

THE GROWTH AND YIELD OF EXOTIC CONIFERS IN CANTERBURY.

(F. E. HUTCHINSON.)

II.—Previous Records.

The first recorded information dealing with the growth of exotic trees in Canterbury appears in the special report of the Lands Department on "Forestry in New Zealand," in 1909. Part V. of this report, headed "Afforestation," contains a contribution by the late T. W. Adams, Esq. of Greendale on the growth of forest trees in Canterbury. Mr. Adams had established a most extensive arboretum at Greendale, on the mid-Plains, with a rainfall of about 32in., and a soil slightly better than the average for the plains. His contribution includes, in addition to a general discussion, a detailed tabular statement of height and general growth of over 250 species of forest trees, the majority being conifers. The height measurements given are for the years 1896 and 1908. It is unfortunate that the dates of planting are not given in this table, for the general discussion mentions plantings in 1873, 1881, and 1887, so that the establishment of the arboretum was evidently spread over a lengthy period. Girth measurements are given for the best specimens in a row of insignis pine, of which a photo is reproduced. The planting date of these trees is given, together with that of the corsican and ponderosa pines whose heights are given in the table. As the figures all refer to specimen trees, they are of little value from the point of view of yield, but the general remarks concerning each species are of great interest, and considerable value. The Greendale arboretum now forms a part of the School of Forestry endowment, though of the 250 species mentioned, much less than half that number are now present, the others having proved definitely unsuitable, necessitating removal. Of those remaining the School possesses no further record than that given in the Report under discussion, so that the date of planting of almost all the trees is clouded with uncertainty.

The next recorded information was prepared in connection with the Report of the Forestry Commission in 1913. Appendix C of the Report, "Selected Letters" contains a number of items dealing with growth and yield of exotics. Appendix D gives a schedule of measurements of specimen trees growing in New Zealand plantations, includ-

ing a number of Canterbury cases. The minutes of evidence contain a few further references to Canterbury plantations, while submitted to the Commission, though not included in its report, was a small pamphlet prepared by the Ashburton County Council setting out the heights, girths and ages of selected trees of various coniferous species from a considerable number of the County reserves.

This latter pamphlet, and appendix D of the Report, deal only with specimen trees, and so are of no value from the point of view of yield, though they afford information on height growth, which is of some value as a site index. Some of the letters in Appendix C, however, do, as mentioned above, touch on yields, and are most important in that, as the first figures available on exotic yields, they had a large influence in shaping the report of the Commission, and the subsequent policy of the State, while they also formed the basis of many of the predicted returns quoted by the prospectuses and salesmen of the great number of commercial treeplanting companies which sprang into existence about 1923-25. These figures are therefore worth a little mention, even though they are of extremely sketchy character. *Insignis* pine naturally received fullest attention, and the following quotations are made regarding it. One correspondent dealing with the growth of this species at Matamata and Cambridge in the North Island, states (letter 15) in regard to a plantation at Matamata that "they would now be 40 years old. The majority were 200 feet high, and 18-20in. through, and 150ft. without a branch. [Letter 8 states 130 feet of clean barrel definitely measured by the writer.] They were planted 9 x 6 feet, and I did not record a single miss in the plantation [of 16,000 trees.] I have a *Pinus insignis* near my residence at Cambridge, 50ft. of clean barrel, 30ft. of small knotty barrel, and 4 feet through. The clean timber is estimated to be 5,000ft. [Letter 8 re-affirms this, and adds 1,500ft. of rough timber.] The tree is 30 years old, probably a year less. A tree planted at the same time and cut down when it was 13 years old has now 10in. of solid heart remaining." [Seemingly it was used as a gate post.]

The second citation is from letters 17 and 18, dealing with trees in the Rakaia (Canterbury) district. Letter 17 states that certain buildings constructed of *insignis* pine 37 years previously were still sound. This would indicate that trees were milled in 1876, only 25 years from the settlement of the province. The same writer in letter 18, states that there were in 1913, 400 acres of *insignis* pine forest

in the Rakaia district, "and an average yield per acre would be more than 190,000 sup. ft. Average barrel 30ft., average diameter 2ft. to 2ft. 6in., width of row, 12ft. or so, distance of each tree apart 7 to 9 ft.: fair average equals 200,000 sup. ft." The writer states further that he has it on reliable information that £30 was paid as royalty on $\frac{1}{2}$ acre felled and cut into timber, "by contract, resulting in the loss of much timber quite capable of being made into useful material."

