

FORESTRY COMMISSION

HISTORY

of

THE BLACK ISLE FORESTS

(Findon, Kessock, Millbuie, Kilcoy)

1926 – 1951

NORTH (SCOTLAND) CONSERVANCY

HISTORY OF THE BLACK ISLE FORESTS (FINDON, KESSOCK, MILLBUIE, KILCOY)

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HISTORY OF THE BLACK ISLE FORESTS (FINDON, KESSOCK, MILLBUIE, KILCOY)

CHAIRMAN'S COMMENTS

Mr Dickson has written an excellent and detailed account and there are few points on it to which I need refer in detail.

It will be apparent from the account that acquisition of land and planting on the Black Isle moved slowly for the first few years after a beginning was made in 1926 in the forests of Findon (now 1333 acres) and Kessock (now 910 acres); further that our new plantations on the poorer sites on Findon were by no means encouraging.

On the other hand it was obvious that there was a very large area on the Black Isle which had formerly been under pines. Old stumps, decayed down to the heart wood, were still to be seen in the ground and scattered about were numerous scrub pines, the worthless remnants, one supposed, of the felled crops. The question was what could we produce from such land bearing in mind always what was happening at Findon? In 1935 I determined to go closer into the matter in the light of possible improvements in planting technique.

Since 1931 we had been developing the cultivation with caterpillars and heavy ploughs of heather land at Allerston in Yorkshire and meeting with encouraging success. In 1936 I made an inspection of this work and went on to Scotland.

In the middle of October Messrs J M Murray, James Fraser, Frank Oliver and I made a close inspection of some of the ground which might become available for afforestation. There is no record of this inspection on Headquarters' files, but Mr James Fraser has given me the following account, which fits in with my recollection:-

"We passed a felling by Wylie" (not a bad crop of Scots pine and with sufficient fresh windfall to expose the soil and root development./ R.) "There was also a stand of poor Scots pine on Newhall ground with a very small patch of Sitka spruce not far from the track on which we were travelling. The poor Scots pine were first of all thinned during the war, 1939, and later felled. The Sitka spruce were left standing. The subjects discussed at the meeting were:- depth at which iron pan occurs; distribution of the pan; possibility of ploughing the old stump land which had been burnt over; possibility of ploughing the fresh stump land; depth to which ploughing should be done. On this occasion, the chairman, in speaking of the old stumps, made use of the phrase that the old stumps would come out like "rotten teeth". He used the phrase frequently afterwards. He stated that there was a uniformly distributed iron pan and I disagreed. I believed that I established my point but I did not convince the Chairman. I have since revised my belief and now agree that the iron pan is more widely distributed than I originally thought. The point that I tried to make then, and I still hold the same opinion, was that the hard drift is one of the primary causes of the pan formation and that the hard drift itself is just as effective in holding up water as the iron pan. It was agreed without any dissent that, if we were to plant that Newhall area, we should go in

for ploughing that would cut into the drift as far as we could drive the plough. We knew about Belton at the time. I had the idea then that the chief value of the ploughing was to increase the feeding area of the roots. I might be much less certain of that belief now."

I agreed accordingly to support proposals for large-scale acquisitions on the Black Isle. The same evening I kept an appointment, arranged for me by Mr Fraser, with Major Shaw Mackenzie and agreed with him to purchase the first block of Millbuie (1405 acres). (This is one of the very few cases in which I have intervened personally in negotiations for acquisitions.) Events then moved quickly and we acquired in all from 28 May 1937 to 28 November 1937 upwards of 5500 acres in 7 lots, all by purchase, at an average price of £2 per acre.

My general view with regard to heath ploughing was and still is that it was desirable to break through the pan and to pile up the soil as high as possible, thus increasing to a maximum the depth of aerated soil in which the trees can root. I think and have evidence that full-ploughed soils of fine material will ultimately pack down again into an unaerated state. I have never been alarmed by the difficulties of extraction over deep ploughed land.

The discovery (so far as I am concerned) of the remarkable plots of Douglas fir, Sitka spruce and Tsuga on the Rosehaugh estate was a revelation to me. The soil there may be above average, but the production is so high that it is worth while going to a lot of trouble to find sites where similar results may be secured. For that reason I suggested at one visit that more use be made of such species and, since they are successor species, they be planted on heather sites (the soil being reasonably good) in mixture with the pioneer Scots pine. Such a mixture will undoubtedly stimulate successor species to normal growth if they go into check in the early stages of the plantation.

The history does not refer to 3 visits paid by Ministers to our work on the Black Isle, namely Sir William Jowitt (Minister without Portfolio) and Sir Kingsley Wood (Chancellor of the Exchequer) in August 1943; Lord Jowitt (Lord Chancellor) in September 1945; and Mr Hugh Dalton (Chancellor of the Exchequer) in August 1946. These visits, with others, stimulated great interest in Ministerial circles and greatly helped forestry in general. Sir John Anderson (Home Secretary) was to have joined the Jowitt-Kingsley Wood party but he had to go to America (as I now strongly suspect in connection with work on the atomic bomb).

Sir Kingsley Wood's interest was particularly welcome as I had come in for some hard knocks in connection with the preparation for printing of the Commissioners' Report on Post-War Forest Policy (the White Paper Cmd. 6447). I was called before a Cabinet Committee with Sir Kingsley in the Chair, ostensibly to explain the proposals of the Report. But certain interests criticised severely the action of the Commissioners and myself in particular for daring to prepare a report in advance of Government instructions, and sought to prevent publication. I took the simple line that it was the statutory duty of the Commission to advise Government, and that there was nothing in the Report either to commit the Government or to suppress. In this Sir Kingsley and the Committee as a whole fully supported me, for which I had reason to be grateful.

When, therefore, Sir Kingsley came out into the forests I took the first opportunity to pay him a compliment, and with his consent named our first road in Millbuie the "K.W. Way". I would be glad if this name could be shown on official plans, including OS maps.

On leaving Scotland, Sir Kingsley Wood issued a press statement, relative extracts of which are given below:-

"Another item of great interest to me was the afforestation work on the Black Isle. Here the Commission has acquired over 11,500 acres of which 10,600 acres is plantable, the remainder being largely arable or permanent pasture which is, of course, not planted. A little more than 5000 acres has been planted to date. A large part of this area would not have been planted and would have remained almost entirely non-productive but for the development by the Forestry Commission of the technique of ploughing the land before planting. Heavy ploughs of their own design and caterpillar tractors are used and the effect of this treatment on the growth of the young trees is very striking.

.... During my recent visit I was glad to meet and discuss many problems with many of this fine body of men under Mr A H Gosling, the Assistant Commissioner for Scotland. They greatly impressed me with their single purpose and zeal."

That was a well-deserved tribute and coming from an independent source pleased me greatly.

R.

31st December 1951

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GENERAL DESCRIPTION OF THE FOREST AREAS

Situation

The Black Isle is not an island, but a peninsula joined to the mainland by a 4 mile neck of land stretching from Beauly to Conon Bridge. The Black Isle lies directly north of Inverness across the Beauly Firth. There are 2 derivations of the name "Black Isle", one general and one local. The former of those 2 derivations is due to the fact that, in olden times, even up to a little over one hundred years ago, the area was covered by forest. The latter local derivation is due to the fact that snow never lies on the ground. This is a fallacy, especially on the north side of the Black Isle, but it is, nevertheless, quite an important point from the forest nursery point of view.

On the Black Isle are 4 forests, viz. Millbuie, Findon, Kessock and Kilcoy. These mainly occupy the high centre ridge, although prongs stretch down to the sea.

Area and Utilisation

In all, the Commission have made 28 separate acquisitions in the Black Isle, and these have been allocated to 4 forest units, viz. Findon, Kessock, Millbuie and Kilcoy. The total land acquired amounts to 11,872 acres, of which 10,619 acres are allocated to tree growing and 149 acres to forest nurseries. The allocation of the above land to forest units is as follows:-

TABLE I

From	By	Date	Plantations Acquired	Plantable excluding Col. 4	Nurseries	Agricultural	FWH	Unplantable excluding Col. 4	Other Head		Total
									Description	Area	
Findon											
Messrs Jones	Purchase	31.03.26									750.0
D Wilson	"	15.11.26									24.0
H MacLennan	"	19.04.27									33.5
William Jack	"	23.07.28									16.0
A F Wylie	"	28.05.31									178.5
J W Nicol	"	28.05.33									66.5
C M Fraser	"	22.12.36									95.0
C MacLennan	"	28.11.45									63.0
Messrs Jones	"	05.09.45									42.0
D Allison	"	21.04.27									65.0
Totals				1237.0	31.6	-	51.0	13.9	-	-	1333.5
Kessock											
Sir D Macdonald	Purchase	31.03.26									403.0
Mrs B A Fraser)	Feu	28.05.29									249.0
Mackenzie)											
Sir D Macdonald	Purchase	20.10.33									2.5
Mrs B A Fraser)	"	28.05.39									255.0
Mackenzie)											
Totals			80.0	708.0	-	29.0	2.5	90.0	-	-	909.5

From	By	Date	Plantations Acquired	Plantable excluding Col. 4	Nurseries	Agricultural	FWH	Unplantable excluding Col. 4	Other Head		Total
									Description	Area	
<u>Millbuie</u>	Purchase	28.05.37									1405.0
Major Mackenzie	"	28.05.37									150.0
D J Cameron	"	28.05.37									1045.0
G Ross	"	30.09.37									43.0
D.O.A.S.	"	28.11.37									272.0
D Thomson	"	28.11.37									2397.0
Rosehaugh Estates	"	28.11.37									250.0
Rosehaugh Estates	"	28.05.39									107.0
J Maclean	"	28.11.39									149.0
D Mathieson	"	28.11.40									597.0
Rosehaugh Estates	"										10.0
A J Fraser											
Totals			54.0	5765.0	101.6	300.9	2.6	18.9	Housing Site D.O.A.S.	10.0 172.0	6425.0
<u>Kilcoy</u>	Purchase	28.05.39									3073.0
Kilcoy Estate	Feu										1.0
Mountjoy Estate	Feu	23.03.48									130.0
Ferintosh Estate											
Totals			475.2	2300.2	16.1	155.7	14.0	23.0	Housing Site D.O.A.S.	11.5 208.3	3204.0
GRAND TOTALS			609.2	10010.2	149.3	485.6	70.1	145.8		401.8	11872.0

TABLE II

	Findon (acres)	Kessock (acres)	Millbuie (acres)	Kilcoy (acres)	Total (acres)
(a) <u>Plantations</u>					
Acquired	-	80.0	54.0	475.2	609.2
Formed by Commission to 30.9.50	1232.0	616.0	5765.0	1762.0	9375.0
(b) <u>In hand awaiting planting</u>					
For Afforestation	-	92.0	-	-	92.0
For Re-afforestation	5.0	-	-	538.2	543.2
(c) <u>Nurseries</u>	31.6	-	101.6	16.1	149.3
(d) <u>Agricultural</u>	-	29.0	300.9	155.7	485.6
(e) <u>Forest Workers' Holdings</u>	(4 holdings) 51.0	(1 holding) 2.5	(2 holdings) 2.6	(2 holdings) 14.0	70.1
(f) <u>Unplantable</u>	13.9	90.0	18.9	23.0	145.8
(g) <u>Other</u>					
Transferred to D.O.A.S.	-	-	172.0	208.3	380.3
Housing sites	-	-	10.0	11.5	21.5

Notes

Practically all the ground acquired had originally been under tree crop over 100 years ago. Much of the area had, however, been cleared of trees in the latter half of the 19th century, and since then has been used for winter grazing of sheep brought from the high ground on the west of Scotland, where they were summered. Despite this, very little use was made of the ground generally. There have been no difficulties in resumption, as most of the areas grazed were grazed free of charge and with no leases.

