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OF

BARCADDINE

FOREST

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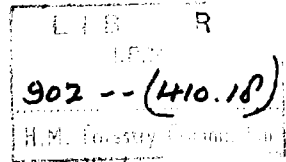
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*Balcaldine*

FORESTRY

COMMISSION

HISTORY

of

BARCALDINE FOREST

1924 - 1951

WEST (SCOTLAND) CONSERVANCY

## HISTORY OF BARCALDINE FOREST

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## HISTORY OF BARCALDINE FOREST

### GENERAL DESCRIPTION OF THE FOREST

#### Situation

Barcaldine Forest extends along almost the whole of the seven mile long south shore of Loch Creran, an arm of Loch Linnhe stretching inland from the Firth of Lorne. It is part of the old estate of the Campbells of Barcaldine, an offshoot of the Campbells of Breadalbane. The land, including the Mansion House (the oldest portion of which dates from about 1710) and the Policies, were purchased by the Forestry Commission in 1924. The House and Policies, and most of the unplatable hill land, were subsequently re-sold.

The name Barcaldine is believed to be a corruption of "Barr a' Chaltuin", or "Hazel knoll", from the hillock on which the recently restored and now inhabited Black Castle of Barcaldine was built in 1600.

The forest is 12 miles from the nearest town, Oban, and nearly 100 miles from Glasgow. It is served by a halt on the Oban-Balachulish Railway line and by the very narrow Trunk Road A 828.

#### Area and Utilisation

The total area acquired was some 10,450 acres, but after several sales of land believed to be of no practical importance for forestry purposes, this area was reduced to approximately 4000 acres.

When acquired, about 1200 acres were covered with oak, birch and hazel scrub, with clumps of maturing, or mature, conifers, chiefly Scots pine and European larch. One particularly fine stand of Douglas fir planted about 1870 is still in existence, but most of the other conifers have been felled and the ground replanted.

All the hill ground was used as a deer forest and for sheep, but cattle were reared on the low ground and amongst the scrub woodlands. Some of the farms had a fair amount of arable and inbye land, and the remains of numerous houses and extensive "lazy beds" throughout the forest indicate that at one time the land carried a considerable population of crofters.

TABLE I

From	By	Plantations Acquired	Plantable Excl. Col. 3.	Nurseries	Agricultural	F. W. H.	Unplantable Excl. Col. 3.	Temp. DOAS Other Land	Perm. DOAS	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		(10)
W. Methven	Purchase 1924	7	3787	6 $\frac{1}{4}$	137 $\frac{1}{4}$	53 $\frac{3}{4}$	-	14	-	4005 $\frac{1}{2}$

TABLE II

(a) Plantations

Acquired 7  
Formed by Commission 3262 3269 acres

(b) In hand, awaiting planting

Blanks after felling -  
Burnt Areas -  
Other Land 525 525 acres

(c) Nurseries

6 $\frac{1}{4}$  acres

(d) Agricultural

No. of Tenancies - 7 137 $\frac{1}{2}$  acres

(e) Forest Workers Holdings

No. of Tenancies - 10 53 $\frac{3}{4}$  acres

(f) Unplantable Land in hand

-

(g) Other Land

14 acres

Total 4005 $\frac{1}{2}$  acres

Physiography

The forest is dominated by the 2324 ft. Beinn Bhreac, which rises steeply from Glen Dubh and Glen Salloch, on its north and west extremities respectively. The forest march on this hill, after the sale of the land above it, lies approximately on the 1000 ft. contour, which was taken as the plantable limit. Between the broad, glaciated Glen Dubh and the head of Loch Creran lies the steep ridge of Coire Circe, curving in a horseshoe as an outlier of Beinn Bhreac round the head of the Glen.

To the west of Glen Salloch lies a lower range of foothills, almost a plateau, sloping fairly gently to the North/<sup>from</sup>734 ft, but dropping steeply to near sea level a few hundred yards before reaching the loch. In detail, this ground is rather broken by a succession of low, irregular ridges and mounds.

Drainage is all towards Loch Creran in the North and North-west. The two main rivers, Abhain Teithil and Dearg Abhain, flowing respectively from Glen Dubh and Glen Salloch, enter the loch about half a mile apart, and are separated by the broad alluvial policies of Barcaldine House and its Home Farm. The nursery is also located on this gravelly alluvium. Numerous burns flow into the two main rivers and directly into the sea, and are typical of the West Highland wet, mountain scenery.

Exposure to the prevailing south-west wind is nowhere severe, but winds from the North and West can subject much of the area to blast. The forest is sheltered from the east winds, but south-east winds coming through Glen Salloch from Loch Etive can be very severe indeed on the slopes to the south-west of this glen.

#### Geology and Soils

Igneous rocks, chiefly granite, predominate, the upper heights of Beinn Bhreac above the forest march being almost pure granite: micaceous and other schistose forms of metamorphic rocks occur to the north-west of the area, and to the west of Glen Salloch black slates and other Dalriadan period rocks are found. At the mouth of the two main glens a fair expanse of the river gravel alluvium occurs, and deposits of boulder clay at intervals throughout the lower lying land are common.

The soil varies greatly from rich gravelly loam to clayey and peaty loams, the latter type being general in the old (hardwood) woodlands. Peat is almost universal in the basin of Glen Dubh and over most of the Achenreir section, varying greatly in quality and in depth from a few inches to many feet, and in these areas there are sections where peat bogs of several acres in extent exist. Hard morainic knolls are common but underneath the 6 in. or more of peat and hard iron pan the soil is frequently quite a good sandy or gravelly loam. Between the knolls it is usual to find a fresh, fertile, though somewhat peaty, loam.