Inaccurate as these figures obviously are, they were offered and accepted in good faith, and greatly influenced the Commission in its recommendation for a larger programme of exotic afforestation, in which the insignis pine was heavily stressed.

Milling of homestead plantations became fairly widespread in Canterbury during the war years, and by 1920 a considerable number of blocks had been cut over. In most cases, however, no records of yields were kept. The stands were largely mixtures, of which only one or two species would be of saw-timber size. The blocks were often of irregular shape, and the age was frequently not known. A few instances of exceptionally good yields received newspaper mention from time to time, the figure of 100,000 sup. ft. per acre for a pure block of insignis pine having been quoted several times in different parts of Canterbury. The writer has endeavoured since 1926 to trace as many of these as possible, though with little success, largely due to the length of time that had elapsed since milling. In a few cases, however, it was possible to secure at least a partial reconstruction of the facts with the result that the writer was forced to conclude the yield quoted was erroneous, through the following causes:—The first, and very frequent error lay in the area computation of small blocks, rectangular or triangular, or of long narrow belts of a chain or two in width. The area taken was the area enclosing the tree boles, though crowns and roots extended many feet further out on all sides. The second factor lay in the expression of the superficial foot content derived. It is customary in the native bush sawmills of New Zealand to compute the footage of all timber under 1in. in thickness as though it were 1in. Applied to $\frac{3}{4}$ in. and $\frac{5}{8}$ in. box shook, which forms the bulk of the output of the exotic mills, an enormous overstatement of yield would result, unless reduced to terms of actual thickness. (It may be said that while one instance of this was encountered, the exotic millers in Canterbury at present calculate their footage on ac-

tual thickness, the so-called "railway tally.") A third source of difference is in the use of the quarter girth log measure, which gives a figure roughly double the actual quantity that can be obtained. This factor again was not often encountered, as little log scaling is done in Canterbury and that mainly by other log rules. In most of the cases investigated the writer was forced to the conclusion that the yield quoted was only an estimate of the roughest kind, the measurement of neither the area nor the timber being more than an approximation. The writer is therefore unable to quote with any confidence any actually recorded yields prior to 1925.

In 1925 a report was formulated for the State Forest Service by H. Roche and the writer, covering a brief study of yields on three areas of insignis pine in Canterbury then in process of milling, one being a pure plantation on the New Brighton sands, another a pure plantation on the mid-plains, and the third a mixed conifer plantation, also on the mid-plains.

Courtesy acknowledgment is made to the Director of the State Forest Service for permission to make the following summary of the contents of this report:

The first study was made in a stand of fourteen acres of pure insignis pine 45 years of age at Burnham on the mid-plains, with an elevation of 175 feet, a rainfall of about 27in., and a soil comprising a light loam over extensive beds of shingle. Summer drought is experienced frequently, and intermittent growth, as shown by two and three growth rings per year, was of almost regular occurrence. The stand had been planted at 9 x 9 feet, and had received no thinning. The measurements on a 1/10th acre plot revealed at age 45 a stocking of 310 trees per acre; a range of D.B.H. from 9in. to 21in., averaging 14in.; a height of dominant trees of 107 feet, and a yield of 12,737 cub. ft. per acre total volume, and 62,500 sup. ft. per acre sawn volume, as obtained by volume curve method from the measurement of 8 felled trees. The sup. ft. contents are by the New Zealand log rule and are taken to a 6in. top. Stem analyses were made of the 8 felled trees, and a yield table prepared from the analyses. The rings showed clearly that in this over-crowded stand, stagnation had been practically achieved for a decade.

The second area studied was on the New Brighton sands, at an elevation of 10 feet, and situated two miles from the coast-line. The rainfall is approximately 23in. The beach sand has a depth of 70 feet, but below 3 feet in

depth is always moist. Root penetration is good, and wind-fall non-existent. Summer drought seems not to affect the trees once the roots have reached the moister depths, though seedling stock suffers badly in dry years.

