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The Development of the Eucalypts In Irish Conditions

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TWO previous contributions dealing with the eucalypt species have appeared in *Irish Forestry*. The first, "Notes on Eucalyptus Species at Avondale, Co. Wicklow" by Mr. M. O'Beirne appeared in Vol. II, No. 1, May 1945. This article dealt generally with the natural distribution, growth and botanical features of the eucalypts and in particular with the performance of certain species which had been introduced and planted at Avondale, Co. Wicklow, from 1908 onwards. Reference was also made to the eucalypts planted at Ballymanus, Glenealy Forest in 1934-35, the development of which will be dealt with in some detail in this article. Seed sowing and nursery treatment was adverted to briefly and the general attributes of the genus summarised.

The second contribution was a note on the raising of eucalypts in the nursery, by P. Ryan, presented in Vol. XIII, No. 2, Winter 1956, and dealt with the merits of the difficult techniques of sowing and transplanting as best suited to conditions in Ireland.

An editorial in Vol. XIII, No. 2, 1956, also gave a summary of the capabilities of the genus and naming the species which have proven hardy here suggested that more attention might be directed to the wood producing potentialities of the species in Ireland.

The intention of this article is to record the growth and production of measurable stands and single trees that have survived from the plantings of numerous eucalypt species in Ireland and to direct attention to observed silvicultural characteristics and to make known the results of limited utilisation studies that so far have been carried out.

Owing to lack of time for a country-wide survey of eucalypts growing in Ireland practically all detailed observations recorded here are confined to Counties Wicklow and Dublin, but from what is known generally of the growth of the species throughout Ireland experience from these counties might be applied in most seaboard regions of our coastal counties and with particular safety to the south-west of the country.

Eucalyptus globulus is illustrative: This species is hardy and grows well along the coast and for some four miles inland in Co. Dublin and Co. Wicklow, but efforts to grow it at Avondale, Co. Wicklow, some ten miles inland, have failed due to frost. In the south-west, however, it is found 20 miles inland and on the shores of Lough Corrib in Co. Galway about 35 miles inland from the western seaboard.

Eucalyptus globulus is listed as being resistant to temperatures down to 20° F. (Eucalypts for planting, F.A.O. 1955) and the fact that it has proved hardy quite far inland even to 15° F. min. temperature line (See Fig. 1) suggests that other species which have been grown successfully at Avondale might prove frost hardy much further inland where frosts are more severe.

Some thirty-five species of Eucalypts have been raised from time to time since 1909 by the Forestry Division of The Department of Lands, mostly from seed from Tasmania and New South Wales, but a study of surviving stands, groups of trees, and single trees of twenty years of age and more suggest that of those tried only ten species can be grown successfully to proper timber tree form. These species are as follows: *E. Johnstoni, E. Muelleri, E. urnigera, E. viminalis, E. ovata, E. Dalrympleana, E. radiata, E. gigantia, E. obliqua,* and *E. globulus.* Within this list of species there are considerable variations as to frost resistance between the individual species but *E. Johnstoni, E. Muelleri* and *E. urnigera* have proved very hardy over a wide range of territory and are outstanding for this reason. *E. ovata, E. Dalrympleana* and *E. delegatensis* are also reliable but their range of trial has been more confined.

Apart from some few known private collections, notably that of Mr. Walpole at Mount Usher, Co. Wicklow, the most important plantings of *Eucalyptus* were made in 1909 and subsequently at Avondale and in 1934, 1935, 1937 on various selected sites throughout the country. Most of these trial plantings were made as small groups of trees and where successful have seldom developed into assessible stands, but one area at Glenealy Forest was laid down to various species in a compact block of some six acres and standing volume estimates of some significance have been possible.

As the information derived from estimates of standing volume of these stands are of importance in considering the potential of the eucalypt species in Ireland the following details from an assessment made in July and August 1957 at Ballymanus Property of Glenealy Forest are presented.

Series 1:

Species	Year of Planting	S.P.A.	Mean Tree Total Height	Mean Tree B.H.Q.Q.	V.P.A. cu. ft. Hoppus	Actual No. of Trees per Plot
*E. Muelleri**	1934	505	69′	7½	6,124	62
E. radiata	1934	786	42′	5¼	2,822	28
E. viminalis (Mountain type)	1934	—	—	—	—	Few scrub trees
E. Dalrympleana	1934	501	57′	7	4,371	29
E. urnigera	1934	704	70′	6½	6,507	80

* *E. Johnstoni* (Maiden) is now given as the accepted name for *E. Muelleri* (T. B. Moore) F.A.O. 1955, but *E. Muelleri* is also associated with *E. subcrenulata.* In

The elevation above sea level of the above plots is 560′, the aspect south-east, on a medium moderately exposed slope.

The eucalypts were planted in 50% mixture with Japanese larch at $4\frac{1}{2}' \times 4\frac{1}{2}'$ spacing. The plantation was laid down on an old oak woodland site in which the predominant vegetation was probably *Luzula syvatica, Rubus fruticosus, Ilex aquifolium, Corylus avellana.* The existing vegetation is similar but *Pteris acquilinium, Vaccinium myrtillus,* and *Hedera helix* is also in evidence. It is of interest to note that the natural climax tendency on the ground outside the stand is towards *Calluna vulgaris* and *Vaccinium myrtillus.* The soil is mainly drift derivative. There is a humus layer of 1″ at the surface and then about 3″ of grey-brown earth over a very deep compact red drift which is packed with small stones and is sometimes sticky in texture.