## Vegetation

When acquired, about 1200 acres of the land below the 500 ft. contour was covered by hardwood scrub of oak, birch and hazel, and by some ash and alder on the wetter sites, these being the remnants of much more extensive oak forests exploited in the past for charcoal burning. On the drier knolls bracken and grasses were the dominant species, with Calluna occurring where the knolls had a covering of thin peat. Calluna also occurs with Scirpus where there is pan, and is mixed with Erica tetralix, Scirpus, Eriophorum, Sphagnum species and other bog plants on the boggy areas; where the bog degenerates into hag, pure Scirpus predominates. Peats were once dug from many of the bogs.

On the better peats, Molinia and bog-myrtle are common, and Juncus (usually Juncus articulatus) dominates the free-draining hollows between the knolls. It was early noted (1930) that the opening of drains on peat lands greatly encourages the growth of Juncus and Luzula sylvatica, but Aira caespitosa becomes dominant when the old woodland sites are drained.

## Meteorology

### (a) Rainfall

Rainfall is very high, though lower than at some West Highland stations, and at the nursery averages about 75 in. per annum, although it is almost certain that a far heavier precipitation, in excess of 100 in. per annum, occurs in the upper reaches of Glen Dubh. During the last few years the nursery records have shown extreme variations from 48.76 in. (1937) to 94.76 in. (1938) and 90.01 in. (1950). Despite the high annual rainfall, however, droughts in April and May are quite common. Heavy snowfalls are rare, and snow seldom lies for any length of time below the 1000 ft. level, although deep drifts in gullies on higher ground sometimes last well into June.

### (b) Frost

Severe winter frosts are uncommon, but spring frosts have caused quite a lot of damage in frost hollows and are to be feared. Severe frost lift occasionally occurs in the nursery, where also early autumn frosts have been known to cause damage to lammas shoots. Temperatures, owing to the strong maritime influence, are generally mild in winter (growth continues sometimes well into October), and the summers are never very hot, 80°F shade temperatures being noteworthy in the average season.

(c) Wind

The prevailing wind is from the south-west during most of the year, although easterly winds are frequent in the spring months. Severe westerly and northerly gales are experienced, but so far no very extensive damage from windblow has been experienced. In January and February 1947 an exceptionally cold and strong wind, blowing from the south-east passed through Glen Salloch and caused a severe setback to exposed plantations which have not yet recovered from it.

Risks

(a) Fire

Fire danger from the railway which runs through the forest is a considerable, but reasonably controllable risk, and in dry weather all the afternoon trains are patrolled. Tourists on foot, cycle or in cars are becoming still more numerous in summer, but fortunately are not so frequent before the end of May, by which time the most inflammable conditions are usually over for the year. The worst hazard is from fire spreading to plantations from muirburning on adjoining lands, and fire losses to date can be attributed almost entirely to such origins.

(b) Vertebrates

Rabbits are not a great problem, although they occur quite freely in the extensive wastes of rhododendron which adjoin the roadside in many places, and fencing against them is required on all low ground.

Sheep frequently take advantage of gaps created in the hillside march fences by landslides and falling boulders, and are difficult to locate and drive out from the thicket-stage plantations.

Deer, both red and roe, are numerous and have caused much damage to new plantations by browsing, and to older plantations (more especially Pinus contorta, of which species they appear to be inordinately fond) by using them for rubbing off the "velvet" from their budding horns. Despite extensive and well repaired fences, both these species appear to have little difficulty in entering or leaving the plantations if they are keen to do so.

Voles are present, but their numbers have never increased to epidemic proportions.

The only birds to cause appreciable damage are blackgame which



were numerous in the early 'thirties and caused considerable losses among larches and pines: in the late 'thirties, and during the war, blackgame died out almost completely but are again beginning to establish themselves.

(c) Insects

Neomyzaphis has always been endemic to Sitka spruce but no deaths have been attributed to this agency, although in some years defoliation has been extensive and severe. When the old pine woods were felled pine weevil was feared, but in fact the infestation never became serious. The pine saw fly is endemic but so far damage has been negligible.

(d) Fungi

Despite the extensive use of Sitka spruce for replanting hardwood scrub areas, deaths from honey fungus are almost unknown.

Nectria curcubitula has not yet been positively identified on any Sitka spruce in this forest, although some trees show typical signs of attack by this fungus.

Heart-rot of Sitka spruce and Norway spruce, Hybrid larch and Thuja is already noticeable in the thinnings from certain localities.

Roads

At the time of acquisition the forest was served by roads skirting the Loch and running through Glen Salloch. There was no access to Glen Dubh other than by a fair-weather cart track, and most of the plantations were completely inaccessible to wheeled traffic. In the last few years, however, some  $5\frac{1}{2}$  miles of road have been constructed for the extraction of thinnings, and on the whole, most of the forest is now reasonably accessible.

Rides were laid out to follow, for the most part, the burns which run straight down the hillsides, and where no convenient burn existed, geometrical subdivisions by straight rides running more or less at right angles to each other were left unplanted. In addition, a very few narrow (10 ft.) extraction and bridle paths were left unplanted. It has not proved practicable to site the new roads on, or very near, most of these paths. Compartmenting was done first of all on a map, and then the compartment boundaries were laid out on the ground by prismatic compass. An attempt was made to lay out the major rides at right angles to the prevailing wind directions with the object of reducing the danger of wind damage.

## Labour

Until thinnings began, sufficient local labour to carry out the necessary work could be obtained, the average labour squad before the war being about 25 men augmented during the planting season by 10 to 15 temporary workers. Since 1940, however, labour has been increasingly more difficult to find, and the present squad of 45 (augmented during the winter months by a few itinerant Island crofters living in the Hostel) has proved inadequate to carry out all operations. During the war a factory to process seaweed products was erected on Barcaldine Policies, and this factory, still employing about 150 men, competes with the forest for the available supply of local labour.

Partly to help meet this shortage of labour, it has recently become the policy to sell thinnings standing to Timber Merchants, and 14 new workers' houses (of traditional brick construction) are now being built in an attempt to attract more permanent and reliable labour than can be obtained at present for the hostel.

