MEANS OF INCREASING PRODUCTIVITY OF EXOTIC FORESTS

Symposium at 1952 Annual Meeting of the New Zealand Institute of Foresters.

I. J. THULIN opened the symposium with a paper on *Means of improving the genetical quality of forest seed in New Zealand.*

After a summary disposal of the usual objections to forest tree-breeding and a brief description of genetical terms and procedure, some definition was given of the desirable characteristics sought after by the forester for the various purposes for which the trees were grown. Where production of sawtimber was the main object, a combination of quantity—diameter and height growth—and quality—especially characteristics such as light branching, good form and high heartwood content—was desirable. Under New Zealand conditions light branching was the quality characteristic probably most wanted.

It was emphasised that for the next few decades forest tree-breeding in New Zealand should be based on selection inside existing species and that the approach towards the objective of trees with superior genetical qualities should be:

(i) Introduction of suitable climatic races of a given species.

(ii) The collection inside New Zealand of seed which has been free-pollinated.

(iii) The controlled production of superior seed.

Great stress was laid on the importance of obtaining seed from the most suitable provenances. Costly mistakes had been made in the past through the introduction of inferior races of several species. It could be shown that much exertion and expenditure would be justified in obtaining seed from the best sources, even if production were only raised a few per cent. Choice of origin should be tested by the establishment of provenance trials—there was considerable danger of inferring too much from species trials of one origin of seed. Allusion was made to the possible existence of distinct strains of *Pinus radiata*, from different localities in California, which was held to justify a comparative test. The current widespread practice of collecting seed from good individuals in stands undergoing clear-felling was condemned owing to the restriction of choice of areas, the difficulties of selection and control, and the limitations of progeny tests where the supply of seed could not be repeated. Thulin made a strong plea for the selection and maintenance of superior stands, with the ensuing advantages of higher average quality phenotypes, ease of control and collection, and long-term existence. Collection by trained parties from standing trees in a seed area was cheaper than selective collection from clear-fellings. Provenance was possibly a factor even with seed collected in New Zealand and it would be
advisable to define “provenance zones” of relatively homogeneous soil and climatic conditions. Seed would only be distributed within the zone in which it was collected.

A description was then given of future work to produce superior seed under controlled conditions. Trees of apparently desirable characteristics would be selected and clones from them would be established in plots by vegetative means to facilitate comparative tests. The testing of progeny of each clone was an indispensable step in the breeding process and would be done by controlled pollination, and vice-versa, from various other clones. By comparing the resulting progeny it would then be possible to pick out clones with superior hereditary characteristics which could be reproduced to achieve the ultimate objective—establishment of “seed orchards” for the production of elite seed. Although the project was a long-term one it was not likely to be so protracted as might be supposed owing to vegetative propagation and techniques that induced early flowering. Possibly some seed could be obtained from the orchards within ten years. Until they could be established, seed collection should be carried out on the best stands, kept reserved for the purpose.

This paper aroused considerable discussion. There was general agreement that much improvement could be made in seed collection, even though there were signs that foresters had become much more “seed conscious” in the past few years.

H. V. HINDS presented a paper on The possibilities of increasing productivity in exotic forests by species selection.

Figures for plantings in period up to 1950 were first given by species to show past and modern trends. In discussing whether the existing species fulfilled possible silvicultural demands it was suggested that although much progress had been made with situing of species since the days of the afforestation boom knowledge of site requirements was far from complete, particularly of those pertaining to the soil and its composition. Much had still to be learnt of inherent characteristics, even of seeding habits of established species. More experience was required of trees suited to heavy clay soils and of soil improvers for ground cover or underplanting. The technique of mixtures required exploration; and there was a shortage of quick-growing and shade tolerant species suitable for interplanting. Many sites, in fact, were not used to maximum advantage. The overwhelming preponderance of pure P. radiata stands had obvious dangers.

It was maintained that the present selection of exotic species would on the whole meet New Zealand’s future wood requirements; but possible exceptions were shortages of high strength timber of quality hardwoods for special uses, and of strong pole and post timbers.