Information on the individual species are as follows:

E. Muelleri. The seed is thought to have come from Tasmania. 98 plants were planted originally and there were no recored losses due to frost during the history of the stand so far, the reduction in numbers to 62 being due to thinning mainly. The trees are straight, of very fine form and finely branched and have a healthy well furnished live crown. Top heights in October 1959 were measured at 87′.

E. radiata. The seed origin was from the Forestry Service of New South Wales. No losses due to frost are recorded, the reduction from the original number of 50 to 28 trees being due to thinnings and other causes. The tree form is fairly good but the crown development is restricted and the live crown is confined to the upper 1/5th of the trees.

E. viminalis. This is probably the mountain type of *E. viminalis* and its origin is recorded tentatively as from Victoria. In this case 20 plants were put down originally and 10 plants were destroyed in the frosts of 1939-40 and 1944. Seven forked trees remained and in 1959 only four malformed stems survived, the biggest having grown only to about 25′ under partial overhead shade from an oak standard.

E. Dalrympleana. The seed of this lot was probably sent by the Forestry Service of New South Wales but the location of the collection is not recorded. There is no record of fatality through frost and the reduction of trees from 54 to 29 was due to thinning mainly. The tree form is good and the live crown occupies about one quarter the height of the tree.

E. urnigera. The origin of seed for this stand is obscure. There were no losses due to frost, the reduction in numbers from 144 to 80 being mainly due to thinning. The form of the trees in this stand is good though the branching is coarse and the crowns heavier than with *E. Muelleri.* The live crowns which are vigorous and well furnished occupy 1/3rd the total height of the tree. Top heights in October 1959 were recorded at 81′.

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this article the nomenclature used is that which has been found in the records or on labels of trees and no atempt has been made to change the originally recorded name to the contemporary version.

The most impressive observation in this group of plots is the high present standing volume and height growth of *E. Muelleri* and *E. urnigera.* From the early suppression of the Japanese larch these trees have grown at 9′ × 9′ spacing and have a remarkable tolerance of side crown competition with fine branched stems and good form, particularly *E. Muelleri.* It seems that it should be possible to grow 6,000 hoppus feet of pulpwood and small timber trees at 23 years without thinning. The indications are that at their wider spacing, say 15′ × 15′ trees of 10″ Q.G.B.H. could be grown at 25 years.

E. Dalrympleana is also a good tree in this series of plots and deserves further notice as there is another record of good *E. Dalrympleana* of the same origin from Dundalk Forest, Ravensdale Property.

The conifer plantations surrounding the series of eucalypt plots under review do not exceed 20′ in height and the eucalypts stand out at least 50′ above the surrounding crops in full lateral exposure and have proved remarkably wind firm not one tree having blown down in the memorable storms of January-February, 1957.

Coppicing under full shade occurs from stumps of *E. urnigera, E. radiata,* and *E. Muelleri.*

A second series of eucalyptus plots were laid down in 1935 and 1937, at Compt. 11. Ballymanus, Glenealy Forest not far away from the plots already mentioned here from which the following information is available from assessments made also in July-August 1957, with the exception of the *E. viminalis* (Mountain variety) which was measured in October 1959 in Plot 6.

Series 2.

Species	Plot No.	Year of Planting	S.P.A.	Mean Tree Total Height	Mean Tree B.H.Q.G.	V.P.A. Hoppus cu. ft. O.B.	Actual No. of Trees planted in Plot
E. urnigera	8	1935	744	57½′	4¾	2,805	120
E. Muelleri	9	1935	899	70½′	5¼	5,441	300
E. Muelleri	11	1935	538	67′	6	5,549	244
E. Johnstoni	13	1935	961	61½′	6¾	7,851	35
E. amygdalina	14	1935	5 trees left	—	—	—	50
*E. gigantea**	15	1935	775	51′	6	4,448	25
E. viminalis (Mountain Var.)	6	1935	500	50′	4	1,250	3,768
E. viminalis (Coast Var.)	7 & 10	1935	Few scrub-by trees	—	—	—	1,985
E. Muelleri	16 W	1937	1,040	61′	6¼	7,737	1,225
E. urnigera	16 X	1937	634	59′	5¼	3,005	530
E. viminalis	16 Y	1937	—	—	3	—	2,120

* The accepted contemporary name is *E. delegatensis.*

The plots in Series 2 were laid down at 600′ elevation on a moderately exposed S.E. slope and in site conditions very similar to those described in Series 1.

In the case of Series 2 no thinning had been carried out previous to the assessment, the trees planted in 1935 having been spaced at 6′ × 6′ and those planted in 1937 at 5′ × 5′.

