THE USE OF NEW ZEALAND GROWN EUCALYPTS*

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Summary

The very strong durable hardwoods imported from Australia for piles, poles, crossarms, sleepers and constructional timbers have long been recognized as the natural complement to our generous supplies of softwoods. High hopes held by many growers of eucalypts that New Zealand could become independent of the Australian supply have not been realized because climatic conditions do not favour the growing of the most highly-esteemed species. Four species whose timbers are grouped in the second and third strength and durability classes in Australia have been grown successfully in North Auckland, immediately south of Auckland and in isolated areas elsewhere; they are potentially useful for some of the purposes mentioned above.

There are numerous instances of plantings of very poor eucalypt species. Even with general utility species such as the "ash" group only a small proportion of the sawn product is suitable for finishing purposes and the lower grades have a limited market because softwood alternatives are in abundant supply.

On sites which are suitable for the growing of the better quality softwoods there is little justification for extensive plantings of general utility eucalypts for which the main indicated uses as sawn timber will be flooring, furniture, handles, farm and mine timbers and firewood. Relatively slow growth on "hard" country appears to result in better quality logs and sawn timber than are produced from trees grown rapidly on better quality land.

INTRODUCTION

The availability of other timbers is one of the most important factors to be considered in a discussion of the use of New Zealand grown eucalypts. This country has been well endowed with natural resources of medium density coniferous timbers whose excellence for general purposes was at least in parallel with that of the best Australian hardwoods for special purposes. The latter group of timbers has in fact provided the complement to the local timbers to a remarkable degree. Our regard for eucalypt timbers which led to their introduction on an intensive scale was engendered by a desire for self-sufficiency in meeting our needs for poles, piles, heavy construction timbers, sleepers and similar purposes where high strength combined with very good durability is required. It soon became obvious that climate must seriously limit the extent to which the very durable, strong species

could be grown. Many species allegedly suited to New Zealand conditions were established from seed purchased in good faith from Australian suppliers. There was every reason to be disappointed. Seed in many instances was from poor strains (it must be admitted that the same criticism applies to many exotic conifers). Nursery and planting techniques were more costly than was the case with many other introduced trees. And we discovered also the incidence of insect disease of some species and the poor and unreliable quality of much of the timber produced. Most plantings have been as relatively narrow belts on farm land, conditions described as “free-growing” (or open grown) as distinct from “forest grown”. Fast initial growth in “open grown” trees is now recognized as being undesirable for eucalypts as well as for most other forest trees i.e. from the wood-users’ angle. It is of course the height of optimism to expect that trees grown to give high shelter, as quickly as possible, should also provide good sawlogs. I have no adequate details to support a statement that the wastage in conversion by sawing of large eucalypt logs in New Zealand is 60 to 70 per cent. of the true volume but there is confirmation of this criticism in statements from South Africa. Part of the explanation lies in the fact that many of the species widely planted in New Zealand are not suitable for sawn conversion.

Factual information being assembled on eucalypts growing in North Auckland and the Auckland vicinity by Mr Barr has come to hand during the writing of this paper. It is indeed fortunate that a guide to growers and potential users alike should become available for the districts where climate favours the growing of the dense, durable species, especially as these trees grow satisfactorily, without the disability of fast initial growth on poor gumland clays where conifer stands are poor.

REASONS FOR PLANTING EUCALYPTS

(a) Early extensive plantings for farm shelter and firewood were made with *E. globulus*. Its hardiness was known and also its capacity to form a large volume of dense wood at a remarkably rapid rate.

(b) It is presumed that later farm plantings deviated away from *E. globulus* because it was difficult to split into posts and firewood, and young trees did not produce durable wood for fencing; mortality due to disease also began to play havoc with *E. globulus* belts. *E. macarthurii*, *E. vinzinalis* and *E. botryoides* were prominent among the favoured species, although the reputation in Australia of the first two was low.

(c) Forest areas established about the turn of the century were intended to yield sawn timber and poles. They contained many remarkably poor species particularly so in the Rotorua district where frost-hardiness was considered a pre-requisite. Of twenty-six species listed as successful at Rotorua from the growers’ point of view in 1922, only a handful have produced satisfac-
N.Z. JOURNAL OF FORESTRY

tory sawlogs. Experience has been that coniferous species would have given a much better return on the land made available for forest establishment. Elsewhere where the climate has been more favourable some of the better quality eucalypts have been grown. Ash-type eucalypts together with *E. fastigata* and *E. obliqua* have been some of the most consistent in log quality and yield in the south.