Lines of action suggested were:—

(a) Continued study of site factors and tree characteristics with special reference to ecology and soil research. Part of the study would desirably be carried out in N.W. America.
(b) Collection of data of past trials of the less common species and of all mixtures.
(c) Testing of timber quality of secondary species as soon sufficient suitable supplies were available.
(d) Some adjustment of large scale planting to conform to timber requirements.
(e) Limited and strictly controlled trials of promising new or insufficiently tried species.
(f) Optimum treatment of these trials and of plots in stands already successfully established.
(g) Trials with soil improvers and mixtures.
(h) Experiments towards accelerated conversion of inferior species on good sites, e.g. *P. ponderosa* var. *scopulorum*.

The following possibilities were suggested on present information for more extensive planting on suitable sites:

Established species:—Larch, including hybrid and Japanese; and Douglas fir.

Partially or locally established species:

- *P. pinaster* (poor sites); southern pines; *Thuja, Cupressus macrocarpa, Cryptomeria japonica, Euc. gigantea* (inter-planting and underplanting); poplars and selected eucalypts (for woodlots).

For analysis of past results and trial if justifiable:—


Quality hardwoods and soil improvers:

- Selected oaks, ash, acacias, chestnut, sycamore, *Alnus* and beech.

In conclusion it was emphasised that approach on these lines to extracting the full silvicultural possibility from exotic species could not be divorced from the parallel problems of seed improvement, provenance research and the evolution of optimum tending practice.

J. E. HENRY presented, *in absentia*, a short paper on *The full use of forest land by the planting of minor species*.

It was maintained that the current practice in New Zealand of planting large blocks of one species resulted in unestablished areas both within and on the edges of compartments. This wasted land could well be put to grow useful produce and provided opportunity for planting species not in general use. Possibilities were numerous; material for local use—constructional timber, bridge stringers, high lead poles; timber for special purposes such as turnery or sports gear; or even posts or firewood.

The vacant areas could also be used as testing grounds for the neglected species—the oaks, maples, eucalypts and other hardwoods. Such a diversion from current practice would provide foresters with mental and practical exercise and would foster the development of
new nursery and silvicultural techniques, as well as making fuller use of the forest estate.

In discussion on the two preceding papers it was generally agreed that insufficient attention had been given to the breaking up of large blocks of pure species, and there was some support for an enhanced use of mixtures, especially those containing hardwoods. It was suggested however that experimental plantings should be in specific blocks to avoid the patchwork of stands that had proved an embarrassment to management in Southland.

R. S. MACARTHUR read a paper on *Some observations on initial stand density and its influence on the growth increment and timber quality of Pinus radiata*.

It was stressed that the data to be presented were not intended to be more than a minor contribution to a problem of great complexity. They included some of the salient facts that had come to light in the course of an extensive detailed investigation that had not yet been completed. Comparable stands of different initial spacings of merchantable age were so rare and data so inadequate that conclusions were more in the nature of intelligent guesswork—not however an out-of-the-way situation for a practising forester.

Tables were presented comparing outturn from stands of wide initial espacement with that predicted from the yield table for Rotorua *P. radiata*. Figures for Site II (for which the more data were available) were:

### SITE II. Volumes to 6 in. top cubic feet i.b.

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Initial Stand Density</th>
<th>Yield Table</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>300 trees/acre</td>
<td>300-500 trees/acre</td>
</tr>
<tr>
<td>11</td>
<td>—</td>
<td>400 (3)</td>
</tr>
<tr>
<td>16</td>
<td>2,500 (3)</td>
<td>—</td>
</tr>
<tr>
<td>17</td>
<td>2,700 (1)</td>
<td>—</td>
</tr>
<tr>
<td>20</td>
<td>3,300 (1)</td>
<td>4,300 (2)</td>
</tr>
<tr>
<td>21</td>
<td>—</td>
<td>4,600 (1)</td>
</tr>
<tr>
<td>22</td>
<td>—</td>
<td>6,200 (3)</td>
</tr>
<tr>
<td>27</td>
<td>6,300 (1)</td>
<td>—</td>
</tr>
<tr>
<td>28</td>
<td>7,300 (2)</td>
<td>9,000 (2)</td>
</tr>
<tr>
<td>30</td>
<td>8,400 (1)</td>
<td>—</td>
</tr>
</tbody>
</table>

(Figures in brackets indicate numbers of plots.)

