific men. It seems probable, however, that there is some slight relation, and that forests may have a certain local effect. Should, however, the climate be of a moist, insular character, such as that of New Zealand, then deforestation would make no appreciable difference. The whole subject is too complicated for discussion here, nor is sufficient literature available. It seems to me, however, that it may be confidently asserted that were the whole of the trees of New Zealand, native and introduced, removed, the rainfall, owing to the moist sea-winds and the mountain-ranges favouring precipitation, would not be affected in the slightest degree.

(2.) *Effect on Distribution of the Rainfall.*

It is easy to see that a continuous covering of trees must have a great effect upon the surface of the ground beneath with regard to the rainfall, and that the maximum result will be attained by a rain-forest with its many tiers of vegetation, each serving as a roof, its abundance of sponge-like mosses, and the surface layer of porous humus or vegetable matter still only partly decayed.

A land-surface unprotected by a plant-covering will be reached by the whole of a downpour, light or heavy. Some water will sink into the ground, the amount depending on the porosity of the soil, and some will flow away, if the surface is sloping. But in a forest-clad area the volume of water which gains the ground will depend upon the intensity of the rain and the length of its continuance. A light shower will not reach the forest-floor at all, and even heavy rain will at first be held in no small measure by the foliage of trees and shrubs, while the mosses on the trunks, spreading roots, and fallen trees will absorb a great quantity of water, and those of the ground-surface, together with the litter and humus, will function as veritable reservoirs. Long after the rain is over one soon gets wet through in traversing a New Zealand forest; water can easily be wrung from the mosses, the filmy ferns are dripping, and the great asteliads§ in the trees may each hold no small quantity. There is therefore under no circumstances a sudden accession of water by the ground which it cannot to some extent absorb, provided the soil be not already saturated.

It is also easy to be seen that on an unprotected area of land there is nothing to check the powerful evaporation from the soil caused by sun and especially by wind, such also increasing with altitude. To be sure, as shown above, a forest or shrubbery does arrest a considerable quantity of water which never reaches the ground, but this is merely a trifle compared with what would run off an uncovered surface, or be lost by evaporation. Not only does the forest as a whole provide a deep column of moist air which can only at times, and slowly, receive additional moisture, but the wet moss-covering on the one hand helps by its slow evaporation to keep the atmosphere within the forest saturated, and on the other hand to check all evaporation from the ground-surface until the moss itself is dry, when it will absorb moisture from beneath by capillary attraction. Moreover, this ground-covering hinders the rain-drops, already much broken by the tiers of foliage, striking on and consolidating the soil, which remains in consequence porous and with full absorbing-power. It has been calculated that in a European deciduous forest evaporation may be decreased to seven-eighths of that in the open, and certainly the New Zealand rain-forest must act still more powerfully in this regard.

It can be readily seen how forests, through this mere suppression of evaporation, function in the conservation of water and so assist in keeping up the underground supply on which the permanency of rivers depends, but at the same time it must be pointed out that the trees themselves take up moisture from the soil and assist in keeping it dry. The surface-rooting rain-forest trees, however, function

* In almost every district there are one or two enlightened property-owners who carefully preserve pieces of the native forest on their land.

† The popular notion that if a small piece of the natural forest is preserved, say, one or two acres, it is certain to die, is quite erroneous, but this is dealt with further on.

‡ This is owing to *G. ribifolia* having leaves rather better adapted to a dry station than those of *G. Lyallii*.

§ Plants with leaves something like a "flag-lily" (Iris); native name, kahakaha or wharawhara.

much less in this regard than those of other regions with deeply descending roots. Nor must another most important attribute of forests be overlooked—namely, their sheltering function against the ever-present wind, that greatest evaporation-causing factor. Nowhere is this effect more marked than in the low and wind-swept coastal forest of the Auckland Islands, within which is a wind-still and saturated atmosphere, while without is blowing a fierce antarctic gale.

The amount of water which penetrates into the ground, and the rate of penetration, depends upon the permeability of the soil—a very variable factor, governed by its texture; coarse-grained soils (coarse sand, volcanic cinders, &c.) being extremely permeable, and fine-grained (clay, heavy loam) being the contrary. But the covering of mosses, decaying leaves, &c., renders the surface of the soil granular and so more permeable, while descending roots, and the channels left by those which have rotted, make special downward paths for the water. Furthermore, the floor-conditions, referred to at greater length below, of a New Zealand rain-forest are very favourable towards preventing the water running off the ground-surface, and so lengthen the time during which it can penetrate. Briefly, then, forest-conditions, and those of a rain-forest more especially, assist materially in maintaining the sub-terranean water-supply.

Run-off.—Closely bound up with the permeability of the soil is the volume of water which can flow away when the ground is sloping. Such flow is called by the Americans "run-off," a sufficiently expressive term. On the clay soils so common in New Zealand—which, although finally holding a large amount of water, receive the same very slowly, being extremely impermeable—the run-off is very considerable, and if there is a scanty plant-covering a quite moderate shower soon swells the volume of the neighbouring streams, which, where not sheltered by trees, decreases with equal rapidity.

It is easy to see from what has gone before that a covering of trees, or even of shrubs, will have a powerful effect on moderating the run-off, and if a typical rain-forest* occupies the ground a considerable amount of rain must fall before the streams are affected; or, if there has been a dry period, and the mosses, &c., are no longer wet, even a heavy downpour will have no result. This restraining of run-off is even more important than the evaporation-checking function of forests, and has a very marked effect in hindering an excessive volume of water swelling the streams in a brief period of time—*i.e.*, it helps in preventing floods.

The melting of the winter's snow is a powerful element in causing floods. Forests, of course, have a considerable effect in regulating the gradual meeting of what falls within their precincts, but in New Zealand their importance in this matter is not so great as in colder lands, the winter snow-line being above the subalpine forest belt. Their effect will be rather to restrain the volume of water descending after a warm rain than to hinder the melting. The shrubs along mountain streams will play an important part in the above matter, and their protection from fire is eminently desirable.

Perhaps even more than anything else does the irregularity of the forest-floor, by offering obstacles to the flow of water, operate regarding run-off. Everywhere lie the fallen trunks rotting and water-holding, heaps of humus stand high above the level of the floor, depressions large and small are common, moss-cushions, tussocks of sedges with water-absorbing decaying leaves at their bases, prostrate stems of climbing-plants,† the general close-growing ground-vegetation—all these collectively form a powerful obstacle to surface streams during the downpour. But, on the other hand, the steep slopes and innumerable gullies, shallow or deep, so characteristic of the New Zealand topography, play their part in rapidly conducting the water downwards, and no forest, however dense or crowded with obstacles, can altogether check their power.

(3.) *Effect regarding Denudation.*

It is with regard to the prevention of denudation and in regulating the flow of streams, touched on above, that forests play their most important part. Their services in this particular are of course greatest in mountainous countries, such as our own, and cannot be overestimated. Their power to restrain denudation is plainly manifest to any one who looks at the now bare and scarred foothills of the Tararua Mountains while journeying by train through western Wellington. Nowhere, however, can the protective effect of a tree covering be better seen than when traversing the old coach-road from Springfield to the West Coast. There, on the eastern portion of the dividing range, climate has not permitted the natural afforesting of many of the ranges, and in consequence gigantic *débris*-fields clothe most of the peaks, sometimes from summit to base (see photo opposite page 89). This result of intense weathering has been increased to no small extent by the action of the runholders since the earliest days of settlement, in burning the patches of subalpine shrubs, which, but to a lesser degree than actual forest, act as a protection to the substratum. Once reach the wetter region, and close forests succeeded by a belt of shrubs clothe the mountains, while it is only on the highest slopes that *débris*-fields of comparatively limited extent are in evidence.

Not only burning, but overstocking, exercises a deleterious influence. The various plant-associations of the mountains have arisen by a slow process of evolution, and still all stages of development may be observed, from the vegetation of rocks to a close shrubby covering, by way of loose *débris*-fields, which are being gradually occupied by plants and turned into a scanty pasture. Upset the balance of nature by burning or overstocking, and a reversion to *débris*-fields takes place, which in the presence of stock can never become reclothed with pasture, but, on the other hand, will pour their stones on to the land below. Certain creeping shrubs, especially the mountain totara (*Podocarpus nivalis*), are

---

* A beech forest (*Nothofagus*) of the drier districts has much less undergrowth than a taxad forest, or even beech forest of a wet area, and so functions less powerfully in checking run-off or evaporation, although its action is by no means feeble in this regard. A sub-alpine mountain-beech (*N. Cliffortioides*) forest will have, in places, a most dense undergrowth of young beeches.

† This class of plants becomes much less abundant above 2,000 ft. elevation.

of great importance in holding together the easily loosened soil. Unfortunately, the alpine shrub-associations are readily burned, especially when they contain species of needle-leaved heath, or turpentine-scrub, as it is sometimes called (*Dracophyllum*).

Photograph on page 89 shows what vast heaps of stone may be brought by quite a small stream into the valley below. Watercourses of this kind, which only flow during heavy rain, make hundreds of acres in the aggregate quite useless, spreading stones, gravel, and sand over the fertile land. A stream fringed by shrubs, or one passing through the forest, is much less liable to sudden changes, and will flow all the year round. It is quite common in the Southern Alps to find a watercourse absolutely dry where there are no trees, which higher up, perhaps a few yards away in the forest, is always running.

Where the forest has been removed channels are cut on the slopes, gullies deep out of all proportion to the general rainfall are formed, landslips are not infrequent, the surface may become quite bare, and no vegetation can recapture its barren and unstable surface. Finally, streams on which the settler depended will become dry, exposed to scorching sun, drying wind and bright light.

The flood-waters from the denuded areas pour down the streams and gullies, bearing with them to the land below *débris* of all kinds, which, choking up the main rivers, leads to change of streams, erosion of banks, and destruction of fertile lands. Matters such as this are apt to be overlooked in a sparsely populated country. Only the unfortunate sufferer whose acres are being borne away on the turbid stream, or whose grazing-land has become a receptacle for stones and mud, can bewail the apathy or ignorance which permits the mountain-forests, and those fringing the streams, the natural safeguards of the plains and fertile slopes, to be destroyed.

Were it possible to at once clothe the surface with grass, the evil of removing a tree- or shrub-covering would be to some extent mitigated, but the settler wishes to make use of his land as soon as possible, and the early grazing of sheep or cattle forbid the grassy covering becoming close enough to stop denudation. On the higher mountains, too, where the principal rivers have their source, the chance of herbaceous plants occupying the ground before damage to the surface takes place is very poor. Only the native species slow of increase are suited to the conditions, and they can advance but slowly from the margin of the bare area inwards. A natural mountain "meadow" indeed is no great protection against denudation, there frequently being more bare patches than vegetation-covered ground.

It is the closely populated countries that have grasped the vital significance of the mountain-forests. Nor can such countries seek to mitigate the evil, as we can, by the cheap means of forest-conservation. They have been forced to adopt the more drastic method of reafforestation. Thus in 1866 in France it was estimated there were 2,964,000 acres of denuded forest lands needing reclothing with trees. The Government of the day took 780,000 acres, spending on them £2,000,000, while private owners and communities added £6,000,000 more, and all to repair the want of foresight in the past. Corea, Professor Macmillan Brown tells me, is suffering from the reckless cutting of the forest, and everywhere is fertile ground being damaged by *débris* coming from the now bare hills. Example after example could be given both from the Old World and America, but these will suffice.

So far as New Zealand is concerned, the Department of Lands has not been unmindful of its duty in this matter. Mr. W. C. Kensington, in his interesting introductions to the Forestry Reports of the past, has made many allusions to the importance of the New Zealand forests from the climatic standpoint. Nor is this all by any means. The practical course has been adopted of making climatic reserves. The upper forests of the Ruahines, Tararuas, the Seaward Kaikouras, and other forests, I understand, have been so reserved. This is a wise and long-sighted policy, and one which will meet with warm approval in the Old World, where the evils of reckless forest-destruction are so well known. Unfortunately, there is in New Zealand a constant cry to cut down the forests. The lessee of a grazing-run cares little what becomes of his leased mountain-land—it will serve his time. He would rather see the subalpine forest burnt than standing: its site might grow a little more grass. The scrub is fired for the same purpose, and in order to signal during mustering. Patches of bush, too, are burned. Vain hope that a run may be thus improved: its area of grass is reduced rather, its value is diminished. Nor is this the worst, since the fertile lands below may eventually suffer. The policy of conserving the mountain-forests should be unhesitatingly adhered to. There are many small areas along mountain-streams of importance. There is scrubby bush on certain of the lower hills which would be far better if left intact than if meddled with. Finally, the larger forest-areas, partly destroyed, if on worthless ground, are better standing than cut down to encourage settlers to take up land which will yield an uncertain and very scanty livelihood at best.

(4.) *Shelter.*

In most parts of New Zealand the wind exercises a very powerful influence upon the plant-life. So great is this in some places that the presence of particular species or combinations of plants is altogether a matter of exposure with regard to wind. Similarly this same factor exercises the greatest influence upon the welfare of the farmer's crops, and in an area of farm land the protection, which trees alone can give, becomes a vital necessity.

From the point of view of affording shelter, then forests are of much moment. It has already been noted how the settler, having cleared his land, at once is forced to plant belts of trees. Pieces of beech forest in the mountain districts are of great value in time of heavy snow for sheltering the flocks. The plantations of the Canterbury Plains, some of which are large artificial forests, are worth many thousands of pounds to the Dominion as a whole, and their threatened destruction some time ago by a species of aphis was feared as a national disaster. Drifting sands are best coped with by a forest covering, but unfortunately, except in parts of Chatham Island and Stewart Island, and a few places on the mainland, this is absent. The general question of wind-breaks rather concerns tree-planting than natural forests, and need not be further discussed.

5. PRESERVATION OF FORESTS FOR SCENIC PURPOSES.

For a number of years past the fact that in our scenery we have a source of much wealth has been slowly becoming recognised by the public, so that at the present time there is hardly any one prepared to assert the contrary. Now, it is the *special character* of the scenery which constitutes its attraction to visitors, and this depends altogether upon the plant-covering of the land. Moreover, this covering is not artificial, as is that of Europe generally, where the forests have been planted by man, or at any rate much modified, and even the mountain-meadows altogether changed by the grazing of animals. The vegetation is in fact primeval; New Zealand, where unmeddled-with, being really a piece of the primitive world just as planted by Nature. Also, the vegetation is absolutely different from that of any other land, as shown by the fact that out of about sixteen hundred species of the higher plants (ferns, lycopods, trees, shrubs, herbs) the astonishing number of one thousand one hundred and seventy-two are found nowhere else in the world, and yearly discoveries of unnamed species may be expected to swell this total. These plants have been combined by Nature into distinct plant-societies, each with its special physiognomy, and it is these which form the characteristic dressing of the land, giving the scenery the distinctive New Zealand stamp. In the above regard the forests play the major part. The majestic Sounds of Otago, the delightful inlets of Stewart Island, the defiles of the Southern Alps—these owe their colouring, their special character, their peculiar charm to the forest covering. The standing forest of such places is of little moment for commercial purposes: its larger trees once removed, they will only be replaced after a long interval, or not at all: any damage will change the character of the scene, and the value be accordingly lessened. Moreover, the land, were the forest once destroyed, would be worthless, while denudation, moving *débris*, floods, and drought would follow. Over the length and breadth of New Zealand are large areas of mountain-forest serving a splendid purpose both from the climatic and scenic standpoint, and their perpetual preservation is eminently desirable But against this is the opinion of some that trees are of no value except for timber and firewood, and cumber the ground; that when they cannot be utilised they are best cut down and burnt. Such a policy I have already attempted to show would in many cases be disastrous, and it seems to me that no forest-area on the mountains should be meddled with without grave reasons, and that the National Parks and scenic reserves should be guarded with jealous care. If there be one action of New Zealand which in every civilised country is being applauded as eminently wise and sane, it is the having set aside these special reserves.

But, apart from what is generally included under the category of scenery, come in those plant-associations whose like not only is not elsewhere, but which for certain reasons bid fair to become extinct. A case in point is that association known as the kauri forest. This is not only peculiar to New Zealand, but is confined to a limited region in the north. Not only, too, is it of extreme commercial value, but a virgin kauri forest both from within and without is a truly magnificent spectacle—almost the finest, so far as forest scenery is concerned, that the world can show. At the rate at which the trees are now being felled, in a few years' time there will be no *virgin* kauri forest in existence. But the State still possesses to the south of Hokianga, and growing for the most part upon poor ground, ill-adapted for settlement, a considerable area of virgin forest, the Waipoua. Some short time ago I expressed my conviction that this noble tree-association was of more importance standing as it is than if it were converted into timber, in the following words:—

"The Waipoua Forest and one or two other smaller reserves are the only virgin kauri forests now belonging to the State. The kauri forest, as I have already stated, is the only plant-association of the kind to be found in the world. I have also attempted to show that it is one of great beauty and of extreme scientific interest. The forest reserve contains examples of 241 species of flowering-plants and ferns. It is therefore at present an important forest museum. Before very long, at the rate at which the kauri is being converted, there will be no forests of that kind, and very few examples of the trees either—in twenty years' time, or even less. Thus will pass away for ever from the face of the earth one of the noblest of forests and one of the unique attractions of New Zealand. Our fiords, glaciers, and hot springs have their like elsewhere; our kauri forests are nowhere else to be seen. What the future of the Waipoua Forest will be I cannot pretend to predict. If it is felled it will give employment for a few years to a certain number of men, who in any case at the end of that time will have to look for other employment, and in its place will be much waste land and a few farms, isolated from other settlement. If it is preserved there will be a magnificent heritage for future generations, and an attraction, constantly increasing in its interest, for the visitors to our shores."