## SILVICULTURE

### Preparation of Ground

Areas carrying heavy scrub were thinned out heavily before planting, and the remaining trees girdled at, or soon after, planting. Where scrub was sparse, clear-felling was done. In the early days heather was burnt before planting, and for a few years it was the practice to cut bracken a year before planting with the object of reducing weeding costs. It was soon found that the strong resultant growth of grass more than outweighed the weakening of the bracken.

Adequate drainage of wet ground was, from the first, considered to be essential; 15 chains per acre was the average intensity, but in boggy, peaty land drains at 8 yard intervals were dug. Some planting of Norway spruce on turves was practiced even in 1925, the first year of planting; it was recorded as being "very successful", and within a few years all spruce planting on ground which required drainage was done on turves.

In 1932 it was laid down that all draining should be done at least a year before planting, and that the size of the drains should be approximately 18 in. wide by 12 in. to 15 in. deep.

Fencing against sheep had to be universal, using rabbit netting wherever appropriate, and a deer fence was erected to protect all plantations, except those alongside the main Connel/Balachulish road where deer were not normally present.

#### Choice of Species

The spruces have always been considered to be the genus best suited to the extremely wet, mild climate and, according to the 1948 Census, now amount to no less than 82% (65% Sitka spruce, 17% Norway spruce) of the ground stocked with conifers. Scots pine forms 6.5% of the crop, Japanese larch and hybrid larch 4%, European larch 2.5% (practically all planted before 1933) and all others (chiefly Douglas fir and Pinus contorta) 5%. In recent years, however, a large proportion of poorer quality ground has been planted with a 50% mixture of Sitka spruce and Pinus contorta.

The following are some notes on the species used and their success, or otherwise, to date.

#### Sitka spruce

Sitka spruce is the predominating species. It has proved very accommodating as to soil, site and exposure. In the early days it was planted on all sites except hard Scirpus and heather knolls, and in general, no departure from this prescription has been made. Growth is very slow where planted on bad peat, and if heather is at all prevalent, severe checking has generally resulted, although it appears that once a canopy has been formed, recovery is rapid. On the less adverse sites, however, growth is extremely fast, 3 ft. leaders and a total height of 60 ft. in 20 years with a volume of over 4000 cu.ft. per acre are not uncommon.

#### Norway spruce

Norway spruce has been kept for the better moist soils, especially where Juncus is present, and under scrub, and in dense, moist bracken sites. It is also intolerant of heather. It has never been planted on high, exposed situations in this forest, Sitka being preferred for such sites. Growth rates are not so high as Sitka spruce, although some very fast rates of growth have been recorded: one fairly sheltered 24 year old plantation has reached 56 ft. top height and produced 4990 cu.ft. per acre.

#### Scots pine

Scots pine was planted on all the drier types of heather knolls,

occasionally in mixture with Sitka spruce in years when the latter species was scarce. On one of the better sites, in Glen Dubh, sheltered from north, north-west and all east winds, it has yielded 1700 cu.ft. per acre in 23 years, and is still healthy and vigorous. This plantation is in marked contrast to most of the Scots pine at Barcaldine, which generally were badly blasted by the 'forty-seven winter and have never fully recovered. A great many Scots pine plots, too, suffer severely from defoliation in the spring, just before growth commences; the cause of the defoliation has not yet been determined but is probably physical.

#### Corsican pine

Corsican pine, on the few areas where it has been planted, has grown successfully: one plantation, formed in P.28, is now standing at a top height of  $35\frac{1}{2}$  ft. with a volume per acre of 1867 cu.ft. It has so far been planted only on the better quality knolls at fairly low elevations.

#### European larch

European larch was planted on a fair scale up till 1933, since when it has not been used to any appreciable extent. It was kept mainly to the best mineral soil sites, on well drained slopes, although a fair amount of moist ground was planted with this species in the first two years. P.25 and P.26 began to suffer badly from dieback from about 1938 onwards, but this plantation was very heavily thinned at the beginning of World War II, and the remaining trees have now recovered almost completely, although they are heavily covered with lichen. Canker has never been very severe at Barcaldine, although it is present.

Later plantations were planted solely on well drained and frost free gravelly slopes, and so far have shown little sign of dieback. One of the early plantations, now aged 26 years, has a top height of  $49\frac{1}{2}$  ft. and a standing volume of 1600 cu.ft. after the removal of 820 cu.ft. per acre by thinnings in the early 'forties.

#### Japanese larch

Japanese larch was originally planted on strong, pure bracken sites, but from 1928 was planted increasingly, and is now planted almost exclusively, on sites where heather has an admixture of light bracken, i.e. usually on the better quality morainic knolls with a thin layer of peat over good gravelly or loamy soil. Of extremely fast growth in the first few years after planting,

one 26 year old plantation now stands 56 ft. high with a standing volume of almost 2000 cu.ft. per acre, after the removal in four thinnings of 1500 cu.ft. The form of much of the Japanese larch planted on rich, moist bracken soil is somewhat poor. Recently this species has been planted to form a fire-break on the outside of plantations adjoining areas subject to muirburn.

#### Hybrid larch

Hybrid larch grows even faster than Japanese larch, and one plantation, aged 23, has reached 52 ft. and a volume of 1750 cu.ft. per acre after the removal of 1420 cu.ft. in four thinnings. The stem form, even when planted on very rich, moist soil, is straight, in marked contrast to Japanese larch planted on similar sites. As is the case with its Japanese parent, the very fast early height growth at Barcaldine is now, after about the twentieth year, definitely beginning to fall off in all plots, although the trees still appear to be healthy and vigorous. In recent thinnings some of the trees have shown traces of butt-rot.

#### Douglas fir

Planted originally on dense bracken sites with a good gravelly mineral soil. Many of the early plantations were made by "pitting" very large plants, and on the softer sites these trees blew before they were 15 years old. In 1938, on the Chairman's suggestion, an experiment was tried in the hope of obtaining some produce from these blown trees: a proportion of them was removed and the remainder topped and left lying in the hope that some of their branches would straighten up and become satisfactory poles. The experiment, however, was not a success, and all blown areas had eventually to be cleared and replanted with another species. Douglas fir has not been planted in any quantity since 1932, although 4 acres of Douglas fir/Thuja plicata mixture were planted in P.34.