The land handed over to the Department of Agriculture for Scotland for management was practically entirely arable land – farms and crofts.

The sporting value was negligible.

Physiography

The range of elevation is from sea level to about 850 ft. Slopes are gentle, except on the south face of Kessock, where locally they are very steep. In the main, the plantations formed by the Forestry Commission lie on the centre ridge, and therefore the aspect is partially northerly and partially southerly. The prevailing wind is from the south west, but tree life suffers fairly severely from spring drying winds, which come from the east and north east, ie. winds which come off the sea.

Geology and Soils

The underlying rock over practically the whole of the Black Isle is Old Red Sandstone, and to date the Commission land lies only on sandstone areas. There is a fringe along the seashore running from Avoch to Ethie where the underlying rock is gneissose and schistose rocks not yet differentiated. These areas will be of comparative interest in a short time, as part of a pending acquisition lies on this geological formation.

From the forester's point of view, it appears a safe general statement to make that our geological problems are largely problems of the nature and distribution of fairly recent fluvio-glacial deposits. The soils originate from the wash material of the Old Red Sandstone drift, and are largely light and sandy. The wash is covered over the greater part of the area by a fibrous peat, which varies in depth from 2 in. to 12 in. which it seldom exceeds, except perhaps in bogs. The average peat depth is 5 in. to 6 in. The peat layer varies according to location. It is extremely shallow on the top of the disintegrating rock, eg. at Ord Hill, Kessock (an outcrop) and also where water has caused the removal of the wash. The Black Isle is a noted sheep grazing area, and doubtless hard burning has helped to reduce the peat thickness. On the lower slopes, the readvanced moraine has left deeper depositions of wash, and consequently a deeper and richer soil is to be found. This is especially true on the steeper slopes. On the higher levels, on which the Commission ground is in the main sited, between the peat layer and the impermeable drift, there is a leached layer normally about 6 in. deep. Between the drift and the soil there is a hard iron pan which is non-continuous. This pan appears to be fairly continuous on the higher ground, and is especially marked on the Kilcoy Mounteagle area and the Millbuie Auchterflow area. On the lower areas, it is only found spasmodically.

The limiting factor for tree growth is the depth of the peat and leached layer above the hard drift. Generally, the deeper it is, the better the soil class. This has a marked effect on the selection of species for planting.

Recent investigations into the rooting habits of trees, more especially in the old acquired Bellton Wood, have shown that the roots will not break through the hard drift layer unless it is fissured. The species in this wood is Scots pine, a relatively deep rooter in normal soils. These investigations have shown that the deeper the humus layers, the deeper the tree roots will go. This was especially marked where the old drains had penetrated a few inches into the drift layer and where the root layer dipped down in the drain line so as to follow the hard layer.

Briefly, the Black Isle soils can be classified into 3 main types:-

- (1) Where the peat layer is exceedingly thin on top of disintegrating sandstone lying on top of the rock outcrops, eg. Ord Hill and Bogallan, Kessock Forest. This type is a poor tree subject.
- (2) Where the surface soil is absent and on which the large pebbles of the drift appear on the surface, ie. no wash on top of the boulder clay, eg. Grey Cairn, Millbuie. This type is one of the most sterile.
- (3) The general type where there is the shallow layer of peat, and underneath a leached layer lying on top of the drift. This type varies in quality according to the depth of the soil on top of the drift layer. This type is the general type on which the Commission's forests are sited.

On the broad north side of the centre ridge and also towards the south-west end, there are numerous small lochs and bogs primarily due to irregular glaciation of the surface and to irregular distribution of the drift on the surface.

Vegetation

The ruling vegetation types are varieties of heather and heath types. The long, even, rather flat slopes have a cover of heather and usually varying small numbers of other flowering plants. In rich conditions, grasses and herbs are plentiful in number and species. On the poor areas, heather, lichen and Scirpus predominate. In the narrow hollows and wet, short slopes, grasses and flowering plants are the ruling cover. Scots pine scrub is plentiful.

The vegetation types are largely governed by the degree of drainage. On large tracts, since the removal of the trees some 50 to 100 years ago, drainage has been neglected, and the soil quality has steadily deteriorated, and the vegetation is generally poor heather with lichen and Scirpus in abundance.

Climate

The rainfall is low, about 25 in. per annum. The lowest rainfall is in the south-east corner, increasing fairly rapidly as one moves west. Extremes of temperature are rare. Hard, cold, drying

winds during March and April are trying on young plants, especially nursery seedlings and transplants.

Risks

Owing to the continuous nature of the land acquisitions, even although divided by roads, fire protection has received specific attention. In 1941 and again in 1942, the Chairman drew attention to the need for adequate measures for fire protection. It has now become standard practice to plant 10 rows of Japanese larch round the boundaries and along fire traces. All plantations have been sub-divided into blocks of 200 acres or less by means of bulldozed or ploughed fire traces which are kept black. These fire traces vary in width from 30 ft. to 75 ft. but, of recent years, the latter width is preferred. In addition, static water tanks have been placed in all forests at strategic points and, where nature provides water, dams have been built. Forest roads for protection and ultimate extraction of thinnings have been constructed, the areas being fairly well served by these. Additional roads will have to be made at a later date for extraction of produce.

The expense incurred in protection from rabbits has been heavy because of the proximity to agricultural and crofters' land, and all plantations have had to be rabbit netted. The rabbit population is now as low as it has been for many years, chiefly owing to Commission killings. Even on new acquisitions, rabbit netting will still be essential as there are many breeding grounds outwith Commission control.

Roe deer have not yet been a serious trouble but, owing to the growth of the trees as cover, their number has been tending to increase of late.

Red deer, black game and capercaillie have been of little importance, although damage has been suffered from black game.

Squirrels were plentiful in the past but, since 1945, as a result of Commission killings in 1943-45, they have been of little significance.

Roads

The Black Isle is fairly well served by County Council and District Council roads, old military roads and service roads. A number of the military roads and service roads have been reconstructed to carry heavy traffic. In order to ease extraction on the older forests, viz. Kessock and Findon, one road has been constructed on each forest. These have in general followed along the line of existing rides and tracks. Roads additional to these already constructed will be few, and these mainly on Millbuie, where it will be necessary to improve, at a later date, existing bulldozed rides to carry fair weather traffic.

Labour

Labour has not been a problem in the Black Isle forests, except during the war years, despite the great post-war increase in nursery and planting programmes. Sufficient squads must be maintained for the nurseries and, in fact, are maintained to allow for the maintenance of plantations during the

off nursery seasons. It is doubtful whether ultimately sufficient labour will be available to cope with the thinning programmes, in addition to the other work, but this question can be settled by sales standing if necessary, as the region is sufficiently accessible to be attractive to timber merchants.

SILVICULTURE

History of Ploughing in the Black Isle

Examinations of old woods in the Black Isle showed that foresters, during the past 2 hundred years, fully appreciated the difficulty of growing trees on the type of soil common to the Black Isle. The intensive degree of hand drainage carried out indicated that not only were drains for water carrying essential, but also that drainage for aeration was equally essential. In the first Commission plantings, it is doubtful whether this was fully appreciated. The early plantings on Kessock were successful largely because of good soil conditions, but those of Findon, where typical Black Isle conditions are met, were not very successful. It is difficult to ascertain the number of chains per acre of drains put into the 1927-30 Findon plantings, but indications are that it was around 3 to 4 chains per acre on the normal soil conditions (exclusive of wet hollows). This, it should be noted, is not very much more than is being put in nowadays after ploughing. Our present day figure is about 2½ chains per acre.

In the early 1930s it is apparent that the need for drainage and aeration was beginning to become appreciated, the quantity of drains per acre steadily increasing from 1933 to 1936, and the need for mechanical breaking up of the soil became appreciated as of major importance.

The costly nature of intensive hand drainage – and the drains had to be deep enough to break into the drift layer – tended to rule out commercial forestry except where the soil depth was such as to produce reasonable growth. In the Black Isle soils, quick growth on the edges of the drains was most evident where the drains were cut into the hard layer. In addition, by cutting into the drift layer, improved vertical drainage was obtained, and the rich spoil coming from the drains spread over the planting surface enriched the soil surface by weathering. On such soils, it has been proved that the effects of the drains were confined to a narrow width (estimated at 2 to 3 feet) from the sides of the drains.

The greatest step forward in the preparation for the planting of the Black Isle soils, which had been classed generally as difficult to plant, if not unplatable, was the introduction of ploughs. Ploughing on a big field scale was begun in August 1937 and the history of ploughing is largely a story of attempts to increase the depth-cutting powers in order to bite into the drift layer lying normally about 12 in. below the surface.