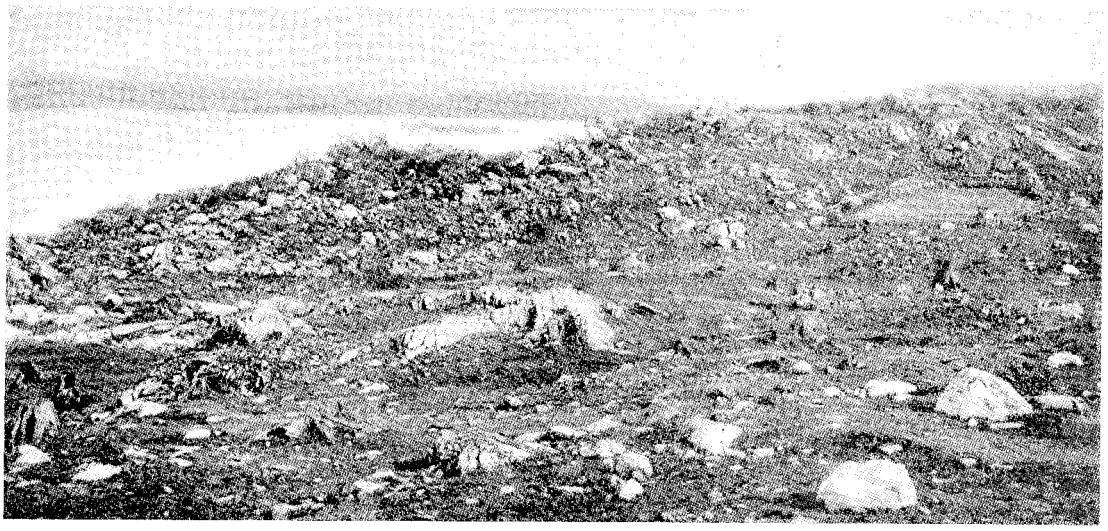
Other special classes of forest have also a claim for preservation, but generally speaking such is provided for in the great National Parks and certain of the scenic reserves. One park, the Waimakariri,* is an exception. Unfortunately, before the reserve was proclaimed the forest-clad portion had been constituted a forest reserve, and so, although within the limits of the park, timber can be removed. Such might quite well be the case before long, notwithstanding that the forest only consists of the at present valueless mountain-beech (*Nothofagus cliffortioides*), since it abuts for some miles on what will be the Midland Railway line. The preservation of this special forest is distinctly of national importance to the Dominion. In the first place, it covers those high mountains whence issue the various sources of the River Waimakariri, and its destruction would undoubtedly lead to frequent and disastrous floods in that great river, dangerous not only to the farm lands of the Canterbury Plain but to the City of Christchurch itself. Further, the railway-line, which in many places will be none too secure, would be endangered a hundredfold were the slopes over which it winds denuded of trees. Finally, the scenery of the Waimakariri National Park is of the highest character. With the extension of the railway to the Cass there will be opened up shortly a splendid holiday resort and natural sanatorium.

* Mentioned in Scenery Preservation Report under title of "Arthur's Pass National Park"; but that pass and its environs form merely a fraction of the area, which includes virtually the whole northern watershed of the Waimakariri.



200 Square Miles in China ruined by Deforestation.

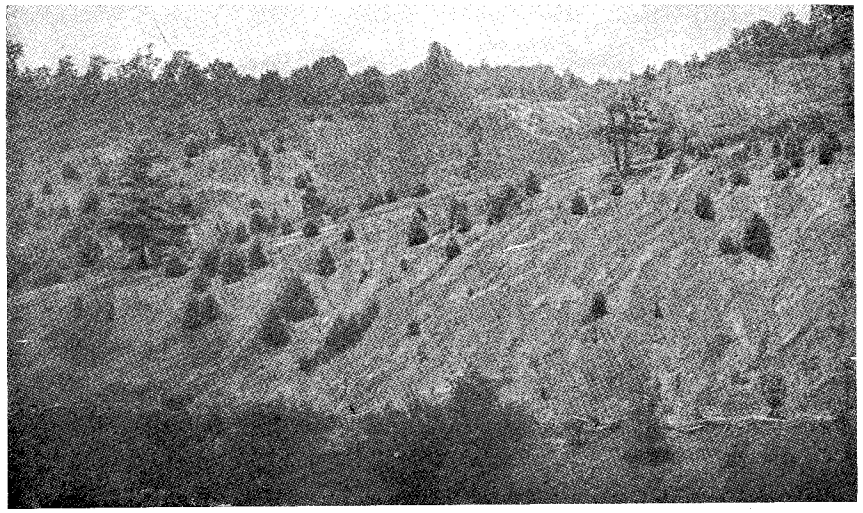
[*N.Z. Graphic, photo.*



Canadian Lake-shores ruined by Clearing.

[*Face p. 92.*

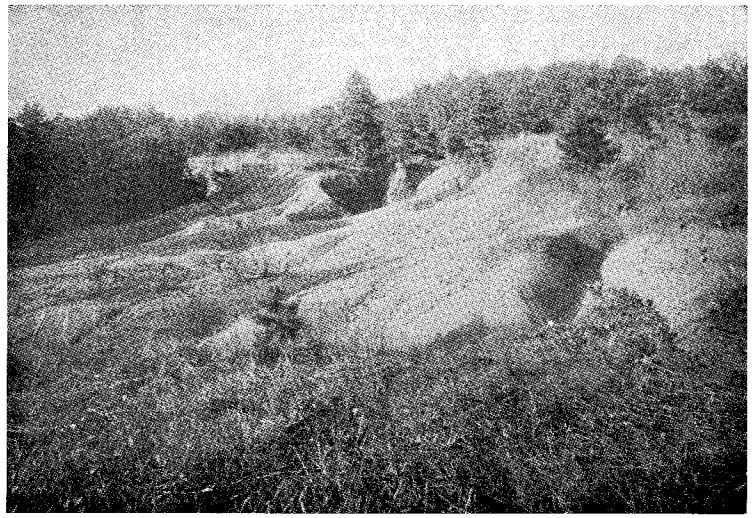
[*N.Z. Graphic, photo.*



A Deforested Hillside.



How the Germans plant Waste Land.



[*N.Z. Graphic, photo.*

Erosion—First Stage, cleared Hillside.



Erosion—Second Stage, the Fissured Soil.

6. DANGER OF FIRE.

The most common and yet extremely curious objection that is made regarding the setting-aside of forest reserves is that it is quite a useless procedure to establish such, as they are liable to be destroyed by fire; and one cannot help feeling that such destruction, if it took place, would not be a source of lamentation to the objector. Of course, were this fire danger an acute one, even then the necessity for the reserve would remain the same, and that it might some day be destroyed should simply suggest its careful guarding. Further, the same argument could be used against the planting of artificial timber forests, a matter, fire or no fire, of absolute necessity.

In point of fact, however, it is a very difficult matter to burn a virgin forest. Fires occur almost exclusively where timber has been removed and a litter of dead and dry material lies scattered over the ground. The summer of 1907–8 was almost unprecedented for dryness in the North Island. Bush-fires caused by settlers burning the felled trees on their holdings and the fire spreading thence into forest that had been milled, &c., were common, and for miles the air was thick with their smoke. Yet along the railway-line in the Waimarino Forest for some days a fierce fire burnt on both sides of the line and the road under the stimulus of a high wind, right up to the margin of the virgin bush, which notwithstanding was quite undamaged except just at its outside, where a few trees were scorched. Above the forest-line it is not difficult to burn the subalpine scrub,* which should form a part of any climatic reserve; but a fire there could only be the result of unpardonable carelessness or of design. The truth is, that those who speak of fire have usually in their minds cases where partially "milled" bush or damaged forest has been burned. Such cases, I do not deny, are quite common, the fire originating in the dead branches, &c., on the forest-floor.

Another frequent objection is, that it is quite impossible to reserve small areas cut off from a general forest-mass. This is a half-truth at best. Such areas, even if only an acre or two in extent, will remain intact for years, perhaps for quite as long as they would have done had the whole area been preserved. The Town Belt of Dunedin, the Botanical Gardens of Wellington, Dean's Bush near Christchurch, and hundreds of other examples in both the North and the South Islands could be cited. But turn cattle, &c., into such pieces of forest, make wide roads into them, set them on fire occasionally, and of course they will no longer remain intact. On the other hand, even when much damaged, quite small pieces of forest may confidently be expected to improve rather than to dwindle away.

(B.) DEFORESTATION AND ITS CONSEQUENCES.

[By J. P. Grossmann, M.A., Director of the School of Commerce, Auckland University College.]

To most people the cutting-down of our native trees and the clearing-away of the bush appeals only because it means the disappearance of beautiful scenery or the loss of valuable timber. Now, while it must be admitted that the destruction of the bush is to be regretted from the point of view of the tourist or the lover of the picturesque, there are many more substantial reasons that render the process of deforestation which the country is undergoing a question of very serious public interest. And, though the scarcity of timber consequent on the reckless destruction of the bush is a matter that certainly requires the attention of Government and people alike, I venture to believe that there are other evils inseparable from deforestation from which the country is already suffering, and which even more urgently demand that some concerted and systematic attempt shall be made to remedy them, before it is too late.

To realise what must be the inevitable consequences of the destruction of our native bush, it is in the first place necessary to consider what are the functions performed by trees in the economy of nature. Professor Schlich, in the most important text-book on forestry in the language, tells us that forests produce the following effects:—

"They reduce extremes of temperature by increasing the humidity of the air, and thus tend to increase the rainfall; they help to regulate the water-supply by insuring the steady feeding of springs, and thus they tend to reduce the volume of floods; they help to prevent landslips and the silting-up of rivers, and they arrest moving sand; they afford shelter to vegetation from strong winds; and, by aiding the generation of oxygen and ozone, they tend to improve the hygenic conditions of life."

From these considerations it is easy to infer the nature and extent of the harm done to a country by the destruction of its indigenous forests. To describe briefly the character of these injuries, I may quote from a distinguished American authority, Professor Trotter:—

"When the forests are cut down, delicate adjustments in the balance of nature are destroyed. The soil is exposed to the disintegrating effects of the atmosphere. In summer it is baked to dryness; in winter it rapidly loses heat by radiation. In colder regions the loosening effects of frost are readily seen in an exposed soil. In a region denuded of trees the supply of springs becomes intermittent, no longer fed from the constant and unfailing reservoirs of the forest-soil. The heavy dash of rains washes away the loose earth, carrying it into the streams, which become turbid torrents. In the spring, when the ground is still hard from frosts, the rainfall and the rapidly melting snow run off the slopes, leaving only a small part to sink into the ground. This immediately swells the brooks and tributaries of a river-basin beyond their carrying-capacity, causing freshets, which tear away the banks and obstruct the

* Certain varieties of beech forest may also be set on fire.

channels at various points with accumulations of stone and other *débris*. The overfull brooks discharging into the larger tributaries raise the waters of the rivers into mighty torrents that sweep seaward, often causing disastrous floods in the lower valleys. Almost as quickly as they rise, the rivers fall again, and, should a prolonged period of dry weather follow, they will shrink away into their deeper channels, leaving the side shoals exposed as mud-flats. The brooks become dry beds, no longer fed through springs nursed by the bountiful supply of a forest region."

In similar terms, Marsh, in his classical work "Man and Nature," describing the destructive effects of deforestation on the land, says :—

"The soil is bared of its covering leaves, broken and loosened by the plough, deprived of the fibrous rootlets that held it together, dried and pulverised by sun and wind, and at last exhausted by new combinations. The face of the earth is no longer a sponge, but a dust-heap, and the floods which the waters of the sky pour over it hurry swiftly along the slopes, carrying in suspension vast quantities of earthy particles, which increase the absorbing power and mechanical force of the current, and, augmented by the sand and gravel of falling banks, fill the beds of the streams, divert them into new channels, and obstruct their outlets. From these causes there is a constant degradation of the uplands, and a consequent elevation of the beds of watercourses and of lakes by the deposition of the mineral and vegetable matter carried down by the waters. The channels of great rivers become unnavigable, their estuaries are choked up, and harbours which once sheltered great navies are shoaled by dangerous sandbars. The washing of the soil from the mountains leaves bare ridges of sterile rock, and the rich organic mould which covered them, now swept down into the damp, low grounds, promotes a luxuriance of aquatic vegetation that breeds fever and more insidious forms of mortal disease, and thus the earth is rendered no longer fit for the habitation of man."

In applying these general principles to the case of our own country, I need not enter into the debatable question whether forests increase the rainfall; I do not even need to insist that they exercise a mitigating effect upon extremes of climate: I am content to rest the case against deforestation, in the crude and reckless form that it has taken in New Zealand, chiefly upon the consequences of erosion with its contingent evil of floods, and, as a subordinate though important aspect of the question, upon the coming timber-famine.

First, as to erosion: For a general description of this degradation of the surface of the country let us again turn to Marsh, and contemplate "the transformation of forest-crowned hills, luxuriant pasture-grounds, and abundant cornfields and vineyards well watered by springs and fertilising rivulets, to bald mountain-ridges, rocky declivities, and steep earth-banks furrowed by deep ravines with beds now dry, now filled by torrents of fluid mud and gravel, hurrying down to spread themselves over the plain, and dooming to everlasting bareness the once productive fields. In traversing such scenes," adds this distinguished observer, "it is difficult to resist the impression that Nature pronounced the curse of perpetual sterility and desolation upon these sublime but fearful wastes, difficult to believe that they once were, and but for the folly of man might still be, blessed with all the natural advantages which Providence has bestowed upon the most favoured climes."

Possibly this picture may seem imaginative; but it is, on the contrary, painfully realistic, and is based upon careful observation of what has actually occurred in many other countries, notably in France, Spain, Asia Minor, and China. As it is impossible to separate the effects of floods from the other consequences of erosion, I submit a little evidence bearing on the damage and injury produced by these means working in conjunction :—

"The countless ruins of Palestine," says Mr. A. Page in a recent issue of "The World's Work," "the stony hills and deserted valleys are the result of maltreatment of the land that once flowed with milk and honey. Mesopotamia, one of the most sterile countries in the East, was once a forested and fertile land, and the Euphrates River is now swallowed up in the desert. Greece shows a similar decadence. Sicily, which when covered with forests was the granary of Rome, is now entirely deforested, and even when undisturbed by earthquakes is a poor agricultural country. There are parts of Denmark, Bohemia, Hungary, and Austria which in modern times have become valueless through deforestation. The Chinese have ruined great parts of their empire by destroying their forests, and they are fast becoming waste places in which no man can live."

"China," writes Mr. Emerson Hough, dealing with "The Slaughter of the Trees" in *Everybody's Magazine* (May, 1908), "is the best instance of a land that never cared for forestry. She builds houses now of little poles, uses for fuel saplings, shrubs, herbage. Her children literally comb the hillsides for bits of roots and shrubs for fuel and fodder. The land is bared to the bone. It is a land of floods. Villages are swept away, hard-tilled fields ruined, starvation always stalks in China. Alternate floods and water-famines follow the waste of forests." And in this unfortunate country the work of destruction is still going on. Within the last century hundreds of square miles of country have been converted into a treeless, waterless waste; and what has been the result? The Hwang-Ho and the other great rivers of China are periodically flooded, and millions of lives are sacrificed simply because the forests in northern China have been cut down and never replaced. "They cut off the trees, then the shrubs, then the grass, until not a single living thing remained on the mountain-sides. The rain washed the soil from the rocks. With infinite patience every year they build terraces wherever they can to save a little of the soil for agriculture. The once fertile valley-lands are covered with gravel and rocks, the *débris* of floods. The territory that once was fertile is now bare; its flourishing cities are falling into decay; the land is becoming uninhabitable." (*Vide* photograph opposite page 92.)

Even in the highly civilised countries of Europe the losses thus inflicted by deforestation are admitted to be disastrous and almost irreparable. During 1875 the loss of property in the south of France through floods caused by deforestation was estimated by the State at £3,000,000, and, in addition, at least three thousand people lost their lives. "The indirect results," says Captain

Campbell-Walker, " in the shape of temporary or permanent damage to agricultural districts by the deposit of stones and shingle brought from the mountains by the flood-waters cannot be estimated, still less the damage to pastoral lands on the mountains themselves. It may be stated generally that the results of excessive clearing of forests and abuse of pasturage on the French Alps and Pyrenees have reduced their capacity as a sheep- and goat-carrying area to such an extent that they cannot carry half of what they did fifty years ago; whilst the damage resulting to the agricultural districts below from the drying-up of springs and streams, the torrents caused by heavy rains and the melting of the snows, and their effect on the river banks and channels, followed by long droughts in summer, is simply incalculable, and such as cannot be repaired, even at a large expenditure, within two generations."

It is easy to understand how the process of erosion must ultimately result in floods; and these, indeed, are among the earliest and most strongly marked consequences of sweeping away indigenous bush without making any systematic attempt to replace it. In America, where so large an area of the native forest has been cut out with reckless disregard of all precautions, the effects of these devastating floods have already been carefully studied. " One small neglected stream," we are told, " has been found by actual measurement to wash enough soil from its hills to deposit silt equal to 1½ tons per acre of its watershed in a year. The quantity of silt deposited every year by all the streams in the United States would cover a territory 900 miles square a foot deep. Our rivers have washed 783,000,000 tons of the best soil of the United States from the upland farms, and carried it into the rivers, where it has formed bars, impeded navigation, and finally lodged in the great harbours. The Government has already spent $553,000,000 for river and harbour improvements," and this outlay has been rendered necessary almost entirely through the indirect effects of deforestation. The National Conservation Commission estimates that soil-erosion reduces farm-production in America from 10 to 20 per cent.; and that the annual loss to the farms alone is $500,000,000. The direct damage from floods has increased from $45,000,000 in 1900 to $238,000,000 in 1907—and all this enormous expenditure and loss is attributed by this responsible Commission of experts to the reckless slaughter of the forests.

So far as New Zealand is concerned, the country is still too young to have experienced the worst effects of deforestation either in regard to erosion or floods. But, even as it is, it is no exaggeration to say that there is not a single district in the Dominion in which the native bush has been cleared away round the head-waters of the rivers that does not exhibit some of the disastrous consequences above described. It is only necessary to mention the matter to recall to the recollection of the general public the extent to which floods have increased in recent years throughout these Islands, in all the districts watered by rivers flowing down from hills where the bush has been partially or wholly cleared away. This is a subject on which, no doubt, a large amount of valuable information could be compiled from the reports of engineers and other experts submitted to County Councils and Road Boards from time to time in both North and South Islands." Some years ago Mr. R. W. Holmes, now Engineer-in-Chief to the Public Works Department, reported to the Feilding Borough Council on a serious washout at the junction of the Oroua and Kiwitea Rivers, involving the loss of over 50 acres of valuable land, and he attributed this disastrous flood entirely to the destruction of the bush along the upper courses of the rivers. Throughout the Wellington and Wanganui Districts the same tale can be told. The Manawatu, the Wangaehu, the Rangitikei, the Turakina have all followed the same course, with the same unfortunate consequences. In the Hawke's Bay District similar conditions have produced similar results; and all over New Zealand, wherever the bush around the sources of streams has been cut away, floods of varying degrees of intensity and destructiveness have inevitably followed. Already the penalty paid for our recklessness has been a heavy one, reckoned only in the money-value of land washed away or overlaid with *débris*, in stock drowned and property destroyed, and in the huge and increasing outlay on bridges that must be constantly repaired, and approaches that must be continually lengthened, and groins and embankments that must be perpetually strengthened against the encroachments of these turbulent streams. (*Vide* photographs opposite page 96.)