The main points which attract attention in the 1935 and 1937 series of plots is the practically complete failure of *E. amygdalina* and *E. viminalis* (coastal variety) due to frost. Frost damage also reduced the numbers and cracked the boles of *E. viminalis* (Mountain variety). With the exception of plot 8 the standing volume figures for *E. Johnstoni, E. Muelleri,* and *E. urnigera* are remarkable. In the case of *E. Johnstoni* (Plot 13), *E. Muelleri* particularly and *E. urnigera* the close spacing and delayed thinning has produced shaft like trees of very fine form and they again exhibit very high tolerance to lateral crown competition and vigorous growth has been maintained. The *E. gigantia* (Plot 15) has not grown with the vigour of some of the other species but nevertheless demands attention because of its reputation as a producer of good utilisable constructional timber. There were no losses due to frost though the number planted, 35, was reduced to 25 from unknown causes. The crowns of *E. gigantia* are light and sparsely furnished and appear to lack vigour and the tolerance of lateral competition so noteworthy with *E. urnigera* and *E. Muelleri.* Top heights from the various species measured in October 1959 from the 1935 plots gave *E. gigantia* 69′, *E. Johnstoni* 71′, *E. Muelleri* 87′ *E. urnigera* 78′. In Plot Series II also the stands have proved very wind firm and as yet no tree is known to have blown down.

It must be emphasised at this stage that the practical difficulties of achieveing accurate figures for volume per acre in the various species plots under review were very great indeed. In some cases the plots consisted only of three lines of trees sometimes involving a number of marginal trees; in other cases the plots were very small, being only fractions of an acre with, very often, irregular outline and the difficulty of estimating the actual occupational area of the sands was acute in most cases. Also the arbitary Form Factor figure of .45 has been used throughout. For these reasons it is necessary to emphasise that the volume figures can only be regarded as estimates. Nevertheless the V.P.A. figures recorded for Plot Series I and II are sufficiently consistent to establish that exceptional volume production far above anything obtainable from the conifers usually grown here and probably comparable to, if not greater than, poplar, may be expected from certain eucalypts in reasonable growing conditions. Experience suggests that unlike poplar the eucalypts do not demand high fertility and can grow well on shallow dry mineral soils. There are one or two cases that suggest that eucalypts will grow on thin dry mineral peats but it is not considered likely that it will grow on deep peats or on any of the blanket bog types.

As a further illustration of the influence of initial spacing on the growth of *E. Muelleri* figures from a stand of *Eucalyptus* laid down in 1934 at Compt. 5, Bellvue Property, Delgany Forest are of interest.

The eucalypts in this stand were established, presumably, as nurses to hardwood groups which were sited at 20′ apart. The eucalypts were inter planted at about 21′ apart in the same line as the hardwood groups and the intervening spaces were filled in with Japanese larch at conventional spacings. The Japanese larch was either suppressed by the eucalypts or in turn interfered with the hardwood groups and had been completely removed at the time the recorded measurements were made. A small group of well grown *E. Muelleri* standing at their original spacings and with even lateral and vertical surrounding shade was selected (Plate 1). This group was measured for spacing, breast height girth and height the Form Factor of .45 being again used to find stem volume. From this exercise the following figures emerged.

Species	Age	Top Height	Av. Ht.	Max. Girth	Av. Girth	F.F.	Av. Tree Vol.	S.P.A.	V.P.A. Hoppus ft.
E. Muelleri	26	94′	87′	58″	50″	.45	43.55	120	5,226

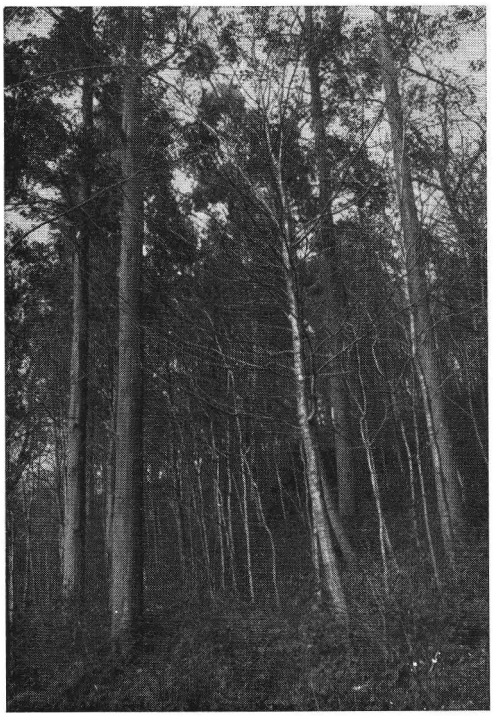

Plate 1. Group of *E. Muelleri* at Compt. 5, Bellevue Property, Delgany forest, Co. Wicklow.

The site on which this stand grows is at 350′ A.S.L. and is a favourable one of moderate fertility and exposure. The dimensions of the trees in this stand indicate that timber size trees can be grown at this spacing at 26 years but whether the wood would be sufficiently mature at this age to give good sawing results is not known, no trials having as yet been carried out.

Further measurements from single trees and trees from groups at Avondale measured in the autumn and winter 1959 may serve to give completeness to the record of the Forestry Division collection.

Species	Year of Planting	Total Height	Girth	Form	Condition
E. ovata	1909 (?)	93′	64″	Good	Vigorous
E. urnigera	1909	114′	96″	Rough	Vigorous
E. Muelleri	1909	119′	60½″	Rough	Vigorous
E. obliqua	1909	81′	71″	Rough	Moderate Vigour
*E viminalis**	1909	120′	131″	Good	Moderate Vigour

* This tree has always been known as *E. ovata* but identification was reviewed recently and *E. viminalis* was confirmed by Kew.