Initially, the ploughing outfit consisted of a Caterpillar "22" and an agricultural type double furrow plough. The Caterpillar was new, and it ran successfully for 18 months without a major repair of any sort, and is still in service as a nursery tractor. The double furrow work went on for a few days only. The furrows were shallow and were not deep enough to reach the drift layer. The first deep ploughing at 5 ft. intervals was done by a Unitrac Major plough and this plough, with

improvements, is still used occasionally. Early difficulties were the failure to run the plough in a line with the direction of the pull, falling back of the soil into the furrow and the failure to get a deep furrow. The advice tendered by the makers, Ransomes, was not helpful. A suggestion was made to a local agricultural engineer that altering the point of attachment of the drawbar by bringing it forward on the plough might straighten the line of progress. This change was effective in straightening the line of advance of the plough, and it improved the throwing out of the soil, but it did not eliminate the falling back of the sods into the furrow. The use of big disc coulters and of knife coulters was tried with no improvement in the falling back of the sods. The local engineer then suggested that changing the shape of the mould board would eliminate this, and his suggestion proved very satisfactory, and this was later further improved by setting a long "feather" at the rear end of the mould board. The chief advances in the ploughs from that time have been in strengthening of the beams of the ploughs and in strengthening all other wearing parts.

Following on the Unitrac Major came the Solotrac, and later the Haddington, all Ransomes produced, each stronger than its predecessor. Other ploughs used were the R.L.R., a plough developed by Sir Roy Robinson, a plough which did a good job where ground conditions were suitable on the more extensive areas which are not now readily available; the Double Furrow Cuthbertson still used on an extensive scale for drainage and general ploughing; the Begg ploughs which are of little use in Black Isle conditions; and, more recently, Blane's Tine, which is of extremely simple design and which will probably prove itself one of the best on account of the deep breaking up of the drift layer and the shallow turf thrown out for planting, a point which will ease extraction difficulties in later years. One somewhat different type of plough used successfully was the disc plough which, for the first time, gave cultivation of old felled woodlands where stumps were still too fresh to permit of ordinary ploughing.

In tractors the improvements have been mainly increased power and wider tracks.

All the foregoing tractors and ploughs have been used in the Black Isle. The first ploughing was done on Millbuie, and later ploughs have been used on Millbuie and Kilcoy.

Practically all the ploughing so far done has been at 5 ft. or, in the case of the Double Furrow Cuthbertson, 10 ft. intervals, with the idea of going as deep as possible. Trials have nevertheless been carried out using different techniques, viz:-

- a. Consideration of costs influenced the laying down of a small plot where deep ploughing was done at 15 ft. intervals. Planting was carried out on the furrows and direct into the ground between the furrows. The poor start of the plants on the unprepared surface is still evident. The growth on each side of the furrow, and most markedly on the thrown out spoil, is better than on the unprepared surface between the furrows.
- b. In 1946 trials were made to compare the effect of deep single furrow ploughing at 5 ft. intervals, deep complete ploughing and shallow complete ploughing. Results so far available are dealt with in Appendix IV.

Up to date, little has been taught about the desirable methods of suppression of surface vegetation. The destructive effect of burning was known. Heavy breakages in ploughing equipment compelled

us to burn in places where there was heavy growth of vegetation. Burning was normally done a few months ahead of ploughing but, apart from a considerable saving in breakages, there appears to be little ill or good effects from burning. Ploughing has never been so far advanced as to allow the vegetation to get ahead of the planted trees, except in the isolated instances of checked spruces.

It is noteworthy of the results of ploughing that the Scots pine scrub spread widely over Commission areas has come out of check and is putting on normal growth. The Scots pine scrub was left on the area for shelter and ploughing through it was done in the best manner possible.

Choice of Species

The species planted have varied little from those of the first plantings in 1926, apart possibly from a gentle decrease through the years in the amount of Scots pine used on average Black Isle soils.

The ruling species is Scots pine, and it must be remembered that ploughing has enabled us to plant land which at an earlier date was classified as unplantable. Scots pine may be planted over practically the whole range of Black Isle soil conditions. Generally, however, its use has been confined to the following range of vegetation types – Calluna, Erica, grasses, Calluna Vaccinium, Calluna Scirpus, Molinia and Scirpus Calluna. The use of Scots pine on the latter 2 types was made possible by ploughing and the use of Pinus contorta on ploughed ground has been of minor proportions, as practically everywhere ploughing has exposed the mineral soil.

The use of Pinus contorta has steadily declined with ploughing. On the poor soils before the ploughing era it was used to a limited extent on Findon, especially on areas of poor Calluna Scirpus or on areas where water action has removed the surface wash, in deeper peat, or in poor flush conditions in mixture with Sitka. Relatively its use has been negligible.

Corsican pine was used in some of the early plantings of Findon and Kessock, but fell out of use until recent years, when experimental blocks have been planted on Kilcoy and Millbuie. The high death rates tended to limit its use, but where used it has been confined to the slightly better soils of the Calluna Vaccinium type.

The use of European larch has been confined to the richer Calluna grassland types, where herbs are plentiful and where the soil is deep and drainage free. The use of European larch has also been on a minor scale and, where it was used, it was normally mixed in with Scots pine either in chessboard fashion or row about, the latter method not being very successful.

The chief use of Japanese larch has been in the formation of fire breaks. Its soil demands are similar to those of Scots pine. It has grown exceedingly well and its more general use is increasing. Occasionally it has also been used as a nurse for Sitka spruce.

The amount of Norway spruce used has been relatively small. It has been used on deep mineral soil found in the fresh valleys of streams and on a few alluvial flats and on gentle slopes formerly cultivated. It has also been used on hardwood scrub areas. The percentages used can, however, in the main be accounted for on formerly cultivated land.

It is probable that criticism can be levelled at the quantity of Sitka spruce planted on the Black Isle, a low rainfall area. There is little doubt that, in the light of experience, Scots pine would be planted on certain areas now under Sitka. This is attributed to the effect of ploughing on vertical drainage when very wet areas become dry within a year after ploughing. Sitka has been used on the poor types of flushes such as the Calluna - Molinia association, where the Molinia is predominant. Some very successful Sitka has been grown on old croft land where drainage had been neglected for decades. These are on the lower edges of slopes where there is a certain flow of water. Sitka has been planted with a variety of nurses, viz. Scots pine, Japanese larch, Pinus contorta, but generally these have been unsuccessful as the Sitka has so far failed to come out of check and is tending to become dwarfed by the other species. These mixtures have normally been planted in hollows and the Sitka has been severely frosted.

The Chairman instructed in 1941 that Douglas fir should be tried out in our plantings. The Black Isle can grow good Douglas fir, as can be seen on Rosehaugh Estate, but this stand is on soil above average for the Commission areas. Small areas of Douglas fir, sometimes pure, sometimes mixed with Scots pine and sometimes under Scots pine scrub, have been planted each year since 1942 on Millbuie, and latterly Kilcoy, apart from 1947 when no suitable plants were available owing to frosting during the severe winter of 1946-47. More recently on Kilcoy there has been a tendency to step up the planting of this species on the scrub land adjoining agricultural land. Douglas was planted extensively on Kessock in the pre-ploughing era and trials were also made at Findon. In selecting areas for growing Douglas fir, the best success can be looked for on the birch scrub land and on the richer Calluna vegetations, ie. where there is a good depth of soil over Old Red Sandstone outcrops. Firm soil is desirable.

Of the other conifers, special mention must be made of Tsuga. Tsuga has been used for underplanting, and has also been planted pure. The Tsuga used for underplanting, especially P. 31-33 Kessock, cannot be too harshly criticised as the old crop was not opened up sufficiently until very recently. The Tsuga in the open, namely P. 28 Kessock, is a revelation and indicates that, on the Douglas soil types of a slightly drier nature, there is a future for this species on areas without side and overhead shelter. The indications are that it is less frost tender and less demanding of side shelter than we had believed. Heart rot in late years may detract from the merits of this species.

Mountain pine was used in some of the early plantations for quick killing out of the vegetation on ride and road sides. The prostrate variety was used, and has been of little value. Sometimes 1, sometimes 2, rows were planted.

Broadleaved trees form little part of the Black Isle crops, apart from birch, where an odd good stand has been preserved as a crop, notably in Kilcoy, Bogallan. Efforts at planting and direct sowing of birch have failed and there are few relics of such attempts. Similarly, beech planted in the early years have practically all disappeared. Alder and rowan do grow on the Black Isle, but they are little, if any, better than scrub. In the rich Big Burn valley there are numbers of fair quality beech, ash, oak and lime which are being preserved.

Appendix III gives details of the species planted, with percentages.

Planting

In the Black Isle there are 2 distinct planting eras; firstly the pre-ploughing era and, secondly, the ploughing era. Broadly, Findon and Kessock plantings fall into the former and Millbuie and Kilcoy into the latter. The areas in Findon and Kessock planted after 1938 were ploughed, but these form a small percentage of the total areas planted on these forests.

Pre-Ploughing Era

In the pre-ploughing era programmes were not nearly so great as these of the ploughing era, principally because of the greater need for hand preparation of ground, although it is doubtful in Findon that sufficient drains for drainage only were put in, apart altogether from drains for aeration. Since 1947 approximately 2400 chains per annum have been put into the early plantings in the flats in order to get the trees "away". On the knolls the trees have put on a slow, but nevertheless satisfactory, growth.

In Findon planting was started in Bogbuie Wood. Following on Bogbuie, Culbokie Wood was planted and then Culbo Wood. Various small subsequent acquisitions were planted as the ground was acquired, namely Toberchurn —1937 to 1939 and Blairtua and Balgail — 1947 to 1948. The areas planted from 1943 to 1946 were mainly replacements of areas burned. The first planting on Findon was carried out in 1927 and from 1927 to 1930 the rate varied from 133 to 156 acres per annum. Thereafter, the rate fell to around 90 acres per annum from 1931 to 1934, and there was a further fall from 1935 to 1937 to approximately 60 acres per annum. Subsequent planting rates were governed by acquisitions.

The history of planting on Kessock is somewhat similar but soil conditions were, especially on Ord Hill, infinitely superior to these of Findon. Ord Hill rises steeply from the seashore and on the summit there are numerous outcrops of rock, with only 1 in. to 2 in. depth of humus. The readvanced moraine has left rich deep soils on the slopes, especially on the sea side of the hill. The quality of the soil can be judged by the heavy growth of hardwood scrub, broom, whins and bracken which, through war years' neglect, have had an adverse effect on the tree crop.

The rate of planting from 1927 to 1929 was 70 acres, 87 acres and 66 acres respectively. In 1930 222 acres were planted. These areas were mainly on Ord Hill but Gallow Hill was started in 1930. In 1931 84 acres were planted and, in 1932, 33 acres. The areas planted during these years were Gallow Hill and Allanglach Wood. Soils on Gallow Hill and Allanglach Wood were possibly slightly superior to normal Black Isle conditions but, nevertheless, rather similar, apart from the south end of Gallow Hill where the land dips into a small ravine and where again there has been a deeper deposition of soil as a result of glacial action.

