EUCALYPTS SUITABLE FOR NEW ZEALAND FORESTRY

By J. E. HENRY

1. Introduction

In recent years the supply of hardwood timber from Australia has decreased to a point where this country's need can no longer be fulfilled from that source. Not only are we forced to find the balance of our requirements from our own resources, but we also have to pay over three times the 1939 price for the inadequate quantity that Australia can supply. The following figures from Forest Service annual reports are of interest :

Year	Volume Imported	Value	Cost per 100 ft. B.M.
1939	30,840,000 ft. B.M.	£456,600	£1 13 1d.
1948	33,257,000 ft. B.M.	£719,800	£2 5 3d.
1951	14,154,000 ft. B.M.	£522,800	£3 13 10d.

It has been estimated that there will be an increase of 50 per cent in the population of Australia within the next twenty years and that the population of this country will increase by one million within the next ten years, so that there is every likelihood of the supply of timber from Australia decreasing still further as our own requirements become larger.

The area at present under eucalypts in New Zealand is estimated at only 20,000 acres and as much of this is valueless there is no possibility of the existing stands fulfilling much of our present, let alone our future, needs. The annual cut of eucalypt timber in this country in recent years has been less than 3,000,000 bd. ft. per annum. Native species such as *Nothofagus* can supply only a small percentage of the total quantity of hardwoods required and if these forests are put on a sustained yield basis the cut will be decreased rather than increased because only a small proportion of the area at present carrying these hardwoods can, owing to changed ecological conditions, be regenerated with the same species.

Our main hardwood requirements are for poles, piles, posts, sleepers, girders and crossarms. Concrete has often been suggested as a substitute for the first three of these, but it has not proved to be as suitable as timber for such purposes. The flexibility of timber poles enables them to withstand a more severe buffeting by storms than concrete ones. Wooden fender piles will always be needed to keep steel ships off concrete wharves, and wooden posts are far cheaper and easier to handle than concrete ones. The use of preservatised softwoods has also been suggested as an alternative to growing our own hardwoods. The main reasons weighing against this are the

cost of the softwoods plus preservative and handling charges, and their inferior strength, hardness and wearing qualities. Eucalypts are the outstanding trees capable of providing hardwoods for our requirements and the purpose of this paper is to give information on certain species selected as the most suitable for timber production in New Zealand.

2. Climatic Requirements

Observations on the health and vigour of the selected species growing in this country have enabled them to be divided into four groups according to their temperature requirements.

Group I—Those suitable for the milder parts of the North Auckland and Auckland districts and of Poverty and Hawke's Bay, that is—northern areas generally not more than 20 miles from the coast.
The species selected as the most suitable for this group are *Eucalyptus pilularis* and *E. maculata*, but mention is also made of *E. diversicolor*, *E. microcorys*, *E. punctata* and *E. gomphocephala*.

Group II—These are species suitable for such areas as the inland lowlands of the Auckland Province, coastal areas of Taranaki and Wellington and for Banks Peninsula. They are also suitable for Group I areas.
E. saligna, *E. botryoides*, *E. scabra*, *E. camaldulensis*, *E. tereticornis* and *E. blakelyi* are the most important species of this group.

Group III—Species suitable for altitudes between 750 feet and 1,500 feet above sea level in the Auckland Province and for all but the coldest districts elsewhere. They should not be planted in Group II areas.
The species dealt with are *E. fastigata*, *E. regnans*, *E. obliqua* and *E. sieberiana*.

Group IV—Those species suitable for very cold areas subject to severe frosts and occasional snow. *E. gigantea* is the best species for these areas and is the only one considered.

Almost all eucalypts suitable for timber production in New Zealand come from high ranfall areas and in this country require sites where adequate rainfall is assured. In the past many failures have been due to the planting of moisture-loving species in low rainfall areas where they have not had sufficient vigour to withstand and overcome insect attacks. Eucalypts capable of enduring drought conditions are all hot climate species which cannot bear the cold winters of New Zealand's drier areas. It is possible by careful selection to get certain species to grow well on comparatively arid sites but particulars of these are beyond the scope of this article.

3. Notes on Species

Group I—The species dealt with in this group will stand very light frosts only. They are all first class timber producers and should be planted wherever there is a suitable location.

E. pilularis has grown to a millable size in South Auckland and has proved to be a very rapid grower and profuse seeder. The seedlings are frost tender and need careful wrenching to be transplanted open-rooted. Because of the plentiful seed supply it is a useful species for broadcast sowing on burnt areas. It prefers well drained sites and a free soil, but does quite well on clay, provided it is well drained. In Australia the annual cut of this species exceeds 80 million super feet per annum. The timber is used as a general hardwood and for flooring, carriage construction, bridge decking, sleepers, poles and posts. Local grown timber has been sawn and used for wharf construction and similar work.