It was concluded that outturn from wide-spaced unthinned stands could only be expected to approach that predicted by the yield table at ages of 30 years or more.

Spacing trials at Rotoehu Forest (8 years, Site I) and Kaingaroa Forest (11 years, Site II) were referred to and figures were presented

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which showed that the greatest volumes at these ages were produced
at 6 x 6 feet spacing or less.

In considering the effect of initial stand density on rate of growth,
the fall-off of mean diameter as the spacing became closer was well
demonstrated by the Rotoehu and Kaingaroa trials. In the much
older stands in Kaingaroa Forest where understocking from various
causes had given rise to stands of different initial spacing this effect
was also very pronounced but the following figures showed that the
difference became much less when only the largest trees in the stand
were compared.

<table>
<thead>
<tr>
<th>Initial Stocking (Stems/acre)</th>
<th>Mean diameter at 28 years</th>
<th>Current Annual Volume Increment (5 years)</th>
<th>Total to 6 in. top (cu. ft. i.b.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All live trees (ins.)</td>
<td>All normal trees (ins.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The 60 largest trees (ins.)</td>
<td></td>
</tr>
<tr>
<td>*1. 1,003</td>
<td>12.8</td>
<td>13.8</td>
<td>19.2</td>
</tr>
<tr>
<td>2. 565</td>
<td>15.8</td>
<td>17.0</td>
<td>19.1</td>
</tr>
<tr>
<td>3. 457</td>
<td>16.4</td>
<td>16.8</td>
<td>19.6</td>
</tr>
<tr>
<td>4. 356</td>
<td>16.7</td>
<td>17.7</td>
<td>20.5</td>
</tr>
<tr>
<td>5. 218</td>
<td>18.3</td>
<td>20.0</td>
<td>21.3</td>
</tr>
</tbody>
</table>

* Actual age 30 years. Diameter at 28 years obtained from increment borings.

A study of the current annual diameter increment from borings in
each of these stands showed, however, that at that age there was
little difference in current growth. Current annual diameter incre-
ment varied from .32 inch to .38 inch with no significant difference
between stands. This was also borne out by current annual volume
increment which was very much less in the wider spacings owing to
the fewer number of live trees. The fact that there was little or no
difference in C.A.I. between stands 1 to 3 seemed to be significant
and worth further study.

The most noticeable feature of the relative rates of growth was
the effect on the eventual rotation for production of a given size.
If a mean diameter of 22.5 in. d.b.h. was arbitrarily assumed as being
the optimum tree size required then rotations under the various
initial stockings on Site II would be (for unthinned stands):

<table>
<thead>
<tr>
<th>Initial Stocking</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stems per acre</td>
<td>Years</td>
</tr>
<tr>
<td>1,003</td>
<td>63</td>
</tr>
<tr>
<td>565</td>
<td>55</td>
</tr>
<tr>
<td>457</td>
<td>45</td>
</tr>
<tr>
<td>218</td>
<td>38</td>
</tr>
</tbody>
</table>

These figures were obtained from stem analyses of mean sample
trees.
Initial stand density and timber quality. The very limited data that had been given tended to confirm the already generally known fact that initial stockings of less than 500 trees per acre resulted in reduced total volume production and increased diameter growth. In certain circumstances of forest ownership and management practice these two facts might be balanced to meet the local objects of management. The other major factor affected by these natural growth laws was that of timber quality—the most difficult of all to evaluate.

An attempt to obtain information on this point had been made at Kaingaroa last year when five one-acre plots (referred to above), selected for their differential initial stockings, had been felled, milled and graded as scantling under current grading rules. The plots were on identical sites (IIa) and the distribution pattern of trees within the plots had been shown statistically to be quite satisfactory. No thinning had been done.