The 1944 planting was the replacement of a small area in Allanglach Wood of Weymouth pine, which was of very poor quality and was felled during the early war years. The 1947 to 1949 plantings of 8, 7 and 20 acres respectively were largely the result of the Kilcoy

acquisition which these areas adjoined and which made the fencing and planting of these areas economic.

The normal planting methods on both forests was by screefing the vegetation and then notching in the plants. On an experimental scale, from time to time pit planting was used notably for hardwoods and on odd occasions for conifers. Turf planting of spruces was the normal procedure on wet ground.

On these forests Scots pine was retained. Birch, notably on Ord Hill, Kessock, was thinned but not completely cut out. Douglas fir was generally planted under the birch, some of which was ringed and some cut out when the Douglas fir required the removal. In some cases shortage of labour during war time resulted in the birch being retained too long, with detrimental results. On the north side of Ord Hill a modified Anderson group system was employed. This deviated from the normal in that the centres of the groups were 45 ft. apart. The Douglas has grown well but the crop is naturally far too thin on the ground and the areas between the groups have grown up with birch and whins which have had to be treated.

Ploughing Era

Millbuie and Kilcoy belong entirely to this age and the Chairman's instruction that all ploughable land should be ploughed has been faithfully adhered to. The necessity of ploughing eventually entailed the development of the disc plough, which has been used on recently felled areas. Only very small areas, where stumps were too high for the disc plough, have escaped ploughing.

Progress in planting has naturally increased out of all proportion to the programme undertaken at Findon and Kessock, this largely being possible on account of the mechanical preparation of the ground. As has been stated, approximately $2\frac{1}{2}$ chains of drains per acre have had to be made by hand, over and above the normal ploughing. It should be noted that this figure includes main leaders and side drains which have been ploughed out by Cuthbertson, but require deepening by hand, and also the drainage of wet hollows. The normal procedure has been for the Cuthbertson to put in the leaders in advance of ploughing. Apart also from the first year or 2 on Kilcoy fencing has been possible on large areas of 500 acres and up, which has cut costs and work.

The Chairman instructed in 1937 that planting at Millbuie should be on a scale of 500 acres per annum. The war years and, more especially, the aftermath of the war years, intervened but nevertheless a very high rate of planting was maintained, the 5765 acres of plantable land on Millbuie being completed in 1950, ie. in 13 years an average of over 440 acres per annum. On Kilcoy the first planting was done in 1946 and the final planting of the 2300 acres of plantable acquired will be in 1951, ie. an average of 383 acres per annum. It must be remembered that Kilcoy did not get into its stride until 1948. The planting figures are as follows:-

<u>P. Year</u>	<u>Millbuie</u>	<u>Kilcoy</u>
38	433 acres	-
39	633 "	-
40	661 "	-
41	732 "	-
42	539 "	-
43	521 "	-
44	264 "	-
45	215 "	-
46	248 "	25 acres
47	302 "	147 "
48	380 "	378 "
49	464 "	664 "
50	345 "	548 "

The normal procedure has been to plant on the back side of turf thrown out and normally in the loose soil by means of notching. This practice has been varied slightly on occasions, for example where there is a depth of moss which would lead to drying out of the plants due to the thickness of the sandwich, losses were cut by planting on the furrow side of the turf, this because the plough normally tore out the vegetation on the edge of the furrow. An area of Norway spruce on Millbuie planted late in 1938 was planted in the bottom of the furrow for the sake of moisture and the plants have grown very successfully.

Turfing of wet hollows and normal turf planting was carried out where ploughing was impracticable. Similarly, on stump ground, intensive draining was carried out but, where turves were not available, L notching was employed.

Success and Failure of Species Planted

Scots pine

Approximately 74% of the Forestry Commission's plantings on the Black Isle are Scots pine. Scots pine has, therefore, been used on an extensive range of soils and it is not surprising that, in isolated instances, growth has been poor. Such areas are limited in extent and their slow growth can be traced generally to the soil conditions.

In Findon (pre-ploughing area) it is noteworthy that results similar to those in acquired plantations have been attained. The knolls and inclines where the soil is deeper and the drift layer lower, have grown good Scots pine, while in the flats and hollows, although the trees have not entirely failed, growth has been exceedingly slow. Considerable quantities of new drains have been put into these areas from 1947 to 1949 but some areas have completely failed. It is estimated that 73 acres (mainly Scots pine) will require to be ploughed and replanted. Of this 5 acres have already been treated thus.

In Kessock (also pre-ploughing era) soil conditions are better and results have been comparatively better than on Findon. Growth has varied according to the depth which the drift layer lies below the surface but, apart from a few minor patches, it can be considered satisfactory. The most unsatisfactory patches are those where the peat layer is exceedingly thin on top of disintegrating sandstone lying on top of rock outcrops on the Ord Hill.

On the ploughed ground of Millbuie results have so far been good generally, apart from some small areas, notably in Whitebog Wood, where the surface soil is absent and on which the large pebbles of the drift appear on the surface. It is too early to state the results from planting on disced ground. Growth figures for this species on ploughed ground are given in Appendix IV.

The Scots pine on Kilcoy have every appearance of keeping in line with those of Millbuie, but the first planting was only made in 1946.

Ploughing has brought in large tracts of land which were formerly classified as unplatable. These tracts have in the main been planted with Scots pine and results have been sufficiently encouraging to permit us to anticipate a productive value of Quality Class II/III Scots pine.

Corsican pine

Growth in the early plantings of this species, P. 30 – Findon, P. 29 – Kessock, P. 30 – Kessock and P. 39 – Millbuie, has been comparable with that of Scots pine. The trees are of rough quality. Particularly promising is the P. 39 area of Millbuie on poor ploughed ground where height growth averages 8 ft.

Pinus contorta

With the introduction of ploughing in 1937, the need for planting Pinus contorta has greatly diminished and, of recent years, there has been no planting of this species. It was, however, used in the early ploughing years on Millbuie and figures for its growth are to be found in Appendix IV. From these it will be apparent that Pinus contorta has on an average put on 1 in. more growth per year than Scots pine. There is little doubt that Pinus contorta has done better than Scots pine, apart from ploughed ground. In the flats and hollows on Findon growth has been much better than that of Scots pine.

Although the uses of Pinus contorta have become very limited, the uses of this species should not be neglected, especially on poor land which cannot be ploughed and where ploughing does not turn up the mineral soil. There is the possibility, and there is evidence of it, that there is a danger of wind-blow on ploughed land.

Japanese larch

The planting of this species has been mainly confined to fire belts. Its growth has been exceptionally good on a variety of soils and, although growth may have tended to be slow on some of the poorer soils, it has, nevertheless, been satisfactory. On the better soils, it has

tended to be wavy. The good growth of this species has shown that its uses can become more general. Growth figures are available in Appendix IV.

European larch

European larch has only been planted in small patches or in intimate mixture mainly with Scots pine. Sites have been selected and growth has been good, apart from one small area at Kessock (Allanglach Wood) which has been beaten up with Scots pine. In this case the soil was too poor for European larch. In mixture with Scots pine it has generally topped the pine.

So long as one finds good soil conditions and free drainage, the limited use of European larch is to be recommended.

This species is fairly heavily and uniformly infected with Chermes.

Norway spruce

Norway spruce results have been rather mixed. On Kessock results have been poor as the bulk of Norway spruce planting has been on ground which contains a fairly high proportion of heather or on ground which has been difficult to drain. In both instances the trees have tended largely to remain in check. On Findon results have been somewhat better, although still only fair. The species has only recently been planted at Millbuie and Kilcoy (1947-1950) and it is too early to express an opinion. There is a very good block of Norway in P. 38 Millbuie planted in the bottom of the furrows where the plants have grown steadily since planted. Recent plantings have been confined to damp old arable ground or to flushes with a fair grass content, which have tended to make small localised blocks. On these soils it is found that there is very little check period. Its use for underplanting has been very limited but, where it has been used, it has been successful.

Sitka spruce

From results there appears little doubt that this species has been too widely used, chiefly because the species for planting had of necessity to be selected before the results of ploughing which, in many cases, tended to make the soil a Scots pine proposition, had become evident. Results have been very satisfactory on wet arable ground, eg. Findon, Bogbuie Croft and on richer flushes, but on the poorer heathery sites poor results have been obtained. The ground has tended to become rather dry with ploughing and the Sitka plants have gone into check, with the result that the heather has got on top of them. A certain amount of the Sitka planting has been on what might be termed "frost hollows" and the Sitka has suffered severely from frost. There are indications that, once the plants get beyond the "frost line", they will grow satisfactorily.

Sitka has been planted in mixture with most species in the poorer classes of soil, but the plants have been and commonly are still in check. It is possible that the mixtures are not intimate enough, as commonly the planting has been 3 to 5 rows of Sitka and 3 to 5 rows of another species.

Its use for underplanting has been very limited and it has not been too successful, chiefly because of too much side shade.

Douglas fir

Since 1942 this species has been consistently planted on selected sites, and more especially of recent years. In the early years, on the Chairman's instruction, it was planted on ground slightly better than average Black Isle soils, but nevertheless not of a high quality. It was planted pure, in mixture with Scots pine and under Scots pine scrub. There has been little to choose between the different methods, except that frost damage may have been slightly less in the latter case. The 1942 and 1943 plantings have grown well but, in 1949 and 1950 there were signs that they were beginning to go back. In these years the trees turned a sickly yellow colour and have become badly infected with Chermes. This stage may be transitory. Douglas has, however, recently been confined to grassy land bordering agricultural land, or on slopes with plenty of free flowing water.

Early plantings of Douglas on Kessock have done well. Growth has been good but whins and broom and delayed removal of birch scrub have had their effects on the death rate and consequently the quality of the trees tends to be rough. Soil conditions on the Ord Hill faces, due to the readvanced moraine, are good, with ample depth on top of the drift. There is, therefore, very little risk in planting Douglas. A modified Anderson group system was tried on the north side of Ord Hill and has done well, except in that the centres of the groups were too far apart and consequently too much third rate birch was left on the ground.

Extra groups have now been planted.

On Findon there are a number of fairly good sized, although rough, Douglas trees from the 1928 planting. There was a heavy death rate early on and Sitka spruce was used for the beat up. The Sitka have not done well and, as a result of their failure, the Douglas have become heavily branched.

There is little doubt that Douglas can be grown on the Black Isle but, for success, it must be confined to the better and deeper soils, principally indicated by birch scrub.