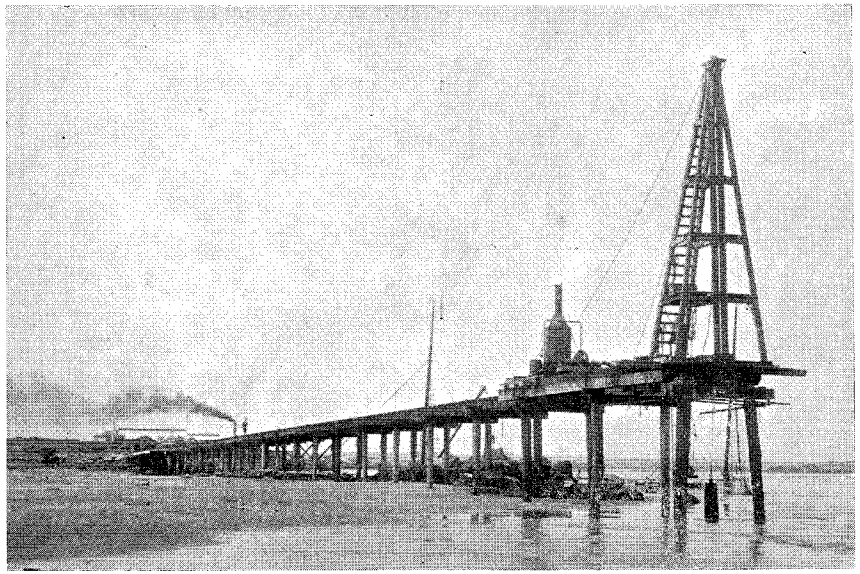
So far back as 1870 Sir James (then Doctor) Hector, addressing a Select Committee on Colonial Industries, said that the complete destruction of our native bush was most wasteful and unnecessary. " It is not at all necessary," said this eminent scientist, " that the forest should be completely removed in the way that it usually is, either for the purposes of agricultural settlement, or the obtaining of timber for mills, firewood, and fencing. The thinning-out of the forest would be ample in most cases to supply all our wants." No doubt our system of deforestation is just as extravagant as it was forty years ago in New Zealand; and, so far as the rest of the world is concerned, there seems to be a general consensus of opinion that careful and scientific methods of timber-cutting would make a vast difference to the present position and the future prospects of the industry.

Rudolf Cronau, an authority who has had wide experience of American forests during the past thirty years, tells us in an article on " A Continent despoiled " in a recent issue of *McClure's Magazine* that the lumbermen waste half of every tree they cut. " One-fourth of the standing timber is left or otherwise lost in logging. The loss in the mill is from one-third to two-thirds of the timber sawed. The loss in the mill-product through seasoning and fitting for use is from one-seventh to one-fourth. Only 320 ft. of timber are used for each thousand feet that stood in the forest." This estimate corresponds closely enough with the opinion advanced by Dr. Bristol, of the United States Forestry Department, who states that at least 50 per cent., if not more, of the average tree as it stands in the forest is wasted before reaching the market in the form of timber. In similar terms Mr. M. I. Seckendorf, writing on " The Elimination of Waste " in *Munsey's Magazine*, has shown that some seventy-five per cent. of America's forest-products is wasted, and that most of this disastrous loss is due to preventable fires, careless logging, and wasteful mill operations.

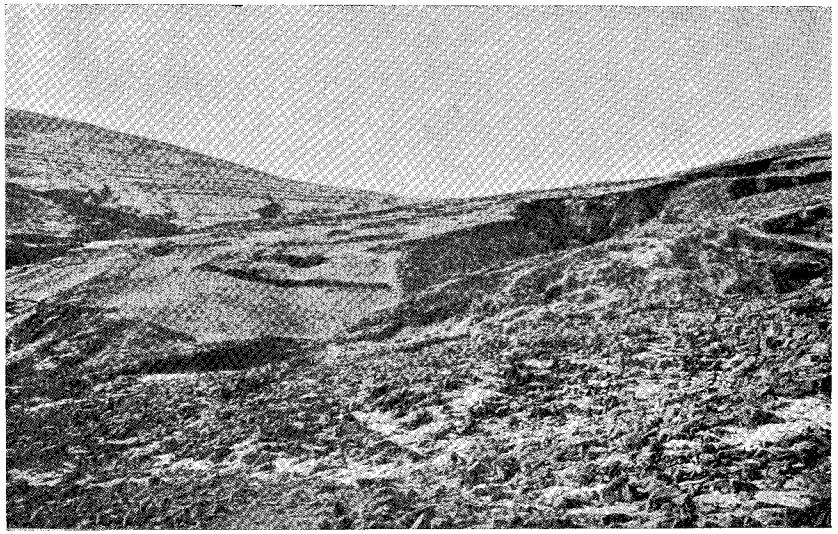
This last sentence contains a reference to what is by far the most serious danger by which the world's existing timber-supply is threatened—the menace of fire. But, contrary to the general belief, a great deal can be done by care and proper organization to combat this peril effectively. In the opinion of a great many people who have had much to do with timber, it is impracticable to protect standing bush against the ravages of fire. Thus the Hon. E. Mitchelson, giving evidence before the Timber Commission in Auckland recently, gave it as his opinion that it would be quite impossible to preserve kauri bush unless it were surrounded by a very large area of mixed bush, because of its inflammable nature; and Mr. H. P. Kavanagh, Chief Timber Expert for Auckland District, also told the Commission that it is impossible to save kauri-bush owing to its susceptibility to fire. Now, admitting the wide experience of these gentlemen, I would like to point out that the same opinion has been often advanced in other countries as to the impossibility of saving standing bush, and it has frequently been disproved by practical experiment.

Let us take the case of fire-fighting in America, where the enormous extent of the forests and the roughness of the ground inside the timber-belts would seem to render bush-saving an impossible task. Yet, as the result of careful precautions and the regular employment of a large staff of men, whose special duty it is to watch for and extinguish forest-fires, the losses from fire inside the national forest reserves—covering an area of 160,000,000 acres—have been reduced to a remarkably small figure. Thus, in 1906 it was officially reported that less than one-eighth of the national forests had been burned over, and that three one-hundredths of 1 per cent.—about one three-thousandth part—had been destroyed. The total loss was less than £20,000; yet it is calculated that the United States has been losing on an average about £10,000,000 a year in marketable timber for a long time past through fire alone. And the remarkable results recorded inside the national forest-area have been secured without any extraordinary outlay. The expenditure, in fact, bears no appreciable relation to the value of the work done. Returns furnished by the American Department of Agriculture show that the southern forests can be patrolled effectively against fire for 2 cents an acre per year; the northern forests for not more than 4 cents, and those of the Rocky Mountains and of the Pacific Coast for 1½ cents, an acre per year. Considering the value of the property thus protected, and the large proportion of it that would otherwise be annually destroyed by fire, the expense of fire-fighting is absolutely trivial. And it is not unreasonable to infer that the work done so cheaply under such difficult conditions and over so vast an area in America could be performed quite as effectively and as cheaply in New Zealand if a systematic attempt was made to apply the same methods here.

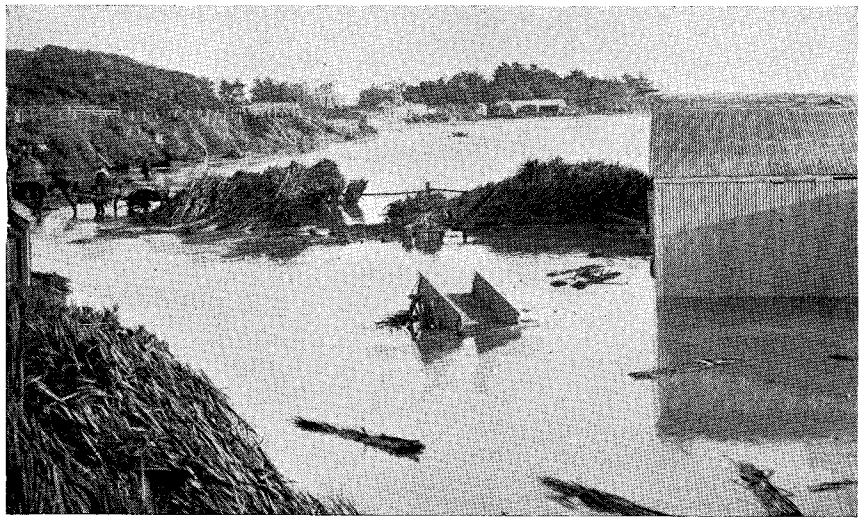
Face p. 96.]



WANGANUI RIVER MOUTH HARBOUR-WORKS.

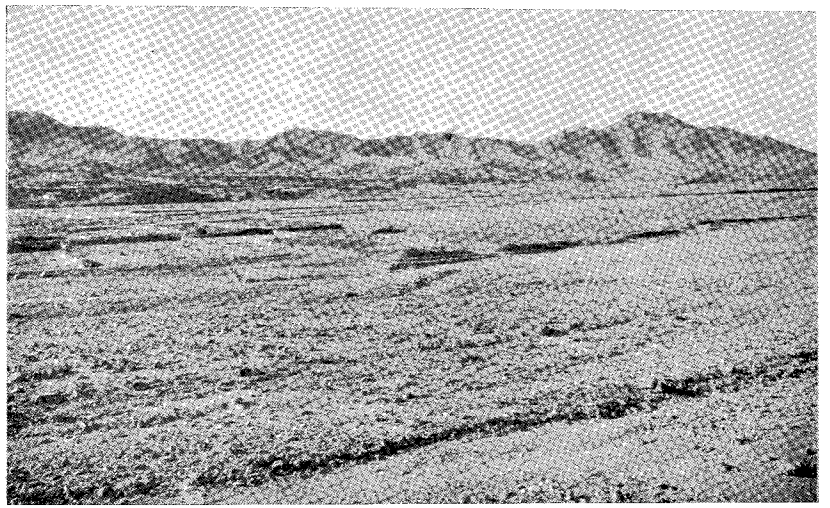


EFFECTS OF DEFORESTATION.



FLOODED OUT AT FOXTON.

[*N.Z. Graphic, photo*



EFFECTS OF DEFORESTATION.

[*N.Z. Graphic, photo.*

PART IV.—FOREIGN SUPPLIES.

CONTENTS.

	Page.
General remarks	97
(A.) Timber-supplies in Europe	98
(B.) The timber-supply of the United States	99
(C.) Canada's forest wealth and timber industry	100
(D.) Forest resources of Australia	104
(E.) Other sources of supply	107

GENERAL REMARKS.

Appended hereto are details of the principal forest countries in the world, and, although it has not been possible to obtain as full information as is desirable, yet sufficient data has been gathered to enable citizens of this Dominion to realise what the supplies of timber from outside New Zealand are likely to be in the near future, and what extent they may be drawn upon by our timber-merchants.

The timber-supply of *Great Britain* is not nearly sufficient for the needs of its population, large quantities having to be imported from outside. The forests in other *European* counties are mostly only sufficient for the needs of their own populations, and Sweden is apparently the chief country which is able to export to any considerable extent, although the Central Bureau of Statistics stated that, in 1900, 106,000,000 cub. ft. were annually being withdrawn from her forests beyond what is annually produced. Its distance from this Dominion, moreover, renders a large importation of timber (except at very high prices) somewhat problematical. In 1907 France imported 6,769,560 pounds' worth of timber, and only exported £2,773,760; Germany imported £11,622,754 and exported £1,669,552; whilst Sweden in 1906 imported only 322,630 pounds' worth of timber, but exported £13,136,943.

It has been thought that the supply from North America would be sufficient to stave off any fear of a timber-famine in Australasia during this century, but on referring to the Government statistics in section (B) it will be seen that the timber-supply of the *United States* is only sufficient to meet the demand for another thirty-three years at most, and that even now the States draw large quantities of timber from Canada. Mr. Gifford Pinchot, the Chief of the Forest Service of the United States, asserts that "the United States has already crossed the verge of a timber-famine so severe that its blighting effects will be felt in every household in the land. At the present rate of consumption, the supply of timber in the United States will be exhausted in thirty years. The lumber business, now the fourth greatest industry in the country, will disappear. All forms of building industries will suffer. Mining will become vastly more expensive, and there will be a corresponding rise in coal and iron. The railways, unless a substitute for the wooden sleeper is found, will be profoundly affected, and the cost of transportation will rise. Farming will be more expensive. Water-power for lighting, manufacturing, and transportation will be affected. Irrigated agriculture will suffer most of all, for the destruction of the forests means the loss of the waters as surely as night follows day. With the rise in the cost of producing food, the cost of food itself will rise. Commerce in general will necessarily be affected by the difficulties of the primary industries upon which it depends. In a word, when the forests fail, the daily life of the average citizen will inevitably feel the pinch on every side—and the forests have already begun to fail."

Turning to *Canada*, we find that its forests are certainly enormous, and until very recently were expected to supply all possible local and foreign demands for at least a century. Yet Mr. Sheck, a forest expert attached to the German Consulate in Montreal, in December, 1905, reported to his Government that, after most careful investigation of the matter, the time had practically arrived when, outside spruce and birch, no timber could be exported from Canada. He stated that the best quality of white-pine had almost entirely disappeared, that there were insignificant supplies of red-pine, that the supplies of low-grain timber, cedar, and hemlock were rapidly disappearing, that all valuable hardwood was at the vanishing-point; but that there were large supplies of spruce, balsam-fir, Banks pine, birch, and poplar. For example, he found that in 1881 17,000,000 ft. of white-pine (the most important Canadian timber) had been felled and used, but that in 1891 the fall was down to 9,000,000 ft., and in 1901 it was only 2,250,000 cub. ft. Oak yielded 5,500,000 ft. in 1881, but only 1,800,000 ft. in 1891, and 100,000 cub. ft. in 1901; larch, which in 1881 furnished 4,500,000 cub. ft. and in 1891 3,500,000 ft., had practically disappeared in 1901; and so on in proportion. In 1904 Canada imported 11,000,000 ft. of hickory, chestnut, and cherry, and 46,000,000 ft. of oak, together with 15,000,000 ft. of pitch-pine, 2,500,000 ft. of ash, and 1,250,000 ft. of walnut.

It must, however, be pointed out that Mr. Sheck probably alluded chiefly to the eastern provinces of Canada, as we know there are still immense forests in the west of Canada (which Mr. de Schryver mentions in his article further on) which will be available for New Zealand requirements for many years to come. But it is also certain that the forest resources of Canada will be taxed to their greatest extent before long to supply the United States and European requirements, and that the present fairly low price of timber (especially Oregon pine) cannot be expected to last much longer. It is to

Canada, however, that we must look for much of our timber-supply when our indigenous forests are nearly cut out, and our afforestation operations are not sufficiently advanced to meet the whole of the local demand.

Australia will also furnish a fair proportion of hardwood timber for some time to come; but there again it is found on careful examination that the forest resources are not nearly so large as had been thought. The particulars that have been ascertained by the Western Australian and New South Wales Royal Commissions are sufficient to show us that the question of supply and demand even in these vast States requires to be systematically studied, and it is quite possible an export duty may eventually be placed on much of the valuable Australian timbers for which New Zealand and other countries may indicate a growing preference. At present, however, there it a large open market that is available for our timber-merchants, and supplies of suitable timber appear likely to remain reasonable in price and sufficient in quantity for another decade.

It has been suggested that a profitable market may be opened up in *Manchuria* and *Siberia*, and timber-merchants both in New Zealand and Australia are now making careful inquiries with a view to ascertaining the various kinds of timber grown in those countries, and their suitability for local needs. It would seem that the trade is already established in the Commonwealth, as the Tasmanian timber industry is reported to have felt the competition of Manchurian pine timber very much recently.

The following summary serves to show the quantities of timber imported into New Zealand of late years, and the countries from which it is derived:—

Year.	Logs.	Laths and Shingles.	Posts, Palings, and Rails.	Sawn, dressed.	Sawn, undressed.	Logs, hewn.
			AUSTRALIA.			
	No.	No.	No.	Sup. ft.	Sup. ft.	Sup. ft.
1904	2,302	1,232,150	647,120	62,292	11,175,250	4,477,255
1905	2,627	1,727,917	575,719	87,988	10,755,822	2,914,307
1906	4,665	1,675,533	684,116	118,971	12,233,205	5,815,297
1907	4,140	1,169,282	737,580	73,403	13,783,644	10,404,396
1908	3,787	1,599,107	803,232	64,433	21,336,462	14,452,000
			CANADA.			
1904	11	62,000	Nil.	Nil.	9,575	7,300
1905	Nil.	100,000	Nil.	Nil.	65,625	..
1906	Nil.	650,000	Nil.	Nil.	803,600	..
1907	Nil.	1,565,080	4,500	Nil.	37,550	869
1908	38	6,264,929	Nil.	Nil.	11,572,878	15,330
			UNITED STATES.			
1904	6	25,000	Nil.	62,305	759,264	2,460
1905	Nil.	Nil.	Nil.	40,795	139,305	6,503
1906	18	Nil.	Nil.	45,066	907,788	18,207
1907	Nil.	650	Nil.	34,381	152,083	17,356
1908	Nil.	1,644,500	Nil.	100,422	4,166,629	15,001
			OTHER PLACES.			
1904	Nil.	320,000	Nil.	24,162	157,513	886
1905	10	100,000	3,400	7,900	94,201	4,857
1906	Nil.	Nil.	Nil.	3,910	79,692	5,952
1907	61	Nil.	Nil.	6,600	189,351	7,524
1908	Nil.	1,000	Nil.	10,931	74,829	19,078

(A.) TIMBER-SUPPLIES IN EUROPE.

SUMMARY OF WOODED AREAS IN GREAT BRITAIN.*

—	Total Area.	Area under Woods.	Cultivated Area.	Mountain and Grazing Land.	Commons and Field Lands.
	Acres.	Acres.	Acres.	Acres.	Acres.
England	32,381,908	1,715,473	24,560,399	2,401,263	1,950,917
Wales	4,748,398	184,361	2,787,514	1,319,982	681,855
Scotland	19,069,674	868,409	4,863,473	9,080,729	Nil.
Total	56,199,980	2,768,243	32,211,386	12,801,974	2,632,772

* Particulars extracted from minutes of evidence taken by the Royal Commission on Coast-erosion and Afforestation, 1908.

British Imports and Exports of Timber.

Year.	Value of Imports. £	Value of Exports. £
1903	27,122,956	51,164
1904	23,637,985	67,593
1905	23,274,020	77,056
1906	27,507,410	91,575
1907	27,093,054	111,841

Of the timber imported it is estimated that at the present time 87 per cent. is pine and fir, 3 per cent. oak, and 10 per cent. teak, mahogany, and other furniture-woods.

Extent and Percentage of Wooded Area in certain European Countries.

(Calculated chiefly from the Agricultural Statistics of the Board of Agriculture, Vol. xiii, 1907; and published on page 43 of the Journal of the Royal Statistical Society, 31st March, 1909.)

Country.	Total Area.	Wooded Area.	Per Cent. under Wood.
	Acres.	Acres.	Acres.
Sweden	101,520,000*	52,734,614	51·9
Russia in Europe, excluding Poland	1,244,367,000†	425,564,842	34·2
Austria	74,102,001	24,174,443	32·6
Hungary, including Croatia and Slavonia	80,979,000	22,262,483	27·5
Germany	133,585,000	34,569,794	25·9
Switzerland	9,900,160†	2,176,907	22·0
Norway	76,717,000†	16,845,400	21·9
Belgium	7,277,000	1,259,000	17·3
France	130,374,482	22,224.134	17·0
Italy	70,787,000‡	10,266,310	14·5
Netherlands	8,038,000*	636,299	7·9
Denmark	9,500,000*	682,823	7·2
England	32,383,550*	1,715,473	5·3
Scotland	19,070,244*	868,409	4·6
Wales	4,748,624*	184,361	3·9
Ireland	20,350,725*	306,661	1·5
Isle of Man and Channel Islands	185,754*	869	0·5
United Kingdom	76,737,897*	3,075,773	4·0

* Excluding lakes and rivers. † Excluding lakes. ‡ Including lakes.