#### Mountain pine

Mountain pine was extensively used (37 acres in P.28, 23 acres in P.29) up to P.38 for planting the worst hard exposed peat knolls. The upright variety (var. uncinata) has been planted in quite a few localities, but all of these stands contain a fair proportion of stems which have produced the bushy habit of the type. One plot in which var. uncinata predominates, now aged 23, is standing at an average height of 18 ft. and has put on leaders averaging 14 in. for the last five years. Mountain pine has also been used

to beat up checked Sitka spruce. The intention in planting this species has not been to produce timber, but to make cover and to improve the soil sufficiently to allow of the introduction of timber species at some future date. This introduction has not yet been attempted anywhere on Barcaldine.

#### Pinus contorta

Pinus contorta was first planted in F.Y.28 and has been used increasingly since 1932 to take over the role originally allotted to mountain pine. Even on the poorest, most exposed sites it has grown satisfactorily. In 1938 it was introduced to checked Sitka spruce areas, and is now being used on all difficult Scirpus/Tetralix sites as a nurse species for Sitka spruce with which it is planted in 50% mixture, normally in alternate rows. At the age of 23 one plot of pure Pinus contorta has reached a height of 39 ft. and a volume of 3115 cu.ft. per acre, and the leaders are showing every sign of continuing to grow at a rate of 18 in. to 22 in. per annum. Deer, unfortunately, prefer this species to all others planted at Barcaldine, both for browsing and for rubbing the "velvet" off their antlers.

#### Minor Species

##### Thuja plicata

Thuja plicata was planted in a few selected sites on the better mineral soils. No extensive plots were made in view of the difficulty of raising this species in the nursery, and the danger of fungus attack. All existing trees seem to have overcome successfully the attack of Keithia thujina, and no losses from this disease in the plantations have ever been noticed. P.24 now stands at 2126 cu.ft. per acre, height 54 ft. and current annual height increment 2 ft.

##### Picea omorika

Picea omorika was planted on two sites: in 1925 a half acre was planted on a very poor, deep peat frost hollow, and the trees now stand at a height of  $40\frac{3}{4}$  ft., current annual height growth 1 ft. 10 in., and a standing volume of 2850 cu.ft. after the removal of 420 cu.ft. per acre. The other plot, P.29, consists of a few trees planted in Compartment 2 on former oak scrub ground, with a soil of clayey, but well drained, loam: at this date both plots compare very favourably with adjacent Sitka spruce and Norway spruce - in the P.25 area Sitka spruce is still in severe check. Cones were collected from these plantations in 1950.

### Abies procera

Abies procera was planted in old scrub land with a skin of peat over a clayey loam, on a moderate slope with rocky outcrops and deep soil in between. The vegetation was a mixture of heather and blaeberry. On the best sites it has now reached 46 ft. in height, 3520 cu.ft. per acre and 1 ft. 11 in. leaders at 24 years of age.

### Pinus ponderosa

One small plot was planted in P.27 on a rather thin-soiled bracken/grass/heather site, which is moderately exposed. After a very slow start the trees have now reached a height of some 15 ft. to 20 ft. with 12 in. to 18 in. leaders.

### Hardwoods

The only hardwood used to any extent was beech, 20 acres of which were planted under thinned oak scrub in P.26 and P.27. These are now 10 ft. to 20 ft. high, but not of good form. Some grey and Oregon alder were planted on moist, free draining soil, but many of the trees have died.

### Planting

#### (a) Spacing

Spacing was originally at  $4\frac{1}{2}$  ft. (5 ft. on better ground for Sitka) for spruces and pines,  $5\frac{1}{2}$  ft. for the larches and  $5\frac{1}{2}$  ft. to 6 ft. for Douglas fir. By 1932 these had been amended to 5 ft. for Norway spruce and the pines,  $5\frac{1}{2}$  ft. for Sitka spruce and European larch, and 6 ft. for Douglas fir and Japanese larch, but on the poorest soils the spruces and pines were planted 6 in. closer. "Square" planting has always been the rule, and some of the older plantations, judging by present day standards, are remarkably regularly spaced both in and across the lines.

#### (b) Type of Plants

Most plants used were grown locally as transplants raised from imported 2 year seedlings: Barcaldine nursery has always been considered unsuitable for a large area of seedbeds.

The age of plants used was generally 2+2, although older plants, 2+3 or 2+2+1 in the case of Douglas fir, were frequently planted, and sometimes 2+1 Scots pine. Later the 1932 Working Plan laid down that wherever possible, 2+1 plants should be planted on mounds, but large plants (to be not less than 10 in.) were to be used for flat planting.

In recent years it has become the practice to plant Japanese larch, Scots pine, Douglas fir and Sitka spruce as 2+1 and Norway spruce as 2+2.

Two year seedlings of Japanese larch were used as early as 1932, and losses did not appear to be any more severe than in the case of transplants. The seedlings were put into small pits made with a semi-circular spade. In post-war years considerable use of heathland nursery seedlings has been made (1 year for Japanese larch and Sitka spruce and 2 year for Pinus contorta) together with 2 year Japanese larch seedlings from agricultural type nurseries.

(c) Methods of Planting

The normal method of planting for most species was by "L" notching. In the first Forest Year (P.25) screening of all types of vegetation before planting was done, but in all subsequent years only dry heather knolls, unlikely to retain surface moisture, were screened. The pines were generally planted with the mattock, screening being done at the same time as planting, although in at least P.28 Scots pine was pit-planted on the hard knolls. Pit-planting generally was abandoned in the early 'thirties as being too expensive and notch-planting substituted. When planting turves, roots were put between the inverted turf and the ground: if the turves are large, this sometimes involves cutting a "step" into the turf, especially for small seedlings: this practice may help to provide a little additional shelter for small plants.