In more recent times more plots were laid down in 1950. One plot in Compt. 1 failed practically completely for reasons not particularly associated with climatic conditions. A second plot in Compt. 1 was planted with *E. pauciflora* (11), *E. gigantia* (11), *E. cinerea* (11), *E. obliqua* (11), *E. Cordieri* (7), *E. Huberiana* (15), *E. Blakelyi* (22), *E. manifera* (11). In this plot one *E. mannifera* survived and six *E. gigantea,* most of the latter are growing well, the tallest being 35′ (Nov. 1959). The third plot in Compt. 5 contained *E. urnigera* and *E. Muelleri* (48), *E. rubida* (8), *E. bicostata* (23), *E. Dalrympleana* (7), *E. dives* (2), *E. phellandra* (41), *E. radiata* (4), *E. elaeophora* (5). Of these survivors to date are as follows: *E. Muelleri* and *E. urnigera* 17, *E. rubida* 3, *E. Dalrympleana* 6, *E. phellandra* 3. The original spacing of the eucalypts in this plot was 12′ × 12′ with Japanese larch nurses at 6′ × 6′. The Japanese larch has grown vigorously and may possibly have been responsible for suppressing weakly eucalypt plants in the early stages. On the other hand the nursing effect may have brought *E. rubida* and *E. phellandra* through the different early stages. Though the identity has not been botanically confirmed the latter two species are so far as the writer knows two new survivors in Ireland.

Any study of the eucalypts in Co. Wicklow, or indeed in Ireland, would be incomplete without a record of the well known collection at Mount Usher already referred to.

The main and original planting of eucalypts at Mount Usher were made in 1910, supplemented by occasional subsequent introductions, one of the most interesting being *E. subcrenulata* planted in 1949 which is now 47′ high. The site of these very beautiful gardens is a river flat at about 100′ above sea level and some 2 miles from the sea, and the

climatic conditions must be regarded as mild though the lie of the land is somewhat suggestive of a frost hollow.

The following measurements we take from some of the more noteworthy trees in the collection and are tabulated with the yearly total rainfall in inches and the yearly minimum temperature Farenheit from 1949 to 1958 inclusive. This information was kindly made available by Mr. R. B. Walpole.

Notable Trees Measured, December 1959.

Species	Year of Planting	Top Height	Girth at 4′ 3″
*E. subcrenulata**	1949	47′	28″
E. viminalis	1910	110′	119″
E. viminalis	1910	95′	139″
E. delegatensis	1910	92′	74″
E. gigantea	1928	91′	103″
E. Muelleri	1910	114′	99″
E. urnigera	1910	89′	109″
E. coccifera	1910?	55′	
E. urnigera	1910	89′	91″
E. Stuartiana	1910	106′	128″
E. Stuartiana	1910	106′	120″
E. Johnstoni	1910	83′	61″
E. urnigera	1910	103′	123″
E. amygdalina	1948	33′	13″

* *E. subcrenulata* is now associated with *E. Muelleri.*

Total Annual Rainfall and Absolute Minimum Temperatures at Mount Usher.

Year	Total Rainfall	Minimum Temperatures	
1942 ...		24° F.	
1943 ...		26° F.	
1944 ...		26° F.	
1945 ...		12° F.	Feb. 19° F. and 12 weeks of frosts.
1946 ...		23° F.	
1947 ...		18° F.	Dec., Jan., Feb., Mar.
1948 ...		24° F.	
1949 ...		27° F.	
1950 ...	39.33″	22° F.	
1951 ...	46.96″	25° F.	
1952 ...	33.85″	26° F.	
1953 ...	28.87″	24° F.	
1954 ...	43.61″	25° F.	

1955	...	35.91″	22° F.
1956	...	35.52″	16° F. Feb.
1957	...	38.49″	24° F.
1958	...	50.76″	22° F.
1959	...		22° F.

The trees recorded in Forestry Commission Bulletin No. 30 as having been killed by frost at Mount Usher are as follows: *E. amygdalina* 22° F., *E. obliqua* 22° F., *E. polyanthemos* 22° F., *E. regnans* 6° F., *E. rostrata* 18° F., *E. virgata.* Perhaps the most interesting of the trees seen at Mount Usher from a forester's point of view were *E. gigantia, E. delegatensis* and *E. subcrenulata.* The *E. delegatensis* was grown in a small group of trees and has very fine form with straight unforked stem. The *E. gigantia* was grown as a single tree with straight unforked well formed stem though rather heavily branched. The *E. subcrenulata* grown as a single tree has developed fine compact form and refined branching the height growth and vigour being remarkable. *E. Muelleri* and *E. Johnstoni* are consistent with their performance elsewhere in being trees of fine form and light branch. The record of 6° F. screen at Mount Usher must be regarded with some doubt and may have arisen from 16° F. in February 1956 or previous like temperature.

The Killiney district on the coast about 9 miles south of Dublin is remarkable for a number of fine specimens of *E. globulus* mostly as single trees in residential grounds. The grounds of the Canadian Ambassador's residence in particular contains groups and single trees of remarkable dimensions and in vigorous condition and these trees present a very fine spectacle.