Excellent specimens of *E. maculata* are to be seen near Whangarei It prefers ridge sites and grows well on poor soils, provided they are well drained. The timber in Australia is regarded as being durable and of good quality and is used for many purposes. It is an excellent timber for bending and for any job where springiness is essential, such as tool handles and shafts. The annual cut exceeds 40 million super feet. No information is available about the New Zealand grown timber.

Four other species which have done well in this country are worthy of mention in this group because of the high quality timber that they produce. The first two, *E. diversicolor* and *E. punctata*, are doing well around Auckland and in Poverty Bay. The former seems to prefer a fairly good soil but the latter is thriving on heavy soils. Both require to be planted closely to prevent branchiness. The second two, *E. microcorys* and *E. gomphocephala*, are rather slower growers and care must be taken that they are not crowded out by faster growing species. Both have done well around Auckland on volcanic soil.

Group II—The trees discussed in this group will all stand reasonable frosts and will also thrive in the warmest conditions in New Zealand.

The closely related species *E. saligna* and *E. botryoides* are both very rapid growers which develop tall shaft-like boles and have a preference for damp sites. Many poor forms of both species are to be found and the greatest care should be taken to see that seed is collected from trees of superior form.

E. saligna needs a good deep moist soil for best development. It is an easy tree to raise in the nursery, but it is often necessary to wrench early to prevent seedlings from growing too large to handle. Because of the tall clean-stemmed boles seed is very

difficult to collect and for this reason will never be plentiful; and every opportunity should be taken to gather it from all good form trees that are felled. This is the only way in which any quantity of good quality seed will be obtained. In Australia the timber is regarded as durable and is used for many purposes; the annual cut exceeds 10 million super feet. Timber has been sawn from trees of this species grown in New Zealand but no information on its quality is available.

Euc. botryoides prefers good deep moist soils, but will grow quite well on drier sites and is probably the best species for planting on the North Auckland clays. It also grows satisfactorily on fairly saline areas and is one of the best species for coastal planting. It is a freer seeder than *E. saligna* and is an easy tree to raise in the nursery. The timber is durable and in Australia is used for general building purposes. Two other closely related species, *E. deanei* and *E. grandis*, should also be tried on moist sites in warm localities.

The next species *E. scabra* (syn. *E. eugenioides*) is one of the finest hardwoods that can be grown in New Zealand. Excellent plantations have been milled in the Waikato and on Banks Peninsula. The timber grown here has proved durable in the ground, saws and splits well and is first class for all-round constructional work. It has been widely planted in New Zealand and many fine trees are to be seen; those growing on Banks Peninsula appear to be the best strain and all seed should be collected from that locality. It is a profuse seeder which retains the seed on the trees for a number of years, and so is a good species for obtaining seed in quantity; but unless trees are felled collection is difficult. This is one of the few trees that develops a straight lightly branched bole and which sheds its lower branches even when planted in the open. Growth is comparatively slow and accordingly care should be taken not to plant it with faster growing species. *E. scabra* needs a well drained free soil for best development and will not thrive on clay soils. Fair growth is made in the nursery but careful wrenching is required if seedlings are to be transplanted successfully open-rooted. There are some other closely related species which can be grown, but until satisfactory strains have been selected general planting cannot be recommended.

Three allied species, *E. camaldulensis* (syn. *E. rostrata*), *E. tereticornis*, and *E. blakelyi*, have all grown well in the lowlands of the Auckland Province. The best known is *E. camaldulensis*. It should be planted on river flats and banks as it requires an abundant supply of moisture. *E. tereticornis* prefers slightly drier sites on flats and hillsides and *E. blakelyi* has grown well on clayey hills in the Waikato as well as thriving in peat swamps. The timber of all three is of the first quality and is very durable.

There are many posts of *E. blakeylyi* in fences near Hamilton which are still sound after being in the ground since 1912. These species are all suitable for power poles and should be grown much more extensively for that purpose, as well as for all other uses for which strength and durability are required.

Group III—This group includes four of the most useful species for forestry purposes. They do not demand a particularly good soil and will withstand fairly cool weather conditions.