Tsuga

Wider introduction of this species, especially for pure planting, might be tried with benefit, judging by past results. Tsuga has done extraordinarily well in the open on readvanced moraine soils. Under-planted, it has succeeded fairly well but growth has been slow owing to inadequate and belated opening out of the overcrop.

Broadleaved species

The use of broadleaved trees (birch, alder and beech) has been infinitesimal and the growth and success in establishment has not warranted the general use of these. Beech has failed completely, the only remnants being isolated scrub trees. Birch has not been successful in its

early establishment, but good crops are to be found in the older woods on the better soils. On average Black Isle soils its use is practically non-existent, and its success is limited to scrub or a nurse crop. There is one very good clump of grey alder on P. 38 Millbuie or rather poor soil with a foot of peat.

Beating up

Fundamentally, the original species planted have not been changed by beating up. Occasionally Scots pine has been substituted for Sitka spruce and Sitka spruce and Scots pine substituted for European larch, but only in the case of local failures, the alterations being infinitesimal.

On account of the ground being ploughed and the consequent easier establishment of trees, there has been less beating up than elsewhere. The only major beating up was as a result of the severe frost of 1947 when plants, planted before the frost occurred, suffered heavily to the extent of 30% in Millbuie, and as a result of the drought during the 1949 summer when a 10% beat up was generally required on Millbuie and Kilcoy.

Chief factors necessitating beating up have been frost, drought and black-game, the latter having been occasionally troublesome and possibly the too extensive planting of Sitka spruce on ground which, as a result of ploughing, has dried out too much for this species, causing scattered losses. Minor localised losses have occurred on areas where the soil has been sterile, although to outward appearances it was not dissimilar to the surrounding soil. Such failures have generally occurred in areas which were planted in the pre-ploughing era.

As regards species, there has been no marked failure, apart from recent local plantings of Corsican pine where, although not unexpectedly, failures have been severe and where severe Scots pine has been substituted. The planting of this species has been very restricted.

No beating up of Japanese larch fire traces has been done, on the Chairman's instructions. (See Report of Inspection dated 13.6.39.)

Weeding

Weeding has been slight, and of little importance, except on Ord Hill, Kessock and Toberchurn, Findon. Both these areas have suffered from extensive whin growth and, to a lesser extent, birch growth. The birch was tackled early and did little damage, but the whin growth got out of hand during the war years in a few compartments and considerable damage was done, especially amongst Douglas fir at Kessock and larch at Findon. These areas were tackled after the war and, although there is sufficient of a tree crop to make a final crop on the areas, the trees will be very rough. One small area at Kessock, amounting to 4 acres, was practically completely killed out and, since the war, has been restocked.

Treatment of Established Plantations

a. Planted by Forestry Commission

Weeding has not been a heavy charge on the Black Isle Forests, as the ground vegetation has been mainly heather and, even with ploughing, the trees have become established before the heather becomes rank. On parts of Kessock, whins and broom have been troublesome and considerable cash expenditure has been involved in local patches.

Cleaning which consists mainly in the removal of birch scrub was somewhat neglected during the critical period, viz. the war years, and the crops were already damaged before adequate measures could be taken. Cleaning is now up to date.

In the Black Isle thinnings are up to date on Kessock, Kilcoy and Millbuie, chiefly on account of a local timber merchant carrying out the major part of the thinnings from 1947 onwards. On Findon, growth has been erratic and patchy and thinnings have been confined to small local patches. The first really general thinning is now due and is in the process of being sold standing at the moment.

Owing to the availability of labour and the timber merchant, thinnings have been light and often; even in the Scots pine areas we have since the war been working on a 3 year thinning cycle which includes the acquired plantations, these forming the only thinnable areas on Millbuie and Kilcoy.

b. Acquired Plantations

The woodlands acquired amount to 609 acres, spread over 3 forests, Kessock, Millbuie and Kilcoy. The major part of these lie on Kilcoy and amount to 475 acres. The age classes are spread over 20 to 90 years, but roughly one third of the area lies in the 70 to 90 age group, comprising the area on the north side of Ord Hill, Kessock, Oliver's Wood, Kessock, Allangrange Station Wood and the major part of Bellton Wood, Kilcoy. The bulk of the remainder of the acquired plantations lie in the 35 to 50 year age class, with a little on Millbuie and Kilcoy in the 20 to 30 years age group. The species is almost entirely Scots pine with some scattered larch, except for a 5 acre block of Douglas fir in School Wood, Kilcoy and a little in Shantullich, Kilcoy.

These woods, when acquired, were in a neglected condition. They had apparently received little or no silvicultural treatment since the time they were planted. The woods of the 70 to 90 year classes have, however, done reasonably well because the area had been extensively drained and this draining had allowed the crop to become established. Thinning had been neglected, the woods being left to thin themselves. With money becoming scarcer in later years, insufficient drainage, according to Black Isle standards, was done on ground which was subsequently planted with the result that trees of the 20 to 70 year age class have grown reasonably well on knolls but have failed on the flats and hollows. The ravages of squirrels, of which there were far too many as late as 1944, have contributed in no small way to malformed stems.

Volume production has been variable, due to the uneven stocking. In the 81 year old plantation of Bellton Wood, Kilcoy, where the crop is uniform, the volume is estimated at 3800 cu. ft. per acre. This wood was intensively drained when planted, the drains varying from 21 ft. to 30 ft. apart, and the trees remaining are on the sides of the drains. This volume gives a possible line on the volume production which we may anticipate from our Scots pine planted on ploughed ground. This wood extends to 171 acres and, so far as is known, had not been thinned until it became Commission property. It has been thinned twice since then in 1944 and in 1948 and has yielded 230,000 cu. ft. in thinnings, or approximately 1350 cu. ft. per acre. Owing to the density through lack of thinning, the first thinning amounted to 150,000 cu. ft., while the second yielded 80,000 cu. ft. The crop has been heavily damaged by squirrels and the thinnings were too late to influence the growth of the crop, the thinnings consisting of the removal of the worst trees.

The Douglas fir, which lies in the valley of the Muirton Burn on rich alluvial soil, is of a high quality. The age is approximately 40 years and the volume was, prior to the last thinning in 1950, estimated at over 5,000 cu. ft. per acre. Owing to lack of thinning in the earlier stages, the trees are tall and "whippy", but they improve with thinning. This area has been thinned 3 times since 1944, the thinnings being fairly light.

All acquired woods due for thinning have been thinned regularly since acquisition. The acquired plantation at Ord Hill was thinned and underplanted in 1931-33, but the opening up of the canopy of this wood was inadequate, especially during the war years when it was most required. It has recently been very heavily thinned. The plantations with failed patches have been thinned and the failed patches have been ploughed and replanted. The last of this work will have been completed this year. In the younger plantations brashing and cleaning have been carried out as required.

Nurseries

The bulk of the nursery area in the North Conservancy is now concentrated in the Black Isle, amounting to nearly 150 acres, of which 17 acres are heathland nurseries. Findon (South Glascairn) was the first to be opened, fully an acre being laid down in 1928 for lining out purposes, but seed-beds were later laid down in 1931. The area was extended to fully 3 acres in 1937, in 1940 to 6 acres and again in 1943 to 8 acres. The post-war extension (Breakloch Nurseries) has been considerable and the nursery area (established) is now 31 acres approximately. In addition, Findon has a heathland nursery of fully 7 acres, which is actually on Kilcoy ground.

The Millbuie nurseries, the most extensive in the Black Isle, had their beginning in 1938, when 4 acres were opened up at Blackstand and were slightly extended in 1940. The first extension of importance was in 1943, when Poyntzfield, Ardmeanach and Woodhead were opened up, increasing the area to 14 acres. In 1944 the area was 17 acres approximately, the foregoing nurseries being extended. A further increase was made in 1945 to 20 acres. The large post-war increases were made in 1946 to 60 acres, which brought in 2 nurseries at Blackstand and again in 1948 to 108 acres bringing in the Colony, part of which was closed (approximately 10 acres) in 1950. In addition, a heathland nursery of approximately 3 acres was opened in 1948.

The Kilcoy nurseries are all heathland nurseries and extend to nearly 9 acres. The first on Kilcoy (Bellton) was opened in 1948 and increases have been made yearly since then. In 1950 there are 3 nurseries – Bellton, Littleburn I and Littleburn II, while a further 2 acres in School Wood is being added in 1951.

The Black Isle nurseries have been the main supplying units for all forests and forest nurseries in the North Conservancy. In 1949 the stocks of one year seedlings amounted to about 36 million. The export of transplants has been in the region of 6 million per annum recently, but this will have to be progressively stepped up in line with the planting targets. In addition, anything from 1 to 2 million seedlings have been exported annually for planting.

All species are raised in the Black Isle seed-beds, but within the last 2 years lining out has been mainly confined to the pines, larches and Douglas fir. It is the practice to line out the spruces in the nurseries in the west, where the higher rainfall provides better transplants, and consequently only the surplus spruces after the west nurseries have been served are lined out in the Black Isle. The Black Isle nurseries do not provide good plus one spruce transplants, although the plus 2 transplants are fairly good.

As regards nursery plant life, the most trying agents are frosts and cold drying winds, which are prevalent in March and April. While commonly snow does not lie on the Black Isle, winter frosts are apt to cause heavy deaths. The greatest cause of deaths is, however, the drying winds which occur during lining out and commonly the plants turn brown and retain this colour for about 2 months after lining.

The heathland nurseries have been very successful from the point of view of saving expense on weeding, but so far as growth is concerned, they have been only moderately successful. The first heathland nurseries laid down were, in the light of experience, on sites lacking enough shelter, although typical in other respects. At present these early nurseries are now used to produce pines and larches which grow very successfully and which will be lifted at one year. The later nurseries, viz. Littleburns, have grown in every respect first rate one year spruce seedlings. So far, there appears no immediate need in the near future to abandon any of those heathland nurseries on account of weed growth.

Manurial prescriptions have in recent years been laid down by the Macaulay Institute. In the early days manures were applied according to "rule of thumb" methods. The quantities applied were much lower than applied at present. Slag and lime have recently been forbidden on account of the effect on the pH value, on which great emphasis was laid up till 1948, but since then there has been a slight bend back to the use of lime, mainly for rectifying the soil acidity or pH value. There is little doubt that fertilisers applied in balanced quantities are of great importance, although we are still suffering from the effects of shortages of certain types of artificials during and after the war years. Green crops have been practically entirely of oats and tares and, apart from 1950, have been exceptionally good. In some instances in 1950, due to the poor summer, the weeds got ahead of the green crop. The large nursery extensions in recent years have allowed overcropped wartime areas to be brought back into good condition. Green cropping is done regularly every 3/4 years.

