FORESTRY COMMISSION

HISTORY

OF

CLASHINDARROCH

FOREST

E(S) CONSERVANCY

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HISTORY

of

CLASHINDARROCH FOREST

1929 - 1951

EAST (SCOTLAND) CONSERVANCY

History of Clashindarroch Forest

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HISTORY OF CLASHINDARROCH FOREST

CHAIRMAN'S COMMENTS

The history has now been well compiled and brings together the main facts in a readable way. Most of the points which I have made following various inspections have been noted, except the last inspection of June 1952.

The main block of Clashindarroch was acquired during my absence in the Antipodes at the Third British Empire Forestry Conference. My first impression on seeing it was that we had taken on a difficult area; high lying and probably harsh climitically for the most part, surface vegetation not encouraging but soils better than might have been expected. It was not to be anticipated therefore that afforestation operations were going to be plain sailing. With this in mind I asked for a series of pilot plots to be laid down to test species and conditions.

The first plantations flattered only to deceive. The two main species planted were European larch and Sitka spruce. The former started off very well, the latter as usual looked well enough for a couple of years and (as usual) went into check on heather sites. There was little change in planting procedure for a few years, that is until caterpillar ploughing was introduced, when a small unpromising area of Sitka spruce on a poor site was interploughed and Scots pine planted on the plough. Ploughing became general wherever possible from about 1936, but seems to have been neglected during the war, to be strongly resumed thereafter.

The value of mixing pines and Japanese larch with spruces on heather ground was well established experimentally by the middle 40's, but the idea was slow to take hold at Clashindarroch. I found, for example, on my inspection of 1949 that Sitka spruce was still being planted pure on heather ground and it was clear to me that local officers did not fully appreciate the advances which had been made. I insisted, therefore, that the Research Branch should be brought into the picture forthwith and later drew some diagrams showing how by the use of local data predictions could be made of probable results from mixing species(see Headquarters file 115E/50). Improved rehabilitation methods have since been adopted.

I mention this point mainly because of its general interest, which is the difficulty, in a widespread undertaking such as ours, of getting improvements in technique universally known and put into practice.

My inspection of June 1952 was of great interest to me. The previous one (1949) had followed the extraordinary frost of 1947 and new plantings (and underplantings of Sitka spruce) were not looking well. In the interval we had been favoured by an absence of spring frosts (excepting a relatively mild one of early June 1952) and the trees had obviously benefited, in particular Abies grandis and underplanted Sitka spruce.

Of outstanding interest was the absence of fresh die-back and the recovery in European larch in all except the worst (very frosty) sites. From an examination of individual trees it seemed possible to date the beginning of the recovery to 1946 or 1947, or occasionally to 1945. The course of the epidemic seems to have run approximately as follows:

Earliest plantations	P.30	
First Chermes attack reported	1937	(age 7 years)
Die back beginning	1938/39	(" 8/9 ")
" " severe	1940	(" 10 ")
" " apparently catastrophic	1944	(" 14 ")
Recovery beginning	1945/46	(" 15/16 ")
Dominant crowns practically normal	1952	(" 22 ")

Most of the dominant trees seem to be out-growing the kink formed at the point of die-back and in a few years only slight evidences of it will remain.

The main effect of larch die-back, therefore, may be under-stocking, the degree of which must vary from place to place. This presents a new problem which may be solved by under- or inter-planting. Enumerations should be made and experiments carried out forthwith.

A few other points in 1952 were, very briefly:

(1) The success of the pine-spruce mixtures of P.37 at White Geese. Too little advantage was taken of this pointer which is outstanding.

(2) The high promise of the more recent pine-spruce mixtures on ploughed ground.

(3) The good growth of Scots pine at lower elevations.

(4) The growth of mountain pine on the upper fringes of plantations. The neglect of this species in mixture with Sitka spruce on poor and exposed sites is surprising.

There is still a lot of useful information to be gathered up and applied at Clashindarroch and I cannot urge local officers too strongly to make a habit of systematic study of results to date.

Clashindarroch has had a somewhat expensive and chequered career, but will in the end make a satisfactory forest.

R.

July 16th, 1952.

COMMENTS BY STATE FOREST OFFICER

Mr. Horne and Mr. J. M. Kennedy have produced this historical account of Clashindarroch although I must take responsibility for the views expressed in the section on Silviculture. Kennedy, who knows this big forest better than anyone, has claimed for several years now that what may be proved at Clashindarroch may also be disproved: Be that as it may there is no doubt that the major lessons to be learned at Clashindarroch are now understood and are incorporated in our forest practice in this Conservancy. There is still a lot to be learned about hardy races of our commoner trees and about exposure and about the succession to pioneer species, and we are already started along some of these exciting trails.

The checked areas are now behind us. Should anyone feel depressed let him walk through mixtures of Sitka spruce and Scots pine on ploughing in P.38 (Lag Valley) and see Sitka thrusting up through pine at over 1000 ft. elevation: Let him see a whole small valley (Compartment 224, etc.) planted with one-year seedlings of Sitka spruce and Scots pine on ploughing in 1948 and now growing vigorously, or let him tread the wonderful forest floor where once was heather under Japanese larch and hybrid larches in many places through the forest. Clashindarroch is already an achievement and will soon be a highly productive forest.

In a history one should reminisce, and I remember Mr. Gosling saying to me some years ago, "It isn't that we don't know the right thing to do, it's getting everyone to do it!" In any case he was mistaken: I didn't know, but it was an encouraging remark. Clashindarroch has taught us the right thing to do: we must now get everyone to do it.

(Sgd). T. H. WOOLRIDGE

STATE FOREST OFFICER.

HISTORY OF CLASHINDARROCH FOREST

GENERAL DESCRIPTION OF THE FOREST

Situation

The area mostly lies to the west of the Huntly-Rhynie road and is bounded on the west by the rather elevated county boundary or the Gartly Parish line. The agricultural lands on the east side are bounded by the River Bogie while the south boundary crosses the Rhynie-Cabrach road. The farthest point of the north boundary almost reaches the River Deveron about 3½ miles west of Huntly.

The forest derives its name from the shooting lodge of that name which was acquired with the first acquisition.

Area and Utilisation

The areas at the time of acquisition and the utilisation of ground at 30.9.51 are as shown in the following tables:-

Clashindarroch Forest History

TABLE I

From	By	Date	Plantations Acquired	Plantable exc. Col. 4.	Nurseries	Agricultural	F.W.H.	Unplantable excl. Col. 4	Other Land		Total
									Description	Acreage	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Duke of Richmond Gordon & Lennox	Purchase	1929		7978		2520	350	6917			17765
Daniel Ferguson Lockhart	Purchase	1930		425							425
Mrs. Annie Wright Barrie	Purchase	1938		162		1		91			254
George Watson Thom	Purchase	1944		60				49½			109½
John McRae	Purchase	1944		143½		13		18			174½
Garnet Ewart Lambert & Another	Purchase	1945		1672		223		526			2421
Disposals to Aberdeen County Council						.4					21149
Miss Grant				.75							1.2
TOTALS				10439.75		2756.6	350	7601.5			21147.8

TABLE II

(a)	**Plantations**			
	Acquired	Nil	Acres	
	Formed by Forestry Commission	8082	"	8082 Acres
(b)	**In hand awaiting planting**			
	Blanks after felling	Nil	Acres	
	Burnt Area	Nil	"	
	Other land	1445	"	1445 Acres
(c)	**Nurseries**			
(d)	**Agriculture**			
	D.O.A.S.	13 tenancies	)	
	Forestry Commission	8 "	)	7695 Acres
(e)	**F.W.H's**	13 "		33 Acres
(f)	**Unplantable land in hand**			3890 Acres
(g)	**Other land**			3 Acres
				21,148 Acres

At the time of acquisition farming was not in the prosperous state that it is today. This was particularly the case with hill sheep farming. The low-lying farms which were mainly arable subjects were well farmed but the upland places which were mainly black faced sheep farms with a little in-by ground were not properly worked and the poor prices for wool and mutton at the time made these difficult to let at economic rents. The higher Calluna moor was given over to sport and it is doubtful if much sheep grazing was done there.

Rabbits and hares probably far outnumbered sheep.

As can be seen from the preceding Tables much land still remains in agriculture. This land is, of course, the best and most fertile land and will probably always be farmed. The number of persons engaged in agriculture cannot be much smaller now than it was at the time of acquisition. It is estimated that three or four shepherds at the most have been "put off the hill". The production on the lands remaining in agriculture today is without doubt greater than the total in 1930. One very progressive farmer who farms 2315 acres has re-seeded considerable areas and is now raising Hereford cattle on what was formerly Calluna moor.

His suggestion that parts of Clashindarroch could have been broken up by wide green belts of grass by re-seeding is worthy of consideration in future planning of big acquisitions where agriculture and forestry must be complementary. The woods would benefit the grazing and the grazing belts would afford first class fire protection.

The Forestry Commission has built 11 workers houses and 1 head forester's house. Six of the houses acquired with the land are used to house forest workers.

The farms are worked mainly as mixed farms. Of the 21 tenancies 10 have black-faced sheep flocks. No sheep stocks are tied to the land. It is not intended to resume any more land from agricultural subjects under Forestry Commission management (at least not in the immediate future). With regard to the farms managed by Department of Agriculture for Scotland, the Department was prepared to make an area on the lower slopes of Tap o' Noth available for planting. The area was long and narrow and in addition to the very expensive enclosure, fenced sheep passes would have been necessary. The proposal was considered uneconomical.

The method in which all the farms on the forest are worked is such that it would be unwise to seek further resumptions.

Land for planting F.Y.52, 53 and 54 has been resumed from Forestry Commission grazing tenants and entry secured.

The shootings are let on lease at an annual rental of £500 (Clashindarroch). Grouse provide the main sport.

Physiography

The area is elevated and hilly, the bulk of the higher ground lying towards the west boundary, where we find a continuous belt above the 1250 ft. contour extending to 3400 acres. Within this belt or just beyond the forest boundary we have the Grumack Hill 1723 ft. Cloichedubh Hill 1598 ft., Hill of Haddoch 1711 ft. and Leid's Hill 1571 ft.

Another block of 1130 acres over 1250 ft. embraces Tap o' Noth and Hill of Kirkney. Other small blocks over 1250 ft. occur as follows:-

(a) Raven Hill and Cross Hill - 450 acres

(b) Long Bank, Cransmill Hill and Quarry Hill - 250 acres.

(c) Clayshot Hill - 200 acres

(d) Kyehill (Saughs) - 10 acres.

This gives a total of 5430 acres over 1250 ft. elevation. The Tap o' Noth is a prominent conical feature rising to 1851 ft. The deep valley of the Kirkney and the Lag Burn almost trisect the area, each section being further divided by secondary valleys. Valley slopes vary from steep to moderate. Slopes of 20° to 25° are common on the Kirkney and Lag Valleys. The slopes are dry except at Bogancloch and Brown Hill where the gentler slopes are typically moist. The north facing slopes tend to be moist and mosses and peat are accumulating where the canopy has been long in forming.