One of the most promising species for plantations is *E. fastigata*. It is a vigorous grower, a prolific seeder and an easy tree to handle in the nursery. Very fine specimens are to be seen at Cambridge Railway Station and all seed for future planting in this country should be obtained from these trees. Many other good stands are to be seen in various places and in Kaingaroa Forest there is an experimental plot of this species mixed with *Pinus radiata* which shows great promise. *E. fastigata* grows best in moist valleys but does well on any soil so long as there is a reasonable rainfall. In Australia the timber is used for general building, coachwork and paper pulp.

Another species showing great promise is *E. regnans*. This tree is very similar to *E. fastigata* but it will stand more cold. On cool moist sites it develops a fine tall bole free from side branches. At Waitati, just north of Dunedin, there is a fine naturally regenerated stand which is gradually invading the surrounding manuka—a process which could be greatly accelerated by careful burning of the adjacent scrub (Plate 5). The timber of *E. regnans* is used in Australia for a wide variety of purposes. Some of the uses are for flooring, linings, weatherboards, joinery, interior trimming, furniture, cabinet work, framing, motorbodies, cooperage, cross arms, tool handles, boxes, crates, cases and other containers, veneer and plywood, match splints, woodwool and for ground and chemical pulp.

E. obliqua is one of the few eucalypts which will grow in a cool climate and produce a durable timber, and for that reason alone should be more widely planted. The best quality timber is from trees grown on stiff soils. Many good specimens are to be seen in this country and a row of very fine trees growing amongst *Pinus radiata* was cut down some years ago near Rukahia. It will grow on a wide variety of soils provided there is an adequate rainfall. Seed is plentiful and it is an easy tree to handle in the nursery. The timber splits and saws well. In Australia it is used for general building purposes, sleepers, furniture, posts, piles and palings, and for paper pulp.

E. sieberiana is a species that has been neglected in New Zealand. It is a fast growing tree which seeds freely and although it is a little difficult to handle in the nursery, it regenerates

naturally very well in and around established trees. Seedlings are capable of pushing their way through fern cover. It does not seem particular about soil requirements. In Australia the timber has a good reputation for purposes where strength and toughness are required, and it is suggested as a substitute for hickory. Other uses are for general building purposes, coachwork, flooring, furniture, and for chemical pulp.

Group IV—The only species dealt with in this group is *E. gigantea*. It is suitable for planting on the coldest sites in the country and should never be planted unless the area is subject to heavy frosts or snow and an abundant supply of moisture is assured. It is a vigorous grower, a free seeder, and an easy tree to handle in the nursery. Spot and broadcast sowing of seed has been successful on bush burns in Southland and the saplings have escaped serious damage by deer. *E. gigantea* would be a useful species to grow in association with Southland beech. In Australia the timber is used for the same purposes as *E. regnans*.

The species dealt with above have all proved themselves to be healthy and vigorous growers in New Zealand but it will have been noticed from the comments on the individual species that very little has been recorded about the quality of the timber when grown in this country. In view of our need for hardwoods it is time that competent authority put these New Zealand-grown timbers under test. There has been much disparaging talk about the sawing and seasoning qualities of locally grown timber. To this, it can only be said that we have many competent men who are quite capable of tackling and overcoming these conversion problems, and it would be discreditable for us to accept such statements without even trying to overcome the difficulties.

Another point requiring careful assessment is the relative value placed on eucalypt timbers in Australia. It must always be borne in mind that such areas as coastal New South Wales and the south-west of Western Australia have timbers of unsurpassed durability and people who have been accustomed to such excellent wood are inclined to belittle other very useful timbers. We have not yet succeeded in growing ironbarks and jarrah but we can grow *E. pilularis*, *E. microcorys*, *E. punctata*, *E. gomphocephala*, *E. camaldulensis*, *E. tereticornis*, *E. blakelyi*, and *E. scabra*, all of which produce very hard durable timbers suitable for most of our needs. We must learn to assess these timbers for ourselves and to give due consideration to our ability to grow them in this country.

4. Establishment of Eucalpyts

Many mistakes in establishment have been made in the past and the two main reasons have been the incorrect siting of species and failure to select a suitable type within the species. These mistakes