Heathland nursery manures have been prescribed by the Macaulay Institute also, but ever since the first nursery was established in 1948, there appears to be a change in the manurial treatments with artificials. The early prescriptions were not too generous, especially so far as potash was concerned, but this has been altered in the last 2 years. Hop waste has normally been used as the nitrogenous manure, but straw compost, using sulphate of ammonia as the activating agent, and bracken and hop compost have also been used. The results have not differed, although there was a better start with the straw compost, possibly on account of the sulphate of ammonia content. This effect, however, wore off and there was no difference at the end of the growing season, as compared to seedlings grown on ground treated with raw hops only.

Practically full mechanical preparation of seedbeds is now possible using drill ploughs and rotovators for the final preparation. Seedbeds are now covered entirely with lime free grit or sharp sand when sown and the one year seedbeds are treated in the autumn with a 75% sand, 25% peat humus mixture as a protection against frost lift. The less frost hardy species are covered with lath protection.

Lining out was partially mechanised, but within the last 2 years bedding out has been fully resorted to and this has been mainly done by hand to prevent losses, especially as about 50% of the seedlings transplanted are now one year seedlings and more care in handling is necessary. Bedding out has always been done for seedlings transplanted in the autumn but, even with bedding out, losses have been heavy. At present the back end bedding is done only during August and September and is then stopped for the winter, as losses of Norway spruce and Scots pine bedded during these months have been less than in October and November bedding out. Back end bedding out is confined to the plants surplus to what can be lined in the spring and instructions as to the quantity are issued from the Conservancy Office.

Future nursery programmes for the Black Isle will be very extensive, but the practice will continue to be to raise seedlings for home and Conservancy nursery transplanting and transplanting the balance of what the other Conservancy nurseries cannot hold. This quantity will be considerable. At the moment approximately 9 million plants are being transplanted and this will increase to somewhere in the region of 16 million in 5 years.

RESEARCH - HISTORY OF EXPERIMENTS IN BLACK ISLE

by J A B Macdonald

Research Branch has 20 registered experiments in the Black Isle to date. Of these, 5 concern provenance.

1929 Much the most interesting provenance experiment and the oldest is Findon 1.P.29 which contains 14 lots of Scots pine collected from various places as far apart as Arctic Finland and Spain, the Ural Mountains and Scotland. The provenances from both extremities of the range have done badly, both in survival and growth, but the differences between the British lots are small.

A western yellow pine experiment (2.P.29) has produced some fine trees up to 25 ft. high, but the races came only from the extreme northern end of the species range and no difference between them has yet emerged. Best growth occurs on the grassy heath types; it is much poorer on the pure heather land.

1934 A poor stretch of heatherland where the rock frequently comes very near the surface was selected in 1934 (Experiment 3) for a collection of Scots pine races and over 100 are under test there. Unfortunately, in addition to the site being poor, the experiment was begun before the days of ploughing and so growth has been extremely slow.

1938 A small trial of pine species experiment was laid down in Findon forest in 1938. Pinus contorta has grown reasonably well and, although growth has been slow, few of the Pinus peuke have died. Death rate has been higher among the 8 other species under trial.

The collection of Pinus contorta races on single furrow ploughed land established in Millbuie forest that year (1938) is one of the most important collections of this species. Many representatives both of inland lodgepole type and of the coastal or shore type are included. The coastal types are the most vigorous in appearance and are dark green in colour, retaining their needles which are short and numerous for a long time. They are somewhat more bushy in form and suppress the vegetation quickly, forming a canopy at an early age. Their branches are rather coarse and the main stems tend to fork, but the height growth is good. The inland or lodgepole types vary in height, their branches are finer and their main stems straighter. But their longer needles tend to turn yellow and fall, resulting in a rather sickly appearance.

1940 In 1940 2 nursery salvage experiments were extended into the forest at Findon. Scots pine in experiment 5 had been undercut in various ways in the nursery. The majority of the plants are now poor and have made little growth and there is practically no difference between treatments. Origin of seed is Tusset, Hluboka, Czechoslovakia, so it may be that the plants would not grow well even if planted under ideal conditions. Wrenched, root pruned and shoot pruned plants were planted in experiment 6. There is practically no difference between treatments. Plants have a fairly good appearance, but growth has been slow, as it has been with normal planting throughout the same area.

- 1942 In 1942 (Millbuie 2.P.42) an experiment comparing various mixtures of Sitka spruce with pines and Japanese larch on single furrow ploughing on poor heather land was laid down. Results are not of great interest as growth has been poor, due possibly to the fact that the area was ploughed in 1938 and thus heather had become luxuriant before planting was done. Japanese larch is the best species, Pinus contorta is reasonably good, but Scots pine is poor and the majority of the Sitka spruce are in check and unhealthy looking.
- 1943 In the following year a races of mountain pine experiment was laid down in this forest (Millbuie 3.P.43). All lots have grown reasonably well but, to date, there are no obvious differences between the various lots.
- 1946 In 1946 (experiment 4) a trial was laid down with various mixtures of Sitka spruce with mountain pine on poor ploughed Calluna ground. Sitka spruce are all in check. Mountain pine are healthy but growth has been very slow. As in experiment 2 the area was ploughed in 1938 so that there was a strong Calluna growth before planting in 1946. This year an important comparative trial of different methods of ploughing was laid down by the Division (Millbuie 11.P.46). The ploughing methods were:-
1. Single furrow deep ploughing at 5 ft. (12 in. - 16 in.)
 2. Complete deep ploughing 12 in.
 3. Complete shallow ploughing (4 in. - 6 in.)
- and no manure was added, planting being carried out 2 row mixtures of Scots pine and Sitka spruce. It has been extremely interesting to observe how much more quickly check has set in on the single furrow ploughed land than where ploughing has been complete. So far there is little difference between the shallow complete ploughed and the deep complete ploughed sections.
- An experiment on natural regeneration of Tsuga was laid down on Rosehaugh Estate in 1946. Unfortunately sheep ate the first excellent crop of seedlings and very few new ones have appeared since the area was fenced.
- 1947 Three experiments were laid down on ploughed ground in 1947 at Millbuie. These concern mixtures of conifers (5.P.47), advance planting with a view to introducing Douglas fir (6.P.47) and direct sowing (7.P.47).
- 1948 An age and type experiment of Sitka spruce and a repetition of the direct sowing experiment were laid down in the following year (8 and 9.P.48).
- 1949 Direct sowing was again done in Kilcoy 1.P.49, but results have been poorer than in any other place, the compact till here being very unsuitable as a seedbed and frost lift taking a heavy toll in the first winter. Position of planting Sitka spruce was investigated in 2.P.49 in the same forest and, as has occurred very generally in these experiments on heaths, the plants in the furrows have made a much better start than those planted on the sides of the ridges or elsewhere.

In 1949 an experiment on pruning by disbudding of Scots pine was begun, lateral buds being removed each year by hand. Sawfly did considerable damage in 1950, but despite this disbudded trees are looking exceptionally healthy and 1949 and 1950 shoots are thicker than shoots on control trees. Later normal pruning methods will be incorporated for comparison for costs and effects.

Summary of Results to Date

Provenance experiments include Scots pine (1929 and 1934) with altogether some 70 different lots which were planted without previous ploughing. The oldest Scots pine trial (Findon 1.P.29) in which 14 lots are compared shows the Scottish and "England East" races to be best with most of the foreign ones, especially those from far north, very poor. The Pinus contorta collection at Millbuie (1.P.38) which was planted on ploughed ground is becoming most interesting but, so far the only striking difference is between the coastal and inland strains. There are small collections of Pinus ponderosa and of Pinus montana. Ten different pines are compared in one 1938 experiment.

Other experiments include 3 tests of direct sowing on ploughed heathland which proved more unsatisfactory than elsewhere because of the retentive, compact, clayey soil and tendency to frost-lift. There are also 2 nursery experiment extensions which, as is commonly the case, yielded no result in the forest. Four experiments deal with various mixtures of species on ploughed land, the earliest of which (1942) should soon be approaching the interesting stage.

A Divisional methods-of-ploughing experiment has drawn a lot of attention in recent years as the Sitka planted therein have grown much better to date on 'complete' than on single furrow ploughings.

NOTES BY JAMES FRASER, CONSERVATOR (NORTH) SCOTLAND ON BLACK ISLE FORESTS

The history has been compiled and written by Mr J Dickson.

Page 9

Dickson has stated correctly that the iron pan is non-continuous and that it varies in prominence. My view is that fertility of the soils in the Black Isle as elsewhere is determined chiefly by the depth of "wash" which lies on the top of the unweathered drift.

Page 9 – Classification of Soils

I suggest that Dickson's (1) should be sub-divided to allow for relatively small areas where the disintegrated weathering rock is close to the surface and where the drift is thin. In this sub-division, growth may be satisfactory. The type is usually distinguishable by the plentiful growth of Vaccinium in the shallower conditions and by a rich varied herb and grass cover where deep.

Page 15 – European larch

The Director (Scotland) has suggested a wider use of the old practice of planting wide spaced (20 ft.) European larches wherever they have a reasonable chance of success. The late Lord Lovat was a strong advocate of this practice. It is difficult to say at times what are "reasonable chances of success" for larch. In the Black Isle there are good larches in places where the traditional beliefs of what is required for larch are sadly upset. There are, however, small remnants of woods in the Black Isle which show that, given the conditions specified by Dickson, there is a fair chance of success for larch. Depth of soil and free flow of water appear the all-important soil conditions.

Page 16 – Use of Sitka spruce

Dickson has drawn attention to the diminishing amount of Sitka used in the Black isle. The need for the change in our views about the use of Sitka, both in the east and west conditions, had become apparent only in the late thirties. It is difficult to agree with Dickson that the effect of ploughing is to reduce the amount of water available to the plants. Arguments, but not proof, could be easily advanced to support the view that the effect is to increase available water supply. I agree, however, with the view that poor flushes in Black Isle and elsewhere should have pine as the ruling species, and especially on the edges of the flushes.

Page 25 – Tsuga

The very satisfactory growth of Tsuga on Kessock without overhead cover, which we had formerly accepted almost as a prime necessity, is noteworthy.

Appendix II

Special mention should be made of the very effective and devoted service given to the Commission by Denman in the difficult war years and in the years succeeding 1945. His work in all places was good and, in the Black Isle, his skill, knowledge and energy were exercised to their full capacity.