Some of the taller trees measured in these grounds gave the following dimensions:—109′ high × 81″ B.H.G., 116′ high × 125″ B.H.G., 119′ high × 95″ B.H.G. and many of these trees which, incidentally, stand about 200 yards from the sea, developed at from 15′ up to 20′ apart and had undivided stems from about 60′ up to 80′ high which suggests an amazing V.P.A. potential under the circumstances.

These trees were probably planted about the turn of the century, possibly before but it was not possible to get a reliable estimate of their age.

Climate.

The most obvious climatic factor limiting the number of eucalypt species that can be grown is of course minimum temperature. Not only the actual minimum temperatures experienced but also the duration of sub-zero temperatures appear important in their influence in killing the species. The eucalypts are particularly vulnerable in the nursery stages and even hardy species such as *E. urnigera* may be killed by quite ordinary frosts. Frost tender species are usually eliminated in the

sapling stages and those that pull through to the pole stages are likely to survive all but the most severe frosts. At the pole stage and afterwards the main injury caused by frost is frost crack which is a vertical splitting of the bark right through to the wood extending very often for 20′ up the tree. *E. viminalis* has proved particularly vulnerable to this type of damage here and frost crack is quite a feature with the species the big *E. vininalis* at Avondale being very deeply fissured in the frosts of 1939-40 which gave screen temperatures as low as and probably lower than 12° F.

Severe frosts are, however, quite capable of burning foliage completely on trees of very substantial size. This actually occurred during frosts in 1938, '39, '40, when complete defoliation of big trees of *E. Gunii, E. urnigera, E. cocifera* and *E. viminalis* with subsequent recovery was reported. In the severe frosts of December 1939 and January 1940 the foliage on big trees of *E. globulus* was completely burnt but the trees recovered and put out new foliage in the following season. The frosts of December 1939 and January 1940, considered one of the most severe frosts since 1934 were of long duration and killed *E. amygdalina* and *E. viminalis* in the Ballymanus plots.

Unfortunately, however, the all important records of temperatures are not reliable and no information is available for Avondale or Glenealy for the most noteworthy years of 1939-40 and 1945. Such records as there are cannot be satisfactorily related to the eucalypt sites where damage was caused and are not worth quoting.

For general appraisal of the situation it may serve some purpose to quote figures supplied by the Meteorological Office for recording stations nearest to the eucalyptus stands under review.

Station	December, 1939			January, 1940			January, 1945	
	Absolute Min.	Date	Mean for Month	Absolute Min.	Date	Mean for Month	Absolute Min.	Mean for Month
Dublin Airport	22.8° F.	—	41.8° F.	12.8° F.	—	40.0° F.	18° F.	35.3° F.
Phoenix Park	20.0° F.	29th	39.1° F.	12.0° F.	18th	33.9° F.	—	—
Hazelhatch	20.0° F.	29th	38.7° F.	12.0° F.	20th, 21st	33.9° F.	14° F.	34.1° F.
Newcastle	30.0° F.	29th	41.3° F.	12.0° F.	17th, 18th	34.9° F.	22° F.	38.0° F.

Newcastle Station lies some seven miles to the N.E. of Avondale, two miles south from Bellevue and four miles N.N.E. from Glenealy and is the nearest to the eucalypt stands described but lies at about 300′ A.S.L. and is less than two miles from the sea so that frosts would tend to be possibly more severe at Glenealy but definitely so at Avondale where the winter climate is regarded as severe, and winter temperatures there would be more comparable to those quoted for Hazelhatch.

In the meteorological records January 1940 is summarised as being "exceptionally cold with intense frost and considerable snow in the latter half of the month."

The severe conditions of the period are further emphasised by the

record of 15 days of ground frost in December 1939, the average being 8 days, and of 19 days of ground frost in January 1940 where the average is about 13 days.

Another very severe period was experienced in 1947 when there were innumerable and sustained falls of snow from January to the end of March. In 1947 that year the January mean of 39.5° F. was quite high but February proved to be one of the severest months of recent times with an absolute minimum of 10° F. and a mean of 32.5° F. and seventeen days of ground frost. However, no particular damage to eucalypts was recorded, or is remembered, for that period. The possibility that the trees may be in a more vulnerable condition during December and January might therefore possibly be considered. If this were the case not only the degree and duration of the frost but also the month in which the frost occurred might have significance. On the other hand in February 1945 and 1947 most of the trees under discussion were well established and in a strong and vigorous condition. A perusal of records of Absolute Minimum Air Temperatures (in degrees Fahrenheit) recorded at certain stations during their effective periods gives the following interesting and relevant figures. On January 28th, 1945, 11° at Shannon, 15° at Cork, 4° at Claremorris, 18° at Mallaranny, between January 17th and 22nd, 1940, 14° at Tralee, 16° at Waterford, 19° at Carrick-on-Suir, so that out of a total of 21 stations recorded seven absolute minimum temperatures occurred in January 1940 and January 1945. Of general interest is the lowest temperature ever recorded —2° F. at Markree Castle in Co. Sligo on 16th January 1888, but this minimum appears to be quite exceptional.

However, the classification of the eucalypt species in order of their resistance to frost by C. Martin as published by F.A.O. in Eucalypts for Planting (1955) seems to bear some relation to experiences in this country and is as set out as follows:

Resistant To.

