doubled by the addition of interest charges. Furthermore it was assumed that 20 per cent. of the trees pruned would be removed in thinnings or fail to reach maturity thus adding one quarter to the cost on the surviving trees.

**TABLE SHOWING RELATIVE COSTS OF PRUNING.**

<table>
<thead>
<tr>
<th>Species</th>
<th>Method</th>
<th>Trees pruned per hour</th>
<th>Cost per hour</th>
<th>Cost per tree</th>
<th>Computed cost per tree at maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas fir</td>
<td>Long saw</td>
<td>12</td>
<td>24d.</td>
<td>2d.</td>
<td>5d.</td>
</tr>
<tr>
<td>Western yellow pine</td>
<td>Long saw</td>
<td>12</td>
<td>24d.</td>
<td>2d.</td>
<td>5d.</td>
</tr>
<tr>
<td>Corsican pine</td>
<td>Long saw</td>
<td>11</td>
<td>24d.</td>
<td>2.2d.</td>
<td>5.5d.</td>
</tr>
<tr>
<td>Corsican pine</td>
<td>Long saw</td>
<td>10</td>
<td>24d.</td>
<td>2.4d.</td>
<td>6d.</td>
</tr>
<tr>
<td>Austrian pine</td>
<td>Long saw</td>
<td>8</td>
<td>24d.</td>
<td>3d.</td>
<td>7.5d.</td>
</tr>
<tr>
<td>Corsican pine</td>
<td>Axe</td>
<td>5</td>
<td>24d.</td>
<td>4.8d.</td>
<td>12d.</td>
</tr>
<tr>
<td>Douglas fir</td>
<td>Axe and irons</td>
<td>3</td>
<td>30d.</td>
<td>16d.</td>
<td>25d.</td>
</tr>
<tr>
<td>Douglas fir</td>
<td>Axe and irons</td>
<td>1</td>
<td>30d.</td>
<td>30d.</td>
<td>75d.</td>
</tr>
</tbody>
</table>

The costs range from 5 pence for the cheapest operation, to 6/3 per tree for the more extensive method tried. From the above figures it would seem that pruning operation to 15 feet with the long-handled saw could scarcely fail to be profitable and to the writer it appears that even the more extensive operation would be advisable on the taller and better trees.

**THE SIZE OF SAWMILLING UNITS IN NEW ZEALAND.**

By A. F. CLARK.

From time to time discussions have arisen as to the desirability of the existence of the many small sawmills which operate in the Dominion, especially from the point of view of efficiency and low costs. It is difficult to arrive at the output of the average sawmill. The official year book for 1935 gives 355 mills with a total output for the year 1932-33 of 166,000,000 super feet. This figure gives a yearly average output of 467,000 super feet per mill. This is a very low figure and the abnormal conditions in the industry at the time, together with the fact that it is a general average, must be considered fully. The average figure is probably of little real value but there can be no dispute that the sawmill in New Zealand is generally a small industrial unit.

The opponents of the small unit base their opposition to it largely upon the assumption that small industrial units must necessarily be of low efficiency, that the trend in most industries is toward
the development by various means of large very efficient units and that therefore the sawmilling industry would best be organized upon the basis of a relatively few large units.

Supporters of the small unit argue that firstly large units, if developed, would tend to concentrate power, mainly political, in the hands of a few people who would be able to influence political opinion unduly in their favour and secondly that the existence of a large number of small sawmills is sound *prima facie* evidence of their suitability to the industry.

Taking the first argument of the supporters of the small unit, there is no doubt a tendency for those owning or operating very large industrial units to be able to exercise undue political influence, but nevertheless this fact has not prevented the large industrial unit from developing where favourable, and most states take more or less adequate steps to limit this political power which inevitably accumulates. So far as sawmilling in New Zealand is concerned there is moreover little doubt that the small units concentrate their possible political power by forming associations which are organizations largely and frankly designed to further the interests of the industry by political as well as economic means. There is probably not a great deal to choose between the power exercised by small units forming an association and the possible power which would be exercised by a few large units. If anything the writer would judge that the association if firmly established, would in a democratic state, be the stronger.

The second argument of those in favour of the small unit can be taken in conjunction with those of the supporters of the large unit. The fact that small units exist is not itself by any means sound evidence that they are the most suitable to the industry, rather it may show that it is in a low stage of industrial evolution. An industry may be organized into small units for various reasons, the chief of which are that the market for the product is limited, capital is not available for the formation of large units, the demand for the product is inelastic and the industry therefore subject to great fluctuation in price levels, and that there are difficulties of an inherent nature which keep the industry divided into small units. Political action in the form of protective tariffs and the formation of selling organizations amongst members of the industry in that they restrict competition within the industry, tend also to support the small unit.

It seems evident that the factor which keeps the sawmilling industry organized into small units is inherent in the nature of the industry in New Zealand. It is true also that, owing to high costs of transportation, the market available to most sawmill units is limited, yet the market is sufficiently large (especially with the recent development of the export trade in rimu timber) to justify on that score alone the formation of much larger units.