(d) Rate of Planting

The annual planting target, after the first year when late entry allowed only 86 acres to be completed, was 200 acres per annum, and planting continued at roughly this rate until 1932 when it was reduced to just over 150 acres: it continued at this rate until planting virtually stopped after F.Y.41. After the war 71 acres were planted in P.49, 151 in P.50 and 223 in P.51.



(e) Manuring

The first record of slagging was in F.Y.26 - "Mounded plants on waste peat were slagged in May". In P.27, 27 acres of mounds were slagged, and this became the normal practice for all very sour land. In 1935 "Semsol" was used instead of slag, but the plants treated (P.34 Sitka spruce on poor peat, showing signs of going into check) showed a tendency to scorching, and slag was used instead in later years. Slagging continued until 1942 on all checked areas but was not normally applied to plantations more than two to three years old.

(f) Success in Establishment

Practically all species have succeeded in establishing themselves satisfactorily on all but the worst types of peat (especially at the head of Glen Dubh) where Sitka spruce and Norway spruce, when used, are still in check after more than 10 years. The only real failures were the alders, grey and Oregon, and also perhaps the very large (3 ft. in some cases) Douglas fir transplants which blew even after they had been staked at 5 years of age or even younger.

So far seedlings appear to have been just as satisfactory as transplants, although it is perhaps too early to pass judgment on post-war seedling planting.

Ploughing

No ploughing took place at Barcaldine until P.49, in which year, and in all subsequent ones, all suitable ground has been plough-drained by Cuthbertson single furrow plough, using D.2, D.4 or Fowler tractors as the traction units. Spacing has been at 21 ft. and turves cut from the ridges by hand/<sup>and</sup>laid out at 5 ft. (for Norway spruce) or 5½ ft. intervals. After ploughing was completed most of the drains had to be led into the leaders by hand.

### Beating up

In the early years it was the practice to beat up every blank as soon as possible - of the 86 acres planted in P.25, 53 acres were beaten up in P.26. The heaviest mortality was among the European larch, and in P.27 the normal practice of beating up with the original species had to be amended and European larch was replaced by Norway spruce and Sitka spruce.

The only other instance of such a change of species was when Pinus contorta was introduced to checked Sitka spruce on areas of sour peat in P.29, and when a few checked areas of Norway spruce were beaten up with Sitka spruce. Beating up, in general, continued for several years after the original plantings. The losses in European larch were fairly severe, in P.32 for instance, only 17M European larch were used for planting yet 4,000 plants were used for beating up in 1933 and 5,000 in 1935, i. e. more than half the original plants had to be replaced. Losses, and therefore replacements by beating up of Scots pine, Japanese larch and especially Douglas fir, were also sometimes fairly severe, but beating up of other species has been negligible, in the order of 1% to 2%, or even less.

### Weeding

On mound-planted ground very little weeding was required during the first growing season except on very rusky and vigorous bracken land. In the second and third years weeding had to be much more extensive, up to 70% of the land requiring weeding at least once during the summer. Strong bracken had to be cut at least three times every year in the worst areas until the plants were big enough to prevent the bracken from collapsing on top of them. It is believed that lack of adequate attention to weeding bracken has been responsible for most of the deaths that occurred among larch in their early years.

In old scrub areas honeysuckle, bramble and coppice growth of birch, oak, and goat willow have proved to be very vigorous, some areas requiring to be weeded of these species several times before the conifers could close canopy and suppress them.

### Mixture of Species

Until recently there have been very few examples of mixed planting. In P.34 4 acres were planted with a mixture of Douglas fir/Thuja, but most of the Thuja has died. In P.37, during a scarcity of Sitka spruce, this species was planted in mixture with Scots pine on four acres of hard knolls, and on 10 acres it was mixed for the first time with Pinus contorta. Both these mixtures appear to have been successful, although the Sitka spruce, after a slower start, is overtaking the Scots pine. In post-war years it has been the practice to plant the worst peat areas, where Scirpus is at all prevalent, with a 50% row by row mixture of Sitka spruce/Pinus contorta. In P.51 2 acres Scots pine/European larch mixture were planted. No under-planting has been done at Barcaldine with the exception of some Abies procera and Tsuga underplanted in a small acquired plantation. When this was felled during the war the underplanting was lost completely.

### Rates of Growth

This has already been referred to for each species in the section dealing with 'Choice of Species'.

Details of the plots measured are shown in Appendix III.

It may be of interest to record here the growth of the 43 Douglas fir trees which comprise Sutherland's Grove. This plantation, spaced at approximately 24 ft. when planted over 80 years ago on a broad alluvial gravel flat near the south of the Glen Dubh river, is well sheltered at ground level but at a height of about 100 ft. above the ground level is fully exposed to the North and West, and to some extent also to the East. It is believed to have been planted from seed collected from the Taymont Douglas which were themselves planted in 1850. The origin of the Taymont Douglas, which are of excellent form, is unfortunately unknown.

The 43 trees, re-measured in 1951, now range from 91 ft. (broken tip) to 155 ft. in total height, the average being 135 ft. One tree is 158 ft. to the tip, but the top 30 ft. have died back. B.H.Q.G. (O.B.) ranges from  $19\frac{3}{4}$  in. to  $43\frac{1}{4}$  in. the average (by Weiss's 40% rule) being 30 in. giving an average O.B. volume of approximately 251 cu.ft., and the total volume for

the 0.6 acre plot 10,900 cu.ft. It is interesting to note that when the trees were measured in 1936 and 1948 the estimated average height and quarter girth were respectively 110 ft. and 125 ft. and 27 in. and 29½ in. In F.Y.37 the trees in the Grove and nearly all of the scattered roadside and parkland trees of the same age, were pruned to a height of some 35 ft. to 40 ft.