Research Report

The early fears about ploughing effects on the stability of the trees have been expressed again by Mr Dickson. No very convincing proofs of the effect have been shown yet, and any signs of blowing on ploughed land should be examined carefully, while giving full attention to any defects in surface drainage. The use of Blane's Tine with only one board turning a very narrow furrow will eliminate the inconvenience in early extraction work and the use may also hide the need for efficient surface drainage over impenetrable or slow-draining drift. I appreciate very fully the value of Blane's Tine, but the tool should not be over-valued and the demand to use the tine with 2 boards, designed to turn out broad flaps for heather suppression, should be safeguarded by insisting on provision of adequate open deep surface drains. The Black Isle is an excellent place to see that the drift surface does not always run roughly parallel with the surface soil. A soil drained to give vertical drainage only may easily develop surface gathering of water on the drift.

The trial of different forms of ploughing already made should be completed by deep and shallow complete ploughing followed by complete working of the outturned furrows. Further trial plots should be prepared with complete ploughing, surface working and close spaced tine ploughing. To date we have had no complete explanation given of the ways in which ploughing has improved growth. A study of the effects, even if it results in incorrect or incomplete explanation, would probably suggest new methods of working.

July 1951

APPENDIX I

Notes from Inspection Reports

<u>Forest</u>	<u>Date</u>	<u>Inspecting Officers</u>
Findon, Kessock	Sept 1929	Technical Commissioner
Findon, Kessock	Sept 1930	Forestry Commissioners
Findon	June 1932	Chairman and Assistant Commissioner
Findon	Oct 1932	Major Strang Steel and Assistant Commissioner
Millbuie	June 1937	Chairman and Assistant Commissioner
Findon, Kessock, Millbuie	June 1938	Forestry Commissioners
Millbuie	Oct 1938	Chairman
Millbuie	June 1939	Chairman, Assistant Commissioner and Research Officer (Scotland)
Kessock, Millbuie, Kilcoy	March 1940	Sir John Sutherland
Kessock, Millbuie, Kilcoy	Aug 1940	Sir John Sutherland and A/Assistant Commissioner
Millbuie, Kilcoy	May 1941	Chairman and A/Assistant Commissioner
Millbuie, Findon	Aug 1942	Chairman and A/Assistant Commissioner
Kessock, Millbuie, Findon	Feb 1943	A/Assistant Commissioner
Kessock, Millbuie, Kilcoy	Aug 1943	Chairman, A/Assistant Commissioner. Mr Connell and Mr Dunnett
Millbuie and Findon	Aug 1944	Chairman, A/Assistant Commissioner
Millbuie, Kilcoy	Aug 1946	Chairman and Rt. Hon. Hugh Dalton
Kessock, Kilcoy, Millbuie	Nov 1948	Director (Scotland)
Millbuie, Kilcoy	Nov 1948	Forestry Commissioners
Findon, Millbuie	Oct 1949	Research Advisory Committee

The Chairman on his visit of 1932 to Findon stressed the need for adequate control of weevil and the need for control of whin and broom. He did not consider the measures already taken adequate.

The Chairman's visit of 1937 to Millbuie was made at the start of Millbuie Forest and broad lines of management were laid down by him as follows:-

1. Ground to be ploughed before planting.
2. Annual area for planting, after first year, to be in the region of 500 acres per annum.
3. Findon Nursery to be extended to 6 acres to ensure adequate supply of 1 + 1 pines, which will be the main crop.
4. First work to be on Newhall, where difficulties are least.
5. Fire protection to receive special consideration. The area will be blocked off, each block (of not over 500 acres) will have around it:-
 - a. A bare strip (about $\frac{1}{2}$ chain width), later to be ploughed;
 - b. A strip of hardwoods;
 - c. A third unplanted ploughed strip adjoining the plantation of adequate width (eg. one chain).
6. Rides to be demarcated before ploughing.
7. Angle of furrows in relation to slope to be fixed so as to drain area but not permit of too rapid run off.
8. The wood on Rosehaugh, when acquired, to have a wide belt of ploughing round it for promotion of Scots pine natural regeneration.

(Note: Under fire protection, the areas have been divided into 200 acre or less blocks by bulldozed fire traces. Largely Japanese larch has been substituted for hardwoods, as hardwoods after trial did not succeed.

The Chairman, in his visit of 1941, condemned the method of 5. above and instructed the ploughing up of the inner fire-belt.

As regards 8., the wood was felled by the Timber Production Department before ploughing for regeneration could be carried out.)

The Chairman on his visit of 1938 stressed the need for adequate rabbit control and requested that a classification of land for ploughing should be made.

(Note: Owing to quantity of easily ploughable land on Newhall and Whitebog and the fast development of tractors and ploughs, no great difficulties were encountered in ploughing, except for the areas felled during the 1939-45 war which were eventually ploughed.)

On the visit of 1939 the Chairman commented favourably on the growth of the young plants, especially Japanese larch on the fire traces, but instructed that no beating up of the fire traces was to be carried out. Again he stressed the need for control of whin and broom.

An area at Blackstand was inspected where ploughing on old felled woodland had been done. Furrows were at 15 ft. spacing and it was agreed that this was not sufficiently close. It was also decided that Sitka spruce was to be planted on turves between the furrows.

On his visit of 1941 the Chairman inspected the Newhall area and remarked on the useless nature of the present fire traces (as laid down on his visit of 1937). He instructed that the inner bare strip be ploughed and planted with Japanese larch and to plough the outer traces completely.

(Note: Bulldozing was the standard method used initially and ploughing thereafter when vegetation invaded the fire trace.)

Inspected also were the 5 rows Sitka spruce and 3 rows Pinus contorta and 5 rows Sitka spruce and 3 rows Japanese larch of P.38. It was agreed that these species might have been more helpful to each other had they been planted in more intimate mixture.

After his visit the Chairman laid down that Douglas fir should be planted, one block pure, one block in mixture with Scots pine, row about, one block under Scots pine scrub and instructed that, in so far as the soil conditions were suitable, Douglas fir should be planted each year. The Chairman was very impressed by the Douglas on Rosehaugh Estate, and expressed a desire to purchase the area.

(Note: This was carried out each year on Millbuie from 1942, apart from 1948, when the nursery stock was too badly frosted to plant out. Plots have also been planted on Kilcoy. The Douglas fir P.42, 43 have turned yellow during the last 2 years.)

On the same visit the acquired woods on Kilcoy were inspected and instructions given to have these thinned as soon as possible.

On his visit of 1942 the Chairman inspected P.38 Millbuie, and instructed that dams be built on burns and that static water tanks be used where water was not available.

An area was inspected which was too wet to plough and had been hand-drained. The Sitka spruce were looking very backward and Mr Gosling suggested that 2 furrows be ploughed between the drains and planted with Scots pine.

The Douglas fir planted P.42 were inspected and looked very well. There were many Scots pine seedlings on the area and the Chairman suggested that an area in P.43 be selected and left unplanted for natural regeneration.

The wonderful growth of Japanese larch and the need for mixing Scots pine with Sitka spruce were also commented on.

A re-inspection of P.42 Douglas fir, Millbuie, was made by the Chairman on his visit of 1943. The Douglas fir was growing satisfactorily. Thereafter discussion arose on the types of roads and methods of making them. The Chairman favoured a large number of rough bulldozed tracks rather than a few well made roads.

Kessock was also visited and the underplanted Tsuga area and the Douglas fir groups were inspected. The latter was deemed unsatisfactory owing to the wide spacing of the Douglas fir groups.

The Douglas fir, Sitka spruce, Scots pine and Tsuga plots at the back of Rosehaugh House were inspected by the Chairman on his 1946 visit. The Chairman instructed that, in view of the profuse natural regeneration of Tsuga, strips about one foot wide at 4 ft. intervals should be screefed in the grass to study the regeneration.

On Millbuie the P.42 and 43 Douglas fir plots were inspected. The Chairman expressed the belief that the Douglas fir would go into check, but when the Scots pine topped them they would shoot ahead of the Scots pine.

The ploughing experiment – 1. deep ploughing at 4 ft. 6 in. intervals, 2. deep complete ploughing and 3. shallow complete ploughing – was inspected and the shallow complete ploughing was condemned outright.

Kilcoy was also visited and in Upper Knockbain Wood the Chairman instructed that some of the blanks which had been ploughed up should be planted with Douglas fir.

(Note: Owing to shortage of Douglas fir plants, only one blank was planted with Douglas. The Scots pine have regenerated naturally on this area.)

In 1948 the Director visited the Douglas fir groups at Kessock and instructed that the blanks be filled with Douglas fir where the blanks were of such size as to warrant this treatment.

APPENDIX II

SUPERVISION – BLACK ISLE

Divisional Officers

1926 – March 1931	Mr F Scott
20.03.31 – 1940	Mr James Fraser
1940 – 29.12.42	Mr D S Spraggan
30.12.42 – November 1945	Mr Andrew Watt

Conservator

29.10.45 – continuing	Mr James Fraser
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State Forest Officers

Grade – Divisional Officer

01.10.48 – 21.09.49	Mr J T Fitzherbert
01.04.51 – continuing	Mr J A Dickson

Grade – District Officer

21.9.49 – 31.3.51	Mr J A Dickson
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District Officers

1927 – 1937	Mr F Oliver
1937 – 1939	Mr T A Robbie
21.09.39 – 31.01.47	Mr W Denman (T)
28.10.46 – 20.09.49	Mr J A Dickson
01.10.49 – January 1951	Mr E G Richards
08.02.51 – continuing	Mr M Long

Foresters and Foremen-in-Charge

1. Findon Forest

1927 – 1929	Mr J Macrae	Foreman
10.02.30 – 30.09.35	Mr W Mackay	Foreman
01.10.35 – 27.06.39	Mr W Mackay	Forester II
04.08.39 – 31.12.40	Mr J Gordon	Forester II
01.02.41 – 09.05.45	Mr R S Brown	Foreman
07.05.45 – 31.03.46	Mr J Gordon	Forester II
01.04.46 – continuing	Mr J Gordon	Forester I

2. Kessock Forest

01.07.26 – 31.03.28	Mr P Stewart	Foreman
01.04.28 – 18.08.47	Mr P Stewart	Forester II
12.05.47 – 17.07.48	Mr A C Gray	Forester I
08.05.48 – 31.12.50	Mr D Ross	Foreman
01.01.51 – continuing	Mr D Ross	Forester II