The results showed that the temperament of the breast bench operator appeared to have a profound influence on grades and conversion factors but they also showed that the percentage of No. 1 dimension timber was not markedly affected by initial stocking viz:

Plot No. 1. Initial stocking 1,003 stems/acre No. 1 Dimen.% 18.5
Plot No. 2. Initial stocking 565 stems/acre No. 1 Dimen.% 18.3
Plot No. 3. Initial stocking 457 stems/acre No. 1 Dimen.% 19.4

The reasons for this apparent similarity could possibly be explained by the fact that:

(a) Diameter is a function of branch size.
(b) *Pinus radiata* tended to assert its dominance as shown by the slight difference in mean diameter between the largest trees of stands at different initial stockings.
(c) Stands of lower initial stockings at the age under investigation contained more sound tight intergrown knots.

These possibilities were confirmed by the following analysis of 2% of the sawn material.

<table>
<thead>
<tr>
<th>Initial Stocking Stems/acre</th>
<th>Surface area of knots as % of total surface area sawn</th>
<th>% Intergrown knots</th>
<th>% bark encased knots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 1,003</td>
<td>.92</td>
<td>76.6</td>
<td>23.4</td>
</tr>
<tr>
<td>2. 565</td>
<td>.80</td>
<td>83.7</td>
<td>16.3</td>
</tr>
<tr>
<td>3. 457</td>
<td>.98</td>
<td>86.8</td>
<td>13.2</td>
</tr>
<tr>
<td>4. 356</td>
<td>1.18</td>
<td>84.9</td>
<td>15.1</td>
</tr>
<tr>
<td>5. 218</td>
<td>1.16</td>
<td>82.0</td>
<td>18.0</td>
</tr>
</tbody>
</table>

The 2% sample from which the data were obtained was not however large enough to give statistically valid results.
These data could be supplemented by actual branch measurements (10 feet above ground to 4 in. top) on 5 sample trees in each of plots 1, 2, and 5.

<table>
<thead>
<tr>
<th>D.B.H. o.b. (ins.)</th>
<th>Mean branch diameter (ins.)</th>
<th>Maximum branch diameter (ins.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.4</td>
<td>.8</td>
<td>2.2</td>
</tr>
<tr>
<td>18.3</td>
<td>.8</td>
<td>2.0</td>
</tr>
<tr>
<td>14.9</td>
<td>.7</td>
<td>2.0</td>
</tr>
<tr>
<td>12.0</td>
<td>.7</td>
<td>2.0</td>
</tr>
<tr>
<td>9.0</td>
<td>.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Plot 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.4</td>
<td>1.2</td>
<td>2.8</td>
</tr>
<tr>
<td>20.2</td>
<td>1.2</td>
<td>3.0</td>
</tr>
<tr>
<td>16.4</td>
<td>.7</td>
<td>1.8</td>
</tr>
<tr>
<td>14.1</td>
<td>.7</td>
<td>1.8</td>
</tr>
<tr>
<td>10.8</td>
<td>.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Plot 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.0</td>
<td>1.5</td>
<td>4.0</td>
</tr>
<tr>
<td>23.9</td>
<td>1.5</td>
<td>3.6</td>
</tr>
<tr>
<td>20.3</td>
<td>.8</td>
<td>2.2</td>
</tr>
<tr>
<td>17.3</td>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>12.9</td>
<td>.8</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Allowing for bark thickness at the point of measurement and taper of a branch inwards within the tree it could be seen that overall there was not such a great difference as might be expected, and this, plus the fact that intergrown knots up to 1½ in. were acceptable in certain grades, explained the slight difference in overall grading results.

Additional figures that were presented from a variety of stands showed that whatever the initial stocking mean branch diameters were inevitably over .5 ins. owing to the tendency of *P. radiata* to assert its own dominance. Stands at wide spacing produced trees with mean branch diameters up to 2-3 times that size which must have an inevitable effect on grade. It was an argument for pruning if clear grades of timber were to be produced in reasonable rotations.