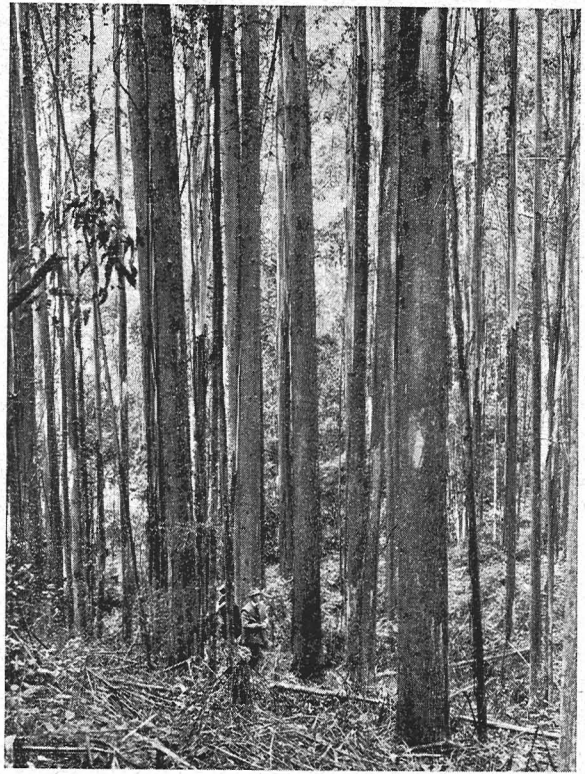

Plate 5.—50 Year-old Natural Regeneration of *Eucalyptus regnans*, at Waitati, Dunedin. Growth to 160 ft. in height and 24 ins. D.B.H. O.B.

Photo : N.Z. Forest Service

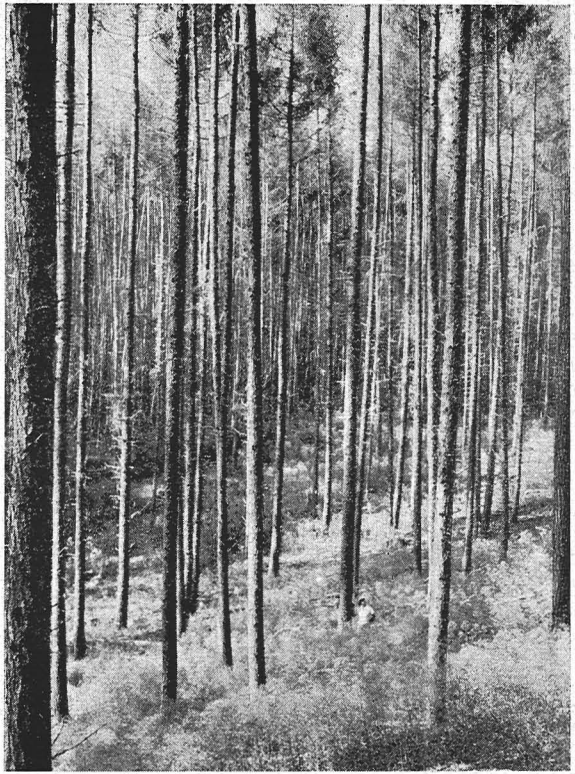

Plate 6.—1907 *Larix decidua* in Waiotapu State Forest. First thinned 1952 to 150 stems per acre yielding 3,000 cu. ft. About 4,500 cu. ft. left.

Photo : T. Johnson

have led to the establishment of unhealthy stands subject to insect attack; it will be essential to avoid them in future. The greatest care will be necessary in the siting of species—there is plenty of evidence to show that where this has been done the trees are healthy and vigorous.

Eucalypts have shown themselves to be suitable for spot and broadcast sowing on burnt and ploughed areas, and they are not difficult to establish by planting. The nursery technique for eucalypts is simple and if properly carried out will produce sturdy well-hardened trees that can be successfully transplanted open-rooted. Seed should be sown as early as possible in October on ground that has been well prepared and manured. The beds should be allowed to settle for at least a few weeks before sowing takes place and should then be lightly raked over before sowing. The seed may be sown in single rows with a Planet Junior set as for carrots, after mixing with dry sand to give a more even distribution of seed in the rows. Germination usually takes place within three weeks. When the plants reach the "two pairs of leaves" stage, any thick patches can be thinned and the surplus plants used to fill in any gaps in the rows. The plants should grow steadily throughout the summer if shallow inter-row cultivating and weeding is done when necessary. By April the trees should be about 15 inches high with a well developed top.

The first wrenching can be done during the first wet spell in April. The object is to harden off the foliage and to trim the root system back to a handleable size, and then to allow all cut surfaces to callus over and be ready to start developing fresh rootlets. In most parts of this country the majority of eucalypts continue to grow slightly throughout the winter and it is this fact which must be borne in mind during wrenching. The whole procedure is aimed to prevent growth of foliage, to encourage the healing over of the cut root surfaces and to stimulate root growth. If growth stopped completely, as it does with some trees, it would not be possible for the cut surfaces of roots to callus over and produce new rootlets. It is this callusing that is important and which makes all the difference between success and failure in transplanting. Very sharp and clean spades should be used because cleanly cut roots heal over more rapidly than do torn and broken ones.