3. Kilcoy Forest

1943 – 1946	Mr W Mackay	Forester I
09.07.43 – 31.07.48	Mr A S Mackenzie	Foreman
01.08.48 – 28.06.49	Mr A S Mackenzie	Forester II
22.02.49 – 13.05.49	Mr A Mackay	Forester I
24.06.49 – 30.09.50	Mr J R A Frater	Forester II
01.10.50 – continuing	Mr J R A Frater	Forester I

4. Millbuie Forest

28.06.39 – 30.09.43	Mr W Mackay	Forester II
01.10.43 – 11.07.49	Mr W Mackay	Forester I
26.07.49 – continuing	Mr W Murray	Head Forester
06.01.49 – 28.06.50	Mr A C Stewart	Forester II
29.06.49 – continuing	Mr A S Mackenzie	Forester II

OTHER NOTES OF INTEREST

APPENDIX III

DETAILS OF SPECIES PLANTED

<u>Forest</u>		<u>Acreage</u>	<u>% of Total Area</u>
<u>Kessock</u>	Scots pine	317.9	52.53%
	Douglas fir	139.2	23.00%
	Norway spruce	34.8	5.75%
	Corsican pine	31.3	5.17%
	Tsuga heterophylla	19.5	3.22%
	Scots pine)		
	Norway spruce)	16.0	2.64%
	European larch	13.7	2.26%
	Scots pine)		
	Douglas fir)	13.6	2.25%
	Sitka spruce	11.2	1.85%
	Scots pine)		
	Douglas fir)	8.0	1.32%
	Japanese larch)		
	Japanese larch	4.6	0.76%
	Hybrid larch	4.0	0.66%
	Pinus contorta	1.3	0.22%
<u>Findon</u>	Scots pine	884.1	75.60%
	Sitka spruce	77.5	6.63%
	European larch	56.3	4.81%
	Norway spruce	55.2	4.72%
	Japanese larch	38.1	3.26%
	Pinus contorta	30.6	2.62%
	Corsican pine	12.5	1.07%
	Douglas fir	7.5	0.64%

	Scots pine	)		
	European larch	)	4.0	0.34%
	European larch	)		
	Japanese larch	)	2.0	0.17%
	Scots pine	)		
	Sitka spruce	)	1.0	0.08%
	Broadleaves	)		
	Scots pine	)	0.3	0.03%
<u>Kilcoy</u>	Scots pine		1055.2	65.04%
	Japanese larch		188.9	10.73%
	Norway spruce		174.5	10.01%
	Sitka spruce		158.2	9.06%
	European larch		60.1	3.43%
	Scots pine	)		
	European larch	)	49.9	2.84%
	Douglas fir		22.5	1.27%
	Corsican pine		11.0	0.60%
	Japanese larch	)		
	European larch	)	8.7	0.49%
	Scots pine	)		
	Sitka spruce	)	6.4	0.33%
	Norway spruce	)		
	Scots pine	)	6.5	0.35%
	Pinus contorta		1.0	0.05%
			ie. area planted by F.C.	
<u>Millbuie</u>	Scots pine		4725.8	80.21%
	Norway spruce		244.2	4.15%
	Japanese larch		199.0	3.38%
	Scots pine	)		
	European larch	)	198.6	3.37%
	Sitka spruce		141.5	2.40%
	Scots pine	)		
	Sitka spruce	)	78.9	1.34%

Pinus contorta		56.0	0.95%
Douglas fir	)		
Scots pine	)	54.0	0.92%
European larch		52.0	0.88%
Corsican pine		26.3	0.45%
Sitka spruce	)		
Pinus contorta	)	18.7	0.32%
Scots pine	)		
Scots pine	)		
Pinus contorta	)	17.5	0.30%
Sitka spruce	)		
Pinus contorta	)	17.0	0.29%
Rowan		14.0	0.24%
Douglas fir		10.5	0.18%
Scots pine	)		
Japanese larch	)	7.0	0.12%
Tsuga heterophylla	)		
Norway spruce	)		
Scots pine	)	7.0	0.12%
Scots pine	)		
Tsuga heterophylla	)	6.0	0.09%
Tsuga heterophylla		5.0	0.09%
European larch	)		
Japanese larch	)	3.0	0.05%
Japanese larch	)		
Hybrid larch	)	2.0	0.03%
Norway spruce	)		
Sitka spruce	)	2.0	0.03%
Hybrid larch		2.0	0.03%
Scots pine	)		
Norway spruce	)	1.9	0.03%
Sitka spruce	)		
Japanese larch	)		
Sitka spruce	)	1.7	0.03%

APPENDIX IV
Rates of Growth

(Note: M = Millbuie ploughed ground; F = Findon unploughed ground)

Species - Scots pine

	P 27		P 30		P 34		P 38		P 42	
	M	F	M	F	M	F	M	F	M	F
Compartment	-	3	-	28	-	48	10	-	48	-
Altitude	-	600	-	450	-	500	550	-	500	-
Aspect	-	SW	-	N	-	NW	NW	-	NW	-
Slope	-	Slight	-	Slight	-	Slight	Slight	-	Slight	-
Exposure	-	S	-	SW	-	NW	NE	-	NE	-
Mean Height of Dominants	-	20'	-	22'	-	18'	12'	-	6'	-
Mean Height Increment	-	10 1/2"	-	13"	-	11 1/2"	12"	-	9"	-
Current Annual Increment during last 5 years	-	12 1/2"	-	14"	-	13"	17 1/2"	-	10 1/2"	-

Geology and Soils

Old Red Sandstone. Soil - shallow peat 6" layer, 6" leached layer and then compact draft.

Species - Pinus contorta

Compartment	-	-	-	23	-	-	11	-	69	-
Altitude	-	-	-	400	-	-	530	-	400	-
Aspect	-	-	-	S	-	-	NW	-	NE	-
Slope	-	-	-	Slight	-	-	Slight	-	Slight	-
Exposure	-	-	-	SW	-	-	NE	-	NE	-
Mean Height of Dominants	-	-	-	20'	-	-	15'	-	7'	-
Mean Height Increment	-	-	-	12"	-	-	12 1/2"	-	10 1/2"	-
Current Annual Increment during last 5 years	-	-	-	13 1/2"	-	-	19"	-	14"	-

Geology and Soils

Old Red Sandstone. 2" cover of peat overlying hard drift layer.

Species – European larch

	P 27		P 30		P 34		P 38		P 42	
	M	F	M	F	M	F	M	F	M	F
Compartment	-	-	-	28	-	48	1	61	63	-
Altitude	-	-	-	450	-	500	600	250	480	-
Aspect	-	-	-	N	-	NW	NW	NW	NE	-
Slope	-	-	-	Slight	-	Slight	Slight	Slight	10°	-
Exposure	-	-	-	SW	-	NW	NE	NE	SW	-
Mean Height of Dominants	-	-	-	30'	-	18'	7'	10'	8'	-
Mean Height Increment	-	-	-	15"	-	13½"	7"	10"	12"	-
Current Annual Increment during last 5 years	-	-	-	17"	-	15"	7"	10½"	13"	-

Geology and Soils

Old Red Sandstone. 15" layer of peaty humus. Drift layer more bouldery and open.

Species – Japanese larch

	P 27		P 30		P 34		P 38		P 42	
	M	F	M	F	M	F	M	F	M	F
Compartment	-	-	-	28	-	48	10	61	49	-
Altitude	-	-	-	450	-	500	550	230	500	-
Aspect	-	-	-	N	-	NW	NW	NW	NW	-
Slope	-	-	-	Level	-	Level	Level	10°	Level	-
Exposure	-	-	-	SW	-	NW	NE	NE	NE	-
Mean Height of Dominants	-	-	-	33'	-	25'	20'	15'	7'	-
Mean Height Increment	-	-	-	20"	-	19"	20"	15"	10½"	-
Current Annual Increment during last 5 years	-	-	-	24"	-	20"	18"	15½"	11½"	-

Geology and Soils

Old Red Sandstone. Soil shallow peat layer, 6" leached layer and then compact drift.

Species – Douglas fir

	P 27		P 30		P 34		P 38		P 42	
	M	F	M	F	M	F	M	F	M	F
Compartment	-	-	-	-	-	-	-	-	50	-
Altitude	-	-	-	-	-	-	-	-	500	-
Aspect	-	-	-	-	-	-	-	-	NW	-
Slope	-	-	-	-	-	-	-	-	Level	-
Exposure	-	-	-	-	-	-	-	-	NE	-
Mean Height of Dominants	-	-	-	-	-	-	-	-	6'	-
Mean Height Increment	-	-	-	-	-	-	-	-	9"	-
Current Annual Increment during last 5 years	-	-	-	-	-	-	-	-	11"	-

Geology and Soils

Old Red Sandstone. Shallow Peat and leached layer, Drift slightly looser.

Species – Norway spruce

	P 27		P 30		P 34		P 38		P 42	
	M	F	M	F	M	F	M	F	M	F
Compartment	-	-	-	-	-	-	-	-	63	-
Altitude	-	-	-	-	-	-	-	-	480	-
Aspect	-	-	-	-	-	-	-	-	NE	-
Slope	-	-	-	-	-	-	-	-	5°	-
Exposure	-	-	-	-	-	-	-	-	SW	-
Mean Height of Dominants	-	-	-	-	-	-	-	-	6'	-
Mean Height Increment	-	-	-	-	-	-	-	-	9"	-
Current Annual Increment during last 5 years	-	-	-	-	-	-	-	-	12"	-

Geology and Soils

Old Red Sandstone. 15" peaty humus overlying drift. Rich flush.

Species – Sitka spruce

	P 27		P 30		P 34		P 38		P 42	
	M	F	M	F	M	F	M	F	M	F
Compartment	-	7	-	26	-	-	11	-	69	-
Altitude	-	550	-	350	-	-	500	-	400	-
Aspect	-	SW	-	-	-	-	NW	-	NE	-
Slope	-	Level	-	Level	-	-	Level	-	Level	-
Exposure	-	S	-	SW	-	-	NE	-	NE	-
Mean Height of Dominants	-	42'	-	25'	-	-	2'	-	2'	-
Mean Height Increment	-	17"	-	15"	-	-	Checked	-	Checked	-
Current Annual Increment during last 5 years	-	20"	-	18"	-	-	-	-	-	-

Geology and Soils

Findon – Old Red Sandstone. Old arable ground. Flush conditions.
 Millbuie – Old Red Sandstone. Wet. Scirpus-heather bog. Shallow peat overlying drift.