The countries in Europe that export more timber than they import are,—	£
Austria-Hungary, exports in 1907	10,931,000
Norway, exports in 1906	4,428,277
Russia, exports in 1907	11,321,750
Spain, exports in 1906	2,833,036
Sweden, exports in 1906	13,136,943
„ (wood-pulp)	1,513,065

(B.) THE TIMBER-SUPPLY OF THE UNITED STATES.*

On the 30th November, 1907, the United States Department of Agriculture, through its Forestry Bureau, published "The Drain upon the Forests," which stated: "The estimates of the forest-area of the United States run from 500 million acres to 700 million acres, and it is safe to say that under present conditions the annual growth does not exceed 60 board feet per acre." [A "board foot" is a piece of timber which is 12 in. square and 1 in. thick.] "This gives in one case a yearly increase of 30 billion feet, and in the other case one of 42 billion feet. In other words it appears that the annual growth of our forests does not exceed the amount of wood used for lumber alone. Considering all the drains upon the forests, the annual consumption of wood is probably three times the annual growth. Assuming a stumpage of 1,400 billion feet, an annual use of 100 billion feet, and neglecting growth in the calculation, the exhaustion of our timber-supply is indicated in fourteen years. Assuming the same use and stand, with an annual growth of 40 billion feet, we have a supply for twenty-three years. Assuming an annual use of 150 billion feet, the first supposition becomes nine years and the second thirteen years. Assuming a stand of 2,000 billion feet, a use of 100 billion feet, and neglecting growth, we have twenty years' supply. Assuming the same conditions, with an annual growth of 40 billion feet, we have thirty-three years' supply. With an annual use of 150 billion feet, these estimates become respectively, thirteen and eighteen years."

* Information supplied to the British Royal Commission on Coast-erosion and Afforestation, 1908, by Professor William Somerville

According to these statements, the timber-supply of the United States will be insufficient to meet demands, in nine years as a minimum, and in thirty-three years as a maximum.

On the 24th April, 1907, the United States Government sent out another publication, entitled "The Timber-supply of the United States." There we find such statements as these: "Rapidly as the population of the United States has increased, the lumber-consumption has increased still more rapidly. In round numbers, and allowing for incomplete reports, the lumber cut in 1880 was 18 billion feet; in 1890, 24 billion feet; and in 1900, 35 billion feet. The increase in population from 1880 to 1900 was 52 per cent., and lumber cut increased 94 per cent. The United States is now using annually 400 broad feet of lumber per capita, whilst the average for Europe is but 60 feet per capita. . . . It has been shown that the present annual cut of forest-products requires at least 20 billion cubic feet of wood. To produce this quantity of wood without impairing the capital stock our 700 million acres of forest must make an annual increment of 30 cubic feet per acre. Under present conditions of mismanagement and neglect it is safe to say that the average annual increment is less than 10 cubic feet per acre. This means that each year's cut at the present rate takes the growth of more than three years."

Miscellaneous Notes.

The railway companies use 110,000,000 to 150,000,000 railway ties (sleepers) annually at the present time. About 40 per cent. is oak, 20 per cent. southern pine, and the remainder comprises Douglas fir, cypress, tamarack, hemlock, cedar, beech, and other experimental woods. (*New York Tribune*, 6th March, 1909.)

Professor Henry Garnett, of the United States Geological Survey staff, in 1905 estimated the wooded area of the United States at over a million square miles, which is about one-third of the total area of the country, and thought that on this area there stood about 2,500,000,000,000 ft. of merchantable timber. The annual growth at 3 per cent. would yield 75,000,000,000 ft. of merchantable timber. This estimate, however, has been strongly challenged as being far in excess of actual facts.

In 1907 the States imported timber to the value of £9,916,875, and exported timber to the value of £17,933,958 (excluding paper)

(C.) CANADA'S FOREST WEALTH AND TIMBER INDUSTRY.

[By Th. de Schryver, Auckland.]

Canada's forest wealth is simply "immense." Though the Canadian Government through its Forestry and Survey Departments has succeeded in compiling fairly reliable statistics with regard to the extent of forest lands, it is hardly possible to make even a rough estimate of all the available timber. Tremendous areas, covered with virgin bush, bear on the map the significant label "Unexplored."

It will take many years yet before anything more definite will be known about these still-dormant lands. Trappers and hunters have crossed and recrossed these vast wildernesses, and much of the knowledge we have gained comes from this source, but naturally this information has relatively little value from a statistical, scientific, and economic standpoint. No doubt when the easily accessible forests have been worked out, which will still take many many years to come, the "unexplored" bush will have to give up the secrets of its dark interior.

"The total forest-area of Canada is estimated at 1,657,600,000 acres (exceeding that of the United States and Europe combined), and of this British Columbia has 182,750,000 acres."

The above figures do not include unsurveyed timber land, and I trust I am not far out in estimating the total timber area of Canada at two billion square acres.

Taking the low average of 30,000 ft. per acre, the board-measure figure in feet is hardly conceivable —60,000,000,000,000. ("Board foot" is equivalent to "superficial foot.")

British Columbia, as stated before, is in the best position to supply New Zealand with building-timbers. Australia, Africa, South America, Japan, and China, draw enormous quantities from this region, against which the exports to New Zealand appear insignificant.

There are in all about 160 sawmills in British Columbia. Out of these there are at present about forty-five mills in the interior, with a combind output of about 280,000,000 ft. annually, representing an investment of nearly $10,000,000. They pay out for wages and supplies $2,500,000 annually. These mountain-mills look almost entirely to the prairie country for their market. The largest mills are round the coast, and their equipments are the most up to date.

Lumber Export from Canada.

Articles.	Value, Year ended 31st March, 1908.
Logs and round manufactured timber,—	$
Elm	18,967
Hemlock	31,489
Oak	2,796
Pine	2,894
Spruce	101,231
Tamarack	..
All other	541,761

LUMBER EXPORT FROM CANADA—*continued.*

Articles.	Value, Year ended 31st March, 1908.
Lumber,—	$
Basswood, butternut, and hickory	95,410
Battens, and pine and spruce clapboards	17,585
Deals, pine	1,677,158
Deals, spruce and others	6,670,673
Mostly Oregon,—	
Lathwood	6,376
Laths, palings, and pickets	1,740,486
Planks and boards	21,092,297
Joists and scantling	1,046,465
Deal ends	318,509
Staves, other, and headings	216,172
Lumber, all other n.e.s.	279,587
Hop, hoop, telegraph, and other	117,406
Masts and spars	7,262
Piles and pile-timber	301,372
Posts—cedar, tamarack, and other	29,757
Shingle-bolts of pine or cedar	55,918
Fence-posts and railway-ties	657,521
Stave-bolts	100
Shooks, other than box	208,960
Timber, square,—	
Ash	24,786
Birch	127,085
Elm	213,268
Maple	26,525
Oak	401,800
Pine, red	6,097
„ white	998,298
All other	32,842
Wood blocks for matches	275
Wood blocks for pulp	4,656,721

	$
Total exports of rough and manufactured wood, 1907–8	44,082,747
„ „ „ 1908–9	39,575,826

There are other items of manufactures of wood which are not shown in the above figures.

[NOTE.—In "Accounts relating to Trade," published in England, the following figures for 1907 are given: Value of timber imports, £2,715,403; value of timber exports, £10,082,055.]

EXPORTS FROM CANADA TO NEW ZEALAND.

Article.	Year to 31st March, 1908.
Wood, and manufactures of lumber,—	$
Laths, pailings, and pickets	7,071
Planks and boards	25,648
All other lumber	..
All other unmanufactured wood	360
Wood, manufactured,—	
Furniture	12,635
All other manufactured wood	63,822
Total wood, and manufactures of	109,536

GROWTH OF CANADIAN TIMBERS.

Most of the Canadian lumbers are quick growers, except some of the hardwoods. Millable timber is produced within from twenty-five to forty years; therefore, the supply, notwithstanding reckless cutting, bush-fires, &c., practically will never give out.

In connection with forest-renewal, Dr. Bell says, "The dead trunks of the larger trees generally stand for many years after a great fire. In the summer following one of these conflagrations the blackened ground becomes partly covered by a growth of herbaceous plants, berry-bushes, and shoots from the roots and butts of deciduous trees which have retained some vitality, besides numerous small seedling trees. The huckleberry-bushes, which are very common for the first few years, especially on rocky, siliceous ground, bear abundant crops of fruit. They have sprung from large old roots, which are almost everywhere present in the thick woods, although their tops are quite inconspicuous, and bear few or no berries. In fifteen or twenty years the ground is covered with poplars, birches, willows, &c., to a height of about 30 ft. By this time the dead trunks of the old *brule* have lost most of their branches, and the smaller ones have fallen down. If we look under this growth we shall discover many healthy young conifers overshadowed by the more rapidly growing deciduous trees. At the end of about fifty years the conifers are everywhere showing their heads in the form of sharp apices, their

dark colour contrasting strongly with the lighter shades of the other trees. In the race to get above the deciduous trees they develop tall trunks with the branches high up. In one hundred years the poplars are dying and falling down, and the canoe-birch has attained maturity and soon after shows signs of old age. Meantime the older conifers have overtopped the other trees, and given a new character to the general appearance of the forest. The younger conifers of various ages which have been springing up from seed every year take possession of the ground left by the decay of the first occupants, and in about 150 years the forest has again become almost entirely coniferous. Such is the rotation of crops of trees which is perpetually going on in these regions. Perhaps one-third of the whole area consists of second growths of less than fifty years, one-third of trees from fifty to one hundred years old, while the remaining third may be a hundred years and upwards."

Notwithstanding her own wealth of timbers Canadian furniture-manufacturers are always on the lookout for something new, and no doubt Canada would be a good market for many of the New Zealand timbers for cabinetmakers. As Canada does not impose any duty on raw sawn timbers, there ought to be a splendid opening for enterprising New Zealand timber-merchants.

In this connection it will come as a surprise to New Zealand timber millers and merchants to know that Canada, notwithstanding her wealth in quantity and variety of timbers, imported in 1907 raw sawn lumber to the amount of $8,412,256 on which no duty was paid, and $2,565,341 subject to a duty of 17½ per cent. *ad valorem*. New Zealand imported during the same period £270,770, or, roughly, $1,350,000, on which from £1 to £2 per 1,000 ft. duty had to be paid, or, in many instances, from 35 to 70 per cent. of the value.

The finer-class New Zealand furniture-timbers could be exchanged against the coarser Canadian building-timbers and such furniture-timbers as are not procurable in New Zealand, to the advantage of both countries.

Principal Canadian Timber-trees.

The principal commercial woods of Canada are the following, taken from a list of 123 indigenous trees of the Dominion.

Yellow-cedar, Yellow-cypress (*Thuja excelsa*, Bong.).—The yellow-cypress is not nearly so abundant in British Columbia as the arbor-vitæ, nor is its circumference so great. Its height is about the same as the arbor-vitæ—150 ft.—and its average diameter about 4 ft., though occasional trees attain 5 ft. The yellow-cypress is confined to the coast and the adjacent islands. Its wood is very close, and, as the wood takes a very high polish, it is greatly valued for interior finishing and for the manufacture of furniture. It commands a higher price than either Douglas fir or arbor-vitæ. The Natives along the northern coast of British Columbia make many articles for domestic use from this wood. Average price at seaboard, £1 2s. 6d.

White-ash (*Fraxinus americana*, Linn.).—The white-ash ranges from Nova Scotia to western Ontario, increasing in abundance and size until its western limit is reached. It enters largely into the manufacture of agricultural implements of all kinds, wagons, carriages, and sleighs, as well as handles of tools.

White-elm (*Ulmus americana*, Linn.).—The American or white-elm is of wide distribution in Canada, being found from the maritime provinces westward to rivers falling into Lake Winnipegosis, in Manitoba. It increases in size and abundance until western Ontario is reached, where it is often found 6 ft. in diameter and over 100 ft. in height. It also grows to a large size in the valleys of the Winnipeg and the Red Rivers. As lumber it is rather coarse, but is very largely used in the manufacture of furniture, coffins, and flooring. Varying greatly in colour and grain, it is employed to imitate other woods, nearly all the cigar-boxes used in Canada being made of elm, while practically all coffins are made of either elm or basswood stained and polished to imitate other woods.

White-oak (*Quercus alba*, Linn.).—Though the true white-oak is *Quercus alba*, several other species are so classified commercially. The most important among these is the bur-oak, *Quercus marcocarpa*, Mich. The true white-oak is found in western Quebec and in Ontario as far west as Lake Huron. The bur-oak has the same range as *Quercus alba*, but is also found in the maritime provinces and in the west throughout the wooded portions of Manitoba. The wood of both species is very heavy, hard, tough, and durable, that of the bur-oak being the most durable of any American oak when in contact with the soil, which makes it very valuable for use as fence-posts, railway-ties, and piles. The wood of the white-oak is also largely employed in shipbuilding, carriage and wagon making, and cooperage, the manufacture of agricultural implements, and for cabinet and furniture work, flooring and interior finishing. Quarter-cut it exhibits a great variety of grain and colouring. Average price per 100 sup. ft. at seaboard, £1 15s.

Western White-oak (*Quercus Garryana*, Douglas).—Though a few trees of this species grow on the mainland of British Columbia, it is practically confined to the southern part of Vancouver Island, the finest trees growing in the vicinity of the City of Victoria, where trees three or four feet in diameter from which logs from ten to twenty feet long can be obtained are not uncommon. The wood resembles that of English oak, and is very beautiful when made up into furniture and cabinet-work.

Red-oak (*Quercus rubra*, Linn.).—The red-oak extends from the maritime provinces westward to Lake Superior, reaching the greatest size in the Province of Ontario. The wood is inferior in quality to that of the white-oak, but is almost as hard, heavy, and strong. It enters more largely than the white-oak into cooperage work, and, as with white-oak, second-growth wood is much used for handles of all kinds, wheel-stock, axles, whiffletrees, &c. For furniture, cabinetmaking, and interior finishing it is almost as valuable as the white-oak. The bark is rich in tannin. Average price per 100 sup. ft. at seaboard, £1 5s.

White-pine (*Pinus strobus*, Linn.).—The white-pine is by far the most valuable of Canadian trees, and, notwithstanding the reckless waste that characterized lumbering operations until very recently, there still remains in Canada an immense quantity of growing timber, from which vast quantities of lumber will be made. The white-pine ranges from the maritime provinces westward through Ontario and Quebec to the extreme eastern edge of Manitoba. White-pine is exported principally in the form of square timber deals and boards. Its chief uses are in construction-work of all kinds, and, as the slabs and edgings are made into shingles and laths, there is now little waste of material. The wood is light, soft, and not strong, but it is suited for a great variety of purposes, as it is easily worked and free from resin. Average price per 100 sup. ft. at seaboard, £1 5s.

Western White-pine (*Pinus monticola*, Dougl.).—None of the western pines are found in quantity near the coast, and so far they have been utilised for local purposes only. The best of these is *Pinus monticola*, Douglas, which is little inferior to the white-pine of the east.

Black-pine (*Pinus Murrayana*, Balfour).—The black-pine replaces the preceding species on the eastern slopes of the Rocky Mountains. It is abundant in the northern part of the interior plateau of British Columbia, where it covers great areas. In the southern part of the province it is most abundant at altitudes ranging between 3,000 ft. and 4,000 ft. It is much used for mine-props and other construction-work in the mining districts of British Columbia. It is admirably suited for this purpose, as the wood is very tough, and when not exposed to the weather does not easily decay.

White-spruce (*Pinus alba*, Link.).—The white-spruce ranges from Nova Scotia north-westward to within twenty miles of the Arctic Ocean, near the mouth of the Mackenzie River, and with the black-spruce it forms a great part of the subarctic forest which extends from Labrador across the continent. The wood is tougher, stronger, and more elastic than that of pine. It is now more used than formerly as lumber as well as very largely as railway-ties, fence-posts, piles, telegraph-poles, and sounding-boards in pianos.

Menzies' Spruce, Sitka Spruce (*Picea sitchensis*, Carr.).—This spruce grows chiefly in the immediate vicinity of the coast, ranging in British Columbia from the international boundary north to Alaska. It is in great demand for the manufacture of doors, window-sashes, boxes, shelving, and interior finishing. The wood is very white, is elastic, and bends with the grain without splitting, so that it is much used in boat-building, the making of light oars, staves, woodenware, &c. It resists decay for a long time, and, like the Douglas fir, is not attacked by insects.

Hemlock (*Tsuga canadensis*, Carr.).—The hemlock grows in the maritime provinces, Quebec, and Ontario. It is one of the best woods for wharves and docks, and great quantities are used annually for piles.

Douglas Fir, "Oregon-Pine," Red-pine, Yellow-fir (*Pseudotsuga Douglasii*, Carr.).—This is the most abundant, as it is the most valuable, tree in British Columbia. Its range on the mainland is from the international boundary north to the Skeena River, in latitude 54°, on the coast, and in the Rocky Mountains from the international boundary north to latitude 55°, though its northern and north-eastern limits are not well defined. It is not found in the Queen Charlotte Islands. It attains its greatest size on Vancouver Island, or along the shores and in river-valleys near the coast on the mainland. There, trees 300 ft. in height are not rare, the average height of those felled for lumber being over 150 ft. Trees of a greater diameter than 7 ft. are rarely cut, though those of 8 ft., 10 ft., or 11 ft. in diameter are not rare. The fact that the largest trees are found near the coast greatly facilitates the transport of the logs from the woods to the mill, and, as the majority of the mills are so situated that the largest ships may load within a few yards of the saws, the cost per 1,000 ft. of handling Douglas fir and other west-coast lumber is small.

Mr. George Elley writes about the Douglas fir as follows:—

"Douglas fir (or Oregon pine, as it is sometimes termed) ranks first in importance. This tree has been known to attain a height of 300 ft., ranging from 6 ft. to 8 ft. in diameter at the butt, its only rival in size being the redwood of California.

"Fir forms from 60 per cent. of our marketable timber, and, although confined to no particular belt, attains its greatest sizes in the valleys of those rivers emptying into the Gulf of Georgia, and on the eastern part of Vancouver Island, the latter being the most densely wooded area in British Columbia.

"The age of a full-grown fir averages about five hundred years, but specimens six and even seven hundred years old are not rare. In the early stages of the tree's growth the foliage is very thick, branches spreading out from the trunk in all directions; these gradually disappear, however, until nothing remains but a few stunted limbs at the top, the lower portions being comparatively free from knots. The bark-growth is heavy, of a reddish appearance, and extensively used for tanning purposes.

"The commercial value of this wood is too well known to merit extensive mention. For general all-round purposes it has no equal, especially in heavy construction-work, owing to its ability to withstand enormous strains; and in this respect it is equal if not superior to oak, which wood it is rapidly displacing, especially in the building of cars. Tests have recently been made by railway engineers on several of the large systems, with a view to comparing the relative strength of the two woods, and in most instances their reports have been favourable to fir, particularly where long timbers are required. In one instance ten pieces of each wood were selected, and a lift made until they broke, with the result that the fir withstood some 600 lb. greater strain than oak, conclusively proving its superiority in this regard, not to mention its advantage in lightness. Fir is also well adapted for house-construction, being used in every portion of the building. Mention should be made of the excellent spars and masts procured from this tree."