(d) A few keen eucalypt growers have kept alive the urge for self-sufficiency in items such as poles, piles, crossarms, bridges and constructional timber and have achieved a measure of success with establishment in select localities of species in the top two groups for strength and durability. One nursery in Hawke's Bay, where the writer was employed about thirty-three years ago, offered for sale a very wide range of eucalypts including many of the top group species. Records of successes and failures in the farm woodlots and local body plantations are notably incomplete. The sustained effort in North Auckland during recent years to assess the value of the various species is healthy: similar farm forestry organizations in other localities may be expected to provide a much-needed guide to growers along similar lines.

FACTORS WHICH DETERMINE UTILITY: THEIR REALIZATION WITH EUCALYPTS IN NEW ZEALAND

**Availability**

Continuity of supply is a very important consideration with large organizations budgeting ahead for any important commodity. Locally-grown eucalypts have not been available in sufficient quantities to warrant trials by the organizations with whom the Forest Service has the most active co-operation. Disposal of supplies even of the best quality eucalypts is therefore localized and mostly unrecorded. Other timbers with excellent properties such as European ash, oak, sycamore, birch, beech and walnut are only too frequently converted into firewood, mine props or similar rough uses because the very restricted quantities offered are not attractive to the specialist user.

**Tree Form and Size**

A few eucalypt stands mainly on good land have yielded uniformly good grade logs. It is much more common to find that the majority of logs are of poor form. Stands of conifers give a more assured return to the grower on most sites.

**Sawn Conversion, Grading and Seasoning Round and Sawn Material**

New Zealand is more accustomed to handling softwoods rather than hardwoods, and has been inclined to condemn any species which does not stand abuse as do the indigenous softwoods. Even with an amenable hardwood like tawa, trade has been slow to develop because in the first instance the producer failed to adjust his sawing and seasoning techniques, and secondly the user has failed to realize that extra care
in storage and moisture content control is necessary. One may instance the mishandling and misuse also of the beech timbers as the primary reasons for their restricted uses. Confusion of species with different timber properties has played a part in retarding the use of the beeches; the far wider differences between the timbers yielded by the locally-grown eucalypts have all too-frequently been overlooked. "Blue-gum" has been a cover-all name in the same way that "birch" has been for the beech timbers.

Various ideas have been put forward for preventing splitting or distortion of eucalypt timber during or after sawing. They include:

(a) Leaving logs after felling in the shade to season in the round for two years or more, or even until sapwood decays in *E. globulus*.

(b) Leaving heads and roots attached to allow partial seasoning in the round before cross-cutting and milling—reported to have reduced checking in *E. obliqua* and *E. saligna* but not in *E. resinifera*, as compared with trees crosscut immediately.

(c) Ring-barking 1½ to 2 years before felling for *E. viminalis* and *E. fastigata*.

(d) Autumn or winter-felling to allow partial seasoning before summer (this is recognized as advantageous for many other timbers).

The reaction of the timber industry to these ideas may confidently be claimed to be unfavourable.

Some of the denser beech timbers are block-stacked for several weeks immediately after sawing and then filleted with thin fillets in stacks roofed to give protection from sun and rain. End coatings are also used to prevent end-checking. This end-coating and seasoning procedure is recommended for the eucalypts. In Taranaki high stacks with gable type roofs gave very satisfactory results with *E. fastigata*; 1 in. stock seasoned to 20 per cent. M.C. in 5 to 6 months without showing much face checking. Fillets were at 2 ft. centres.

Preliminary air seasoning of 1 in. stock for 4 months under cover with closely-spaced thin fillets preceded kiln-drying of small lots of 35 to 40 year old eucalypts from the Whakarewarewa State Forest. The boards, which were in good condition after re-conditioning, were run into flooring and used in two houses; *E. risdonii var. elata*, *E. obliqua* and *E. viminalis* were the species used. Of the other species included in the trials *E. ovata*, *E. fastigata* and *E. stuartiana* seasoned fairly well while *E. amygdalina*, *E. coriacea* and *E. sieberiana* seasoned badly. Overall, quarter sawn boards were better than flat-sawn and showed better recovery after re-conditioning. Timber from the central wood twisted and split in seasoning. Losses in sawing and seasoning over the whole series were very high.