0° F. *E. vernicosa, E. bicolor, E. nephophila, E. Gunnii*.*

5° F. *E. coccifera*, E. subcrenulata*, E. Johnstoni*, E. urnigera*.*

10° F. *E. pauciflora, E. delegatensis*, E. rubida, E. stellulata, E. aggregata, E. cordata, E. Dalrympleana*, E. ovata*.*

15° F. *E. viminalis*, E. obliqua*, E. Blakelyi, E. pulverulenta, E. bicostata, E. Robertsoni, E. melliodora, E. resinfera.*

20° F. *E. globulus*, E. regnans, E. amygdalina, E. Perriniana, E. elaeophora, E. saligna, E. linearis* and others.

From the above list the species marked with an asterisk have been grown successfully now for 20 years or more. A few *E. rubida, E. phellandera, E. mannifera,* have survived from the 1950 planting at Avondale but *E. Blakelyi, E. bicostata, E. elaeophora* failed in the early years after planting. *E. amygdalina* has survived since 1948 at Mount Usher but missed the bad frost years of 1945 and 1939-40 the latter of which killed most *E. amygdalina* at Glenealy. Comparison of the

above list with the Absolute Minimum Temperature map of Ireland (Fig. 1) suggests the possible range of these species in our country though in the case of *E. globulus* of which we have some experience the 15° F. absolute minimum line looks a more appropriate limit than the 20° F. limitation. It does appear indeed, and it may well be true for other species also, that in Ireland *E. globulus* tends to survive lower temperatures than set out in the F.A.O. list.

The effects of other climatic factors on eucalypts in Ireland have not been studied and little is known on the subject, but high rainfall and a limited sunshine so often experienced does not seem to have a detrimental effect on growth, except in so far as it is greater in hotter and sunnier climates.

There is little doubt, however, that the species grown here have proved remarkably wind firm in our conditions in which gale force winds of up to 70 m.p.h. are not unusual. During the exceptional gales of January-February 1957 when gusts of over 100 m.p.h. were experienced little or no damage was caused with single eucalypts or in eucalypt stands.

Utilisation:

Though most of the wood from available eucalypt trees is too immature to give a range of material from which comprehensive findings particularly as to timber quality might be obtained, some preliminary exploration as to utility has been possible. Older trees have not as yet become conveniently available due to their amenity value or the importance of their position in a stand. Small saw logs from 23 year old *E. urnigera* were sawn in 1957 but the results were not encouraging. The wood which is white with a pink tint towards the centre of the tree cupped and twisted badly. Scantlings and smaller cuts became distorted into extarordinary shapes "collapse" being a prominent feature in all cuts.

On the other hand boards cut from a planked and seasoned eucalypt of over 50 years at Gorey Forest in 1958, probably *E. Gunnii* or *E. gigantia* were fairly stable and offered attractive face grain and colour. This eucalypt was unfortunately not identified at felling and is only thought *E. Gunnii* or *E. gigantia* from local association.

It is hoped in future to select old trees from time to time and put them through subjective systematic seasoning and milling tests but information obtained to date is of little value.

Two loads of *E. Muelleri* from 23 year old thinnings at Glenealy Forest were sent to Bowaters Irish Wallboard Mills Ltd. at Athy. The first consignment in January 1958 of 23¾ tons gave encouraging results which may be briefly summarised as follows, from information kindly made available by Irish Wallboard Ltd.

The eucalypt notwithstanding its weight (supplied fresh to mill) was handled easily by the chipper, giving chips of suitable size.

Defibration was satisfactory but considerable foaming occurred in the stock chests and board machine.

The finished board was different in colour from the normal conifer board being purple tinged to a slight extent. The board was satisfactory except for one point, that of its high moisture absorbtion capacity which might give rise to movement in the board after manufacture.

The following figures are of interest.

	Sp. Wt.	Percentage Bark	Lbs./Cu. Ft.	Percentage Moisture Content Wood	Bark
Scots Pine	0.650	7.3	40.6	55.6	44.4
Douglas Fir	0.670	12.5	41.8	50.7	63.4
Spruce	0.694	8.7	43.4	57.4	63.4
Larch	0.654	14.7	40.9	43.5	43.8
Eucalyptus	1.050	8.5	65.6	45.0	62.6

Finished Product.

	Thickness MM.	Lbs./Sq. ft.	Bending Strength P.S.I.	Tensile Strength P.S.I.
Eucalyptus	3.20	.69	7,781	4,445
Conifer Thinnings	3.43	.70	6,631	3,451

	Breaking Load Lbs.	Water Absorbtion 2 hrs.	24 hrs.	Swelling 2 hrs.	24 hrs.	Moisture %	Sp. Wt.
Eucalyptus	55	16.1	46.9	7.6	26.6	5.7	1.031
Conifer Thinnings	54	4.9	14.2	3.1	11.0	7.9	1.029

A further consignment of *E. Muelleri* from the same plots as previously was sent to Athy in July 1958. This consignment weighed 21½ tons and if anything gave more encouraging results than the first consignment, a prominent though unexplained feature being the reduction of moisture absorbtion to 26% for 24 hours as compared with 47% for 24 hours in the January consignment. There was a decrease of 17% in the strength of the board after humidifying.

Comparison.