Finally, it was stressed that the differences in branch size between stands at 6 x 6 feet spacing and wider spaced stands was so small that it was outweighed in many instances by individual tree variation. The following measurements were of two trees alongside each other in Kaingaroa Forest—both planted at 6 feet spacing and with mean radial distances to the 4 closest trees of 9½ feet and 9 feet respectively.
<table>
<thead>
<tr>
<th></th>
<th>Tree No. 1</th>
<th>Tree No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.B.H. o.b. (ins.)</td>
<td>16.7</td>
<td>17.3</td>
</tr>
<tr>
<td>Total height (ft.)</td>
<td>108</td>
<td>115</td>
</tr>
<tr>
<td>Nos. branches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 ft.—4 in. top</td>
<td>250</td>
<td>133</td>
</tr>
<tr>
<td>Distance 20 ft.—4 in. top</td>
<td>70 feet</td>
<td>66 feet</td>
</tr>
<tr>
<td>Nos. of whorls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 ft.—4 in. top</td>
<td>48</td>
<td>17</td>
</tr>
<tr>
<td>Mean branch diameter</td>
<td>1.0 in.</td>
<td>1.3 in.</td>
</tr>
<tr>
<td>Maximum branch diameter</td>
<td>2.4 in.</td>
<td>2.8 in.</td>
</tr>
<tr>
<td>Nos. of cones on main stand</td>
<td>73</td>
<td>Nil</td>
</tr>
<tr>
<td>Per cent branches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for diameters of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0-0.9 in.</td>
<td>58.0</td>
<td>41.4</td>
</tr>
<tr>
<td>1.0-1.9 in.</td>
<td>36.8</td>
<td>48.1</td>
</tr>
<tr>
<td>2.0-2.9 in.</td>
<td>5.2</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

It appeared that individual tree variation could produce branching effects and influence timber grade and quality to an extent equal to that produced by initial spacing. It was suggested that site/type relationships and tree breeding should receive equal or greater emphasis in the search for optimum spacings for *Pinus radiata*.

In a contribution on *Contract Pruning at Karioi Forest* J. L. ORMEROD described the large acreage of *Pinus ponderosa* and *Pinus murrayana* that had received no silvicultural attention. Pruning could not be expected to be economic unless it was done in the next few years. In order to cover the ground as quickly as possible a piece work system had been introduced. The result had been higher earnings for the workers (mostly displaced persons from Europe) and a much higher performance per man-day. Marking techniques and methods of organising and controlling the work were described.

A paper by J. G. GROOME on *Thinning by Poisoning* is given elsewhere in this Journal.

J. T. MILLER read a paper on *The resiting of species as an aid to increasing productivity in the Tapanui District*.

The exotic State forests of Tapanui District, Southland, dated from 1900 and were old by New Zealand standards. In the early days planting practice had been largely experimental and based on European procedure; and so numerous attempts had been made to establish a large variety of the well-known timber trees of European hardwoods, such as oak, ash, sycamore, birch, beech, and alder, and conifers such as Norway spruce, larch and Corsican pine. Although survival had been good poor growth and form had brought about
their rejection as suitable species. A second practice influenced by European tradition was that of planting over limited areas to make up a patchwork of stands, commonly under 10 acres, sometimes only 3 acres or so. Some 1,850 acres of Dusky and Conical Hills Forests were so constituted. By 1910 however larger and more workable stands were being established with species of proven value, with a few non-European exceptions such as *P. ponderosa* var. * scopulorum*.

The result to-day was that 3,000 acres out of a total of 18,000 acres had an abnormally low production potential, either owing to the presence of lingering unsuitable species or because they were set out in too intricate a system of stands and species to allow economic management. It was therefore necessary to assess the unproductive areas as prospective sites for commercial species and to devise and apply methods of conversion. It was not difficult to suggest suitable species as the patchwork scattering of plantations over a wide variety of sites provided ample comparative data. But many of the existing stands were difficult to utilise or even get out of the way and it was clear that speed of conversion would have to be sacrificed to economy.