### Past Treatment of Established Plantations

#### Brashing

Brashing has always been done only on selected stems, the intensity of the brashing ranging from 15% (as recommended in 1951 by the then Divisional Officer) to something over 50%. The outside few rows of trees adjoining a public road or railway, or marching with land subject to muirburn, have been brashed completely and the brushwood removed, in order to alleviate the risk of a ground fire entering the plantation and spreading to the crowns via the lower unbrashed branches. To date some 370 acres have been brashed but this does not include considerable areas of European larch and Japanese larch which were thinned before brashing.

#### Pruning

No high pruning has been done with the exception of the old Douglas fir in Sutherland's Grove and elsewhere. In a few of the faster grown larch areas dead branches have been knocked off selected stems with a pole.

#### Cleaning

Approximately 100 acres of suppressed trees have been cleaned prior to thinning, but in the past this cleaning operation has been done in conjunction with, or subsequent to, the first thinning. More than 600 acres of regrowth of scrub and coppice have had to be cleaned.

#### Thinning

The first thinning, that of 2 acres of Japanese larch, took place in F.Y.37 and yielded an estimated 200 cu.ft: 4 more acres of Japanese larch and 2 acres of European larch were thinned in F.Y.38, yielding a total of 700 cu.ft. mostly converted to fencing material. In F.Y.39 and 40 heavy

cleanings were done but no thinning. Since 1941 thinnings have been increasing in volume and area, although owing to various factors (difficulty of marketing produce being the chief one) rather sporadically, e.g. 149.5 acres were thinned in F.Y.47 but only 66 acres in F.Y.48.

Total area which has now had its first thinning is 369 acres yielding 82,600 cu.ft., and 243 acres of second and subsequent thinnings have produced 77,405 cu.ft. The aim has been to have an interval of three years between thinnings, but owing to extreme shortage of labour and other reasons, this ideal has seldom been obtained: to improve the die-back of P.25 European larch the trees were thinned out so heavily in F.Y.41/F.Y.42 that no further thinning in those plots has been necessary.

### Markets

The greatest difficulty in finding markets for the bulk of the thinnings from Barcaldine lies in its remoteness from the nearest large centre of population. A very large amount of fencing material has been prepared for use in this and other Forestry Commission forests, usually creosoted (open tank, hot and cold method) before use. Most of the thinnings, however, have been sold as mining timber in one form or another, as long pitwood, tonnage wood, and during the war, pitprops. Other markets are as pulpwood, boxwood for the larger sizes, and telephone poles. A certain amount of firewood is sold locally every year, and one or two waggon loads have occasionally been sold to the Glasgow district. Some of the larger thinnings have been sent to a Forestry Commission mill for conversion to sawn timber for use by the Estate Branch of the Forestry Commission, and some use of well seasoned girdled oak trees has been made by sawing these into bridge decking and battens.

### Research

Barcaldine nursery has one of the most alkaline soils of any nursery

commonly used for growing conifers in Scotland. For this reason it was selected in 1948 for an experiment on acidifying soils. For this purpose sulphuric acid, sulphur and heavy dressings of ammonium sulphate were all used, both separately and in combination with sterilization by formalin. Sulphuric acid was very effective in increasing the size of Sitka spruce seedlings, sulphur had some harmful effects in the first season, but the long term effects were beneficial; the ammonium sulphate was also effective. None of the acidifiers, however, was as effective as the use of formalin. At the conclusion of the experiment it was decided that the simplest method of acidifying the soil in normal nursery working would be to use repeated dressings of ammonium sulphate at the time of greencropping, repeated over a number of rotations.

## Conclusions

### Choice of Species

This is dealt with fairly fully in the section dealing with this subject and it is apparent from the data given that Sitka spruce is the species most suited to the climate and the majority of the soils and sites at Barcaldine except where the heather (Calluna) is at all prevalent. Judging from the timber sawn from some of the larger thinnings, used for joinery and repair work by the Forestry Commission Estate Branch, even the fastest grown Sitka yields sawtimber of good quality, fully comparable with home grown Norway spruce in strength and considerably lighter in weight. When well seasoned, round fencing stobs of Sitka are easily and adequately creosoted by the hot and cold method in an open tank.

Norway spruce is a slower grower, and fast grown timber of this species is inclined to be rather soft, but the species appears to be well suited to the more sheltered lower ground with reasonably well drained mineral soil or thin peat, and is better able to withstand spring frosts.

Japanese larch, or preferably hybrid larch if it can be obtained, grows satisfactorily on a wide range of soils and can tolerate Calluna. Japanese larch, where grown on moist, rich mineral soil, seems to have a tendency to grow crookedly, a defect not apparent in hybrid larch. European larch can be grown satisfactorily at Barcaldine, but seems to require very careful site selection and early and heavy cleanings and thinnings.

Douglas fir is a most disappointing species in the new plantings in view of the high quality of the trees in Sutherland's Grove. It may be that better choice of sites and provenances will enable comparable trees to be grown, but to date nearly all Douglas fir stands at Barcaldine are either much damaged by wind or are of poor type in form and vigour.

Scots pine is another relative failure. At best, it is a low volume producer compared with the exotic conifers. It is possible that plants of guaranteed West Coast Highland origin might give better results. Corsican pine has been successful in the few plots tried, and if more planting land is acquired in the vicinity, is worthy of further trials. Pinus contorta, especially of the inland variety, has grown successfully wherever planted and appears to be the species best suited for bad peats and for exposed, hard Calluna sites. At this forest it has not yet shown any susceptibility to windblow. Mountain pine, especially the upright variety, appears to be worthy of further investigation. If it is to be used as a nurse, in view of its very slow early growth, it should preferably be planted several years before the main crop.

Of the minor species tried Picea omorika is the most outstanding in its ability to grow in a frosty bog and may prove to be the answer to the planting of such sites. Thuja and Abies procera are also promising, the latter being tolerant of heather and exposure. From results in nearby forests Tsuga would be worth trying.

None of the hardwoods used has been particularly successful. It is intended to include a small area of sycamore in P.52.