All aspects are found. The exposure is greatly moderated by the high proportion of valley slopes within the plantable area. It is a serious factor on the upper slopes, ridges and plateaux, where the crowns get blasted by the north-west winds.

Geology and Soil and Vegetation.

We are fortunate in having had these subjects dealt with in a thoroughly scientific manner by Doctors Muir and Fraser of the Macaulay Institute of Soil Science. A study of this work will repay anyone who

has to deal with the silvicultural problems of Clashindarroch. The soils of Clashindarroch are derived in the main from rocks which give fertile soils and they are not likely to prove a limiting factor to tree growth except at high elevations. It is the soil surface which has been our problem and the deterioration which it has undergone since enclosure. This will be dealt with under 'Silviculture' but it is interesting to note that the change from Nardus, Aira flexuosa and Erica spp. to Calluna and Vaccinium can now be observed on the recently enclosed land at Brown Hill, Bogancloch.

All three main classes of rock are represented as follows :-

(1) Metamorphic. Knotted schists, phyllites, slates, contact-altered schists, mica schists, quartzite and flags.

(2) Igneous Norite, hornblende schists and serpentine.

(3) Sedimentary Old red sandstone

The area is extensively drift covered, the covering being thin or absent on the upper slopes, ridges and convex features generally. The drift is specially strong in the region of the hornblende schist, norite, contact altered schists and pebbly grit bands. The comparative lightness of the third and last glaciation explains the close correspondence between the drift and the subjacent rock types. The parent materials occur in the form of (a) residual soils, (b) drift soils, (c) colluvium and (d) alluvium. Impeded drainage is most evident in soils overlying the till.

The following is the soil classification adopted by Messrs. Muir and Frazer.

	H.M. Steven's suggestion for choice of species.
A. Brown Earths	
Normal Brown Earths	N.S., S.S., S.P.
Creep Soils	E.L., J.L., S.P.
Brown Earths with Gleyed C Horizon.	N.S., S.S.
B. Podzolised Soils	
Concealed Podzols	E.L., S.P., J.L.
Normal Podzols	SP/SS, SP/EL, J.L.
Peaty Podzols	SS/SP or SS/PC.
C. Gley Soils	
Ground Water Gleys	N.S., S.S.
Surface Water Gleys	S.S., N.S.
Peaty Gleys	S.P. (S.S.)
D. Peat Soils	
Hill Peat	S.S. (with slag)
Basin Peat	N.S., S.S.
E. Old Arable Soils	N.S.

Vegetation

Here again we are indebted to the Muir-Frazer report for a very detailed classification of the vegetation and its correlation with the soils. Their scheme of classification is as follows :-

1. Grassland

   (a) Recently cultivated
   (b) Semi-natural

2. Heathland

   (a) Grass Heath
   (b) Dry Heath

   Calluna/Erica cinerea
   Calluna/Vaccinium myrtillus
   Calluna/Arctostappylos
   Calluna/Aira flex./Vaccinium myrtillus
   Exposure Types (Calluna/lichen)

   (c) Moist Heath and Submoorland

   Calluna/Aira flexuosa
   Calluna/Vaccinium
   Calluna/Nardus
   Submoorland - Calluna/Scirpus, Calluna/Eriophorum

3. Moorland Types

   Basin Peat - Calluna/Eriophorum/Scirpus
   Hill Peat (sub Alpine) - Calluna/Scirpus, Calluna/Eriophorum

4. Flush Types

   Humose Flush - Alder/Willow, Holcus, Juncus articulatus.
   Peaty Flush - Nardus, Carex, Narthecium
   None-humose Flush - Aira caespitosa
   Ferruginous Flush - Stunted forms of usual flush plants.

Meteorology

The annual rainfall varies from 35 in. to 40 in. The higher figure applying to the higher ground towards the west and south west boundary. The distribution of the rainfall is illustrated by the following averages over 26 years for Huntly (500 ft.)

Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
2.43	2.20	2.47	2.59	2.71	2.03	3.25	3.05	2.76	3.94	3.68	3.02	34.24

These figures do not indicate much risk of drought.

The prevailing wind is westerly but north and north-west winds can be very severe. Snow can be very damaging to young crops of Scots pine. Snow drifts lie late in depressions and on north slopes. Severe frosts are frequent in spring.

The climate is generally severe in winter and as so much of the planting is now done on ploughing frosty weather frequently holds up the work for lengthy periods.

The incidence of frost and exposure at Clashindarroch would be worth a close study. As pointed out at one time by Mr. James Macdonald, frost may be dammed up by bends and constrictions in the long valleys, and the effect of it may be felt much further up the sides of valleys than would be expected. In the same way exposure may be severe in unexpected places and there is no doubt that in some cases e.g. the south side of Lag Valley exposure is much less severe than the present planting line suggests.

Risks

Frost. If we assume that frost is a major cause of die-back in European larch, it must be reckoned as the greatest risk at Clashindarroch. Although frost may severely damage spruces, and even on occasions, kill them, fatal results have never been sufficiently widespread to call for repair treatment.

Blast. Apart from the high exposed regions, blast can be damaging at Clashindarroch on newly planted areas in almost any elevated situation. Severe losses in current year's planting can occur after cold winds in April, and this applies particularly to 1 + 1 Sitka spruce and two-year seedlings of any species. Big plants may also suffer. A one-year seedling can often sustain such damage and make complete recovery.

Fire. The main risk is from muirburning on marching properties. The risk has been largely offset by the provision of a bulldozed ring trace which it is proposed to complete in F.Y.52.

The forest is well roaded for its stage of development and the easy access afforded to any part of the area is valuable help in fire protection. No fires involving loss of woodland have occurred during the life of the forest.

Vermin.

Rabbits. The large areas of agricultural land which border the forest have always been a menace and netting has been erected around all plantings. The rabbit question is being tackled by a team of five trappers. The purpose is to aim at extermination on the planted and plantable land

and the agricultural land under the control of the Department of Agriculture for Scotland and the Forestry Commission. The Department of Agriculture readily agreed to our trapping and shooting on land managed by them.

Mountain Hares. These often cause considerable damage in winter. The trouble is that upper march fences are drifted up with snow annually. Beyond our march fence there is a vast area of high moorland where hares are very numerous. They are controlled by frequent drives during the winter months.

Roe Deer. These are increasing substantially - partly on account of war-time fellings and partly due to the shelter afforded by the young plantations. Strong control measures are necessary if their numbers are to be kept within reasonable bounds. It is doubtful if we are justified in protecting them at any season of the year.

Capercailzie. These birds are not common and no damage has been noted.

Black Game. Black game are increasing and damage has been recorded in recent years. Control measures are necessary.

Insects and Fungi. The only insect and fungus of serious importance are the Larch/Spruce Aphis and larch canker. Together they have contributed to the melancholy state of the European larch plantations.

Roads

Road construction started in 1947 under Directorate, not Conservancy, supervision, with the idea of completing a south to north connection within or near the forest boundary.

To do this, it was proposed to join the roads running up the Kirkney burn from west of Finglenny to the Drumfergue roadhead at Three Sisters and also to join from just north of Tillathrowie to Baillieswards.

Early and heavy snow led to the abandonment of this work in early December.

In F.Y.1948/49 the above two roads were completed, under Conservancy supervision, using a hired excavator and tippers, a Commission bulldozer and forest labour. As these roads might be required throughout the year for the movement of personnel, they were metalled partly from quarry waste, and partly from rotten rock excavated on the road alignment. The latter

material proved unsatisfactory, and the roads had to be resurfaced in 1950.

In November and December, 1948, the road up the long valley was bulldozed by hired equipment, and the first stretch of 600 yards through agricultural land was metalled from stone excavated from the roadside. Owing to forest labour having to be withdrawn for planting, there was not time to drain this road properly, and there was considerable water damage in the winter of 1948/49. This damage was repaired by autopatrol and culverts added in the summer of F.Y.49.

It was now clear that ground conditions for roads in this forest were with certain exceptions very favourable, and it was decided that for fire protection, forest management, and some early thinnings, a system of properly constructed earth roads would probably be adequate, and could be justified.

From the summer of 1949 to September, 1950, approximately 8 miles of fair weather roads and 11 miles of fire tracks were constructed. The fair weather roads were shaped by autopatrol and culverted, the fire tracks were left as bulldozed.

In addition, one mile of road from west of Finglenny to Bogancloch was metalled. This completed the road from south to north within the forest.

The total mileage constructed since 1947 is $6\frac{1}{2}$ all weather, $10\frac{1}{2}$ fair weather and $11\frac{2}{3}$ fire tracks. It is estimated that this forest may require over 100 miles of road or track before it is completed.

Costs are difficult to ascertain accurately as much of this work was done by the forester, and the engineering progress report was not submitted. From the engineering reports available the cost of fair weather roads appears to be £350 per mile allowing S.R.O. rates for bulldozer and autopatrol. Additional culverts will probably be necessary which will put the cost up to approximately £400 per mile.

The main disadvantage that this forest suffers from, as regards road construction, is that if earth roads do not prove adequate, there are no supplies of gravel or suitable rotten rock, so that surfacing will entail blasting and crushing stone, and therefore additional expense.

Labour

Labour supply has been plentiful and of fairly good quality up to

the present. The normal estimates cover a squad of 40 men, but only 35 men are on the squad at present. The size of the planting programme of recent years would require a squad too large to be employed at other seasons. This has been overcome by obtaining help at planting time from the Bin where planting programmes are now small, and by the payment of bonuses for higher production.

SILVICULTURE

It is with a good deal of humility that one sets out to write on the silviculture of Clashindarroch Forest. Much thought has been given by many good men to the problems of the forest and much first class practical work has been and is being carried out in this rigorous and inhospitable region. Nevertheless, we have our failures, some of them on a big scale, and it is a good time to pause and ask ourselves if we are good enough men to learn the lessons now bound up in this forest.

In 1944 I. Gillespie wrote a descriptive, historical and critical report on Clashindarroch. This excellent report gathers together the knowledge we had at that time including opinions of inspecting officers and the essence of the work of Muir, Frazer and H. M. Steven. It is the first real attempt to go back over work done and to draw conclusions of how failure should be treated and future work carried out. The recommendations of this report deal chiefly with the two biggest problems at Clashindarroch, larch die-back and failed Sitka spruce, and an attempt will be made here to give an up-to-date appraisement of these two matters. In addition, these notes will include points of silviculture on which Clashindarroch now gives a lead and points on which further investigation is required. The danger of thinking we now know too much will be avoided so far as possible.

The soils of Clashindarroch are within normal climatic and physical limits, fertile, and there is no reason to suspect that they will not make satisfactory forest soils. On some of the best soils spruce has failed and larch has died back. So far as we can now see, the answer to the failed spruce is known and is incorporated in our forest practice: the reason for die-back larch is not known.