The first attempts had been made in 1949 on the 450 acres of unthrifty *P. ponderosa* var. * scopulorum* 28-35 years old. The stand was thinned to 400-500 stems per acre, roughly windrowed, and interplanted with 2/1 Douglas fir at an intended spacing of 4 x 12 feet or about 900 trees per acre. *Cupressus macrocarpa* and *Thuja plicata* had also been tried but had been found to be less successful in winning clear of weed growth. 130 acres had been covered to date. The method could probably be extended by a similar treatment with *P. radiata* in the Norway spruce areas.

Methods could be more various where the original stand was marketable. Larch of inferior quality that was unlikely to be retained for a second rotation could be underplanted with Douglas fir some years before removal of larch and time saved in re-establishment. Natural regeneration from these plantings and from the existing Douglas fir might become a valuable assisting factor in the future.

Where minor produce could be marketed there were possibilities of clearing on contract or piece work and successful operations in larch were being carried out in that way at Conical Hills to leave a very clean floor well suited to replanting.

The establishment of a small treatment plant would enable a wider range of material to be cleared, both from areas of doubtful marketability and from the patchwork areas. A plant would also influence the working of the larger areas containing undesirable mixtures of ponderosa pine, Corsican pine and Austrian pine, where its ability to turn out marketable produce from a variety of species would enable the areas to be attacked on a face.

In a contribution on *Some silvicultural problems in Canterbury* R. M. MARTIN stressed the need for sound silvicultural practice if
full productive values were to be realised. Frequent winds of gale
force aggravated the normal problems confronting the forester in
New Zealand.

At Hanmer Forest there were 2,500 acres of Corsican pine, two-
thirds of it 20-30 years of age and all virtually unthinned. The crop
was approaching stagnation. It was not too late to thin—there was
less risk of windthrow in so doing than in leaving stands untreated.

1,000 acres of European larch were in a similar critical condition.
Thinning appeared to be governed by the intake of the creosote plant
equivalent to 26 acres per year. Windthrow in untreated areas was
becoming significant. Early thinning again appeared to be the only
answer from the silvicultural aspect—the question was how to recon-
cile it with economic considerations.

A third problem lay in the conversion of 1,400 acres of *P. pon-
derosa* var. *scopulorum* to more valuable species. Underplanting
with larch or Douglas fir appeared to be the best possibility; alter-
natively, clear-felling the best sites and planting with larch.

At Balmoral Forest the major difficulty arose from extensive
windthrow in the 13,000 acres in unthinned *P. radiata* which mostly
dated from the late twenties. Soil was shallow over impenetrable
gravel and rooting was superficial. In 1945 a gale following heavy
rain flattened 2,500 acres and damaged 2,000 acres. Serious damage,
but more dispersed, also occurred in 1951. Thrown trees remain
attached by their roots, and laterals and leaders turned toward the
light. This had enabled protracted salvage to be carried out but
had made the problem of re-stocking more acute. Fallen stems and
phototropic growth masked regeneration, expense of clearing by hand
or by machine was prohibitive, fire would be dangerous and would
destroy the seed.

Where re-stocking had been successful either by planting or by
natural regeneration it appeared desirable to reduce the stocking to
12 x 12 feet when the crop had reached 15 feet in height.

The rotation to be adopted presented a further problem—
whether it would be possible to retain the crop after it had reached
the apparently critical height of 60 feet at about 25 years. A rotation
of 35 years was considered the limit—a shorter one if the crop remained
unthinned. In that case there would be large quantities of small
diameter timber—the yield would be of the order of 1\(\frac{1}{2}\) million cubic
feet to a 4-inch top on a 30-year rotation. It was maintained that
the successful management of Balmoral depended on the establish-
ment of some industry capable of absorbing large quantities of small
material.