Giant Arbor-vitæ, Red-cedar (*Thuja gigantea*, Nutt.).—The giant arbor-vitæ is next to the Douglas fir in importance in British Columbia, where it attains its greatest size on Vancouver Island, along the coast, and in the lower parts of the rivers of the Coast Range. It is rarely found in the dry

interior of British Columbia, but is abundant in the river-valleys on the slopes of the Selkirk and Coast Ranges. Though seldom found more than 150 ft. in height, in circumference it rivals the Douglas fir, trees of from 8 ft. to 10 ft. in diameter not being rare, and they are occasionally found much larger. It is chiefly used in the manufacture of shingles, for which purpose it is unequalled by any other wood. The wood of this tree takes a very brilliant polish, and is well adapted for interior finishing of all kinds. It is not only largely exported, but is now being shipped in increasing quantities to eastern Canada. In British Columbia it enters largely into the manufacture of doors and cabinet-work of all kinds. Like all the cedars, it lasts well underground, and on this account is much used in the form of telegraph-poles and fence-posts. Average price at seaboard, £1 2s. 6d.

(D.) FOREST RESOURCES OF AUSTRALIA.

The following table shows the relative proportion of forest-areas in each State:—

State.	Population, 1908.	Area of State.	Estimated Forest-area.	Specially reserved for Timber.
		Acres.	Acres.	Acres.
New South Wales	1,496,050	198,634,880	15,000,000	7,155,902
Victoria	1,218,571	56,245,760	11,797,000	4,648,596
Queensland	528,048	427,838,080	40,000,000	3,019,919
South Australia	378,208	578,361,600	3,840,000	170,835
Western Australia	254,779	624,588,800	20,400,000	212,480
Tasmania	181,105	16,777,600	11,000,000	266,000
Totals	4,056,761	1,902,446,720	102,037,000	15,473,732

IMPORTS AND EXPORTS OF TIMBER INTO AUSTRALIA, 1906.

Imports.

Country.	Dressed Timber. Sup. ft.	Undressed Timber. Sup. ft.
United Kingdom	41,694	293,086
Canada	833	8,380,951
New Zealand	5,125	65,164,718
Burmah	..	290,060
India	..	248,989
Straits Settlements	..	130,898
Norway	43,712,732	1,284,969
Sweden	2,412,087	2,756,200
Russia	..	285,900
United States	1,727,363	121,601,462
Other British possessions	5,437	8,580
Other foreign countries	304,596	1,122,591
Totals	48,209,222	201,568,404

The value of timber imports into Australia increased from £1,329,456 in 1906 to £1,945,078 in 1908, of which £494,737 was the value of New Zealand pine, the quantity being given as 81,486,528 sup. ft.

Exports in 1906.

Country.	Undressed Timber. Sup. ft.	Country.	Undressed Timber. Sup. ft.
United Kingdom	25,561,273	Egypt	20,460
Canada	567,806	Germany	3,985,212
Cape Colony	4,455,719	Japan	403,326
Ceylon	25,285	Kaiser Wilhelm Land	29,818
Fiji	1,712,468	Marshall Island	502,627
India	63,248,657	Netherlands	1,174,827
Mauritius	820,197	New Pommern	121,043
Natal	1,825,763	New Caledonia	136,383
New Guinea	141,968	Philippine Islands	2,393,518
New Zealand	17,705,412	Portuguese East Africa	3,261,837
Ocean Island	573,498	South Sea Islands	415,071
Straits Settlements	1,047,381	United States	582,274
Other British possessions	5,404	Uruguay	6,137,060
Argentine Republic	2,947,860	Other foreign countries	1,775,770
Belgium	509,177		
China	12,335,396	Total	154,422,490

New South Wales.*

It is estimated that the extent of territory bearing timber of commercial value is 15,000,000 acres, or 7·5 per cent. of the total area of the State. Of this area, 7,155,902 acres are reserved for the preservation and growth of timber, the balance consisting of unreserved Crown lands and private lands.

There are about twenty varieties of hardwood timbers of commercial value indigenous to the State. Of these, ironbark stands pre-eminent for strength and durability. Other hardwoods in demand are tallow-wood, red-gum, blackbutt, the mahoganies, spotted gum, grey-gum, blue-gum, turpentine, and others. In soft or brush woods there are many varieties, the best-known being red-cedar, hoop-pine, cypress-pine, rosewood, white-beech, silky oak, red and black bean, native teak, coachwood, and black-wood.

The total quantity of commercial timber estimated to be at present standing in the State (excluding timber growing on private lands) amounts to 23,116,000,000 sup. ft., consisting of,—

Hardwoods.

	Sup ft.
Ironbark	1,355,000,000
Other hardwoods, for milling	8,668,000,000
For other purposes	11,788,000,000
	21,811,000,000

Softwoods.

	Sup ft.
Cedar	5,000,000
Hoop-pine	230,000,000
Other brushwoods	150,000,000
Cypress-pine	920,000,000
	1,305,000,000

It was estimated that in 1907 the quantity of timber removed from the forests of the State was about 650,000,000 sup. ft., consisting of 590,000,000 ft. of hardwoods, and 60,000,000 ft. of softwoods. At the present rate of consumption, it is estimated that the quantity of hardwood timber suitable for commercial purposes standing on forest reserves and other Crown lands of the State will not last for more than about thirty-six years, and that our supply of softwoods will be consumed in a little more than twenty years.

Owing to the remarkable reafforestative powers of most of our hardwoods, however, it is estimated that in the course of the next ten years there will be sufficiently mature on the forest reserves to be of commercial value 6,776,000,000 sup. ft. of hardwood, or, roughly, at the present rate of consumption, an additional eleven years' supply. With regard to softwoods, we estimate that during the same period 455,000,000 sup. ft. will sufficiently mature to be fit for commercial use, or about eight years' additional supply at the present rate of consumption.

In 1906 the quantity of local timber sawn or hewn was 119,337,000 sup. ft., and 48,235,648 sup. ft. of sawn timber was exported, whilst logs amounting to 1,456,972 sup. ft. were also shipped away. In 1907 the quantity had increased to 360,000,000 sup. ft.

Victoria.

The timbers of commercial value number twenty, all species of the Eucalyptus family. Black-wood is a very valuable commercial timber; it is an acacia (*A. melanoxylon*). Pine timber from the State plantations is now being sold at remunerative rates.

There are about 12,000,000 acres of woodland in Victoria, of which over 4,600,000 acres are set aside as climatic reserves, and for the production of timber. Of the State forest domain some 3,000,000 acres are situated on the slopes of high mountain-ranges, and their protection is essential for the maintenance of streams and springs; over 500,000 acres are not at present accessible for practical working; 500,000 acres are closed for the protection of the young timber; and timber-cutting is carried on in the remaining area of 600,000 acres.

The number of forest sawmills working in 1907 was 119, and the timber sawn amounted to about 75,900,000 sup. ft.

Victoria imports a considerable quantity of timber, including large quantities of American Oregon and Baltic deal. In 1907 the total value of timber imported was £759,433, and the imports from Australian States and New Zealand amounted to £252,797. On the other hand her exports of timber were relatively small, amounting to only £64,654, and the value of Victorian timber exported to Australian States and New Zealand was £17,243. Of the timber imported into Victoria in 1907 New Zealand contributed 122,826 pounds' worth.

Many Victorian timbers are extremely dense and hard, such as red-gum, blue-gum, white-gum or peppermint, ironbark, &c. Other important species are the grey-box and Bairnsdale grey-box, the yellow-box, stringy-bark, spotted-gum, blackwood, cypress-pine, &c.

In 1906, the amount of sawn timber exported was only 145,812 sup. ft., whilst 2,298 sup. ft. of logs was also exported.

* Extracts from the Report of the Royal Commission of Inquiry on Forestry, New South Wales, 1908.

Queensland.

The extensive forests of Queensland yield a great variety of woods, esteemed for their strength, durability, or beauty. The principal timbers lie between the eastern seaboard and the Great Dividing Range, which runs roughly parallel to, and about two hundred miles from, the coast. The principal Eucalyptus are ironbark, grey, spotted, and red gum, blackbutt, and turpentine; Moreton Bay, brown, and Bunya Bunya pines represent the conifers; and red-cedar, beech, tulipwood, and bean are among the brush timbers of fine grain. State forests and national parks comprise 816,272 acres, of which 793,097 were State forests.

In 1908 there were 175 sawmills in operation, which cut during the year 64,696,990 sup. ft. of soft woods, 1,125,866 sup. ft. of cedar, and 34,936,160 sup. ft. of hard woods.

The quantity of local timber sawn or hewn in Queensland of late years was as follows: In 1905, 73,930,279 sup. ft.; in 1906, 82,801,846 sup. ft.; in 1907, 91,752,000 ft.; and in 1908, 100,759,016 ft.

The chief supply of mill-timber is in the southern coastal region, from the New South Wales border as far north as Gladstone. In the regions between Rockhampton and Ingham the supply is not so plentiful; but northward of the latter town the red-cedar, karri-pine, and black-bean are luxuriant. Large supplies of these valuable frees are found on the Barron Valley reserves, and in other localities between Ingham and Port Douglas. Inland from this zone of heavy forest is another, less densely timbered, bearing cypress and other pines, ironbarks, and acacias. In the south-western regions of the State the cypress-pine flourishes.

In 1908 Queensland exported 1,013,650 sup. ft. of timber valued at £9,481, and imported timber valued at £36,944.

South Australia and Northern Territory.

The principal forest districts of South Australia proper are restricted largely to the hill ranges in the neighbourhood of Adelaide and Spencer Gulf, and the trees have not the fullness and lofty growth of the eastern and south-western borders of Australia. Red-gum is widely distributed, though never far from water. The stringy-bark has its habitat principally in the hills; other useful woods are the white and blue gum and peppermint (hardwoods). Blackwood (in demand for cabinet-work) is common in the south-west and along the eastern border. Wattle is cultivated for its gum and bark. The sandal-wood-tree grows luxuriantly in Yorke's Peninsula. In Central and Northern Austraila there is little forest. Heavy timber clothes the uplands about the Roper River; and the table-land which stretches across the territory at a distance from the coast of from thirty to a hundred miles bears large paper-bark trees, Leichhardt pines, and palms. On the higher steppes there is also abundance of bloodwood and other varieties of Eucalyptus, besides other kinds of trees.

The quantity of timber sawn or hewn is very small, being as follows: In 1905, 155,662 sup. ft.; in 1906, 130,763 sup. ft.; and in 1907, about 143,000 sup. ft.

Western Australia.*

Supplies of Jarrah.—Virgin jarrah forest to the north of Blackwood River, and suitable for milling, is estimated at 2,000,000 acres. Based on the present rate of cutting, this would be equivalent to about thirty-two years' supply. To the south of Blackwood River there are also considerable supplies of this timber; but, being so constantly intergrown with karri, blackbutt, and red-gum, no fair estimate of quantities can be given. In addition, there are several millions of acres of jarrah country not of sufficient commercial value for milling purposes, but which will afford immense scope for sleeper-hewing.

Supplies of Karri.—This timber is limited to the tract of country lying between Margaret River and the Porongorup Range, about 1,200,000 acres of which is under karri. Of this, some 150,000 acres have been cut over, leaving an area of over a million acres of virgin forest, estimated to be capable of supplying 12,000,000 loads of karri in the round.

Supplies of Tuart.—The area covered by this timber is very limited in extent. The approximate extent arrived at is 100,000 acres, carrying about 150,000 loads of timber.

Supplies of Blackbutt.—Being so closely associated with jarrah, karri, and red-gum, it is impossible to arrive at the areas over which the blackbutt grows.

In "Notes *re* Timbers of Western Australia," issued by the Minister of Lands and Agriculture in 1906, the following estimate of timbered lands was given:—

"The total wooded area of Western Australia is estimated at some 98,000,000 acres, and the extent of merchantable timber has been reckoned to be approximately as follows:—

	Acres.
"Jarrah (mainly, with blackbutt and red-gum interspersed)	8,000,000
Karri	1,200,000
Tuart	200,000
Wandoo (white-gum and allied timbers)	7,000,000
York gum, yate, sandal-wood, and jam-wood	4,000,000
	20,400,000"

The Royal Commission estimated that the jarrah forests were being depleted at the rate of 60,000 acres per annum.

* The particulars were published by the Royal Commission on Forestry which sat in Western Australia in 1904.

In 1895 the value of the timber exports from Western Australia was only £88,146 being jarrah timber exclusively. In 1904 the value had increased to £654,949, of which jarrah represented £596,272 and karri £58,677. In 1906 the sawn timber exported from Western Australia was 152,161,083 sup. ft., while logs to the amount of 1,737,707 sup. ft. were also exported. The quantity of local timber sawn or hewn during the same period was 136,294,697 sup. ft., but in 1907 it had decreased to 110,395,000 sup. ft.

Tasmania.

The Tasmanian forest consists chiefly of eucalyptus, widely distributed over the island; and of conifers, such as the Huon, the King William, and the celery-top pines, flourishing in the western and southern parts. The principal hardwoods of the eucalypt family are the blue-gum, stringy-bark, peppermint, and silver-top ironbark; whilst among woods of fine grain are the blackwood, beech or myrtle, sassafras, native cherry, and sheoak. Black and silver wattles also inhabit various parts of Tasmania.

The following quantity of local timber was hewn or sawn in Tasmania: In 1905, 40,273,429 sup. ft.; in 1906, 39,498,697 sup. ft.; in 1907, 35,228,000 sup. ft.

(E.) OTHER SOURCES OF SUPPLY.

Professor Somerville, in an article entitled "Forestry in some of its Economic Aspects," read before the Royal Statistical Society on the 16th February, 1909, stated that "The possibilities of *Russia* as regards increased shipments of timber are involved in much uncertainty, and still more so is this the case with *Siberia*. A recent consular report on the lumber industry in the Russian Far East, 1908, by Vice-Consul Hodgson, states that there is hope of development in eastern Siberia, where in the Amur and maritime provinces alone the forests are said to embrace 509,000,000 acres, though in density they cannot be compared with those of North America. Spasmodic attempts at export have already been made; China, Australia, and South Africa being the markets that have been tried."

Mr. G. W. S. Patterson, of Auckland, states, "I am of opinion that our future supplies must come from Manchuria and Siberia, for the reason that labour is cheaper there than in Canada or any other country that I know of, and the quantity obtainable (from what I could gather on my recent trip through Siberia) is practically inexhaustible for centuries to come. A Melbourne syndicate has already introduced this timber into Australia, and is making good headway."

It is stated that Pacific white-pine to the extent of nearly 6,000,000 ft. was imported from Manchuria and the Russian Far East last year into Australia.

Africa has sometimes been mentioned as likely to be able to supply timber to importing countries in the near future; but Professor Somerville, in his evidence before the British Royal Commission, stated that "Africa may hold large quantities of exceedingly hard and heavy wood of the ebony class, rosewood, and so on; but these timbers are not suitable for structural purposes—they are so extraordinarily heavy that, if one were to use them for roofing purposes or anything of that kind, the structure would fall under its own weight."

In *India* the State Forests Department now has charge of 149,000,000 acres (232,701 square miles) of forests. This represents nearly one-fourth of the total area of British India. The Indian Government forests are throughout treated on the principle of a sustained and increasing yield, which five years ago amounted to 232,916,345 cub. ft., of which teak timber exported from India accounted for 73,913 tons, and myrobolans to 61,480 tons. There does not seem much prospect of any large supply of timber from British India except in these two varieties of wood. ("Forest Policy in the British Empire," by W. Schlich, Ph.D., &c.)

PART V.—AFFORESTATION.

CONTENTS.

	Page.
General remarks	108
(A.) Results of tree-growing in the State nurseries and plantations	109
(B.) Anticipated results	111
(C.) Notes on the growth of forest-trees in Canterbury	112
(D.) Notes on the growing of Australian gum-trees in the Waikato	117
(E.) Afforestation in England	118

GENERAL REMARKS.

In 1896 the Afforestation Branch of the Department of Lands was organized, and since then its operations have been gradually expanded. The stations at present comprise :—

North Island.

Nurseries.—The central nursery at Rotorua, under the control of the Superintending Nurseryman for the North Island and a small one at Ruatangata, north of Auckland.

Plantations.—Whakarewarewa, attached to the Rotorua Nursery (including the Waipa site, and the new site at Lake Rotokakahi) ; Waiotapu, and Kaingaroa Plains, attached to Rotorua Nursery ; Puhipuhi, attached to Ruatangata Nursery.

South Island.

Nurseries.—The chief one at Tapanui (Otago), under the control of the Superintending Nurseryman for the South Island ; Hanmer Springs Nursery (Canterbury) ; Eweburn and Kurow (Otago) ; Starborough (Marlborough), recently closed.

Plantations.—Naseby, and Gimmerburn (Otago), attached to the Eweburn Nursery ; Dusky Hill, Conical Hills, and Waitahuna (Otago), attached to the Tapanui Nursery ; Waitaki (Otago), attached to the Kurow Nursery ; Dumgree (Marlborough), planting completed ; Hanmer Springs (Canterbury), attached to Hanmer Nursery.

Extent of Planting Operations.

On the 31st March, 1909, an area of 12,715 acres had been planted with forest-trees, of which no less than 47,835,217 had been raised in the various nurseries and plantations at that date. The average rate of planting during the past three years has been 2,452 acres per annum, and the number of trees planted during that period averaged 5,960,000 per annum. Over thirty-three million trees have been planted out in permanent plantations (*vide* list accompanying article (A) following).

As will be seen from a perusal of the table appended to the report of the late Mr. Matthews, which follows these remarks, the principal kinds of trees planted have been :—

Larch (*Larix europœa*)	10,989,835
Austrian pine (*P. austriaca*)	3,769,431
Corsican pine (*P. Laricio*)	3,756,325
Eucalypti	3,464,589
Catalpa speciosa	2,196,544
Oak (*Quercus pedunculata*)	2,041,621
Bentham's pine (*P. ponderosa*)	1,200,375

The principles upon which the Department has hitherto been working are :—

(*a.*) That, owing to the slow relative growth of indigenous timber-trees in New Zealand, it does not pay the State to plant native trees, which take from three hundred to eight hundred years to attain full maturity.

(*b.*) That the expense of replanting forest-areas that have been felled and utilised by sawmillers is out of proportion to the results obtained in this manner.