The planting of pure Sitka spruce on moist heaths was encouraged

from the beginning. Presumably, the good soil and the vegetation supported this choice - moist heaths according to Muir and Frazer, being chiefly ericaceous with Vaccinium spp., Calluna and occasional Nardus and Aira flexuosa. The tentative schedule prepared in 1929 indicates, however, that Sitka was thought to be suitable for the bulk of the uncultivated hill. (See Gillespie's report). Optimism was sustained until about 1936 when it began to be obvious that the 'check' of notched pure spruce on moist and Calluna heaths was to be permanent, and that drastic action would be necessary. Even then the hopelessness of the situation was not realised; ploughable areas began to be ploughed and filled up with mixtures of Sitka spruce and Scots pine, but the steep slopes were still expected to come away and further pure spruce was planted. We now know that the deterioration of surface conditions particularly on north-facing slopes was proceeding fast as heather dominated the vegetation and became luxuriant. Under the heather, conditions were constantly moist and the formation of peat began. Sphagnum is now common on these slopes even on the down-side of drains. Not even Scots pine introduced in every third row of Sitka spruce (see report of Chairman's visit of October, 1941) could tackle these conditions. This treatment continued for several years (see the recommendations on Gillespie's report, June, 1944) but we now know that even had the pine succeeded in growing it would have been insufficient in quantity to have brought away the spruce.

Progress of Rehabilitation

Failed Spruce

Areas beaten up with Scots pine after ploughing in F.Y. 36-39.

P. Years	Compts	Areas of Sitka spruce beaten up Acres	Plants Used Thousands
31	10, 17, 19	22	24
32	7, 39, 40, 43, 44 and 45.	64	60
33	36 and 39	23	21
34	37	5	1
	Totals	114 Acres	106 Thous.

In F.Y.51 the following failed areas were treated:-

P. Years	Compts.	Area of S.S. & SS/SP B.U.	Plants Used		Total All Spp.
			Spp.	Thous.	
32	43, 50 and 51	21	J.L. S.P.	21) 4)	25
33	36, 38, 41 and 42	41	J.L. H.L. P.C.	34) 4) 23)	61
34	32 to 35, 37, 50 to 53	91	S.P J.L. H.L. P.C.	20) 63) 13) 42)	138
35	50,102,115,118, 119,120,121, 122	33	S.P. J.L.	22) 20)	42
37	35	3	J.L.	5)	5
	Totals:	189	S.P. P.C. J.L. H.L.	46) 46) 143) 36)	271

In F.Y.52 the following failed areas were treated:-

P. Years	Compts.	Area of S.S. & SS/SP. B.U.	Plants Used		Total All Spp.
			Spp.	Thous.	
30	11,12	13.3	J.L.	7.2	7.2
31	15,16,17,19	19	P.C. J.L.	15.8) 8.7)	24.5
32	39,40,44,45, 49,63,64,66, 69	45	S.S. P.C. J.L. S.P.	14.1) 36.5) 7.1) 2.6)	60.3
33	62,76,77,91,93, 94,97,98.	50.2	H.L. J.L.	25.) 40.)	65
34	32	1	P.C.	1	1
35	48	.6	J.L.	1.3	1.3
36	165,169,170	3.9	J.L.	4.	4.
40	195, 196	5.5	P.C.	4.9	4.9
41	220,221,222	9.	J.L.	9.	9.
43	226,227,231,234, 236,237.	65.5	J.L. S.S. P.C.	8.7) 19.7) 51.8)	80.2
44	157	16.5	P.C.	16.	16.
	Totals:	229.5			273.4

The first attempt to treat checked Sitka spruce by ploughing came in F.Y.36. The method was simply to deep-plough between rows of spruce doing as little damage as possible and to beat up along the ridge with approximately a thousand Scots pine per acre. By 1939 a total of 114 acres had been treated in this way. The treatment was stopped and not resumed until after the war.

In 1949 all remaining failed spruce areas were surveyed and scheduled for treatment. In the summers of 1950 and 1951 they were ploughed wherever possible and beaten up with Scots pine, Japanese larch or Pinus contorta, and it is obvious from areas ploughed that about 20% of the spruce will survive to take part in the crop. Where ploughing was not possible on steep slopes, thorough mounding was done and Japanese larch or Pinus contorta planted with phosphate. Altogether since 1936, 528 acres of failed Sitka spruce have been treated either by ploughing or beating up on mounds and the task is reckoned to be now finished. Many small areas of 'checked' spruce will still be untreated but there is a strong likelihood of these areas being brought away either by the ameliorating conditions created by the surrounding plantations or by the existing nurses.

In prescribing treatment for the large scale rehabilitation work of 1950 and 1951 many factors had to be borne in mind. Among them were the following :-

Whatever was done had to be certain of success.

The success of the 1936 to 1939 treatment outlined above.

Once the ploughs were on the ground, ploughing at five feet was only about 30% more expensive than 'band' ploughing.

Success had to be achieved within a reasonable period of time.

Silviculturist (North) after investigating the subjects of side-effect and nursing at Clashindarroch, showed what might be achieved by band-ploughing as against ploughing at 5 ft. It was clear that 'band' treatment was extremely slow in its effect, and probably almost ineffective for some of the worst sites. Ploughing at 5 ft. intervals, between rows of spruce, was therefore adopted as the standard method of treatment.

The choice of species for the treated areas was made along the lines of safety first. Where it was judged that a proportion of spruce would recover beating-up was done with Scots pine with the object of forming

an intimate mixture. Pinus contorta was used instead of Scots pine where appropriate. Japanese larch could not be used in this way, but where it was possible to get in pure groups or where complete replanting was necessary, Japanese larch was selected on account of its proved pioneer qualities on difficult sites.

Die-back of European larch

The first note of warning about European larch was sounded by the Chairman during his 1935 visit, when he expressed a doubt regarding the large acreage of European larch on old arable sites, which he considered really spruce sites. He thought there was a risk of "pumping" and the Acting Assistant Commissioner and Divisional Officer concurred. Apparently canker was not then sufficiently bad to cause alarm while the hybrid larch on Calluna sites still earned unqualified praise. After his visit the following year the Chairman made the comment, "Much of the larch which I saw is making much better growth than I would have expected from a superficial inspection of the surface vegetation." Sir Alexander Rodger likewise expressed surprise at the good growth of hybrid larch on Calluna sites during his visit in 1937. Mr. W. L. Taylor made a similar remark in March, 1939, with reference to the larch in the Lag Valley, while the larch in Long Valley showed signs of heavy Chermes attack the previous year. It was remarked that the large areas of pure European larch would encourage this insect.

On 26.3.40 Mr. Newton wrote the Acting Assistant Commissioner in very grave terms and reported advanced degeneration on the old arable sites, Chermes and canker being then rife. He stated that Chermes was also active on the Calluna sites where canker was just beginning. He also drew attention to the considerable acreage of European larch involved at this forest.

We find no mention of the Shoot Moth until the Chairman and the Acting Assistant Commissioner visited Clashindarroch in October, 1939, by which date its activities were freely advertised by dead twigs even on the relatively vigorous larch on Calluna sites. At the conclusion of this visit most of the European larch on old arable areas was pronounced "manifestly hopeless" by the Chairman and it was agreed that the replacement of dead or dying larch, principally with large Sitka spruce plants

on mounds should proceed right away. As regards the larch on Calluna sites, it was considered best to wait and watch. In September, 1943, the District Officer was asked to report on the condition of the larch on Calluna sites and his report revealed a greatly worsened state of affairs on the southerly aspects particularly near the valley bottoms.

Following the visit of the Chairman and Acting Assistant Commissioner in June, 1944, a discussion was held in the Huntly Hotel in order to thresh out policy and procedure with regard to European larch in particular. The Chairman, Acting Assistant Commissioner, Divisional Officer, District Officer and Research Forester were present. The Chairman opened the discussion by suggesting that all European larch on old arable sites was definitely doomed and that the old method of replacement of random deaths should be replaced by systematic beating up. This was agreed. The Acting Assistant Commissioner urged that it was too early to despair of the bulk of the larch on Calluna sites and that only the worst of it should be tackled at once.

The following work was finally proposed for F.Y.45:-

A. As regards old arable sites still untouched, underplanting of 50 acres if available, with 870 large Sitka spruce per acre on slit mounds, the plants to be set between the European larch lines as follows :-

(a) on 30 acres, by alternate interlining at 5 ft. spacing

(b) on 20 acres, by complete interlining at 10 ft. spacing, staggered, so that every Sitka spruce plant had four others about 7 ft. distant from it.

Areas already treated (old arable or Calluna) with Sitka spruce but below the 870 per acre standard, were to be made good as far as possible by the interlining method. Where Norway spruce previously used, this species was to be adhered to in making good.

B. As regards the European larch on Calluna sites, it was finally decided that a belt 10 chains wide, extending to about 20 acres, be selected in Lag Valley, embracing both aspects, and treated as under (a) above, further treatment of Calluna sites to be subject to developments. On the lower Calluna-Pteris-grass slopes within the belt Douglas fir and Tsuga were to be substituted for Sitka spruce on

a small scale (say, one acre each).

No further cutting out or brashing of larch was to be undertaken except as later required to give Sitka spruce freedom to develop.

The above work was carried out and also additional work of a similar nature until by 1949, 220 acres of larch on heath sites had been treated. About that time it was noticed that die-back was no longer progressing and further treatment of die-back areas was suspended. Sitka had established itself remarkably well in heather under the larch, and although it had suffered in some places from frost, serious damage was negligible. At the present time (1951) it is clear that die-back has abated and that the bulk of the European larch on heath sites will make a satisfactory though somewhat thinly stocked crop. Some of the beating up with Sitka spruce is now seen to have been unnecessary.

On old arable sites larch has consistently been a complete failure and has been replaced by a crop of pure Sitka spruce.

Norway Spruce on Old Arable Ground

One of the minor failures at Clashindarroch has been that of Norway spruce on old arable fields at Old Forest. This spruce on some twenty or thirty acres maintains a perfectly good colour but the rate of growth has been extremely slow for the past twelve years. Many learned opinions have been given but there is a clue if we compare it with an old field (Compartment 259) planted in F.Y.48 and behaving in much the same way. The fields at Old Forest were dirty when planted and today are so full of couch grass that for four to five inches below the surface there is nothing but grass roots and dry earth. The field in Compartment 256 is much the same and across the way is a field free of couch Compartment 259. The spruce in the couch-free field is growing normally.

Preparation of Ground

The only form of preparation of ground apart from ploughing, which might have been practised on any scale at Clashindarroch, is heather burning. In fact, there was until 1951 very little heather burning before planting. Now it is the practice where possible to burn just prior to ploughing.

Choice of Species

The area was visited by Mr. R. L. Robinson, Technical Commissioner, in September, 1929, after which he drafted a schedule (Appendix III) laying down the approved choice of species and methods of planting for the various types of land which he defined. He regarded this area as unique in the division by reason of the large percentage of elevated ground of doubtful economic plantability which it contained. Experiments were to be instituted at once (P.30), in doubtful ground to decide the timber limit, the best species and the best methods to use. He described his schedule as a first attempt to define vegetational types with reference to plantability and he looked to the local officers to extend and improve it as more knowledge came to hand.

If we take the schedule to imply that species were to bulk in the programme according to the order in which they are named, then it was not faithfully followed. The good early promise of European larch was misleading.