	Thickness	Bending Strength P.S.I. Untempered	Tempered & Humidified	Lbs./Sq. ft.	Breaking Load Lbs.	Tensile Strength P.S.I.
Conifer Thinnings 11/7/58	3.477	6,404	7,185	.74	60	5,467
Eucalyptus 11/7/58	3.476	9,159	7,569	.76	66	4,402
Eucalyptus 5/2/58	3.200	7,143	7,781	.69	55	4,445

	Swelling		Moisture Absorbtion %		Moisture
	2 hrs.	24 hrs.	2 hrs.	24 hrs.	Content %
Conifer Thinnings 11/7/58	3.72	12.9	6.08	17.4	—
Eucalyptus 11/7/58	6.79	19.7	12.27	26.0	7.4
Eucalyptus 5/2/58	7.6	26.6	16.1	46.9	5.7

Note: .34% (Solid) Lauxite (Phenolic resin) used in board of 11/7/58 but not in board of 5/2/58.

The foregoing trials indicate that satisfactory Hardboard can be manufactured from 23 year old *E. Muelleri* grown in Eire.

Some time after these trials were carried out information came to hand to the effect that the process liquors from eucalypts are acid to an extent that they corrode the plattens in the manufacturing hydraulic press, reducing their normal effective life considerably thereby. This

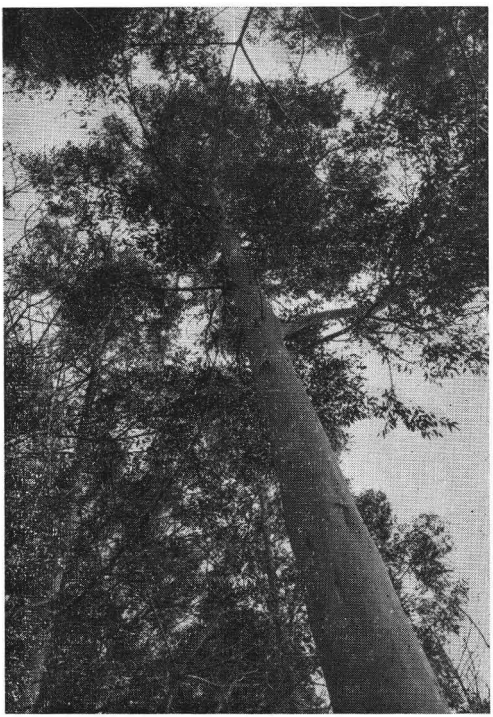

Plate 2. *E. Muelleri* (Ht. 89', B.H.G. 58") at Delgany forest indicating shaft-like stem and crown form.

presents a serious difficulty but great problems have been overcome in pulping processes in Australia, Portugal and other countries, and in Australia they continue to manufacture hardboard in spite of this difficulty.

In December 1958 and January 1959, 36 heavy poles of *E. viminalis, E. urnigera, E. Johnstoni* and *E. Muelleri* were selected and felled for trial as transmission poles. These trees were planted from 1935-37 and were taken from Ballymanus in the plots already referred to and from groups and single eucalypt trees in the immediate vicinity of these plots. The poles accepted under E.S.B. specification ranged from $6\frac{1}{2}''$ to $9\frac{1}{4}''$ top diameter and 28′ to $39\frac{1}{2}'$ in length while the top heights were *E. viminalis* 62′, *E. Muelleri* 78′, *E. Johnstoni* 73′, *E. urnigera* 71′. Although this trial is not yet complete, the poles not having as yet passed through the transmission fitness tests, it is of interest because of the phenomena of end and longitudinal splitting that took place at felling time.

Preparation had been made to apply special oil gloss paint and to cut circular grooves on the ends after felling, as end splitting was anticipated. Although this work was carried out with controls it unfortunately gave no result of value as the end splitting of the trees occurred simultaneously to felling, thus nullifying any favourable effect the paint or circular chiselling might make. These splits occurred mainly across the pith being from 1″ to 7″ long at felling and radiating outwards with time. Some splits also occurred in the direction of the annual rings. There was no fault in felling but the forester reported sharp reports from the trees while still on the saw before the tree went over. Longitudinal splits of some length and depth appeared on the outside of the poles with the passing of time thus degrading their appearance and quality considerably. It was noted that the one tree which got "hung up" in another tree in falling, an *E. viminalis,* did not split. This unfortunate defect in the eucalypts was well known here already, but in the view of some is influenced in its intensity by the season of felling. Research to overcome this defect should be worth while if the poles pass the other tests for transmission as beautifully straight poles for this purpose can be grown within 25 years, particularly with *E. Johnstoni.*

In limited trials carried out with *E. Muelleri* for pit propping, stout props of 16″ to 28″ with $4\frac{1}{2}''$ diameters for specialised use gave service comparable to other coniferous props in use and were considered satisfactory. Split lengths $2\frac{1}{2}''$ thick tried as 4′ to 3′ sleepers became shaken, as might be expected, and did not therefore give satisfactory results.

Heart wood samples from *E. Muelleri, E. viminalis, E. Dalrympleana, E. urnigera, E. radiata, E. gigantia, E. Johnstoni* were supplied to British Leather Manufacturers Research Association for detailed study and research into the chemical make-up of the wood in regard to the possibility of extracting tannins useful in leather processing.