#### Planting

Present planting distances appear to give satisfactory results; these are  $4\frac{1}{2}$  ft. for Scots pine, 5 ft. for Norway spruce, Pinus contorta and Sitka spruce on poor sites, and  $5\frac{1}{2}$  ft. for Sitka spruce on better ground and for Douglas fir and the larches. Small plants (6 in. to 12 in.) are more satisfactory than larger ones, even though extra weeding may be required. Seedlings (1 yr. if of heathland nursery origin, 2 yrs. otherwise) have so far given good results and have been as successful as transplants except where a late planting has been followed by a drought in spring or early summer.

### Mixture of Species

It is doubtful if the present method of mixing Sitka spruce and Pinus contorta (in alternate rows) is the best one from both a silvicultural or thinning point of view, and investigations to find the most suitable method are desirable. It is unfortunate that the Douglas fir/Thuja mixture failed since this mixture is proving a success, so far, at Duror Forest. No reason for the failure of the Thuja is recorded.

### Draining

There is no doubt that adequate drainage of the order of 30 chs. per acre is essential if plantations are to thrive. The deeper plough drains now being used have not been tried long enough fully to assess their silvicultural merits, but they should at least reduce the amount of drain repair work required in subsequent years. Since this history was first drafted, an exceptionally severe gale (winds exceeding 100 m.p.h. were recorded) has caused considerable windthrow (chiefly in P.30 and P.29), and from an examination of the damage done, it appears that practically every blow in spruce began at the edge of a drain, especially where drain repairs had been delayed so long that to get sufficient depth some roots of the drainside trees had had to be cut. This damage is only fresh evidence of the need to keep drains always running freely so that no roots can form in the choked drains. It also emphasises the point that in any new planting the plants must be kept as far away from the drainside as possible.

### Labour

The present squad of about 45 men is totally inadequate to carry out essential maintenance of the plantations, thinning and new planting. Something approaching a squad of 80 (including employees of any timber merchant working on the area) is required. Selling thinnings standing to merchants may well attract more workers, since the merchants are able to pay the high rate of wages necessary to attract workers to the district. The 14 new houses, when completed and occupied, should also help to ease this problem.

### Extraction

After road construction work began at this forest in 1947, it became obvious that, if roadlines had been adequately surveyed and left unplanted in the past, considerable expense in felling trees for the roadline would



have been saved, and possibly a more suitable, cheaper roadline could have been chosen. There is also reason to believe that if the more inaccessible areas (such as the head of Glen Dubh) had been served by a reasonable road at the time of planting, the cost of making the road would have been repaid to a considerable extent by reducing walking time, improving supervision, and consequently improving the quality and quantity of the maintenance work done. Further, the route of the road would have been laid out for all time.

So far, none of the higher ground has yet required thinning, but when it does extraction is almost bound to be difficult and expensive: roads are impracticable and lengthy chutes and/or cableways will probably be required.

(Sgd). S. U. ROBERTSON,  
District Officer.

History of Barcaldine Forest

APPENDIX I

Notes from Inspection Reports

<u>Date of Inspection</u>	<u>Inspecting Officer (s)</u>
10.9.25	Mr. R.L. Robinson, Technical Commissioner
29.3.30	" " " " "
20.9.32	Sir Roy Robinson, Chairman
17.9.34	" " " "
11.6.35	Commissioners' Tour
4.9.41	Lord Robinson, Chairman
9.9.42	Lord Robinson, Chairman and Sir William Jowitt, Minister of Reconstruction.
5.6.46 and 6.6.46	Mr. James Macdonald, Directorate Conservator
9.4.48	Sir Henry Beresford Peirse, Director (Scot.)
30.6.48	Sir Henry Beresford Peirse, Director (Scot.) and Sir Samuel Strang-Steel, Forestry Commissioner
9.6.51	Lord Robinson, Chairman

In 1925 the Chairman stated that the then existing conifers showed that "a large production of timber may confidently be expected". The bare ground scheduled as plantable was probably at one time under scrub. It was recommended that the best ground in the poorest peat areas should be planted first, and a return to the area made when the drains had acted and the first planting could provide some shelter. In 1941 it was urged that the type of poor ground planted in Glen Salloch, P.40, should not be tackled unless it could be plough drained for a reasonable cost, at about half the cost of hand draining.

The tendency to carry larch on to wet ground better suited to spruce was noted in the first year of the forest. In 1934 the speed with which girdled trees died was recorded as being within 2 years for birch, up to three years for alder, and at least 4 years for oak. At this inspection also the marked contrast between ordinary flat planted spruce, which suffered severe checking, and turf planted spruce, free from check, was observed.

In 1935 the Chairman proposed, and the Commissioners agreed, that "Sutherland's Grove" be so named in honour of Sir John Sutherland and that the grove be not felled except with the permission of the Commissioners.

In 1941 the Chairman thought that an extraction route would be necessary down both sides of the Glen Dubh burn, above the croft, and that extraction would be the main problem once thinnings began. Ten years later (1951) he noted that the problems he had foreseen had now arisen and he then suggested very heavy thinnings in the patches of advanced growth to make the extraction from them worth while and to obviate any necessity for a return to them for a number of years, by which time much of the slower grown areas would be ready for their first thinning, sufficient to justify the cost of a road. He advised against any expensive beating up or replanting of the very backward areas at the head of the Glen.

The cost of the reconstructed road to Glen Dubh Holdings in 1941 (approximately £3,500 per mile) was regarded as excessive. The thinning just completed in the hybrid larch in P.27 was regarded as "bold". (Note: volume per acre removed, 2nd thinning, was 390 cu.ft.). The choice of species in P.32 and P.33, Glen Salloch, was commended by the Chairman who, in 1951, was very satisfied with the way this plantation was closing canopy, thus fully justifying his earlier commendation.