Sawing procedure with large logs of the lower density species should be changed to give a higher proportion of quarter sawn boards; some items of equipment used in Australian mills might well be expected to improve the recovery. However, it cannot be expected that even the
best equipment and practice would result in a large proportion of the sawn product of locally-grown eucalypts being up to dressing quality. It is abundantly clear from South African experience with very fast-grown young eucalypts, especially *E. saligna* (or *E. grandis*) that double log edgers or two line gang frame sawing are required to overcome the problems imposed by stresses in the logs.

In the Australian grading rules suitable bases for grading of locally-grown eucalypts are provided for framing, flooring and other dressing lines. Pieces consisting of or containing sapwood are liable to attack by *Lyctus* and possibly also by *Anobium*; immunization treatment as for tawa is desirable, or alternatively strict limitations on the strips of sapwood (along corners) in species with well-defined heartwood in framing. For large constructional sizes, crossarms and poles the N.Z. Standards Institute rules governing Australian hardwoods are applicable. The age of most New Zealand grown eucalypts is such that "heart" (in the Australian sense as meaning the low density brittle centre of the log from over-mature trees) is unlikely to have developed, but the qualities of low density and general defectiveness must be expected in wood from the centre of logs.

### Specific Gravity, Strength and Variability

Where values for these properties are not available for locally-grown wood, it has generally been assumed that the Australian values apply to wood from well-stocked plantations 40 years or more in age. With open-grown trees that assumption cannot be made with confidence. Young trees typically have a steep gradient in specific gravity from the centre; *E. obliqua*, *E. risdoni*, *E. amygdalina* and *E. ovata* 15 to 16 years old had basic densities 27 to 31 lb./cu. ft. averaged from the cross-sections.

Recently strength test material from three 56 year old trees from each of four species grown in Whaka Forest (Rotorua) has been available to test the validity of the first assumption viz. that properties of relatively mature trees would be similar to their Australian counterpart. Findings were—

(a) *E. fastigata* (N.Z.) is slightly less dense, softer, lower in shear strength but generally similar in other strength properties to Australian timber, based on tests of green material. Values from Australia are not available for air dry material to permit comparison with N.Z. timber.

(b) *E. sieberiana* (N.Z.) is very much lower in density and all strength properties than Australian timber. In Australia it is the densest species in the ash group; the local timber is the least dense of the three ash group species tested i.e. grouping *E. fastigata* and *E. obliqua* in ash group.

(c) *E. obliqua* (N.Z.) is of lower density and lower strength than Australian timber.

(d) *E. scabra*. Rotorua timber is much lighter and much lower in most strength properties than Australian timber. A small
quantity of test material of this species from Banks Peninsula
gave values for density and strength similar to those for the
Australian timber.

It is of interest to note that Rotorua material shows up well in
toughness and cleavage strength but is low especially in hardness and
shearing strength. Table 1 presents values for density and principal
strength properties of N.Z. grown timber and for density of Aus-
tralian grown timber of the above-mentioned eucalypts; from the
values also given for tawa and one or two indigenous beeches it is
obvious that despite their sub-normality the eucalypts are still good
strong timbers.

In two of the species under discussion the variation in strength
properties from the centre of the logs to the bark is not excessive;
green modulus of rupture values for *E. fastigata* range from 9,000 lb.
in the central 5 in. cylinder to 10,900 lb. in wood 6 in. to 8 in. away
from the centre.

**Durability and Ease of Preservation**

The sorting out of data on durability of heartwood of eucalypts is
a slow and tedious process but the pattern is taking shape; species
tend to fall into the durability classes quoted by Australian authorities
for Australian-grown timber. At present there is a move to institute
“graveyards” in several localities for eucalypts of sufficiently mature
age growing in those localities as a positive guide to farmers for future
planting. The Forest Service is giving assistance but the credit for this
constructive approach must go primarily to the farmers’ organizations.
Apart from the Auckland and North Auckland areas where warm
climate species in the high durability classes may be grown on selected
sites, the eucalypts which may be expected to provide posts of reason-
ably good durability are few in number—*E. scabra*, *E. botryoides* and
old heart *E. globulus*.