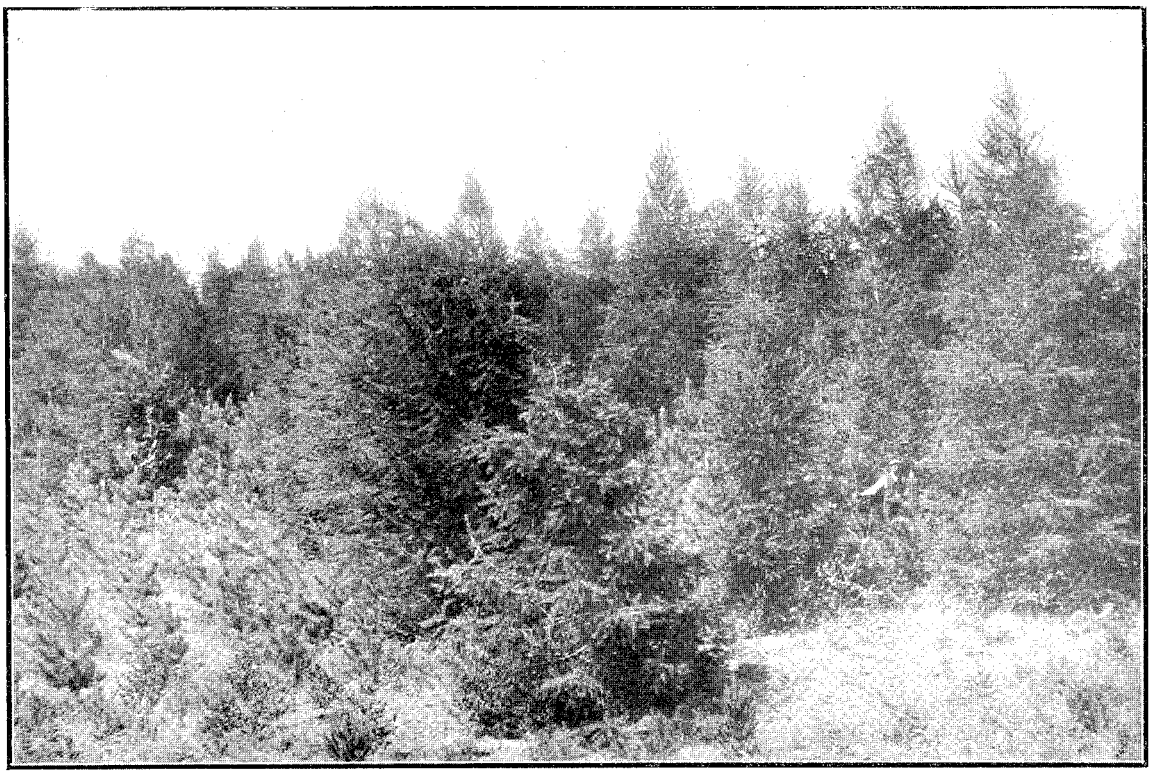
(*c.*) That better results can be obtained by planting exotic trees which attain maturity in about sixty or eighty years, and which experience in other countries has proved to be well suited for commercial purposes, and comparatively easily raised in such a climate as is experienced in New Zealand.

(*d.*) That the best results can be got by planting such trees in treeless localities, where the Crown possesses sufficient areas of land suitable for tree-growing, but unsuited for agriculture to any extent.

(*e.*) That most economical results are attained by concentrating the nursery operations at one central station for each Island, and from there supplying the various plantations that may be started in suitable districts.



A Wind-break of *Pinus muricata* in a State Nursery.



Larch Plantation, Waiotapu.

Face p. 108.]



An American Forest cut scientifically.



German Forest Methods.

[*N.Z. Graphic, photo.*

(A.) RESULTS OF TREE-GROWING IN THE STATE NURSERIES AND PLANTATIONS.

The following report is intended to give an approximate idea of how the operations in the State nurseries and plantations (which were only commenced in 1896) are expected to result.

Larch and eucalypti will be amongst the first species to be fit for commercial use in the way of thinnings—say in from fifteen to twenty years from the time of planting, judging from the present rate of progress. No doubt such timbers will be required for mine-props, fencing-posts, &c.

The average quantity per tree of timber at the end of a given period can only be roughly estimated from the results attained in Europe and elsewhere. In regard to the pumice lands (where the largest plantations are being established) we have no record of any tree-planting being done on a similar soil in any portion of the world. At present the rate of growth on such lands greatly exceeds that on other portions of the Dominion, but we cannot predict whether this growth will be maintained after the trees reach the "pole stage." Dr. Nisbet, in his latest (1905) work, "The Forester" gives a table showing the average quantity of timber produced per acre in Britain on a rotation of fifty years :—

Name of Tree.	Number per Acre.	Timber-contents. Sup. ft.
Oak	300	21,600
Larch	500	30,000
Pine	500	30,000
Oregon	400	48,000
Spruce	600	32,400

Average for 5 species : 32,200 ft.

It would therefore be reasonable to expect that equal results should be obtained in New Zealand; but, to be on the safe side, I venture to give 30,000 sup. ft. of milling-timber per acre at fifty years.

It is true that redwoods have been known to produce a million superficial feet of timber per acre over a limited area, but such trees are considered to be from one to two thousand years of age. The most recent record (29th October, 1908) of the United States Forest Service gives the average yield of redwood at from 10,000 ft. to 70,000 ft. per acre, and five hundred years is the time stated for its maturity.

Eucalypti have in many instances yielded 100,000 ft. per acre on exceptionally favourable soils and situations, while the average yield is from 10,000 ft. to 40,000 ft. I have had special reports furnished by the Foresters at each plantation, which show that the rate of growth varies from ½ in. to 14 in. per annum during the first year, from 3 in. to 17 in. during the second year, and so on, gradually increasing as they become established. This, of course, refers to a general average of all classes of trees. Amongst individual species *Acacia melanoxylon* heads the list with a maximum of 93 in. —the average growth being 30 in. per annum. Amongst eucalypti 38 in. is the maximum rate, while the minimum is 16 in. Larch also varies greatly—from 11 in. to 32 in. per annum in trees planted one and two years, and older plantings up to 5 ft. From the foregoing it will be readily seen that it is impossible to give explicitly the average growth of any given tree, as in many cases there is practically no growth during the first year, but a gradual improvement takes place each succeeding year, depending on the suitability of soil and situation. Moreover, to state an approximate rate of growth would be to a certain extent misleading, as it is only in the sapling and pole stages that trees make their most rapid vertical growth owing to their crowded state; later on, when thinning takes place, vertical growth gives way to increased circumference of the bole.

The following shows the species which have made the most successful growth in various localities :—

Rotorua District : *Eucalyptus Stuartiana, E. amygdalina, Acacia melanoxylon, Larix europœa, Pinus ponderosa, P. Laricio, P. strobus, Sequoia sempervirens*, and *Pseudo-tsuga taxifolia.*

Whangarei District : *Sequoia sempervirens, Eucalyptus Stuartiana, E. obliqua, E. rostrata, E. amygdalina*, and *Podocarpus totara*, the latter of course not to be compared to the rate of those before mentioned.

Hanmer Springs : *Larix europœa, Pinus ponderosa, P. Benthamiana, P. Laricio, Alnus glutinosa, Pseudo-tsuga taxifolia.*

Tapanui District : *Pinus Laricio, P. ponderosa, P. Benthamiana, Larix europœa, Acer pseudo-platanus, Fraxinus excelsior, Pseudo-tsuga taxifolia*, and *Alnus glutinosa.*

Maniototo District : *Larix europœa, Pinus ponderosa, P. Laricio, P. Benthamiana*, and *P. austriaca.*

The following trees would be desirable for planting within the Dominion on suitable soil in localities free from frost : Puriri, pohutukawa, spotted gum, red ironbark, sugar-gum, and jarrah. All the above species provide exceptionally strong and durable timber, and their extensive cultivation under favourable conditions would undoubtedly be highly remunerative within a comparatively few years.

I may add that this Dominion is singularly unfortunate compared with the rest of the world in having no native timber-trees that can be generally planted with a view to quick returns for profit. (Puriri, totara, and pohutukawa cannot be classed as such, as they are only of comparatively rapid growth in exceptional localities.)

Assuming that 30,000 sup. ft. per acre is a reasonable estimate from artificial forests, and reckoning the thinnings therefrom as fencing-material, mine-props, and firewood, it is evident that our present rate of cutting is largely—nearly five and a half times—in excess of future supplies at the present rate of planting :—

Timber milled in 1907 from indigenous forests	432,031,611 sup. ft.
Area planted in 1907–8	2,655 acres.
Expected return per acre	30,000 sup. ft.
Expected return per annum	79,650,000 sup. ft.

USES TO WHICH THE DIFFERENT KINDS OF TREES GROWN IN THE STATE PLANTATIONS MAY BE PUT.

The accompanying table gives a description of the uses to which the timber of the trees now standing in the State plantations may eventually be put. It is corrected to the 31st March, 1909.

Name of Tree.	Number planted.	Uses for which the Different Kinds of Trees are suitable.
Acacia melanoxylon ..	140,335	Furniture, shop-fittings, pianos, railway purposes, billiard-tables, &c.
Acer saccharum.. ..	3,625	Furniture, shoe-lasts, flooring, and general purposes (sap is made into sugar).
,, pseudo-platanus ..	525,247	Turnery, furniture, boxes, dairy utensils, blocks and pulleys.
Æsculus hippocastanum ..	2,232	Cabinetmaking, sides and bottoms of carts, general turnery.
Alnus glutinosa	77,918	Barrel-staves, boxes, general purposes under ground or under water.
Betula alba	252,710	Cabinetmaking, turnery, barrel-staves, crates, brooms, &c.
Castanea sativa.. ..	15,911	Furniture, flooring, interior work, posts, rails, &c.
Catalpa speciosa ..	2,196,544	Furniture, posts, sleepers, and telephone-poles.
Cupressus Lawsoniana ..	23,700	Flooring, sleepers, fencing, and general lumber.
Eucalypti (species) ..	3,464,589	Used generally for all constructive works where durability is essential; also for sleepers, posts, wheels, and other purposes where strength is required, telegraph-poles.
Fraxinus americana ..	2,245	Boat-oars, cabinetmaking, coachbuilding, agricultural implements, tool-handles, &c.
,, excelsior ..	583,925	Ditto.
Hickora ovata	2,500	Coachbuilding, &c.
Juglans cinerea	2,651	Chiefly furniture and pianos, gun-stocks, billiard-tables, clocks, &c.
,, nigra	14,952	Ditto.
,, regia	61,424	,,
Juniperus virginiana ..	1,270	Pencils, cabinet-work, &c.
Knightia excelsa ..	200	Furniture.
Larix europœa	10,989,835	Railway-sleepers, posts, boat and bridge building, pit-props, and general farm purposes.
,, leptolepsis ..	2,850	Ditto.
Picea excelsa	1,242,723	General constructive purposes, flooring, scaffolding, masts, spars, packing-cases, casks, pit-props, wood-pulp, &c.
,, sitchensis	241,623	Ditto.
,, canadensis ..	1,400	,,
Pinus austriaca	3,769,431	Used generally for all constructive purposes both inside and outside buildings, packing-cases, butter-boxes, shelving, pattern-making, posts, sleepers, &c.
,, canariensis ..	1,025	Ditto.
,, contorta	10,290	,,
,, Coulterii	605	,,
,, densiflora.. ..	2,325	,,
,, excelsa	300	,,
,, halapensis ..	66,575	,,
,, Jeffreyii	4,703	,,
,, Lambertiana ..	1,325	,,
,, Laricio	3,756,325	,,
,, montana	2,000	,,
,, muricata	132,025	,,
,, Murrayana ..	14,325	,,
,, ponderosa ..	1,200,375	,,
,, Benthamiana ..	291,145	,,
,, pinaster	11,425	,,
,, radiata	110,161	,,
,, resinosa	2,100	,,
,, rigida	15,525	,,
,, sabiniana.. ..	25	,,
,, silvestris	200	,,
,, strobus	137,125	,,
,, Thunbergii ..	700	,,
,, Torreyana ..	1,820	,,
,, tæda	1,100	,,
Platanus orientalis ..	3,900	Furniture, box-making, turnery, pulleys, and pattern-making.

Uses to which the Different Kinds of Trees grown in the State Plantations may be put—continued.

Name of Tree.	Number planted.	Uses for which the Different Kinds of Trees are suitable.
Podocarpus dacrydioides..	4,280	Butter-boxes and packing-cases.
,, totara ..	546,500	Telegraph-poles, sleepers, joinery, plates, and all purposes where durability is required.
,, Hallii ..	200	Ditto.
Poplars (var.)	20,550	Packing-cases, sides and bottoms of drays, furniture-frames and interior work.
Pseudo-tsuga taxifolia ..	543,597	Beams, general lumber, scaffolding, and all constructive works.
Pyrus aucuparia ..	32,033	Cabinetmaking, furniture, turnery, carving, &c.
Quercus pedunculata ..	2,041,621	House and ship building, wagons, carriages, casks, &c.
,, suber	1,124	Produces the cork of commerce.
Robinia pseudo-acacia ..	161,800	Posts, axe and pick handles, and general farm purposes.
Salix (var.)	13,663	Cricket-bats, barrow and dray bottoms, knifeboards, bread-platters.
Sequoia gigantea ..	300	Venetian blinds, general carpentry and joinery work.
,, sempervirens ..	186,641	,, ,, ,,
Sophora tetraptera ..	7,875	Posts, rake-teeth, dowels, and bent-work, and general joinery and interior finishing.
Thuja gigantea	14,775	General joinery-work and interior finishing.
Ulmus campestris ..	775	Coffins, coachbuilding, furniture, packing-cases, &c.
Corylus avellana ..	1,310	
Ornamental shrubs ..	69,003	
Leguminous plants ..	59,326	
Total	33,092,637	

March, 1909.

H. J. Matthews,
Chief Forester.

(B.) ANTICIPATED RESULTS.

. . . . At forty years we expect to find that, after successive thinnings, 750 trees to the acre remain. This question of thinning, then, is one that is extremely difficult to give even an approximate estimate of under the climatic conditions regulating the growth of trees in New Zealand. Theoretically, trees are planted at 4 ft. apart. The first thinning leaves them at 8 ft., and the second thinning at 16 ft., at which distance they are allowed to mature. In practice, however, thinning does not represent a geometrical problem, but is solely regulated by the growth made by the individual trees.

Close planting is done in order to exclude the light and air from the lower branches, and cause them to wither and drop off; so that, in thinning, the overhead canopy must always be preserved. It is evident, then, that four or five trees may be left in a clump, while others of less dimensions are removed; and just what number would be taken out at a thinning, and the period when it would be necessary to th n, are the points I wish to emphasize as being difficult to calculate.

For the purpose of this report I have thought it would suffice to work on the assumption that 2,700 are planted per acre in the case of conifers, and 1,200 in the case of eucalypti, and that thinning would be done as per the attached table. These two classes of trees are fairly representative of the bulk of our planting.

The value of thinnings is another difficult matter to estimate, as the market conditions in New Zealand differ so much from those on the Continent. For instance, I do not think we could estimate the value of our thinnings at so much per superficial foot, as there is not the demand for this class of timber. The purposes for which the thinnings could be used are perhaps restricted to fencing-timbers, railway-sleepers, firewood, and scaffolding-poles. Probably we might be able to use the thinnings from larch in the forty-fifth year for telegraph-poles and general construction purposes, but I have classed all the thinnings up to the fiftieth year, in the case of conifers, simply as poles, without taking into consideration the superficial measurement beyond differentiating between small poles and large ones.

In a large measure the Government will require to make their own market until such time as the trees which can be sawn into boards are produced. There will, no doubt, be a demand for fencing-material and mining-timber; but in, roughly, twenty years, at the present rate of planting, the Department will be annually producing something like 4,500,000 poles, which it does not seem possible can all be disposed of to the public. The surplus will need to be used up on Government works, such as fencing railway-lines, railway-sleepers, scaffolding, &c. Of course even on the Continent of Europe the first thinnings are often difficult to dispose of to advantage.

There is no doubt that *Pinus austriaca* is an inferior timber-tree when compared with larch or *Pinus Laricio*, but then the proportion which we are planting of that species, compared with larch

or *Pinus Laricio*, is extremely small. *Pinus austriaca* is being used only on small patches of poor dry land, on exposed hill-tops chiefly, where it would not be advisable to plant a more valuable tree; hence very few are planted.

Larch and *Pinus Laricio* are considered by competent authorities to be the best of the European conifers. Simpson, in "The New Forestry," says of larch, "Under ordinary favourable conditions a crop of larch is sure to pay"; and then he goes on to give a comprehensive list of the uses of the timber, which is perhaps superseded only by that of the oak.

The same authority also says of the *Pinus Laricio*, "If the Scotch fir is ever superseded, we venture to think that it will be by this species." And, again, "It thrives in almost any soil, and were it desired to plant fir extensively anywhere we should certainly plant Scotch and Corsican firs, and expect the latter to take the lead from the beginning."

Scotch fir does not thrive in New Zealand, but it is evident that with larch and *Pinus Laricio*—our chief crops—we are planting the best European species. *Pinus austriaca*, then, occupies only a very small place in our operations.

. . . . Judging from the rapid growth made by the various species of trees in New Zealand, it might be considered almost certain that the results obtainable in seventy years in Germany and elsewhere on the Continent could be obtained in sixty years in this Dominion. I am therefore of opinion that in from seven to ten years from date some return will be obtained from some of the State plantations, particularly at Whakarewarewa and Waiotapu, and an approximation of such return is given in table below.

NUMBERS OF TREES THINNED FROM AN ACRE OF PLANTATION FROM TIME TO TIME, AND THEIR PROBABLE MARKET VALUE.

—	Estimated Thinnings from Larch, or *Pinus Laricio*.			Thinnings from Eucalypti.		
	Number of Trees.	Estimated Value.	Total Value.	Number of Trees.	Value.	Total Value.
		s. d.	£ s. d.		s. d.	£ s. d.
At 15 years	1,950	2 0 each	195 0 0	..	..	..
„ 20 „	..	..	..	600	2 6 each	75 0 0
„ 25 „	250	2 6 each	31 5 0	..	..	..
„ 30 „	200	4 0 „	40 0 0	..	..	..
„ 35 „	..	..	..	300	3 0 each	45 0 0
„ 40 „	100	6 0 each	30 0 0	..	..	..
„ 45 „	..	..	..	300	†	250 0 0
„ 50 „	30	10 0 each	15 0 0	..	..	..
„ 60 „	170	*	187 10 0	..	..	..
Total	2,700	..	498 15 0	1,200	..	370 0 0

* 30,000 sup. ft. at 12s. 6d. per hundred. † 40,000 sup. ft. at 12s. 6d. per thousand.