As an industry, the productive aspect of sawmilling is sharply divided into two phases; the first phase is extractive in nature and the second is manufacturing. The extractive side of the industry,
the logging operations, are like all extractive processes, strongly subject to diminishing returns. There is no doubt that this is especially marked in New Zealand. How far these diminishing returns operate and how rapid is their operation, depends upon the favourability of the country, the stand per acre, and the type and quality of the timber involved.* Generally speaking diminishing returns must operate at an early stage in New Zealand owing to the generally low stand per acre, great weight of the timber, high defect factor in some cases, and broken nature of the country. Since diminishing returns are strongly to be found it is necessary therefore, to keep costs mainly of a prime nature. Thus there is a general absence of highly expensive logging equipment employed, and supplementary costs are kept as low as possible. Prime costs should in their essence be as elastic as possible, but there is no doubt that the sawmilling industry like most others, has been handicapped in New Zealand by lack of elasticity in these costs, and even at the present time although certain elasticity has been obtained, public opinion generally prevents this from operating to the full extent. Thus we see that the tendency is to reduce the number of days worked rather than unduly to lower the wages level. This again tends to restrict the use of expensive logging equipment and to restrict the scale of logging operations.

The size of the manufacturing aspect of the industry appears to be influenced largely by the inelasticity of prime costs, the fact that owing to the extractive side of the industry being necessarily upon a small scale, the supply of raw material is limited, the weight and nature of the raw material and the high cost of modern machinery in New Zealand. All these factors tend toward the maintenance of the small sawmill which is equipped with a fairly standard equipment of such a nature that it can be transported and re-erected upon new sites.

It would appear to be quite useless to expect the economies which can only be obtained by large scale units. There is a point beyond which the organization of an industry into larger units is uneconomic; this point is the point of maximum efficiency. With the sawmilling industry the point of maximum efficiency is soon reached and further expansion instead of increasing efficiency would be definitely uneconomic, leading to increasing costs. The dominance of the extractive aspect of the industry appears to be the main limiting factor to the size of the sawmill unit.

The possibility of increasing the size of the mill and securing the economies of large scale production by dividing the industry into two parts, the one extractive or logging and the other manufacturing or milling, the former supplying the latter with raw material, is precluded by transport difficulties. The transport of logs for long distances by rail is too costly owing to the nature of the country, distribution of the forests and the character of the timber. River

* A footnote in the Report of Tariff Commission 1933 notes these points.
Dense silver-beech pole stand thinned to 420 trees per acre: Average age 62 years, mean D.B.H. 6.9 ins., mean height 48 ft. Unthinned silver-beech in right background. Woodlaw State Forest, Southland.
transport is not, except in a very few cases, possible, and in most cases the nature of the timber does not lend itself to this method even if suitable rivers were available.

It would seem that the small unit must continue in the saw-milling industry of the Dominion and that any general aggregation into large units is of very doubtful wisdom.

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**SILVICULTURAL NOTES ON NOTHO FAGUS MENZIESII.**

By T. T. C. BIRCH.

**Regeneration**

A problem of primary importance in the silvicultural management of silver-beech (*Notofagus Menziesii*) is to devise a practical method of introducing regeneration into those portions of the forest which are overmature and unproductive.

A very considerable proportion of Southland silver-beech forest is composed of an upper storey of overmature seed-bearers, a lower or middle storey of *Elaeocarpus Hookerianus, Suttonia australis, Pittosporum eugenioideus, Carpodetus serratus, Coprosma* spp., tree ferns, and other shrubs and small trees, whilst the forest floor is characterised by a dense and often pure covering of the fern *Blechnum discolor*, on a deep bed of organic debris. Under such conditions silver-beech regeneration is absent, and it is evident that this has been the position for many decades. Either fertile seed is not reaching the forest floor or alternatively the condition of the soil is unfavourable for beech regeneration.

In an endeavour to find an answer to the first alternative, several small samples of leaf mould containing silver-beech mast were collected in September, 1935, from beneath typical over-mature trees in the Woodlaw forest. The litter containing mast was sown thinly on three boxes of soil, watered periodically and kept beneath partial shade. The subsequent development of some 50 silver-beech seedlings from these samples clearly demonstrated the fertility at least of the 1935 seed crop in that locality. A close scrutiny of the surface layers or organic matter beneath overmature seed-bearers disclosed the presence of many germinating and fully germinated silver-beech seed, the radicles of which, though well developed, had subsequently shrivelled, unable to penetrate the comparatively dry upper layer of leaf mould which averaged 3-4 inches in depth. In many places the mineral soil was covered by leaf mould and humus to a depth of six inches. Evidence of the establishment of silver-beech was found in many varied sites, beneath dense *Coprosma* thickets, on decomposing moss-covered logs, and in small forest clearings, but never in sites where an appreciable depth of leaf mould had accumulated.