Preservation has made rapid strides in New Zealand but mainly in
the direction of water-borne preservatives for treatment of building
timbers. Several multi-salt water-borne preservatives are beginning to
show up favourably in tests of durability in contact with the ground
but they are not yet accepted by many authorities in N.Z. for these
applications. The choice is virtually limited to creosote and penta-
chlorophenol when preservative-treated timber is accepted for long
service in ground contact. The application of preservation processes in
increasing the utility of locally-grown eucalypts has two main facets:

(a) Immunization treatment against boring insects by diffusion or
pressure treatment with water-borne preservatives of flooring
and other building timbers.

(b) Preservation of natural round products e.g. poles and posts
with creosote or pentachlorophenol to secure penetration of
the sapwood as a completely treated envelope.

Poles must be thoroughly seasoned, pre-bored for bolt holes and
“gained” before treatment, and the development of such treatment
pre-supposes that well-equipped plants will be used—comparable in fact with those currently being used for treatment of softwood poles. Treatment of natural round posts is practicable with simpler equipment. Using hot and cold bath procedure with creosote round posts of several eucalypts carrying about 1 in. of sapwood were given—

2 hours hot bath (180° to 210°F.) per inch of sapwood
3 hours cold bath (90° to 100°F.).

Complete penetration of sapwood was obtained with an absorption of 8 to 12 lb/cu. ft. but the outer ¼ in. had 12 to 16 lb/cu. ft. whereas the inner ¼ in. had only a very light retention (about 1 lb/cu. ft.). The penetration was very much affected by the presence of small checks.

TIMBER USE

Surprise has been expressed by visiting foresters and timber people that N.Z. does not grow eucalypts for our major requirements of poles, fencing posts, construction timbers and firewood. It is timely to examine this criticism in the light of experience with eucalypt species which have been extensively grown and of experience with other timbers for these uses:

(a) Ease of establishment and rapidity of growth has led to the pre-dominance of *E. globulus*, *E. viminalis* and *E. macarthuri* among eucalypts. Poor stands with a minority of good form logs, severe checking of rounds and sawn timber, splitting and twisting following sawing, difficulties in actual sawing are not good preliminaries to the use of the products. When we add to that list the disability of mediocre or uncertain durability for ground contact it is scarcely surprising that these species are not in high regard.

(b) The ash eucalypts and other light species used for similar purposes are generally non-durable and sapwood requires treatment even for light building construction, where their main use lies.

(c) Groups A and B (strength) in durability classes 1 and 2, are the eucalypts which could meet the needs for poles, fencing, heavy construction and crossarms but are not well-represented in N.Z. nor have we assembled sufficient evidence as yet to justify large scale plantings on the climatically-restricted areas. At most it is possible to say that *E. botryoides*, *E. scabra*, *E. saligna* and *E. pilularis* appear to offer reasonable hopes of success if correctly sited.

(d) If attention is directed away from Australia where hardwoods are available almost to the exclusion of softwoods, it will be found that softwoods provide the bulk of the poles, fencing, construction timber and crossarms in Europe and North America. Even Australia is beginning to show a preference for radiata pine sleepers over its own hardwoods; radiata is
easily treated with preservatives and as a treated sleeper promises to give longer service than some reputedly durable hardwoods.

The strength argument is always being pushed forward in support of eucalypts. It is too frequently forgotten that engineering design for long-term service has regard for the residual strength of members towards the end of their service life when, in the case of eucalypts, it is necessary to assume that serious deterioration will have occurred through decay and the effects of weathering. Softwoods which may be treated to rigid specifications are much less subject to deterioration, and the dimensions of members used do not require to be much greater than are required in hardwoods. In N.Z. softwoods are not yet available in the large sizes and relatively good grades required but silvicultural treatment of growing stock may prove to be more practicable than growing of high quality eucalypts.

Pole strength tests have been made on small diameter eucalypts (pole size) in New Zealand. Only one of the four species tested was superior to larch of approximately equal age, and that larch was inferior in strength to most of the Douglas fir thinnings now cut for poles from suppressed trees. More pole tests are scheduled for 1957 to determine the permissible working stresses for softwoods. It is expected, with the lower “factor of safety” applied to Douglas fir and larch as compared with Australian eucalypts, that the diameters (hardwoods in brackets) will work out:

<table>
<thead>
<tr>
<th>Length ft</th>
<th>Diameter (butt) in</th>
<th>Diameter (top) in</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>9 (8½)</td>
<td>6 (5½)</td>
</tr>
<tr>
<td>30</td>
<td>10 (8½)</td>
<td>6 (5)</td>
</tr>
<tr>
<td>30</td>
<td>11 (9)</td>
<td>7 (6)</td>
</tr>
<tr>
<td>30</td>
<td>12 (10½)</td>
<td>8 (7)</td>
</tr>
<tr>
<td>32</td>
<td>11½ (10)</td>
<td>7 (6)</td>
</tr>
</tbody>
</table>

Incidently the eucalypt diameters are for de-sapped poles.