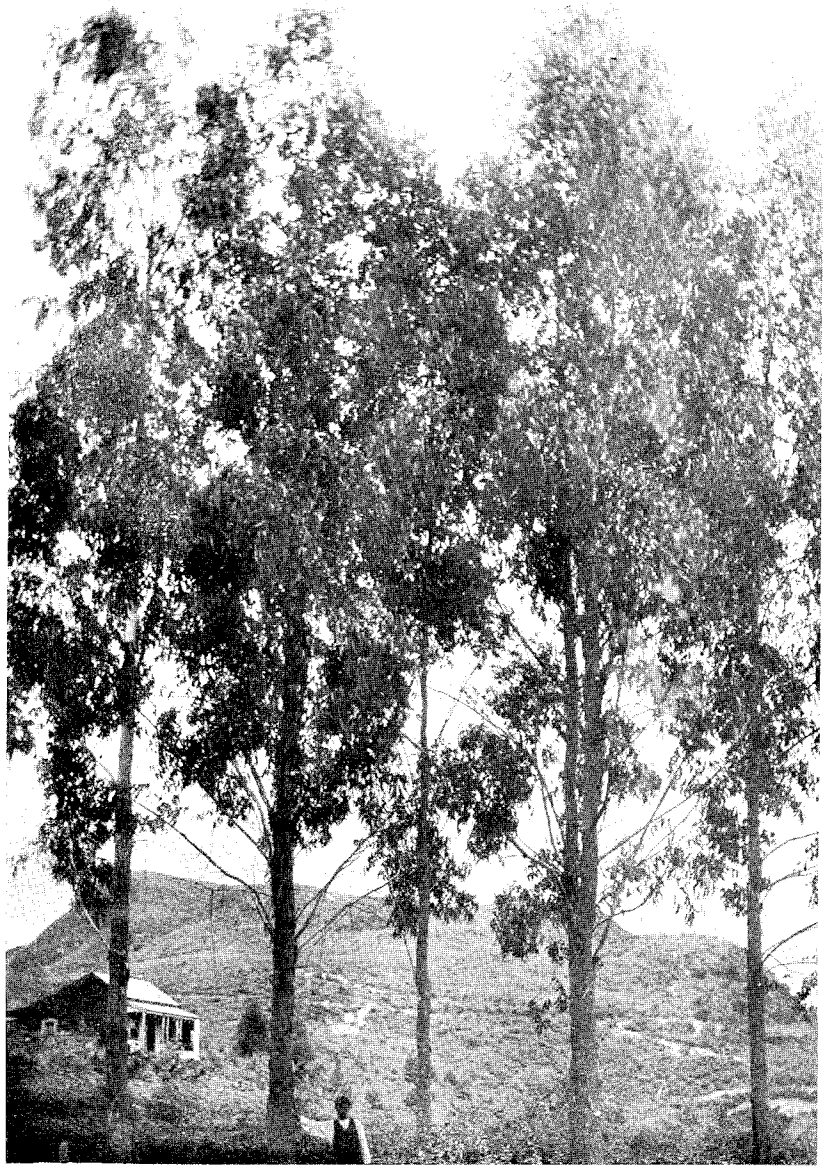
H. A. GOULDIE,
Superintending Nurseryman, North Island.

(C.) NOTES ON THE GROWTH OF FOREST-TREES IN CANTERBURY.

By way of introduction, I may be allowed to state that for more than forty years I have annually planted a considerable number of forest-trees, and made the planting of trees my especial hobby, never losing sight of the utilitarian side of the subject, so that now I have growing probably about a thousand species or varieties of trees and shrubs, some of the earlier-planted trees being over 100 ft. in height and 3 ft. in diameter. There are also growing here hundreds of trees over 50 ft. in height, and thousands of trees from 20 ft. to 50 ft. high. Besides the experience gained at Greendale I have travelled much in New Zealand and watched the growth of trees from the far south to the extreme north, and think that, after over fifty years of planting, sufficient evidence could be gained of the value of the different species to avoid the planting of so many worthless species of trees which one sees planted every year.

For myself, were I planting for profit alone, or a future national timber-supply, I should confine myself probably to not more than twelve species of trees for the whole of New Zealand; but, as "man does not live by bread alone," it is very desirable that the landscape should be beautified by hundreds of different species of native and introduced trees and shrubs, the wood of many of which would be useful for special purposes.

[To face p. 112.]



Eucalyptus regnans, 60 FT. HIGH.



Pinus radiata, SOUTH CANTERBURY.
[*T. W. Adams, photo.*

In thinking of a future timber-supply, one naturally asks what are likely to be the needs of the future; and if we go to older and better-developed manufacturing countries we find that there is a great demand for soft woods for packing-cases, wood-pulp for making paper, &c., and for these purposes some tree or trees are required that will grow quickly and produce cheap wood. Railways, again, are great consumers of hard woods for sleepers and bridges, and it is most necessary that provision should be made for a future supply of this class of wood. There is a third class of wood, of an elastic nature, that is always required for tool-handles, shafts, &c. Then, one thinks of special woods for decorative purposes, furniture, &c. Now, all these are grown and can be grown in New Zealand to perfection, but the question is which are the most economical trees to plant for our several sp cial needs.

In Europe and America the greater portion of the supply of soft woods are from the different spruces, a lesser supply coming from poplars and willows. All these different trees from Europe and America have been introduced into New Zealand, but I venture to say that *Pinus insignis* will produce twice as much timber per annum as any one of them; consequently, for this class of wood, *Pinus insignis* is to be preferred for planting for the production of wood of this class—and I speak from the experience of the growth of twenty species of European and American spruces, besides several Asiatic ones.

For woods of a more durable character, fit for sleepers, the oak, both in Europe and America, has largely been depended upon, and most of the oaks of these countries, as well as many of those of Asia, have been introduced into New Zealand, but none of them can compete with the gums of Australia to furnish a supply of hard wood in a short time. Besides the gums, there are at least two pines out of the many that have been introduced that promise in the south to furnish in a reasonable time timber fit for railway-sleepers: they are *Pinus Laricio* and *Pinus ponderosa*. Both trees grow well here, and specimens are 50 ft. high that were planted in 1881. None of the oaks planted about the same time contain more than half the amount of timber of the above pines, or more than one-fourth of the timber of *Eucalyptus Stuartiana*. So that from a profitable standpoint *Eucalyptus Stuartiana*, *Pinus ponderosa*, and *Pinus Laricio* are much to be preferred to any of the oaks.

In Europe and America for tool-handles the ash is almost exclusively used. In Canterbury, at least, this can only be grown successfully in a sheltered place and on good land. This wood will undoubtedly be in request in the near future; and, unlike most other woods, it is at its best in a young state, and when quickly grown. I have no doubt there are many places in the bush districts of New Zealand where the ash could be successfully grown. The same situation as is required for the ash is necessary for the hickory, judging from my experience here. Of about a dozen species of American and European ashes, and about half that number of species of hickories, all require a sheltered position.

Many of the New Zealand woods have been in request for the making of furniture, and no doubt for a very long time to come will be had in sufficient quantity for that purpose; in the meantime, walnut and oak trees are being grown in considerable numbers in New Zealand, and will, when more matured, be used instead of rimu and kauri and other New Zealand woods, and in the milder portions of the Dominion some of the best Australian fancy-wooded trees may be grown to profit. Of walnuts, for timber purposes, the American black-walnut is to be preferred before all others that have been tried here, as it grows faster and better than either of the European or Asiatic species that have been introduced.

Tables of the growth of trees may be most misleading, as, under cultivation, some trees will make splendid growth which, left to themselves in an ordinary plantation, will be dismal failures; this I could give many instances of, and while I will give a table such as is desired I shall at the same time select fair average growth or state the conditions under which the particular species grew. To give one instance, in 1887 I planted a triangular plantation of a few acres, every other row of which was *Pinus Laricio;* some of these in the second row I cut down twelve months ago, and found they measured on an average 45 ft. long, out of which I cut some good scantling. This row fronted due north. The first row, also facing due north, and along which a water-race ran, I sowed with acorns, planting with them about every 10 yards a walnut-tree. The south-east side of the triangle I treated in the same way, sowing acorns, and planting about every 10 yards a walnut-tree. On both sides the oaks came away well, those on the side of the water-race growing very rapidly into long poles, most of which have been cut down, and when cut down measured at least 25 ft. long; but on neither side have the walnuts made any progress, and I doubt if there is a tree 6 ft. high, they having been completely overtopped by the oaks and pines. The third row was planted with *Abies Menziesii;* these have all been cut out and used for stakes in fencing, for which they seem well suited. They had made an excellent growth, and were, when cut out, probably nearly 30 ft. high on the average. Other trees planted at the same time in this plantation were *Pinus ponderosa*, *Cedrus atlantica*, *Juniperus virginiana*, *Cupressus torulosa*, and *C. Lawsoniana*, *Picea pinsapo*, *Betula alba*, and odd trees of Turkey oak, *Cupressus funebris*, beech, *Araucaria imbricata*, *Libocedrus decurrens*, birch, holly, elm, and alder, all of which are still living and are rather good examples of what each species will do when left to itself under rather favourable circumstances. Between the rows of trees the first year after planting, the land was given to a labourer to grow a crop of carrots, and to encourage him to cultivate a crop of vegetables a second year I gave him some artificial manure. This cultivation of the land for two years gave the trees such a start that they have far outstripped older plantations of the same kind of trees; and this system may be safely commended for general adoption by all those desirous of raising healthy vigorous trees. The following tables give in a condensed form much of my experience, which I trust may prove useful to other planters. It will be noticed that *Pinus insignis* has grown much faster than any other tree*: trees planted here in 1873 range from 100 ft. to 118 ft. in height, and twelve of the finest, lately measured, girthed at 4 ft. from the ground the following measurements respectively: 7 ft. 11 in., 8 ft. 8in., 8 ft. 9 in., 8 ft. 10 in., 9 ft., 9 ft. 4 in., 10 ft., 10 ft. 1 in., 10 ft. 2 in., 10 ft. 3 in., 10 ft. 5 in., and 11 ft. 1 in.

* *Vide* photo opposite p. 112.

——	Height.		Fruiting.	Growth.*	Native of	Remarks.
	1896.	1908.				
	Ft.	Ft.				
Abies alba	17	25	F	M	Canada ..	Wood inferior; used for paper-pulp.
A. Alcockiana ..	3	19	F	M	Japan ..	A distinct tree of no great promise.
A. Douglasii ..	32	60	F	G	British Columbia	The Oregon pine of commerce. Gives promise of being a useful tree.
A. excelsa	25	36	F	M	Norway ..	Has been too much planted.
A. Smithiana ..	7	22	F	G	North India ..	Wood not considered of good quality; ornamental tree.
A. polita	1	5	F	P	Japan ..	Very slow-growing tree, of very distinct appearance.
A. Menziesii	22	47	F	G	California ..	Subject to a blight during recent years.
A. nigra	5	11	F	M	Canada ..	Wood only useful for inferior purposes.
A. macrocarpa ..	2	18	..	G	Southern California	A rare tree; in appearance like *A. Douglasii*.
A. orientalis ..	2	16	F	G	Crimea ..	Has remained healthy.
A. Mertensiana ..	7	33	..	P	British Columbia	Does not thrive well here.
A. canadensis ..	2	6	..	P	Canada ..	Of no promise here.
Acer campestre ..	18	25	F	G	England ..	Seems well adapted to conditions here.
A. pseudo-platanus ..	19	26	F	M	,, ..	Requires shelter here to make any headway.
A. negundo	16	..	F	M	California ..	Where the soil is free this tree grows fast.
A. saccharinum ..	3	11	F	P	North America ..	The sugar-maple of Canada. The winds here destroy the leaves.
A. macrophyllum ..	2	12	..	M	British Columbia	Something like the sycamore. Succeeds only moderately here.
A. monspessulanum ..	1	9	..	M	France ..	After the English maple in appearance.
Æsculus hippocastaneum	20	26	F	M	England ..	The horse-chestnut grows well when sheltered.
Æ. rosea	4	6	F	M	..	..
Acacia dealbata ..	38	44	F	G	Tasmania ..	The hardiest of the wattles.
Alnus glutinosa ..	14	20	F	M	England ..	The alder grows fast in boggy places.
Araucaria imbricata ..	19	..	F	M	Chili	Many trees are dying when about 25 ft. high.
A. excelsa	1	..	..	P	Norfolk Island	Not hardy here.
A. Cunninghamii ..	2	..	..	P	Queensland ..	Not hardy here, but grows near the sea in Canterbury.
A. Bidwillii	2	..	..	P	,, ..	Not hardy. Will grow in Canterbury near the sea.
A. brazillianus ..	11	23	F	M	Brazil ..	Has proved hardy here, and is quite distinct.
Betula lenta ..	3	..	..	P	Canada ..	Of all the birches tried here, this is the least satisfactory.
B. populifera ..	4	20	F	M	America ..	The American white-birch.
B. papyracea ..	3	18	F	G	Canada ..	The canoe-birch. Has large leaves.
B. alba	26	43	F	G	England ..	The common birch. *B. utilis*, 9 ft.; *B. excelsa*, 6 ft.; and *B. corylifolia*, 9 ft., are growing well here.
B. Ermanii	..	9	F	G	Japan ..	This promises to do well.
Catalpa speciosa ..	3	10	..	P	America ..	Not worth planting here except in good position for ornament.
Cerasus scrotina ..	3	12	F	G	,, ..	Used in America for furniture. Promises to be of value here.
Carpinus betula ..	7	14	F	M	England ..	Hornbeam. Of no economic value.
Castanea vesca ..	20	..	F	P	Europe ..	Several large trees have died after fruiting freely.
C. japonica	7	..	F	P	Japan ..	This chestnut commences to bear when only a small bush.
Cedrus atlantica ..	18	35	F	G	Africa ..	Seems worthy of extensive planting; all trees doing well.
C. libani	15	..	F	G	Lebanon ..	Not equal to the African cedar for general planting.
C. deodari	23	44	F	G	North India ..	A very valuable tree for its wood and also its appearance.
Cupressus excelsa ..	7	14	F	G	Guatemala ..	Upright tree with drooping branches.
C. Knighti	11	25	F	G	Mexico ..	Wood light and inferior.
C. stricta	19	..	F	M	Europe ..	The upright cypress. Subject to disease.
C. horizontalis ..	21	..	F	M	,, ..	..
C. Lawsoniana ..	18	28	F	M	Oregon ..	Many trees have been killed by drought.
C. viridis	7	16	..	M	..	..
C. torulosa	27	..	F	G	North India ..	This and the following variety are growing well. The largest tree has been cut up for posts, and is standing well.
C. t. gracilis ..	2	18	F	G	..	..
C. Goveniana ..	18	23	F	M	California ..	Only useful for shelter.
C. macrocarpa ..	47	53	F	G	,, ..	The wood has proved durable in the ground.
C. funebris	6	14	F	M	China	Trees of this are doing well.
C. thyoides	3	8	F	P	Maine ..	Remains healthy, but slow in growth.
C. glauca	9	22	F	G	Portugal ..	Distinct, but does not promise to be useful for timber.
C. nutkaensis ..	8	14	F	G	Alaska ..	The few trees grown here show considerable promise of success.
C. Uhdeana ..	1	15	F	G	Mexico ..	A good-looking cypress.
Cryptomeria japonica	6	8	F	P	Japan ..	One of the timber-trees of Japan; useless here.
C. elegans	8	10	F	P	,, ..	..
Corylus colurna ..	3	7	..	M	Constantinople ..	This nut-tree is very distinct from other hazels.
Sophora tetraptera ..	5	14	F	M	New Zealand ..	Grows well in cultivation.
S. japonica	3	13	..	M	Japan ..	A deciduous kowhai of ornamental appearance.
Eucalyptus globosa ..	65	90	F	G	Victoria ..	Was very much injured by frost in 1899.
E. Gunni	35	55	F	G	Tasmania ..	Hardy.
E. Stuartiana ..	46	65	F	G	,, ..	Fast-growing and hardy.
E. amygdalina ..	51	..	F	M	Victoria ..	Most of the trees killed, 1899.
E. regnans	..	35	F	P	,, ..	Not quite hardy; has been killed to the ground.
E. coriacea	..	40	F	M	Tasmania ..	Endures more frost than any other gum.
E. urnigera	4	35	F	G	,, ..	A good-looking tree, with distinct seed-pods.

* Good, G; moderate, M; poor, P.

——	Height. 1896.	Height. 1908.	Fruiting.	Growth.*	Native of	Remarks.
	Ft.	Ft.				
E. coccifera ..	3	26	F	G	„ ..	Hardy species, of rather poor habit for timber.
E. obliqua	35	..	F	M	„ ..	Not hardy in severe winters.
E. Cambadgei and E. Mulleriana	..	..	..	..	..	Both these gums promise well.
Fagus fusca ..	5	14	..	M	New Zealand ..	Does not succeed on the plains very well.
F. Solandri	18	30	F	M	„ ..	Most successful of the New Zealand beeches.
F. Menziesii ..	5	..	..	P	„ ..	Will only grow in a moist place on the plains.
F. sylvaticus ..	7	17	F	M	England ..	The English beech has not succeeded very well.
F. americana ..	..	..	..	..	..	The American beech. Small plants here are healthy-looking.
Fraxinus viridis ..	..	11	..	M	Texas	All the ashes seem to require good ground and cultivation to succeed here. The English seems equal to any of them in growth.
F. excelsior	22	35	F	M	England	
F. oregana	9	19	F	M	..	One of the best growers here.
F. ornus	2	10	F	G	..	This distinct tree seems to be adapted to the conditions here.
F. americana ..	..	9	..	M	America ..	..
F. elonga japonica ..	..	5	..	..	..	These and others are being tried here.
F. lenticifolia ..	..	10	..	..	..	
F. sumbucifolia ..	..	7	..	..	..	
F. anomala	..	4	..	..	..	
F. jaspida	..	4	..	..	..	
F. quadrangulata ..	..	5	..	..	..	
Juniperus virginiana ..	18	24	F	G	America ..	The growth is not fast, but it is adapted to conditions here.
J. burmudiana ..	..	..	..	..	..	This and several others are growing here.
Juglans regia ..	29	38	F	M	Europe ..	The walnut only grows well in good soil.
J. japonica	6	12	F	P	Japan ..	Inferior in growth and fruit.
J. nigra	..	13	..	G	America ..	The most promising for timber purposes.
Larix europœa ..	24	..	F	M	Europe ..	Not successful on the plains.
L. leptophylla ..	..	15	F	M	Japan ..	May prove better than the common larch here.
Liriodendron tulipifera	7	26	..	P	America ..	Requires shelter and good conditions.
Libocedrus decurrens..	10	18	..	M	California ..	As the trees get older, seem less satisfactory.
L. Bidwilli	2	6	..	P	New Zealand ..	*L. Bidwilli* and *L. Doniana* make very little progress here.
L. chilliensis ..	4	7	..	M	Chili	More promising than the New Zealand species.
Platanus orientalis ..	8	12	F	M	Asia	The plane-trees are all fair growers here.
P. occidentalis ..	9	15	F	M	America ..	..
P. palmata	6	15	..	M	England ..	..
Populus monilifera ..	40	50	F	G	„ ..	The poplars that seem most desirable are *P. canescens* and *P. boleana*. *P. balsamea* is quickly killed in drought, but the upright poplar will stand drought better than most broad-leaved trees.
P. alba	51	60	F	G	„ ..	
P. dilitata	35	50	F	G	Europe ..	
P. canescens ..	49	55	F	G	„ ..	
P. Boleana	..	22	..	G	Asia	
P. tremula	6	16	F	M	Europe ..	
Podocarpus totara ..	4	12	..	P	New Zealand ..	Totara grows very slowly, but is fairly hardy.
Picea Fraseri ..	18	25	..	M	Canada ..	*Picea* (*Abies* of the Americans, and generally on the Continent of Europe): The changing of the names of these trees from Picea to Abies and from Abies to Picea has caused much useless confusion. Members of this family of trees are many of them very beautiful, and most of them grow well. *P. Nordmanniana*, *P. pectinata*, and *P. pinsapo* should be largely grown; *P. concolor*, *P. Lowiana*, *P. grandis*, and *P. cephalonica* give promise of success here; *P. balsamea* and *P. Veitchi* have suffered most from drought.
P. amabilis	2	10	..	P	Oregon ..	
P. balsamea.. ..	5	15	F	P	Canada ..	
P. concolor	5	16	..	M	Arizona ..	
P. Cephalonica ..	6	24	F	M	Cephalonia ..	
P. Lowiana	5	23	F	G	Colarado ..	
P. Nordmanniana ..	7	22	F	G	Russia ..	
P. grandis	6	22	F	G	Vancouver ..	
P. nobilis	3	13	..	P	Oregon ..	
P. pectinata ..	5	21	F	M	Europe ..	
P. pinsapo	7	26	F	G	Spain ..	
P. Veitchi	3	14	F	P	Japan ..	
P. Webbiana ..	2	5		P	India ..	
P. bracteata ..	..	3	..	..		These are also growing here.
P. cilicea	..	1	..	..		
P. firma	..	1	..	..		
P. magnifica ..	..	1	..	..		
P. mareisi	..	1	..	..	..	
P. pindrow	..	2	..	..		
P. sibirica	..	1	..	..		
P. satchaliensis ..	..	1	..	..		
Pinus australis ..	2	7	..	P	..	*Pinus australis* supplies a large amount of timber in America, but is not a success here.
P. austriaca ..	21	35	F	M	..	The Austrian pine is superior to most pines in dry places.
P. mitis	15	22	F	P	..	*P. mitis* is another American pine from which much lumber is cut, but does not succeed here.
P. excelsa	7	29	F	M	..	An Indian pine that grows thriftily here, and promises to be a success.
P. Laricio	31	53	F	M	..	Have planted many thousands of this tree, believing it to be the most promising of all the pines.
P. halepensis ..	25	45	F	M	..	Suitable for sand-dunes. Is seeding itself in many places in Canterbury.
P. insignis	87	118	F	G	..	Has no equal for producing a cheap timber of fair quality.