As regards the "safe land" we note:

(1) Old Arable Soils. A disproportionate use of European larch and a corresponding avoidance of Sitka spruce up to and including P.35;Scots pine is used pure or mixed with European larch in P.30 and 31, while Japanese larch is used fairly freely in P.31, in which year the proportion of Norway spruce shows a definite drop. The avoidance of Sitka spruce in favour of European larch or Japanese larch is, however, the most striking feature up to P.35. In P.37, however, there is a decided reaction and both European larch and Japanese larch disappear from the arable sites, while Norway spruce is favoured at the expense of Sitka spruce. This preference for Norway spruce is even more marked in P.38 and 39 (Old and New Forest and Corshalloch), this species being carried to 1250 ft. in the New Forest area. A mixture of Sitka spruce and Pinus contorta on the plough furrow was used in P.37 at Corrydown where the elevation is over 1300 ft. Since P.39, the only planting of arable sites has been at Saughs(P.44) and Sitka spruce has been the main species used.

(2) Bracken. On the very limited area of bracken which occurs, European larch has been used.

(3) Juncus with Aira caespetosa, etc. on a humose soil. Norway spruce has been the main species on alluvial flats but it has also been used rather than Sitka spruce on fresh flushes on inclined ground.

(4a) Moist heath - (on lower uncultivated slopes). This type occurs most frequently on the northerly aspects and both Sitka spruce and Japanese larch have been used fairly frequently. European larch has also been used on creep soils where the humus layer is thin. In the earlier years there was a tendency to plant Norway spruce on this type. The altitudinal sequence European larch, Japanese larch and Scots pine sometimes noted on the northerly aspects is unfortunate in view of the exposure. Where Sitka spruce was used in place of Japanese larch or Scots pine and went into check, it was freely condemned by Mr. Edwards as being the wrong species (F.Y.38 Census). This judgment confused the problem of establishment with the question of the ultimately best tree. The free use of Scots pine on the upper northerly aspects in Long Valley, etc. is surprising, at least now, in view of the exposure. More respect was shown for this factor in the case of European larch. Up to P.36, pure European larch was used much more extensively than a Scots pine/European larch mixture. In P.37 the European larch acreage dropped sharply and remained low in P.38 and 39, no European larch being planted after 1939.

From P.40 onwards, there has been a growing tendency to use a Sitka spruce/Scots pine mixture on this type after previous ploughing where at all possible. Moist grass heath types over basic igneous rocks have been mainly planted with spruces and especially Sitka spruce.

(4b) Dry Heath. This is found typically on the southerly slopes, which show an over-whelming predominance of European larch mainly on creep soils, the proportion of Scots pine being very low though it does figure in P.33 and 34 (Hill of Clashindarroch) and P.38 (Finglenny) pure or mixed with hybrid larch. There is some pure Scots pine at the top end of Long Valley (P.33) on the southerly aspect at about 1150 ft. elevation and this shows blast effects though less severe than on the opposite slope right down the valley. The Japanese larch on this aspect has grown well but shows rather crooked growth, but mild in degree compared with the Corrydown Japanese larch on old arable sites. In P.40 (Corshalloch) Sitka spruce

has grown well on ploughing on dry grass heath over creep soil. Since pure Scots pine is undesirable for climatic and economic reasons (snow or wind), it is difficult to suggest anything better than a mixture of Sitka spruce and Scots pine for this type over schists, and this has been used at Craigwater, P.43, on unploughable slopes.

Dry grass heath types over basic igneous rocks (mainly Brownhill so far), have been planted with Scots pine or a mixture of Scots pine and European larch, the oldest sample of the latter being in P.33 and 34 at Brownhill. In P.33, the larch is Silesian and not very promising but it carried Chermes from the nursery. In P.34 it is native and much healthier and better grown. There are further samples of the pine/larch mixture in P.38 and 39 at Brownhill which are promising.

(5) Tops of slopes, exposed plateaux at plantable levels. (Calluna-lichen). This was classed as doubtful land in the schedule and probably includes the areas of peaty podsol with pan planted with Sitka spruce at Corrydown (Compartment 19), and Raven Hill in P.31 and 32. They went into check but were interploughed in F.Y.36 and beaten up with Scots pine in F.Y.38 with decided success. The Research Branch experiments at Drumfergue occupy an exposed terrace on a peaty podsol with pan, while their Kirkney plots also include an area of Calluna-lichen. In P.32, Compartments 45, 46 and 49, there is an area of Calluna-lichen with Japanese larch, a mixture of Japanese larch and Pinus contorta and a small area of Sitka spruce still in check. The pure Japanese larch is very slow and sickly but better in mixture with Pinus contorta. The P.37 mixture of Sitka spruce and Scots pine on the plough furrow round the Drumfergue experimental area shows the correct treatment for this type.

(6) Upper parts of 4a and 4b. (Eroded Calluna). The Research Branch experiments in Long Valley are partly on this type and partly on dry heath (Calluna-Erica cinerea type). The P.39 Sitka spruce/Scots pine mixture on the plough furrows east of Quarry Hill is on eroded Calluna (1100 ft. - 1250 ft.) with partial shelter and is fairly promising. The same applies to the P.38 ploughed area on Kemp's Hill with mixtures of Sitka spruce and Scots pine; Sitka spruce and Pinus contorta; mountain pine; and Scots pine.

During the war years a mixture of one-third Scots pine/two-thirds

Sitka spruce was used indiscriminately. Present ideas on choice of species are given under 'Conclusions' (page 33).

Planting

(a) Spacing. Normal spacings have been in use except in the case of one year seedlings where a 3 ft. spacing was employed on 5 ft. furrows. At the present time normal spacings are used for all ages of plants.

(b) Type of plant used. Clashindarroch like other forests, suffered in early years from the big plant held over in our nurseries for the sake of economy. Between 1934 and the war there was an attempt to use more 1 + 1 pines and larches and this practice was again resumed after the war. Planting of one-year Scots pine and Sitka spruce heathland seedlings was practiced on a minor scale in 1948 and 1949, with considerable success. (Compartment 224). One year seedlings of European larch have also been planted (P.32) with success.

(c) Methods of planting. Draining and mounding has been frequently practised on wet spruce sites and turfing occasionally on moist spruce sites. The bulk of the planting of ploughed ground at Clashindarroch, has until F.Y.50, been simple notching for all species. From F.Y.50 onwards wherever planting is done on non-ploughed ground it is given either a turf or is pitted.

(d) Annual rate of planting. This is given by species and P.year in the table in this text.

(e) Manuring. Manuring was not practised at Clashindarroch until post war years. It then became standard practice to manure all species with ground mineral phosphate, on difficult sites.

(f) Success of establishment. All species except spruces have become established reasonably quickly. The question of the establishment of spruces is discussed under 'Conclusions' to this section.

Ploughing

Horse ploughing of old arable ground before planting was a regular practice from P.30 to P.32 inclusive. This was discontinued from P.34 onwards until P.37 and 38, when some tractor ploughing was done in the more elevated Corrydown fields. Cransmill, Finglenny, Old and New Forest and Corshalloch (P.35, 37, 38 and 39) are unploughed. Tractor ploughing of Calluna heaths began in 1936, stopped during the war years and recommenced in 1946. Ploughing has always been done at 5 ft. spacing. To begin with it was done as deeply as possible, but from 1949 onwards it began to be apparent that deep ploughing was difficult to justify on some of the better soils, and more attention was paid to killing out heather and providing a good planting medium with a broad, shallow slice.

Planting on plough is a subject whose finer points are still under discussion but on which in a general way, Clashindarroch can give useful information. From time to time planting in the bottom of the furrow, or a step at the side of the furrow or on top of the slice, has been in vogue. There is no doubt that provided peaty sites are avoided planting in the bottom of the furrow for pines and larches can be successful and has advantages of shelter and moisture initially. Clashindarroch can show in Compartment 157 where the furrow bottom has for no apparent reason, been unsuccessful for both pine and spruce. Step planting has been largely successful for all species but frequently a slow start and great irregularity of growth occurs. Planting on top of the slice has on occasions (Compartment 254 P.48) been very nearly a complete failure. The reasons for this are that the plant was placed with its roots in the spoil of an enormous slice from the R.L.R. plough, and although placed well down the roots were not nearly at the original ground surface. After weathering roots become exposed and in the worst cases plants are swung by the wind and topple over. Our present method is to pare down the slice mechanically by an attachment to the tail of the plough, or by hand, and to plant through the slice with the roots on the original ground surface. This is a method well understood by the men and it promotes consistency and gets uniformly good results.

Selection of the type of plant for use on ploughing follows the normal selection for weed free areas.

Apart from instances where planting on top of a huge slice has led to the failure through weathering of the soil from the roots, plantations on ploughing have been so far, highly successful.

Beating-up

Normal beating up has been necessary on the following scale:-

P. Years	Area (Acres)	Beating up carried out	
		Plants Used	Period
30 to 34	1898	865m	F.Y.'s 34-37
35 to 39	1922	296m	F.Y.'s 36-47
40 to 44	1018	37m	F.Y's 42-48
45 to 49	1768	313m	F.Y.'s 47-51
TOTALS:	6606	1511	-

Weeding

This has been an expensive item due to the very heavy growth of whins on the drier areas planted with European larch and particularly on the die-back areas where Sitka spruce was later introduced.

The moister grass areas called for weeding twice annually for three to four seasons.

Ploughing reduced the cost a little but on the moister areas to no great extent.

Much money was spent on heather weeding of spruce on unploughed areas. It was thought that this would bring them out of check - a forlorn hope.

Mixture of Species

From Appendix IV it will be seen that mixtures apart from a mixture of Scots pine and European larch were the exception rather than the rule until 1937 when attempts began to be made at nursing Sitka spruce with pines. The mixture of Scots pine and European larch has no advantage so far as die-back is concerned and the nursing of spruce with pines is discussed freely in the paragraph on 'Conclusions'. Sitka spruce has been introduced into mountain pine belts and slowly with constant attention the spruce is coming away. Speedier and better results could be obtained with mixtures of Scots pine and Sitka spruce or Pinus contorta and Sitka spruce on ploughing or with band-planting on unploughable ground.

Rates of Growth

Tables giving height growth and volume are attached at Appendices VI and VII.

Past treatment of Established Plantations

Past treatment of the older established plantations has mainly consisted of brashing on a rather lavish scale. This has been criticised by inspecting senior officers from time to time. It provided the only useful work for a big planting squad during periods of hard frost and snow, which are only too common. Now that larger areas are coming into the pole stage men will be employed in brashing a bigger area on a less intensive scale. Later it may be desirable to carry out cleaning and first thinning with forest labour and sell standing second and subsequent thinnings only.

Thinning to date has only been on a small scale.