At Ashley Forest 2,000 acres had been established since 1939,
chiefly with *P. radiata*, but only 700 acres had been pruned and 30
acres thinned. Silviculture was already in arrears and there was
danger that the pattern of events would follow that of earlier-estab-
lished forests of the country. Labour shortage accounted for some of the lag but once more the bogey of windthrow following thinning had been raised—in reality it was not nearly so formidable as on the stony plains as the rooting on the local yellow brown earth was relatively good. A sample plot gave strong indication that a heavy thinning was the best policy. If this were accepted the labour problem would have to be solved—possible ways included contract pruning, provision of transport from Rangiora, better ways of using the existing force and pruning during the summer. Probably all these measures would be insufficient unless the annual planting target of 450 acres could be reduced.

For various reasons orthodox forestry had been largely neglected in Canterbury and the result was an unsatisfactory state of forest management. The remedy lay in silviculture.

A paper on *The larch management problem in WaioTapu Forest* was presented by H. B. FLEMING.

WaioTapu Forest contained over 3,000 acres of 40-48 year-old *Larix decidua*—37% of New Zealand’s acreage of that species. The locality appeared to be an optimum site, and both growth and mechanical properties were superior to Britain’s best. About 98% of the crop was Site Quality I.

The stand had been planted 4 x 4 feet, and almost no tending had been done until the age of 35 years; and even now some 80% of the crop was virtually untouched. Graphs of the relation between suppressed and dominants showed that suppression had set in at the age of 10 years. Intensity of competition waned at about 35 years and there were prospects that the present dominants would be left unhampered at about 65 years. In the peak suppression period deaths had averaged 85 stems per acre per year. At present the average unthinned stand had 600 stems per acre; a dominant height of 90 feet (cf. mean height on British Site Quality I of 76 feet); a mean d.b.h. of dominants of 12 ins. (cf. mean d.b.h. of British Site I of 10.5 ins.); and a volume of 7,500 cubic feet. The stands were grossly overcrowded and it was fortunate that with so many trees predisposed to attack the larch canker had not yet appeared.

Present silvicultural practice consisted in thinning to 140-160 stems per acre—a removal of about 3,000 c. ft. Progress was limited by shortage of labour. It was found that increment on trees left was not enhanced as a result of thinning. Douglas fir had been underplanted for the last three years but it was feared it would not continue to thrive under an overstorey of the current density. (See Plate 6, facing page 314).

The problem of managing the crop to increase its productivity was influenced by the following considerations:

Re-establishment by natural regeneration was impracticable.

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The present demand for transmission poles and the high prices obtained justified clear-felling at an early age.

Profitable thinnings could not be carried on indefinitely at the present intensity as with increasing mortality from suppression there would eventually be insufficient material to make thinning show a profit.

There were many objections to the speedier covering of more ground with a lighter thinning—less profit, more wasted produce owing to subsequent deaths, little chance of enhanced increment, and no improvement of distribution of existing age-classes.

Broadly speaking, increase of productivity could only be obtained by converting part of the site to a different species and by clear-felling part of the crop at the present immature but profitable age.

The measures proposed were:

Conversion of lower Site Quality I, say 1,000 acres, by thinning to 80 stems per acre and underplanting 6 x 6 feet with Douglas fir. Larch to be removed at maturity.

The area already adequately thinned, 600 acres classified as upper Site Quality I, to be left for clear-felling at maturity and then replanted with larch.

Clearfelling the remaining area of upper Site Quality I (primarily for heavy poles) over a period of years, and replanting with larch. There was no reason to think that the market could not absorb the quantity involved.

These measures would result in an immediate start in the formation of a young crop which could be properly tended in a more even series of age gradations. A density of 80 stems per acre would allow profitable thinning for many years; the overstorey would not be too dense for the Douglas fir.

Fleming was confident that the demand for larch would grow as log dimensions became larger, as its strength and durability became appreciated and as the supply of comparable indigenous timber waned. Urgent consideration must be given to the raising of a second crop.

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NOTES

FARM FORESTRY COMPETITION

The farmers in several parts of New Zealand have been more or less keenly alive to the value of shelterbelts and woodlots as adjuncts to thrifty farm management. The Wairarapa generally is one of these parts where many farmers have shown continued interest in trees. Their influence is recognisable in their immediate localities.

To draw attention to their works and to stimulate further interest in tree planting the Wairarapa Branch of the Federation of Farmers