In 1946 it was recommended that instead of selling them for tonnage wood, large straight butts from thinnings might be marketable as boxwood for a much higher price. Mr. Macdonald thought that when cleaning drains the roots of predominant trees should not be cut. The urgent need for forest roads to reduce the maximum horse drag to some 200 yards was appreciated. In P.27 thinning of Sitka spruce was adversely criticised for having removed too many "dominants", in the fear that these would become wolf trees. Natural seedlings of European larch and Scots pine were keeping pace with planted Sitka spruce, and it was agreed that the seedlings should always be encouraged in cleanings and subsequent thinnings. There was some fear that a proposed trunk road diversion to by-pass a dangerous bridge might be routed through the middle of Sutherland's Grove, and this proposal would have to be resisted. (Note: An assurance was later received from the County Road Surveyor that the by-pass, if constructed, would skirt the Grove).

In 1948 arrears of drain maintenance were attributed to severe labour shortage, which it was hoped partially to alleviate by acquiring North Connel ex-R.A.F. camp as a Hostel. The "wastage" of forest labour on nursery work for some six months of the year was also cited. It was suggested that Japanese larch might have been used with more success than the badly blasted P.36 and P.40 Scots pine on the south side of Glen Salloch. The blasting was attributed by Directorate Conservator (Mr. Watt) to the winter of 1947. In 1951 the Chairman advised against beating up until it was seen how many of the Scots pine would recover and form a crop.

APPENDIX II

Supervision

Conservators (Superseding Divisional Officers in 1946)

Mr. A. Watt                    1946 - 1948  
Mr. J. E. James                1948 to date

Divisional Officers

Mr. J. M. Murray              1924 - 1934  
Mr. O. J. Sangar               1934 - 1938  
Mr. A. H. Gosling              1938 - 1939  
Mr. J.A.B. Macdonald         1939 - 1945  
Mr. A. Watt                    1945 - 1946  
Mr. J.E. James                 1947 - 1948  
Mr. H.V.S. Dier                1948 - to date

District Officers

Mr. W. H. Whellens          1924 - 1939  
Mr. J. E. James                1939 - 1943  
Mr. H.V.S. Dier                1944 - 1947  
Mr. R. F. Wood                1947  
Mr. J.G. Chrystall             1947 - 1949  
Mr. S. U. Robertson         1949 to date

Foresters

Mr. A. M. Fraser               1925  
Mr. S.H. Patterson            1926 - 1929  
Mr. H. Cameron                1929 to date

History of Barcaaldine Forest

APPENDIX III

Rates of Growth Schedule

Compt.	Species	P. Year	Age (Yrs)	Soil	a. Altitude b. Aspect c. Slope d. Exposure	Mean Ht. of Dominants (ft.)	Mean Annual Height Increment (in.)	Current Annual Height Increment for 5 yrs. (in.)	Standing Vol./Acre (cu. ft.)	Vol./Acre from Thinnings (cu. ft.)	Remarks
A. 46	S.F.	28	23	3" peat, morainic loam, clay	a. 600' b. S.W. c. Steep d. Moderate	32	17	15	1680	-	
A. 8	C.P.	26	25	Thin peat over deep clay and rock.	a. 50' b. N.W. c. Steep d. Sheltered	35½	17	20	1867	-	
A. 1	E.L.	25	26	Deep loam and clay	a. 200' b. W. c. Slight d. Sheltered	49½	23	22	1600	1st, 150) 2nd, 670)	820
A. 4	J.L.	25	26	Deep loam and clay	a. 200' b. N.W. c. Moderate d. Sheltered	56	26	24	1950	1st, 100) 2nd, 300) 3rd, 412) 4th, 687)	1499
G. 11	H.L.	28	23	Moderate deep loam and clay	a. 200' b. N.N.W. c. Slight d. Sheltered	52	28	20	1750	1st, 180) 2nd, 390) 3rd, 350) 4th, 500)	1420
B. 3	D.F.	27	24	Shallow peat deep loam and clay	a. 150' b. N.N.W. c. Moderate d. Moderate	60	30	31	2360	1st, 533) 2nd, 675)	1208
B. 6	N.S.	27	24	2-6" peat, 12" loam, clay sub-soil.	a. 150' b. N.N.W. c. Moderate d. Slight	56	28	23	4240	1st, 750	A rather exceptional plot
G. 7	N.S.	30	21	Peaty loam over clay	a. 50' b. N c. Flat d. Sheltered	47	27	22	3025	-	More normal for N.S. in rich soil.
A. 2	S.S.	41	10	Deep loam and gravel	a. 200' b. N.W. c. Moderate d. Sheltered	20	24	31	-	-	Replanting blown D.F. Some N.Y. 50 shoots exceed 45"
G. 2	S.S.	29	22	Thin peat over clay	a. Sea level b. W. c. Flat d. Sheltered	66	36	35½	3758	1st, 667) 2nd, 1000)	1667
A. 3	S.S.	25	26	Shallow peat, deep loam and clay	a. 120' b. W c. Moderate d. Sheltered	68½	31	31	4480	1st, 600) 2nd, 340) 3rd, 460)	1400
A. 15	Thuja	27	24	Deep loam and sand	a. 150' b. N.E. c. Steep d. Sheltered	54	27	24	2126	-	

Compt.	Species	R. Year	Age (Yrs)	Soil	a. Altitude	Mean Ht. of Dominants	Mean Annual Height Increment	Current Annual Height Increment for 5 yrs.	Standing Vol/Acre	Vol/Acre from Thinnings	Remarks
					b. Aspect						
A. 4	Picea omorika	25	26	Deep, sour peat, in bad frost hollow	a. 120'	40 $\frac{1}{2}$	19	22	2850	1st, 420	
A. 4.7	P. C.	28	23	6" peat, hard morainic loam and clay	a. 500'	39	20	22	3115	-	
B. 20	M.P. (Var. uncinata)	28	23	Thin peat hard morainic loam and clay	a. 500'	18	9 $\frac{1}{2}$	14	-	-	
A. 14	Ab. Nob.	27	24	1-2" peat, moderate deep clay and loam	a. 100'	46	23	23	3520	-	