The following thinning has been done:-

F.Y.	Pre Thinning	1st Thinning	2nd and Subs. Thinning	Vol. Produced
	Acres	Acres	Acres	H.ft.
44	1	-	-	295
47	-	11	-	2097
51	-	2	12	9400
TOTALS:	1	13	12	11,792

Though the areas coming in for thinning in the immediate future will not be big, it has been considered necessary to divide the forest into a north and a south thinning series of three annual blocks in each. This division has just been completed and a thinning plan prepared. The following table gives the proposals for the next three Forest Years:-

F.Y.	Pre Thinning	1st Thinning	2nd and Subs. Thinning	Total Acres
52	70	46	1	117
53	80	4	-	84
54	96	-	13	109

The species to be treated are mainly Japanese and hybrid larches and good Sitka and Norway spruce mainly at Ballieswood.

One standing sale of thinnings has been concluded at Clashindarroch. This was for 8550 h.ft. of P.30 (Balliesward) Sitka spruce in F.Y.51. The price obtained was £864 approximately 2/- per h.ft.

Research - Note by Silviculturist (North)

Clashindarroch forest has been used as a site for experimental work from its acquisition. A very large programme was initiated in 1931 and the work may be divided into two main projects. First, Clashindarroch Forest was selected for one of a group of experiments designed to compare the survival and growth of European larch from seed of various Continental and Scottish origins. The plants were raised in six different nurseries and planted out in three different forests, Clashindarroch being the poorest and only a marginal locality for European larch. Not only has the growth on the middle hill slopes at Clashindarroch been very much inferior to the two other localities chosen, but the success of seedlings as compared with transplants was poor and the growth of Alpine larch little more than half that of the Scottish provenances.

A considerable collection of plots of European larch of different provenances has been built up in succeeding years at this forest. They perpetuate the strains of many well known stands which have now been felled, and they form useful comparisons with plants from the same seed and nursery treatment which have been planted at Drummond Hill and Lael forests.

The second main project was to follow up the earlier Teindland experiments on the eastern heaths. Much of the land at Clashindarroch is of a better type with no hard pan, but on the other hand, altitudes and exposure are much greater than at Teindland. The first three experiments at Mytice (2.4.P.31) were in fact placed at too great an altitude (1150 ft. - 1400 ft.) and have given no results on the subjects for which they were designed, burning, slagging and arrangement of mixtures. The Scots pine, European larch and Sitka spruce are all growing extremely poorly though there is a slight improvement from top to bottom.

Three experiments at Drumfergue (5.7.P.31) were designed to test various species and mixtures on completely ploughed ground. They now present an interesting series with Scots pine, Pinus contorta, Japanese larch, Sitka spruce, Pinus contorta/Japanese larch and Pinus contorta/Sitka spruce. The nursing of Sitka spruce by Scots pine, Pinus contorta and Japanese

larch in adjacent square chain plots is strikingly demonstrated here. Volume plots are now being established in many of these plots.

Directly planted controls were added to these experiments in 1933 and present a striking contrast, as growth was only half as fast in the early years.

Lastly in 1931 a collection of small blocks of species around the perimeter of Mytice was started at altitudes from 700 ft. - 1400 ft. Many failed, but Pinus contorta is growing slowly at 1400 ft. being 3½ ft. high at sixteen years from planting while prostrate mountain pine has formed a dense hedge three feet tall. Lower down the most interesting species is Serbian spruce (9, 10, 14. P.31-33).

In 1933 similar trials were made on the ridge above Long Valley with mountain pine, Scots pine and Japanese larch with Sitka spruce at 1260 ft. Mountain pine both prostrate and upright are good and there is some hope that the Sitka spruce in their shelter will get away. Other species are very poor (11 - 12.P.33).

The years 1933-35 saw four small experiments laid down with phosphates; semsol applied to both newly planted and checked Sitka spruce produced only a very transient increase in growth, while it killed European larch when placed in the planting notch, though basic slag did not. (P.T's 33/122, 13.P.33 and 20.P.35).

In 1934 there was an attempt to find the effect of 'bad notch planting' the roots being bent or tied up. Surprisingly the result was completely negative, Scots pine, Pinus contorta, European larch, Japanese larch and Douglas fir all grew equally well in all treatments. (16.P.34 and PT 35/1.)

Also at this period there were a series of trials of plants maltreated at lining out by cutting or pruning the root systems. Very small differences were shown by any of the species, Scots pine, European larch and Douglas fir. The latter species is noteworthy as having formed excellent plots at the foot of Mytice (PT 35/1 and 24 and 25.P.37). A Pinus contorta provenance experiment was commenced in 1934 and added to in later years. Growth has been slow at the high elevations at which it is situated. The progeny of home collected seed from Ruttle Wood, Beaufort and from Inchnacardoch forest, are outstandingly good.

Continuing the larch provenance work, comparative trials of European larch were planted in 1933 and of Japanese and hybrid larches in 1938.

The European larch experiment confirms the result of the 1930 trial and indicates the superiority of plants from Scottish seed collections. The hybrid larch experiment shows the superiority of the first generation hybrid, but does not suggest that the second generation hybrid will be inferior after the poorest trees have been removed in the first thinning. The third generation hybrid seems likely to be definitely poorer in quality. The Japanese larch experiment shows no difference between provenances that is not directly related to the vigour of the individual parent trees from which the seeds were collected.

26.P.37 is a large replicated spacing experiment with European larch which has given interesting results when altitide is taken into consideration. Close spacing has undoubtedly increased top height in the plots at the highest elevation.

In 1938/40 three nursery extensions dealt with the problem of the treatment of over-grown planting stock (28-30 P.38-40). Treatments include wrenching in the lines of the European larch, cutting back of Japanese larch and Douglas fir and undercutting of Douglas fir. Generally no improvement was effected in subsequent behaviour. A further trial of wrenching 2 + 0 European larch as an alternative to lining out shows possibilities.

In the early forties, die back of European larch became very severe in the forest and one of a series of heavy thinning trials was commenced; but though the appearance of the crop is greatly improved there is little evidence yet of greater increment on the selected trees (32.P.43).

Two of the post-war series of ploughing trials are located at Clashindarroch. One in the Mytice area shows remarkable growth. Pinus contorta averages 5 ft. after 6 years while Douglas fir is 4 ft. (33.P.45). In both this experiment and a joint trial with the Conservancy at Corshalloch (36.P.47), growth of Sitka spruce has been doubled on complete ploughing, and undoubtedly this is largely due to the elimination of heather. This observation is being followed up by screefing trials in the single furrow Corshalloch plots and an experimental plot laid down for Dr. Leyton of the Oxford Soil Party.

In 1949 an investigation into the growth of various species at Clashindarroch was carried out for Lord Robinson with particular reference to checked Sitka spruce. Charts showing the effect of ploughing and mixture on Sitka spruce were prepared and an experiment on salvage by ploughing, nursing and manuring laid out to incorporate the results obtained (38.P.50).

Recent work has included also an experiment on position of planting on ploughed ground which demonstrates clearly how on dry areas the furrow and on wet the ridge should be used (39.P.50). Finally in 1951 a joint sowing trial was laid down with the Conservancy.

In conclusion it may be said that of 44 trials laid down some 27 are still current and include a wide variety of interesting experiments.

Conclusions

Starting Spruce

Plantations on plough at Clashindarroch show that Sitka spruce can be grown without difficulty on ploughed moist heaths provided it is given a pine nurse. On some good ground the nurse could be dispensed with but since heather returns quickly on most sites after ploughing and since pine appears to help the spruce to form canopy quickly, the advantages of nursing are accepted. The ordinary run of ploughed Calluna ground will take an intimate mixture well - P.38 Drumfergue - but where conditions become at all difficult and the choice of Sitka spruce is made on account of exposure, a mixture of spruce alternating with at least 3 pine is best since it allows the Sitka to check for a few years without harm.

Where we cannot plough, spruce is a risky choice even with turf draining and nursing, and we must make our choice among the pines and larches giving them turfs wherever possible. The danger of these sites is the deterioration after enclosure particularly on north facing slopes. We now know the importance of getting our trees away quickly and to get this is worth spending more on hand work than we have been in the habit of doing.

We should be unwise to allow what has happened at Clashindarroch to prejudice the opinions we hold of the usefulness of Sitka spruce. We know how it has failed and how it can succeed; there is no doubt about the tree's exceptional qualities in withstanding blast and in recovering from frost injury; the soils of Clashindarroch are sufficiently fertile for

spruce and the rainfall is reasonably high. Our real failure would be if we now were to lose faith in this tree.

Die-back Larch

The History of Clashindarroch has come to be written and it can now be seen that what happened to the greater part of our larch plantations (excepting those on old arable) has been happening to larch ever since it was introduced to this country. That is, it has been dying back, recovering, and going on to form an adequate if somewhat thinly stocked plantation.

The shunning of old arable land for larch and the selection of more promising strains of this tree has come to be part of our forest practice and need not be considered further. It should, however, be noted that there is no consistent evidence at Clashindarroch for suggesting that European larch suffers less from die-back in mixture with pine.

Choice of Species

It would be a mistake to confuse the problem of choice of species on the checked areas with those of the choice of species on new ground similar to Clashindarroch. With burning, ploughing, good planting and more experience of what to expect of our trees, new ground of the Clashindarroch type presents not so many problems as it did. On the checked areas a very real problem exists in the unploughable north-facing slopes where luxuriant heather cannot be burned. We are tackling this by using Japanese larch, hybrid larch and Pinus contorta with thorough hand work and phosphate, but there is still, because of our inability to burn, too much hope included in the mixture.

On new ground wherever the plough will go and there is shelter, the choice of species is wide. In recent years there has been wide-spread indiscriminate planting of a mixture of Sitka spruce and Scots pine and however much we dislike such unimaginative work there is no doubt that it will be successful. Having regard to shelter much more Douglas fir could have been planted with a pine nurse where necessary. Norway spruce in many places could have replaced Sitka. Abies grandis, Tsuga and Thuya could have found a place on the lower slopes. Where there is exposure a pine/ Sitka spruce mixture remains the best choice wherever the soil will

support spruce. Where on these exposed sites, the soil is too dry or infertile for spruce we come upon another of our problems. Scots pine is not a tree for the high exposed places, Japanese or hybrid larch is not yet proven and we must fall back on contorta or mountain pine. However useful mountain pine may be as a nurse for spruce it is not a desirable pure crop. Too little seems to be known about contorta to plant it on a big scale although some desirable types such as I.D. 26/58 (Alberta) seems to be emerging. Obviously the watchword here must be caution, and the evidence at Clashindarroch points to the following procedure on exposed, dry, ploughed ground.

Where raw humus or peat is not too deep and mineral soil is turned up by the plough, limited use can be made of pure Japanese and hybrid larches and of a mixture of Pinus contorta and Scots pine. Both pines should be carefully selected but particularly the Scots pine which should come from a race we know to do reasonably well in exposure and under snow.

Where ploughing cannot go deep and turns over little but raw humus and peat we must rely more upon contorta.

Pure Scots pine should be avoided at all costs in exposed situations.

We would like to know more about the use of shelter belts of mountain pine/Pinus contorta/hybrid larch, etc. planted in a north and south direction on exposed sites and we also want more knowledge of the hardy types of Scots pine and Pinus contorta. We are taking active steps to get this information.