Wrenching is best done with two spades worked opposite each other along the rows. The spades are driven beneath the plants to cut the laterals and tap roots. To ensure that the tap root has been cut, the plants are lifted slightly. The spades are then withdrawn and the cut tramped firmly closed to exclude the air. Two or three weeks later, depending on the weather, the spades are re-inserted in the cut and the plants lifted well up and left in that position for several days. The stock can then be pulled, sorted for size and root development, and "heeled in" in a trench to complete the hardening off. After about a week in the trenches, the trees may be sorted over

again. All plants with well developed heads and roots that have healed over and show a strong growth of white rootlets should be counted, bundled, and puddled ready for planting out.

The times mentioned above will vary considerably with season and locality and are given as an indication only. Careful observation of the plants will show when they are ready for the next move. When plants show signs of growing too large for economical handling, growth can be retarded by side wrenching, i.e. cutting of the lateral but not the tap roots. This may be done on one or both sides depending on conditions at the time.

Open-rooted plants are preferable to trayed, potted or tubed stock. They are cheaper to produce, they can be grown to a larger size, and they develop a strong stem of ripened wood with well hardened foliage; and are therefore less liable to damage and leaf drop during and after planting.

Culling in the nursery should be heavy and all plants without well developed heads and not showing a strong growth of white rootlets should be discarded. With good quality nursery stock the successful establishment of eucalypts should present no difficulties.

The selection of seed is one of the most serious problems to be overcome if eucalypts are to be planted on a large scale. The first essential is that the seed trees must be correctly named and the second that they must be the best strain of that species. This selection is most important—it is already possible to see a deterioration in the form of one species commonly used for shelterbelts. Good quality seed should be collected whenever opportunity occurs as it can be stored for many years without loss of viability. Botanical names for eucalypts are essential as common names are confusing and unreliable.

With adequate attention to site and climate there is no reason why healthy and vigorous stands of eucalypts cannot be grown in New Zealand. The planting of pure stands of one species is not recommended and it is considered that experimental work should be directed towards mixed forests of conifers and hardwoods. At present eucalypts appear to be the only hardwoods capable of growing in mixture with such fast growing softwoods as *Pinus radiata* and *Pseudotsuga taxifolia*; the deep-rooting systems of the eucalypts should help in the prevention of any hardpans that may form under the conifers. Mixture with hardwoods may provide the answer to the problem of breaking up the present extensive pure stands.

Further consideration should be given to the planting of eucalypts in cut-over native forests. Their rapid growth enables them to compete successfully with the ground vegetation and they give protection to indigenous timber species. Such a combination might be expected to give a yield of timber within a reasonable time. Too much attention in the past has been directed towards attaining the same object with conifers but these, if successful, would choke out the indigenous species completely. The broadcasting of eucalypt seed in the ashes

of burns in cut-over native bush and other similar areas should be routine practice and adequate stocks of seed should be held for that purpose.

In conclusion, it may be reiterated that there is no difficulty in growing valuable stands of eucalypts in New Zealand provided good seed is selected and the species are correctly sited.

Summary

Eucalyptus species selected as the most suitable for forestry purposes in New Zealand are classified according to their climatic requirements. Their growth characteristics and utilisation properties are discussed and a technique of nursery treatment for planting with open-rooted stock is described in detail. Suggestions are made for the wider use of eucalypts in New Zealand silviculture.

THINNING BY POISONING *

By J. G. GROOME

1. Introduction

Overdue thinning of even-aged stands, in which natural suppression has been negligible, will always present an embarrassing problem where a market for such thinnings is not available. The difficulty of obtaining labour and finance for the execution of operations which are not immediately profitable is too well known to all to require further stress here. Yet those who have been faced with the utilisation of such stands will sympathise with the forester when he seeks to improve them, even though the sympathy may seldom be provided in the form of men and money. The case for thinning to waste of large areas of our slower-growing exotic stands has been admirably presented by D. Kennedy (1) and this paper seeks to present a method for carrying out such thinning when costs must be held to a low figure.

The elimination of unwanted stems by poisoning has been the subject of extensive overseas research although most of this work has been directed against useless hardwood species growing in pine stands. The poisons used are arsenic, hormones and "ammate" (ammonium sulphamate), and these are now known as silvicides, a term analogous to weedicides in agriculture. The only available account of poisoning coniferous stems is that given by Pearson (2) in which he describes the successful use of sodium arsenite on ponder-

* Read before the Annual Meeting of the New Zealand Institute of Foresters on 10th May, 1952.