From the strength angle the natural round is preferred to the de-sapped pole as mechanical damage such as deep adze cuts may be starting points for failure.

CONCLUSIONS

1. New Zealand grown eucalypts are useful for farm shelterbelts in combination with cypresses or other heavy-foliaged trees retaining branches down to the ground. A few of the species with medium to high density timbers may be expected to provide moderately-durable heartwood for fence posts when 40 years or more in age. They are not in general easily split into posts, and the effective size of posts is of course determined by the amount of heartwood present. Material unusable for split posts provides fence batten and excellent firewood. Lower density eucalypt timbers, e.g., the ash group, provide material for split rails, batten and firewood. Natural rounds of both groups in post sizes are suitable for preservative treatment provided they can be seasoned slowly under cover to avoid excessive checking.
2. Farm woodlots may be expected to produce better quality logs for sawing (the larger diameter trees 40 years or more in age) and in a few sites species such as *E. scabra* and *E. muelleriana* suitable for poles. In the vicinity of and north of Auckland some of the choicer species have been shown by Barr and others to be suitable, especially *E. pilularis*, *E. botryoides* and *E. saligna*. I have altogether too little data on the timbers to make a comparison with Australian-grown material.

3. A few relatively large plantations have been established. They have not been very successful in comparison with alternative species which have been grown in close proximity. The four main areas are Whakarewarewa, Waiotapu, the northern slopes of Egmont (Taranaki Forests), and Hawke’s Bay Forests Ltd., north of Napier. In all four sites *Pinus radiata* is of good form and gives high yields, while Douglas fir is also highly successful. The point may be made that the ash-type eucalypts and *E. scabra*, *E. saligna* and *E. botryoides* could provide timbers complementary in properties to the two conifers mentioned. That is correct. But the relative proportion of eucalypt timber required is small. Leaving aside for the moment the problem of low sawn conversion, the major items of such sawn production would be:

(a) Flooring in strips or blocks. Superior to the conifers for uncovered floors but requiring preservative treatment to practically the same extent to combat *Lyctus* and *Anobium* attack of sapwood. Ash-type eucalypts.

(b) Furniture, chair and handle stock (shock and non-shock types), dowels. Not superior to the indigenous beeches and tawa except for shock handles. Ash-type eucalypts.

(c) Crossarms (*E. scabra*, *pilularis*, *botryoides*).

(d) Gates, hurdles (*E. saligna*, *E. pilularis*) and heavy construction. All these items demand high-grade sawn timber. It is doubtful whether the crossarms, gates and hurdles will have many advantages over the product obtainable from Douglas fir and larch. The low-grade stock which would normally be used for building framing and box shakes in Australia is considered to be inferior to what is available from Douglas fir and radiata. Fence battens, mine timbers and firewood are useful items depending on locality.

4. The logical conclusion is that land of Site I or II quality for conifers available for extensive forest establishment should be given over in the main to conifers, except for those few localities where A or B classes of eucalypts with good durability can be grown successfully. Small acreages of ash-type eucalypts are justified but requirements may possibly be met by planting where conifers are subject to high fire risk; some thought has I think been given to interplanting in cutover bush, and to advantages of mixed conifer-eucalypt stands.
<table>
<thead>
<tr>
<th>Species and Origin</th>
<th>Moisture Condition</th>
<th>Density at 12% M.C.</th>
<th>Modulus of Rupture in St. Bend. 1000 lb./sq. in.</th>
<th>M. of E. in St. Bend 1,000 lb./sq. in.</th>
<th>Max. Crush Stress parallel to grain lb./sq. in.</th>
<th>Max. Shear Strength parallel to grain lb./sq. in.</th>
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<tbody>
<tr>
<td>E. fastigata Whaka (N.Z.)</td>
<td>Green (115%)</td>
<td>—</td>
<td>10,150</td>
<td>1,930</td>
<td>4,990</td>
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<td>—</td>
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* Air Dry = 12% moisture content.