Before leaving this point of dry exposed sites, it should be said that there is quite a strong case at Clashindarroch for carrying Sitka spruce on to fairly dry sites. In such cases it would form not more than 25% of a mixture with Scots pine/Pinus contorta or mountain pine or with the larches in bands, but there is a body of opinion confident that with present-day ploughing and planting, Sitka may be started, nursed, and carried with certainty to the pole stage on such sites. It should not be forgotten that the rainfall on these hills is most likely in excess of 40 in and is well distributed throughout the year.

On new ground where the plough cannot go we should distinguish between north and south-facing slopes and between exposed and sheltered sites. The south-facing slopes are usually of a better quality and

were frequently selected for European larch. On these slopes existing plantations would support a choice from amongst the following:- Japanese larch, hybrid larch, Douglas fir, Scots pine, Norway spruce and a mixture of Sitka spruce and Scots pine, and planting would normally be by screef and notch. The north-facing slopes should be treated as being much more difficult for the starting of trees. They will frequently support all the above species but the risk of starting spruce even with a nurse is too great and it should be discarded in favour of the other trees and Pinus contorta. Whatever is planted on these slopes should be given the best possible hand treatment - a big screef with cultivation or a turf. Where exposure is severe our choice would be limited to Japanese and hybrid larches and Pinus contorta.

These notes on choice of species have dealt in a general way with a subject which is infinitely varied and which can on the ground be contradictory to a puzzling degree. It is what a close study of existing plantations at Clashindarroch suggests as future policy and it may be summed up as follows :-

Whatever it is decided to plant, the choice of tree and method of planting must be made according to the well-established rules of good forestry practice.

Ploughing should be done wherever it is possible to plough.

The best pioneer tree on unploughable ground is Japanese larch. This tree will give forest conditions in which other trees may be established, quicker than any other. There is hardly any high quality Japanese larch on Clashindarroch and the use of this tree should be limited accordingly.

Scots pine should not be used except perhaps in mixture with Pinus contorta where exposure is severe or where the soil is shallow and the ground conditions poor.

Spruce on sites other than old arable ground and fresh flushes should be mixed with pine. Canopy is formed much more quickly even although the spruce might grow satisfactorily on its own (see White Geese P.37). If properly treated Sitka spruce will grow almost anywhere on ploughing at Clashindarroch and its inclusion as a small percentage of the crop even on unlikely sites should be considered.

A greater variety of trees should be planted.

As suggested in the section on Meteorology the incidence of severe frost may be much wider at Clashindarroch than we would expect. Frost may be an important factor in larch die-back and after the severe frosting of Sitka spruce in April, 1948, damage extended far up the sides of valleys. This frost was a peculiar one in that although quite mild in intensity needles up to three years old were killed. Very occasionally trees were killed outright, but more often Pityogenes finished them off. Normal late frost damage does not appear to be very much more damaging at Clashindarroch than elsewhere, but it is a factor which must be given full weight when considering choice of species.

Planting and Ploughing

Planting on unploughed heather ground is a subject in which the Commission officers should be well versed. It is a matter of putting what we know into practice and we do not claim any advances in technique at Clashindarroch, although we would admit to many shortcomings over the years.

Planting on ploughing has already been dealt with.

APPENDIX I

Notes from Inspection Reports

Technical Commissioner, September, 1929

See Appendix III

Colonel Fotheringham and Sir Roy Robinson, September, 1931.

Corrylair section, the earliest planting in the forest (P.30) was visited. This comprised (a) various races of larch, both seedlings and transplants, on ploughing on old arable ground and (b) similar races of larch notched on unploughed drier parts of steep heather slopes and Sitka spruce on lower moister slopes. Area generally found satisfactory with native European larch superior to foreign and 1 yr. native seedlings very successful on arable ground; Sitka spruce and Norway spruce seedlings were equally successful. Excessive weeding was suspected on this area. It was thought that more use could be made of turves on Calluna-Scirpus flats and that parts of the upper slopes were better suited to Sitka spruce than European larch. (The European larch areas at Corrylair suffered badly from die-back and are now heavily underplanted or replanted with Sitka spruce which is flourishing. Sitka spruce on upper Calluna slopes with mounding is now accepted as quite useless - November, 1951).

O. J. Sangar, October, 1932

Mr. Sangar summarised his impressions as follows :-

"The main points to date are (a) the short check period of unturfed Sitka spruce on the major part of slopes and the good promise of Japanese larch and Pinus contorta (b) the widely varying results from the use of seedlings (c) difficulty of establishing European larch (and Scots pine) on dry Calluna-lichen-Nardus ground especially on the more exposed sites (d) the success of 1 + 1 European larch and 1 year beech (P.32).

There is a tendency to use more Sitka spruce, Japanese larch and Pinus contorta with shallower screefing and planting of Sitka spruce and more draining and turfing of wet areas (especially for P.33).

Divisional Experiments (P.31), cover choice of species on higher Calluna slopes and ploughed arable land, also (P.30) the strains of European larch and use of hybrid larch. Seedlings of European larch were used in the P.30 experiment and subsequently on a large scale on ploughed

land (the larches, Scots pine and the spruces)".

P.30. Corrylair. Hybrid larch seedlings and transplants on most of the old arable and peat-free soils with Scots pine at the higher levels. European larch seedlings and transplants on old arable after ploughing (double furrow). European larch doing well with native seed best in all cases. On Calluna sites same relative behaviour but more failures and less growth generally.

Baillieswards. European larch on ploughed arable 85% or more alive but of poor type. Spruces on turves or furrows doing well; screefed spruces on Calluna still in check.

P.31. Both at Corrydown and Baillieswards the European larch/Scots pine mixtures on Calluna sites are the least satisfactory of the important blocks. On ploughed arable ground 1 year and 2 + 1 European larch are good, as also 2 + 1 European larch on lower Calluna-Erica cinerea slopes. Sitka spruce still in check on shallower flats, especially where recently burned.

P.32. At Baillieswards, 1 + 1 European larch and 2 + 1 Japanese larch exceptionally good. Very little Scots pine used. Pinus contorta on highest dry ground and a Pinus contorta/Japanese larch mixture below it, followed by some pure Japanese larch in next belt below it. 1 year seedlings of European larch and Japanese larch tried. Former very tiny and 80%-90% died. European larch and Japanese larch transplants show successful take.

Baillieswards - Spruce on turves and furrow on old arable ground has done exceedingly well. The Sitka spruce has been thinned twice yielding in all 950 H.ft. per acre. The Norway spruce is due for thinning in F.Y.54 (See volume tables for both species).

The Sitka spruce on Calluna has suffered a long period of check but though it is patchy, it does not call for repair measures (November, 1951).

Major Strang Steel and Mr. J. D. Sutherland, October, 1933.

Corrydown and Corrylair sections visited. Possibilities of tractor ploughing on the poorer Calluna-peat areas discussed. P.30, 31 and 32 areas in this section inspected and pronounced generally very satisfactory, especially the larches. Experimental plantings of continental and native

larch transplants and seedlings were found interesting, the native transplants being markedly superior and much freer from canker. (Continental and native larch have both suffered heavily from die-back - November, 1951).

Sir Roy Robinson and Mr. J. M. Murray, 15th and 16th May, 1935.

Corrylair, P.50. Compartments 12 and 13. The Chairman stated that he feared pumping of hybrid larch on old arable sites and would have preferred to see spruce there. The Acting Assistant Commissioner and Divisional Officer concurred. The Chairman forecast low production and snow damage to exposed Scots pine. He noted continued check in Sitka spruce and advised more drains. Mound planting would have reduced the check period, he thought. The advantages of ploughing on Calluna sites were considered and the Divisional Officer stated that there was enough ploughable land to justify the purchase of a tractor. The first experiment with European larch/at this forest was seen and Mr. Edwards stated it was the only success with seedlings except for a small area in Long Valley.

Corrydown - P.32 Compartment 39. Sitka spruce was seen to be doing quite well and beginning to come away, but the Divisional Officer stated that it was in check on the ridges.

P.31. Compartments 20, 19, 15. Saw European larch and Japanese larch on ploughed grassy ground and the autumn frosting of Japanese larch was noted. The area of failed European larch seedlings also seen. The Chairman criticised the planting of poor ground in Compartment 19 (Craigie Bog). Advocated interploughing.

P.32. Compartments 45, 46, 49. More drainage prescribed. Checked Sitka spruce and Japanese larch were seen, the latter being mostly seedlings. The Acting Assistant Commissioner prescribed inter-ploughing in in checked Sitka spruce areas. (After the death of the European larch in Compartments 12 and 13, Sitka spruce was planted and has done very well. Sitka spruce in Compartment 50 (P.32) continues in check and was treated in F.Y.51 after ploughing. First mention is made here of the inter-ploughing of checked Sitka spruce areas - November, 1951).

P.35. Compartment 100. Both the Chairman and the Assistant Commissioner thought Sitka spruce would have been better than Norway spruce on Calluna-Vaccinium vegetation type. The soil seen appeared to be good.

Experimental Area - P.51 and 32, Compartments 104, 105. The Chairman remarked on good growth of Scots pine, Pinus contorta, Japanese larch and Sitka spruce and noted the improvement in the soil conditions due to ploughing. The poverty of the flora in comparison with the soil was also remarked upon.

Kirkney Experiment. The rapid changes in the soil conditions were noted. The Chairman advocated the use of Scots pine on the low, hard, flat ground of the type seen, European larch on the drier, well aerated soil, Japanese larch on the drier peat-Calluna types, Sitka spruce on moister peat Calluna types and Norway spruce on grass and flush types. A mixture of European larch and Scots pine might be used on types intermediate between the Scots pine and European larch types. The Chairman condemned the use of Scots pine on high exposed ground.

Long Valley. P.33. Compartment 78: P.34. Compartment 92.
P.33. Compartments 91, 94, 117, 99 & 61.

A European larch seedlings experiment on mounds with transplant controls was seen. The former showed 20% losses and high costs. The Chairman reckoned that with 3 ft. spacing and the 20% losses evenly spread, no beating up was required. The European larch (Swiss origin) and the Japanese larch in Long Valley were admired by the Chairman and Assistant Commissioner.

Cransmill. P.33. Compartments 152, 151, 150, 149. The Assistant Commissioner questioned the use of European larch on some of the grass ground but Divisional Officer explained this was due to shortage of Norway spruce. The blasting effect of the current bad weather on the larch and spruce was noted.

Chairman and Acting Assistant Commissioner, October, 1936.

Drumfergue Experiments. The Assistant Commissioner thought the Norway spruce were going into check. The adjoining Divisional ploughing for which a 50/50 mixture of Sitka spruce and Scots pine was proposed was seen. The Chairman thought that Sitka spruce should succeed pure in this improved

ground but the Assistant Commissioner and Divisional Officer favoured a mixture.

P.35 and 34. Compartments 104, 100 and 60. The Chairman deplored the checked Norway spruce on a Sitka spruce site (Calluna) and both he and Assistant Commissioner admired the good growth of European larch in Compartments 100 and 60, and also the good type of the latter (from native seed).