* Good, G; moderate, M; poor, P.

—	Height. 1896.	Height. 1908.	Fruiting.	Growth.*	Native of	Remarks.
	Ft.	Ft.				
P. longifolia.. ..	2	11	..	P	..	A distinct and beautiful pine from India. Not quite hardy.
P. mugho	4	16	F	P	..	Only useful for planting on high mountains.
P. canariensis ..	2	10	..	P	..	A beautiful pine, that does not succeed here. Most difficult to transplant.
P. muricata ..	28	50	F	M	..	A poor scrubby tree that has been far too much planted.
P. Coulterii	31	47	F	M	..	The largest cones of any pine are grown by this tree. Timber seems of poor quality.
P. pinaster	29	35	F	M	..	A very inferior timber-tree, but will grow in exposed places by the sea.
P. ponderosa ..	24	50	F	G	Western America	A tree of great promise for timber purposes.
P. Sabiniana ..	33	48	F	M	California ..	A very distinct pine, with very fine cones; of no promise for timber.
P. Jeffreyii	12	35	F	G	,, ..	One of the best: grows well, and will likely produce good timber.
P. strobus	16	48	F	P	Canada ..	Enormous amount of timber has been cut from this tree in America; of no value here.
P. Fremontiana ..	3	11	F	P	California ..	This tree has large nutlike seeds which are good to eat; not a timber-tree.
P. Lambertiana ..	11	16	..	P	British Columbia	The giant of the family. Does not promise of be of any value here.
P. pungens	15	28	F	M	North America	A pine of no promise as a timber-tree. Cones and tree distinct.
P. patula	33	..	F	M	Mexico ..	This tree after reaching probably 50 ft. died. Seedlings do not promise much.
P. rigida	15	26	F	M	North America	A scrubby-looking pine, singular in that it will sprout from the stump.
P. tuberculata ..	29	40	F	G	California ..	A spreading tree, making fair shelter and quick growth.
Pinus tæda	..	14	..	G	North America	The young trees here are quick-growing.
P. massoniana ..	5	17	F	M	Japan	These are timber-trees from Japan, and are growing fairly well here.
P. densiflora ..	4	18	F	M	,,	
P. pinea	3	16	F	M	Italy	The seeds of this tree are large, and are good to eat.
P. contorta	14	25	F	M	Oregon ..	A distinct pine, of no special economic value.
P. Murrayana ..	28	46	F	G	California ..	This is a rapid-growing pine, and a superior tree for shelter.
P. Gerardiana ..	1	5	..	P	India ..	The plants thrive well, but are of slow growth; seeds are good to eat.
P. Torreyana ..	2	23	..	G	California ..	A fast-growing open-looking pine; very difficult to transplant.
P. Benthamiana ..	25	55	F	G	,, ..	One of the trees that promises to be successful as a timber-tree.
P. Aristata	..	1	..	..	..	These are also growing here.
P. Bungeana ..	..	1	..	..	..	
P. Banksiana ..	..	3	..	..	..	
P. Bruttia	..	3	..	..	..	
P. cembra	..	1	..	..	..	
P. canariensis ..	..	6	..	..	..	
P. flexilis	..	1	..	..	..	
P. edulis	..	10	..	..	..	
P. Hamiltonia ..	..	1	..	..	..	
P. leucodermis ..	..	2	..	..	..	
P. inops	..	1	..	..	..	
P. Kashya	..	1	..	..	..	
P. Koraiensis ..	..	1	..	..	..	
P. monticola ..	..	2	..	..	..	
P. montana	..	1	..	..	..	
P. monophylla ..	..	1	..	..	..	
P. Parryana	..	1	..	..	..	
P. resinosa	..	1	..	..	..	
P. pyrenica	..	1	..	..	..	
Quercus annulata ..	6	10	F	P	Europe ..	An evergreen oak.
Q. cerris	19	33	F	M	Turkey ..	Grows well, but not so freely as the English oak.
Q. Hodginsoni ..	14	17	F	G	.. ..	The tree under this name is one of the finest-looking of all the oaks.
Q. palustrus ..	6	8	..	M	America ..	The American oaks as a whole have been disappointing, except for their autumn tints, which are often very fine.
Q. coccinea	1	6	..	M	,, ..	
Q. Bannisteri ..	3	5	..	P	,, ..	A dwarf oak of no especial value.
Q. ilex	10	16	F	M	Europe ..	The evergreen oak of Europe, which grows well in New Zealand.
Q. virens	3	13	F	M	America ..	Much like the above in appearance, and growing well.
Q. macrophylla ..	4	8	..	P	,, ..	Foliage very large, but the tree dies back very much annually.
Q. Kellogii	1	13	..	M	California ..	A black oak that is making a good appearance.
Q. rubra	2	15	..	M	America ..	Leaves die off a deep red. Timber reputed inferior.
Q. imbricaria ..	6	16	..	G	,, ..	Leaves entire, and unlike oak-leaves.
Q. phellos	1	7	..	M	,, ..	With willow-like leaves and branches.
Q. lobata	..	5	..	G	California ..	A beautiful oak.
Q. robur	29	35	F	G	England ..	Not likely to be beaten by any other oak for general utility.

* Good, G; moderate, M; poor, P.

—	Height. 1896.	Height. 1908.	Fruiting.	Growth.*	Native of	Remarks.
	Ft.	Ft.				
Q. suber	2	6	..	M	France ..	The cork oak. Cannot be recommended for growing so far from the sea.
Q. acuta	..	6	..	..	..	These are also growing here.
Q. Æsculus	..	1	..	..	..	
Q. alba	..	5	..	..	..	
Q. aquatica ..	..	8	..	..	..	
Q. incana	..	9	..	..	..	
Q. bicolor	..	10	..	..	..	
Q. castanifolia ..	..	5	..	..	..	
Q. chrysophylla ..	..	10	..	..	..	
Q. cuspidata ..	..	10	..	..	..	
Q. dentata	..	5	..	..	..	
Q. dilitata	..	5	..	..	..	
Q. dumosa	..	7	..	..	..	
Q. falcata	..	1	..	..	..	
Q. glauca	..	2	..	..	..	
Q. libani	..	4	..	..	..	
Q. lineata	..	6	..	..	..	
Q. lamellosa ..	..	1	..	..	..	
Q. Michauxii ..	..	4	..	..	..	
Q. Nigra	..	7	..	..	..	
Q. prinus	..	8	..	..	..	
Q. phyllioides ..	..	7	..	..	..	
Q. sessiliflora ..	..	1	..	..	..	
Q. tinctoria ..	..	5	..	..	..	
Q. Weslizeni ..	..	11	..	..	..	
Robinia pseudo-acacia	20	26	F	M	North America	Wood grown here remarkably durable; tree grows very slowly.
Retinospora obtusa ..	2	8	F	P	Japan ..	A timber-tree of Japan. Fails badly here.
R. leptoclada ..	9	20	..	M	,, ..	For ornament this is a very desirable tree.
Salisburia adiantifolia	3	5	..	P	China.. ..	A curious tree, only useful as a distinct tree in a collection.
Sequoia sempervirens	4	14	F	M	California ..	The redwood. A tree that should be largely grown on the pumice lands.
Salix alba	..	..	..	..	..	This and about two dozen other species of willow are growing here. *S. alba* needs the vicinity of water, when it will grow into a fine tree, and is a valuable timber, especially for cricket-bats.
Taxus baccata ..	12	14	F	P	England ..	The English yew. Makes a fine evergreen tree of slow growth.
Taxodium distichum ..	5	8	..	P	America ..	This requires much water, and is a valuable timber-tree for swamps.
Thujopsis dolobrata ..	2	11	F	P	Japan ..	Not to be grown for timber, but is a very distinct tree.
Tilia europea ..	19	28	F	M	Europe ..	The lime-trees are useful for several purposes, and bees make much honey from their flowers.
T. americana ..	4	6	..	P	America ..	
Thuja occidentalis ..	5	11	F	M	,, ..	These are good timber-trees where land is not too dry.
T. gigantea	26	40	F	G	British Columbia	
Ulmus montana ..	19	30	..	G	Scotland ..	A spreading tree that in free soil makes good growth.
U. americana ..	6	10	..	M	America ..	Does not grow so well as the European elms.
U. campestris ..	6	29	F	G	England ..	Of upright growth, and rapid when in good position.
U. purpurea ..	7	16	..	M	..	These elms are distinct in appearance, and make fair growth.
U. exoniensis ..	7	16	..	M	England ..	
U. suberosa ..	25	45	F	G	Europe ..	This is the cork-barked elm. Sends up suckers very freely.
U. fulva	..	6	..	..	..	These are also growing here.
U. racemosa ..	..	5	..	..	..	
U. crassifolia ..	..	4	..	..	..	
U. parvifolia ..	..	3	..	..	..	
U. vegeta	..	8	..	..	..	
U. Koopmani ..	..	10	..	..	..	
U. turkestani ..	..	8	..	..	..	
Wellingtonia gigantea	15	35	F	M	California ..	The "big tree" of California. Requires rich deep soil to succeed here.

* Good, G; moderate, M; poor, P.

T. W. Adams,
Greendale, Canterbury.

(D.) NOTES ON THE GROWING OF AUSTRALIAN GUM-TREES IN THE WAIKATO.

On the 8th October, 1874, my brother, the late J. C. Reynolds, sowed some gum-seeds under different names—viz., messmate, red ironbark, slatey gum, woolly-butt, white ironbark, stringy-bark, bastard box, blue-gum (Aus ralian) black ironbark, bloodwood, and Australian red-gum. The messmate is what is commonly known here as peppermint gum: the bark is rough and thick; the tree is very hardy, will transplant well, is a quick grower, and will stand sharp frosts. The wood is salmon colour. I have been sowing seed of this messmate gum for some years, and it germinates well.

The Rev. J. H. Simmonds, Principal of the Auckland Three Kings College, who is an enthusiastic advocate of forestry, has been securing specimens of gums I have been growing to send to Australia for identification.

I have been cutting out my "cull" trees, and splitting them into posts and rails, specimens of which were exhibited at the Auckland Agricultural and Pastoral Association's show this year. The messmate gum is worth all the rest in the foregoing list put together; the stringy-bark comes second; in fact, I think they are the only two sorts out of my list worth planting. Whether any one ordering messmate-gum seed would get the sort of tree I have I cannot say.

I have another gum in a second plantation nearly as fast-growing and hardy, bark smooth and almost white, seed and seed-pods similar to the messmate. This sort after being in the ground for six years is quite sound (except the sap). I may say the sap of both is similar in thickness, about 1½in. I have not tested this sort as long as the other. Colour of wood, light salmon, almost white. An Australian that I had splitting says the rough-bark one is known as the "red-box," and the smooth-bark one as "white-box."

The trees in this specimen plantation run from 4 ft. 6 in. to 4 ft. 9 in. in diameter, according to variety. The messmate is very much the largest all through, and in the second plantation this smooth-bark gum is the largest.

RICHARD REYNOLDS,
Trecarne, Cambridge.

(E.) AFFORESTATION IN ENGLAND.

The report of the Royal Commission on Coast-erosion and Afforestation in 1908 stated that 9,000,000 acres in the United Kingdom were suitable for afforestation, but were not now under timber; that land suitable for afforestation is mostly devoted to the production of mutton; that calculations on the basis of the present consumption showed that at most 60,000 tons, or 4·8 per cent., of the total Home production of meat, or 2·6 per cent. of the national consumption, would be ultimately displaced; whilst, as to labour, the employment furnished by the present uses, mostly sheep-farming, to which the land in question is devoted, may be taken to average one man to 1,000 acres, which does not represent one-tenth of the permanent employment afforded by the maintenance of a similar area of land under forest.

It was anticipated that a forest of 9,000,000 acres would yield 9,000,000 loads annually in perpetuity. The importation of foreign timber from temperate climates into the United Kingdom in the year 1907 exceeded 8,500,000 loads, or approximately the annual supply which could be expected from the afforestation of this area.

Actuarial statements showed that, for the scheme, after allowing 3 per cent. compound interest on all the capital invested, the approximate equalised revenue would at the end of eighty years amount to £17,411,000 per annum, whilst the value of the property might be expected to be £562,075,000, or £106,993,000 in excess of the sum involved in its creation.

If 150,000 acres were annually taken in hand, the labour of 18,000 men would be required, and permanent employment would in due course be afforded to 1,500 men, rising by an additional 1,500 every year until the end of the rotation. The number then permanently employed would approach 100,000. But the number of men employed may roughly be taken to be represented by about double that figure, owing to the incidental occupations, such as building, the making of implements, the provision of materials, &c., all involving the employment of additional labour.

Although no State scheme of afforestation has yet been put into practice, yet municipal enterprise has already dealt with the subject with very satisfactory results. Appended are a few instances.*

Mr. Joseph Parry, of Liverpool, gave an account of the work done by the Liverpool Corporation at Vyrnwy and Riverton. The Corporation commenced systematic planting operations in the Vyrnwy area in 1896, but it was not until 1903 that much progress was made. Between 1897 and 1907 they had planted 1,034,056 trees, and the work is now being continued at the rate of 300,000 trees per annum. The total area selected for planting on the watershed is 1,202 acres, and when planting is completed the total number of trees put out will be about 4,000,000. The trees here planted are chiefly larch, spruce, Douglas fir, silver-fir, Corsican pine, alder, oak, and ash. The expenditure on planting has been at the rate of £6 15s. 3d. per acre; but this includes cost of clearance, also a large outlay for plants which will in future be supplied from the Corporation nurseries at a much lower rate. As regards the Rivington area, operations were undertaken in 1904, when an area of 571 acres was selected, afterwards increased to 1,243 acres. In the period of three years which has elapsed since, 349 acres have been planted with 1,291,295 trees, chiefly beech, ash, oak, sycamore, spruce, alder, and some willows. A recent plantation has been made at an average cost for planting (including purchase of plants) of £2 8s. 9d. per acre, and it is estimated that in future the cost of planting in the Rivington watershed will not exceed £3 per acre.

Alderman Sir Bosden Leech gave a short account of what is being done by the Corporation of Manchester in the catchment-area of its waterworks. They have planted about 500 acres of land, and during the past six years have been planting at the rate of about 50 acres per annum. During the last two years 75 acres have been planted out each year, and last year 100,000 plants were put out.

Mr Lees gave some account of the planting operations carried on by the Corporation of Birmingham in its catchment-area. Work was commenced in 1902, and 410 acres have been planted at a to al average cost per acre o £7 6s. 6d., of which sum the actual planting-cost was £4 2s. 8d. per acre, the remainder being accounted for by the expenses of clearing, fencing, &c.

* Taken from the Transactions of the Royal Scottish Arboricultural Society, January, 1908, page 62.

Approximate Cost of Paper.—Preparation, not given; printing (1,750 copies, including maps and illustrations), £191 16s.

By Authority: JOHN MACKAY, Government Printer, Wellington.—1909

Price 3s. 6d.]

NORTH ISLAND
(TE IKA-A-MAUI)

NEW ZEALAND

TO ILLUSTRATE REPORT ON FORESTRY, 1909.

Scale of English Miles

Reference

Cities (thus WELLINGTON)
Boroughs
Towns
Railways
Roads
Boundaries of Land Districts

Crown forests,
Alienated forests,
Permanent forests,
Plantations, nurseries, etc.,

RAOUL or SUNDAY I.
MACAULEY I.
CURTIS I.
L'ESPERANCE RF
KERMADEC ISLANDS
COOK ISLANDS

TASMAN SEA
Baurenki Gulf
Bay of Plenty
North Taranaki Bight
South Taranaki Bight
South Latitude
Hawke Bay
Golden Bay
Tasman Bay
Karamea Bight
Cloudy Bay
Palliser Bay
MIDDLE ISLAND
COOK STRAIT
SOUTH PACIFIC OCEAN
TE MOANA-NUI-A-KIWA

172° 173° 174° 175° East Longitude 176° 177° 178°

By Authority: John Mackay, Government Printer

SOUTH ISLAND
(TE WAI-POUNAMU)
NEW ZEALAND

TO ILLUSTRATE REPORT ON FORESTRY, 1909.

Scale of English Miles

10 5 0 10 20 30 40 50 60 70 80 90

Reference

	thus
Cities	
Boroughs	
Towns and villages	
Railways and stations	
Roads	
Boundaries of Land Districts	
Projection – Rectangular Tangential	

Crown forests,
Alienated forests,
Permanent forests,
Plantations, nurseries, etc.,

168° 169° 170° 171° 172° 173° 174° East Longitude

41° 42° 43° 44° 45° 46° 47° South Latitude

Golden Bay
Tasman Bay
Karamea Bight
Cloudy Bay
Pegasus Bay
Banks Peninsula
Canterbury Bight
BOXITUEA

T A S M A N S E A

S O U T H P A C I F I C O C E A N
(*TE MOANA-NUI-A-KIWA*)

COOK STRAIT

Stewart Island

BOUNTY I^SS

ANTIPODES I^SS

AUCKLAND I^SS

CAMPBELL I^SS

(REKOHU or WHARE-KAURI)
CHATHAM ISLANDS

By Authority: John Mackay, Government Printer.