The stand on this area was in the form of a hollow square one to two chains in depth, on a $2\frac{1}{2}$ acre section. Thinning had taken place irregularly at different times. The following measurements were secured at age 35, on the basis of a $1/10$ th acre plot, and the felling and measuring of one mean sample tree. Stocking, 150 trees per acre, the D.B.H. ranging from 13in. to 31in. and averaging $21\frac{1}{2}$ in.; the height of dominant trees averaged 101 feet; the volume per acre was 13,687 cub. ft. total volume, and 76,500 sup. ft. sawn timber volume.

The third area studied was near Darfield, at an elevation of 650 ft. above sea level. The soil is a light loam over deep beds of impacted shingle, the rainfall about 31in. Exposure to nor-west and sou-west winds is complete. The stand was of 65 acres of mixed conifers 37 years of age. Species present were *Pinus radiata*, **P. nigra*, *P. Muricata*, *Larix decidua*, *Picea abies* (syn. *excelsa*) *Pseudotsuga taxifolia*, *Betula alba* and various *Eucalyptus* species. The development had been virtually into a two storied forest, the top storey consisting of *insignis* pine of large size and ponderous form, the lower storey comprising the other species, all small and stagnant in their growth.

The measurement of all material as felled on a $\frac{1}{4}$ -acre plot resulted in the following:—Stocking, per acre, *insignis* pine 68 trees, other species 132 trees. Height of dominant *insignis* pine (at age 37), 103ft. D.B.H. (*insignis* pine) ranged from 9in. to 30in. averaging 23in. D.B.H. of other species practically all below 12in. Yield of *insignis* pine, 6,846 cub. ft. total volume, and 35,720 sup. ft. of sawn timber volume. Yield of other species 1,218 cub. ft. total volume and 3,960 sup. ft. of sawn timber volume. This $\frac{1}{4}$ -acre plot was picked to give an even distribution of *insignis* pine, and a freedom from wind damage, so that it represents the best which such mixed stands could produce. Due to wind damage, the actual total yield for the whole block averaged only 18,000 sup. ft. of timber and $21\frac{1}{2}$ cords of fuel per acre when milling was complete.

This stand is typical of a great number of such mixed conifer stands planted in the eighties. A considerable number have been cruised by the writer during the years 1925-30, and in some cases the amount actually cut has been re-

* Syn. *P. laricio*.

corded. These blocks have been found to run usually along very similar lines, yielding from 20 to 30 thousand sup. ft. per acre depending on the amount of windfall. The mixed conifer stands have furnished the bulk of the exotic timber milled in Canterbury from the war up to the present time, though they are now approaching extinction. Pure stands have been the rule in planting since the beginning of the present century and it is from stands of this type that the future supplies will be drawn.

In 1925 the School of Forestry commenced the installation of a series of permanent sample plots in recently established pure stands of various conifers, principally insignis pine in the plantations of local bodies and private landholders throughout Canterbury. This series of sample plots has been maintained and extended as far as pressure of work, and available finance permit, and it is from the records of these plots, together with other material gathered by the School of Forestry, that the data about to be presented has been taken.

The system of sample plots has been described briefly in previous issues of *Te Kura Ngahere*, in the annual Research List of the School of Forestry, so it is not necessary to repeat it here.

For the field work, compilation, and assembling of much of the matter to be presented, the writer is deeply indebted to a large number of senior students of the School of Forestry, who at various times have measured plots, compiled results, or have carried out special studies or projects bearing upon this subject. General acknowledgment for all this assistance is made while credit will be given to the authors of all special studies from which data is taken.

GROWTH OF CANADIAN AND NEW ZEALAND DOUGLAS FIR.

(G. H. HOCKING.)

The Douglas Fir imported into New Zealand is almost invariably in the form of sawn timber, so that we do not often have the opportunity of studying logs. In June last the "Golden Harvest," carrying a cargo of timber from North American Pacific Coast ports for Australia, was forced to undergo repairs at Wellington, a number of Douglas Fir logs from Vancouver being unloaded in the process.