P.31. Compartments 19 and 20. The interploughing of checked Sitka spruce in Compartment 19 was seen and the interplanting of Sitka spruce proposed.

P.32. Compartments 40 and 39. The large area of checked Sitka spruce was seen. After discussion on methods of improving the ground, e.g. close draining, the Chairman recommended ploughing.

General. It was decided that, where possible, areas of checked Sitka spruce should be interploughed. Some of the checked areas in the Burn of Bedleithen (seedling Japanese larch, etc.), were to be left for the present.

Note by Chairman, 12.11.36. "The ploughing has been well done and should prove the solution of some difficult problems. Much of the larch which I saw is making good growth - far better than I would have expected from a superficial inspection of the surface vegetation."

(Drumfergue Experiment. The mixture 50/50 Sitka spruce/Scots pine advocated by the Divisional Officer and Assistant Commissioner has proved a complete success. The Chairman's recommendation re ploughing of checked areas of Sitka spruce has been followed on areas where no improvement of Sitka spruce could be expected without drastic action - November, 1951).

Sir Alexander Rodger, June, 1937

Lag Valley, P.33 and 34. Tyrolean larch doing very well but some canker was noted and the forester thought that this disease was spreading.

Corrydown, P.32. Compartment 39. The interploughing of checked Sitka spruce was in progress. The total area of unsatisfactory plantation was estimated at 10%, mostly checked Sitka spruce.

Lag Valley, P.31 and 32, Research. In the horse-ploughing experiment, Sitka spruce was seen in check and the die-back of side-shoots of Pinus contorta noted. It was thought that deeper ploughing would have obviated the checking of Sitka spruce. (We now know that deeper ploughing alone will not prevent check in Sitka spruce - November, 1951).

Mr. W. L. Taylor, Technical Commissioner, March, 1939.

Lag Valley. Mr. Taylor remarked on the vigorous growth of the European larch on Calluna-Vaccinium ground in P.34 and 36, Compartments 53, 59, 60, etc. at Corrydown Norway spruce in Compartment 25, P.37, was seen to be in check and Mr. Taylor recalled good result from mulching out the vegetation round the checked Norway spruce . The P.38, Sitka spruce/ Pinus contorta mixture in Compartment 30 was seen to be healthy. Mr. Taylor agreed that the ploughing of the old arable sites for Norway spruce would be beneficial. Checked Sitka spruce in Compartments 32 and 33, (P.34) on Calluna-lichen-mosses thought to be typical and Mr. Taylor was sure it would come away. He thought that, given ploughing, planting would eventually go to much higher elevations. A block of distorted, double-leadered Japanese larch was seen in Compartment 62. Climatic influences were suspected but Mr. Taylor thought that seed origin might be a factor.

The European larch in Compartments 98, 96 and 94 showed signs of heavy Chermes attack the previous year. It was remarked that the large areas of pure European larch would encourage this insect.

Note by Divisional Officer on Japanese larch in Compartment 62.

Gives notes on trees of same origin at six other forests and shows that with favourable site factors, the type gives good results. Generally, Japanese larch is not considered a satisfactory species in the north east of the Division.

(The Sitka spruce in Compartments 32 and 33 P.34 remained in check and has been treated F.Y.51. The block of Japanese larch in Compartment 62 has formed canopy, they are still a rough lot - November, 1951).

Chairman and Acting Assistant Commissioners, October, 1941.

Corrylair, P.30, Compartment 13. Hybrid larch at 1000 ft. elevation was first inspected and the growth admired. The Chairman prescribed the early removal of wolf trees, etc., and the disposal of produce was discussed.

Diseased European larch was next inspected and beating up with large Sitka spruce plants prescribed as required, no cutting out of dead and dying European larch to be done.

Corrydown, P.31, Compartments 20, 19, 18, 21, 22; P.37. Compartment 25. Badly diseased European larch in Compartment 20 was seen before entering the hybrid larch block at 1100 ft. from the same seed but not so strongly grown as the Corrylair lot. Interploughed Sitka spruce in Compartment 19 was next seen and the Chairman remarked on the improved vegetation, also ample depth and apparent good quality of the soil. The planting of Scots pine in the bottom of the furrow was condemned. The roughness of the Japanese larch in Compartment 18 was noted but Sir Roy thought a saleable crop would result. Brashing of Japanese larch in Compartment 22 was condemned as premature and excessive. The P.37 Norway spruce in Compartment 25 was described as promising.

Checked Sitka spruce in Compartment 39 on a moist Calluna slope was next inspected. The Acting Assistant Commissioner thought that ploughing was not feasible on this slope. Increased growth of Polytrichum and Sphagnum on screefed patches was noted.

Lag Valley, P.34 Compartment 53. Roadside European larch on Calluna Arctostaphylos was found to be fairly heavily damaged by larch shoot moth. The Chairman considered that the injury was not constitutional so far. The Divisional Officer stated that the southerly aspects in all cases showed heavier damage than the northerly aspects.

Research Branch Experiments, P.31 and 32, Compartments 104, 105. Elevation 1100 ft. Before entering the experimental area, a very good Sitka spruce/Scots pine mixture (P.37) on the plough furrow was seen.

An experimental 50/50 mixture of Pinus contorta/Sitka spruce (P.31) on ploughing was inspected and the Pinus contorta was found to be in the lead. Sir Roy thought the Sitka spruce would yet surpass the contorta. The Chairman drew attention to the marked nursing effect of P.31 Scots pine on adjoining Sitka spruce up to a distance of three lines. The forester indicated the heavy snow damage to Scots pine as contrasted with contorta and Pinus contorta/Sitka spruce mixtures. The indifference of Japanese larch to various methods of bad planting was noted.

Clashindarroch Glen. The party motored to Finglenny and Sir Roy was impressed by the large plantable area south of Kirkney Water. He thought an annual programme of 450 acres would be commensurate with the plantable area, and that a tractor could be kept fully employed at this forest. The Acting Assistant Commissioner and Divisional Officer agreed. This concluded the inspections.

The following remedial measures were prescribed for unsatisfactory plantations:- (1) Diseased European larch to be beaten up with Sitka spruce (or Norway spruce locally) using large plants not closer than 5 ft. The Acting Assistant Commissioner advised an early start with current year's work. No elaborate preparatory cleaning to be done.

(2) Checked Sitka spruce to be beaten up with Scots pine plant for plant. In every third line, pine to share existing screef with spruce to save extra screefing. The Acting Assistant Commissioner thought mattock planting would be most beneficial.

The Chairman prescribed the laying down of assessment plots in checked Sitka spruce in order to record the annualrate of emergence from check or opposite trend (retrospective and future) after beating up with Scots pine and without beating up. The Acting Assistant Commissioner recommended that the assessment should be on a field scale and the plots permanently marked on the ground.

(Japanese larch in Compartment 18 has improved and will be thinned F.Y.52. The moist Calluna slope Compartment 39 has been partly ploughed and will be beaten up in F.Y.52.

The planting of Scots pine plant for plant in every third line on Sitka spruce screefs has proved ineffective. Scots pine did not itself thrive and Sitka spruce remained in check. Such areas have now been ploughed and extensively beaten up with Scots pine, Pinus contorta or Japanese larch - November, 1951).

Visit of Chairman, 12th and 13th June, 1944.

Present: Sir Roy Robinson, Chairman.
Mr. A. H. Gosling, Acting Assistant Commissioner
Mr. L. A. Newton, Divisional Officer
Mr. J. McDonald, Divisional Officer, Timber Production Department, 13th only.
Mr. I. Gillespie, District Officer.
Mr. J. Farquhar, Research Forester.
Mr. G. Innes, Forester.

Monday, 12th June, 1944

Lag Valley. Entering Compartment 19 near the Three Sisters, a sample of checked P.32, Sitka spruce beaten up with Scots pine in F.Y.43, was passed on the lower slopes before reaching Assessment Plot No.3. It was explained to Sir Roy that half the plot was untreated and the other half (6 lines), has had since P.42, a Scots pine plant to each Sitka spruce plant or screef in the 2nd and 5th lines. Sir Roy thought it was as yet too early to expect any reaction from the Sitka spruce. Interploughed Sitka spruce higher up (ploughed 1937 and beaten up with Scots pine in P.38), was next inspected. Scots pine was coming away uniformly, the Sitka spruce was thick and strong in places or fewer and slower according as the furrow had chanced to fall. Soil profile showed a shallow raw humus layer and a good depth of brown earth with no marked leaching.

Diseased European larch on old arable ground in P.31, Compartments 20, 21, beaten up in F.Y.42 and 44, was next visited and both Sir Roy and the Assistant Commissioner objected to the extensive removal of dead and dying European larch before beating up and the subsequent brashing of the remaining larch. The forester explained that brashing was done during hard weather when no other work was available and thought that both this and the preparatory cleaning were justified by reduced beating up costs, reduced risk of whipping and freer circulation of air. Sir Roy also thought that a larger type of plant (e.g. 2 + 2), should be used for this type of work, but proposed to review the whole question after the inspections were concluded. The exceptional vigour of European larch on lee side of Japanese larch was noted in Compartment 21 in which the European larch are all of native origin. The Japanese larch was traversed and found to be very rough and contorted. Scots pine/European larch mixture in Compartment 21 was not reassuring as regards the European larch, but the old arable character of the site was appreciated. A mixture of Scots pine and European larch on a Calluna-Vaccinium-mosses-lichen site at 1200 ft. in Compartment 22 showed 25% larch (native origin) up to 12 ft. in height and pine up to 10½ ft. A soil profile prepared at Sir Roy's request showed 5 in. raw humus, followed by slightly leached brown earth down to the depth excavated - 15 in. or so.

On repassing the Japanese larch in Compartments 21 and 18, the Divisional Officer asked whether treatment was feasible at this stage but both the Chairman and Assistant Commissioner thought not.

Checked P.31, Sitka spruce, (interploughed F.Y.36 and beaten up with Scots pine in F.Y.38), was seen in Compartment 19 and Sir Roy again condemned the old practice of placing the line in the bottom of the furrow. One pine plant was carefully lifted to expose its root system, which was found to be rather one-sided, tended to follow the line of the furrow and shunned the raw mineral soil by keeping within the humus layer. The extent and degree of recovery in the Sitka spruce was found satisfactory and Sir Roy condemned heather weeding to relieve spruce still in part check.

After lunch the party returned down the Lag Valley to Compartment 58, where Mr. Farquhar explained his Larch Race Experiments, with which the surrounding divisional European larch was compared. Both Sir Roy and Mr. Gosling were impressed by the deterioration of the larch in this vicinity, especially as regards shoot moth damage, since their last visit. As a guide to the efficacy of Sitka spruce for underplanting larch on this dry Calluna-Vaccinium type, the Sitka spruce in Compartment 55 was inspected and found quite promising, if slow, but the adjoining Norway spruce on Calluna showed signs of debility.

The party next visited the Research Branch Experiments. Passing the worst of the European larch in Compartment 100 near the burn, the question of frost damage as a direct factor in damaging the tree was raised by Mr. Gosling, who thought there was little evidence of such damage, though it was not to be dismissed as a possible indirect factor. Sir Roy agreed.