Conclusion.

There is little doubt that a limited number of eucalypt species can be grown successfully in Ireland and some of them can out-produce any other tree species of which we have experience. The poplars may possibly challenge the eucalypts in growth but poplars must usually be given most favourable site conditions where a eucalypt will grow well over a wide range of conditions which include dry shallow mineral soil types in exposed situations. Indeed, in this respect the eucalypts have not yet been fully extended by trials at high elevations on difficult mineral soil types. Experience suggests that eucalypts will do fairly well on certain types of mineral peats but the prospect of their succeeding on deep peats or blanket bog types is not regarded hopefully. In contrast also to poplars some of the eucalypts show exceptional tolerance to lateral competition and can produce vigorous high yielding stands at close spacings such as 6′ × 6′. In this regard some of the species, particularly *E. Johnstoni* produce trees of very fine form, even when growing at 20′ apart. Eucalypts can be regenerated either by coppice shoots or by natural seed fall and most years there is an abundance of fruit and viable seed born on the trees. The seed germinates readily in the nursery but thereafter the seedlings are difficult to handle and planting losses may often be high. It is considered, however, that if sown early in May and well protected from late frosts that seedlings can, under normal conditions of growth, be transplanted into boxes in late July and taken to the planting site in boxes and planted the following winter or summer as may be convenient, without any losses. Where wide spacing is adopted, say 20′ × 20′ this method might well be quite economically exploited. Also, the new techniques of transporting plants from nursery to planting site in polythene bags should give good results.

Although fibre board of good quality has been manufactured from Eucalyptus grown in Ireland, this success has been marred by the fact that the process liquors corrode the mill machinery. This difficulty might be overcome in some way or another and deserves appraisal in the light of the fact that there is no other tree that will produce as much timber in so short a time under our conditions. The economic balance of this consideration deserves attention.

Limited sawing trials with immature timber have given poor results but good boards have been sawn and seasoned from old trees and show very attractive facial grains and have remained stable. No proper conclusions can be drawn at this stage and more intensive conversion trials are indicated as more mature trees become available.

Other lines of investigation still in the early stages are trials of eucalyptus for tannin, pit props and transmission poles. Developments from the latter study will be followed with keen interest because if some way can be found to overcome the difficulty of serious splitting after felling the eucalypts—particularly *E. Johnstoni*—have ideal tree form for this purpose.

There is no doubt, however, that the deep splitting of the tree in the round soon after felling, together with the marked tendency to collapse in the sawn wood, is a major obstacle to the acceptance of the species in general forestry practice in Ireland. Perhaps the development of such species as *E. delegatensis* and *E. gunnii* which have so far been neglected may give better results in regard to saw timber utilisation.

It is surprising that the eucalypts have not attracted more attention from horticulturalists and arboriculturalists, for they have many qualities to recommend them for planting. Its proven ability to withstand wind and its exceptionally fast growth should recommend it as a shelter belt tree over a wide range of mineral soils, excluding heavy wet soils and peaty sites. The fact that it grows well on dry light soils suggests it for use in shelter belts near the sea.

For amenity in parks and demesnes the eucalypts are very acceptable while the full retention of foliage during the winter months make it a valuable tree for screening purposes, and in this respect—provided there is plenty of room and that it is not put too near dwelling houses, it is unsurpassed.

Eucalyptus wood of many species, some of which can be grown here, is accepted as raw material for the cellulose industries and is being planted in a big way in Spain, South Africa, Brazil, Portugal, Morroco and many other countries and if the species could compete and out-produce the faster growing conifers here on the difficult mineral soil types such as are found in Co. Tipperary and Co. Cork Old Red Sandstone mountains they should win consideration in the economics of forestry practice. Meanwhile experience up till now justifies, in the writer's opinion, perseverance in research in this field and extension of trials into more difficult site types and through a greater range of possible species.

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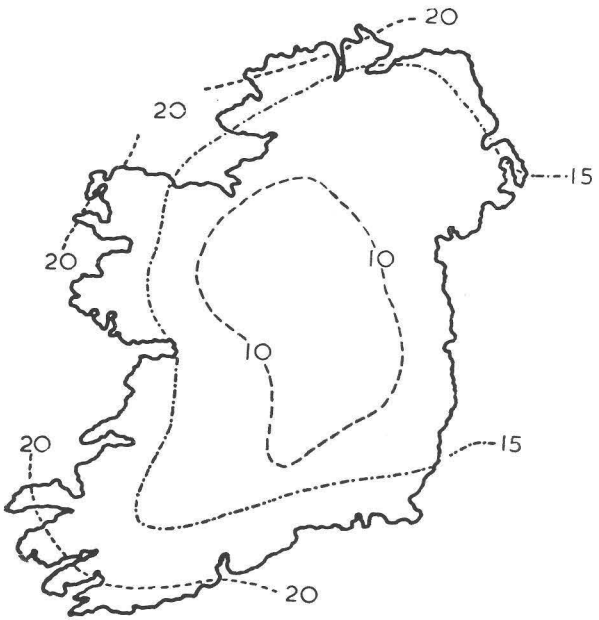

Fig. 1. Map showing the distribution of Absolute Minimum Temperatures in Ireland for years 1901-1940.
H.M. Stationery Office, Climatological Atlas.