Some shoot moth damage to Japanese larch was seen in Compartment 104 before entering the P.37 areas (at part 100% ploughed in F.Y.36), in which the thriving Sitka spruce/Scots pine 50/50 mixture was admired. After Mr. Farquhar had given a very interesting demonstration of the Research Experiments, the party walked through the P.38 mixture of Sitka spruce/ Scots pine on furrows at 5 ft. and returned by the P.37 mixture, also on furrows at 5 ft. Mr. Gosling here suggested that there seemed to be good evidence of slagging in part of the Sitka spruce as shown by the long basal annual growths with slight falling off in later years, being, in habit, the converse of the plant emerging from early check. Sir Roy thought slagging

was superfluous on this type after ploughing.

Tuesday, 13th June, 1944.

Mr. J. Macdonald, Divisional Officer, Timber Production Department, joined the party on this day.

The burn was crossed into Compartment 12, which is a moist Calluna site with northerly aspect. Sitka spruce was found mostly out of check and Sir Roy was certain that small checked patches would steadily diminish in size through the nursing effect of the enclosing vigorous Sitka. Two blocks of European larch above the Sitka spruce contrasted sharply in vigour and Sir Roy directed that the seed origin be investigated. (Records give 1.2 acres native larch, (2 + 1); 1.3 acres native larch (1 + 2); 5.3 acres Swiss larch (2 + 2), i.e. 2.5 acres native in all and 5.3 acres Swiss. The relative size of the blocks separated by the line of the Scots pine encourages the belief that the vigorous lot was of native origin).

The marginal belt of mountain pine was then inspected and Sir Roy remarked on the merits of this type (var. uncinata) as against the erect variety for pioneer work. He thought it was now time to introduce Sitka spruce between the lines of pine where space permitted rather than in a regular pattern.

Kirkney Valley. Looking across the valley from Tillyminnate side Sir Roy remarked on the increased nakedness of the P.36 European larch on the lower opposite slopes (north aspect).

A brief visit was made to the Craigwater area mainly to inspect the recent ploughing. Sir Roy noticed and condemned the planting of pure Scots pine even on a hard ridge in this snow country. In the new ploughing (P.44), both Sir Roy and the Assistant Commissioner agreed that the current method of placing the plant near the top of the furrow was a great advance on earlier ideas, but the Assistant Commissioner would prefer it right on top. In Compartment 227 some P,42 planting on old ploughing (probably F.Y.37), was seen which shows that the advantages of ploughing tend to be nullified by a long delay in planting. Sir Roy thought that some slagging to start the Sitka spruce would be justified.

Sir Roy desired the District Officer to prepare a report on this forest, the first part to be descriptive and covering all factors of

silvicultural importance, the second part historical and tracing the evolution of ideas on choice of species, methods of planting and so on, with a summary of inspections by higher technical officers. Tables were to be incorporated or appended giving acquisition acreages, acreages of species by P.years (slumping acreage of mixtures), acreage of European larch on arable and rough sites respectively, and so on within the bounds of relevancy.

"I. Gillespie"
Acting District Officer
19.6.44.

Remarks by the Chairman

The bulk of the larch woods have shown a marked deterioration since my visit of 1941; only occasionally was any improvement seen. The contrast between their early promise and their present condition is very marked.

This inspection was planned into two parts.

(1) An inspection of representative samples of plantations of all species.

(2) A full discussion of the problems in the evenings. Messrs. Gillespie and Farquhar took full notes and were instructed to draw up detailed reports.

In the course of the inspections it was decided to do various things noted in the report within. One of the most important is a large scale experiment in the treatment of defective larch. Mr. Newton comments on this. The site was noted and the basis of the experiment was to be:-

(1) A broad strip running vertically up both slopes of a valley.

(2) Careful turf planting of large Sitka spruce between the European larch rows at the rate of 800 or thereby per acre. The careful planting is to avoid deaths and the use of large plants to avoid weeding.

(3) Only sufficient work on the larch to enable planting to be done efficiently.

(4) On a few small and suitable sites Sitka spruce to be replaced by Douglas fir, Tsuga, and perhaps Abies grandis.

As regards further action on the larch plantations this must wait until we have reviewed (as is intended to do this autumn) the whole European larch question.

It is important that the reports on the evening discussions and proposals emanating therefrom should be quickly and thoroughly compiled and I wish to see them when ready. I will reserve my comments until then.

With our recent advances in technique and improved understanding of the silvicultural factors involved I am convinced that Clashindarroch can be made into a good forest.

Mr. Newton's suggestion to try experimentally a mixed Scots pine/ European larch plantation on a favourable site should be carried out.

(Intld.) R.L.R.

21.7.44.

(The marginal belt of mountain pine (var. uncinata) has been interplanted with Sitka spruce. The Sitka spruce have grown fairly well but have not had enough room and light. Some cutting back of branches or whole trees of mountain pine is now called for. The value of mountain pine as a pioneer species on very exposed situations is recognised. The Sitka spruce will grow well once forest conditions have been formed - it will stand the blast.

The Chairman and the Assistant Commissioner it is noted were strongly in favour of planting on the top of the "furrow", and were much opposed to bottom of the furrow planting. Though it is not recorded it is assumed that they meant the roots to be in the sandwich layer. With the big furrows produced by deep ploughing, the roots were not always put there.

Plants notched on the top of big furrows have not done well.

Erosion of the mineral soil has frequently left them only a few root tips in the soil - For some years now big furrows have been pared down so that the roots could be placed in the layer of decaying vegetation.

The planting in the furrow bottom is again gaining support. This is thought to be sound for the planting of pine and larch after tine ploughing, but unless the soil is deep and well aerated, it is doubtful practice for any conifer species, other than pine and larch and then only after the deep cultivation provided by the tine - November, 1951).

Chairman's visit to Research Branch Experiments, June, 1944.

Those present at Clashindarroch were Sir Roy Robinson, Chairman; Mr. Gosling, Assistant Commissioner; Mr. Newton, Divisional Officer; Mr. Gillespie, District Officer; Mr. Innes, Forester and Mr. Farquhar, Research Forester. Mr. James Macdonald, Divisional Officer, Timber Production Department, was present on the 13th.

Motoring down the Lag Valley the European larch races, Experiments 18 and 19 P.35 Compartment 58 were inspected. In this block all race lots have now been attacked by Chermes, shoot moth and canker and from casual observation no race lot has escaped more than another.

The Drumfergue group of experiments Compartments 104 and 105, were the next to be inspected. The Chairman and Assistant Commissioner were particularly interested in the contorta/Sitka spruce mixture on ploughed ground in 7.P.31. The fine type of contorta and good growth of Sitka spruce was favourably commented on. It was agreed that the Pinus contorta/ Japanese larch mixture was not a good one and the rough condition of the latter species was noted. The Chairman asked that considerable attention be paid to the Sitka spruce in the near future, i.e. some of the Pinus contorta branches may require to be cut back within the next year or so.

In Experiment 5 P.31, conifers on ploughed ground, the Chairman remarked upon the good growth of Sitka spruce adjoining the pines or larch. He also thought it a pity there was not a Scots pine/Sitka spruce mixture in this block of experiments. Some unofficial Divisional experiments just outside the experimental fence were also inspected. These experiments are Scots pine/Sitka spruce mixture on complete, double and single furrow ploughing. Unfortunately there is no information available regarding their object or lay-out.

On the second day, 13th June, some of the experiments on the lower slope of the Mytice experimental area were inspected. The Chairman was particularly interested in the reasonably good growth of Douglas fir in the root pruning experiments, P.T. 35/1 and 24 and 25 P.37 especially where this species adjoins Pinus contorta in P.T. 35/1. He has asked that three or four acres just above these experiments be ploughed and planted with 50/50 mixtures of Pinus contorta/Douglas fir, Scots pine/Sitka spruce. If the plough is not available the plants are to be notch planted at 4 ft.

spacing. The larch races, 8 P.31 on the higher slopes were pointed out in passing.

The hybrid larch races of Dunkeld origin, Experiment 22 P.38 were next inspected and were of considerable interest to all members of the party. Here height and vigour of growth is superior to adjoining European lots. It was noticed that so far no die-back, canker or Chermes attack has occurred in any of the lots although occasional side shoots have been damaged by the shoot moth.

"J. W. Farquhar"

6th June, 1944.

Visit of Lord Robinson, Chairman; Mr. F. Oliver, Conservator; Mr. W. F. French, District Officer; Mr. J. M. Kennedy, Forester, on 4th October, 1949.

In the Kirkney valley the European larch race plots were noticed and that of Silesian origin was believed to be most promising.

P.36 European larch suffered heavily from disease and had been beaten up with Sitka spruce which had been most severely frosted by late spring frosts. European larch on the north facing slope opposite, was in much better condition. No further action was to be taken in the areas beaten up with Sitka spruce.

At New Forest an area of old arable ground with P.38 Norway spruce (no ploughing) was not established. It had been ploughed and replanted with Norway spruce which the Chairman considered would make a crop.

At White Geese, a mixture of Sitka spruce and Pinus contorta (P.37) was excellent and the Pinus contorta had nursed the spruce well. The adjacent mixture of Sitka spruce and Scots pine (P.37) was equally good. Even in heather the pine had nursed the Sitka which had made good growth since the season after planting.

The Scots pine was believed to be a better nurse because its growth is slower than that of the Sitka spruce and it would need less treatment. With it, more Sitka spruce could be expected in the final crop. The mountain pine/Sitka spruce mixture was discussed but it was considered doubtful if the mountain pine would grow tall enough in the early stage to protect the Sitka spruce.

In comparison Sitka spruce on pure grass was making good growth but was frosted. In P.32 pure Sitka spruce at Corrydown was badly checked (this had been planted on peat and rank heather without ploughing). In 1942 Scots pine were planted in the same screefs as the Sitka spruce in such a manner as to have 800 pine per acre. This was expected to kill off the heather and nurse up the Sitka spruce, but, up to the time of this inspection, this had not happened.

Checked Sitka spruce interploughed and beaten up with Scots pine in 1938, was examined and it was found that there were groups of Scots pine which had nursed the Sitka. This crop was to be left as it would produce some good trees. Failed Sitka spruce was to be ploughed at 10 ft. intervals, so as to avoid damage to the plants, and planted up with Scots pine on the furrow slices.

It was thought that there was some recovery in the diseased European larch. (The Norway spruce planted after ploughing on the New Forest area of old arable has not made much progress. Perhaps the seeding with broom will bring this very difficult area into a fit state for planting, quicker than any other means.

The preference for Scots pine wherever possible rather than Pinus contorta in mixture with Sitka spruce is recorded. Evidence in support of this is furnished in the Kirkhill account under "Mixture of Species".

It is recognised that Pinus contorta/Sitka spruce mixtures will require careful attention when they approach the thinning stage - November, 1951).

Visit of Sir Henry Beresford Peirse, Director of Forestry, Scotland, on 25th October, 1949.

This visit covered approximately the same ground as the Chairman's and was followed by discussions from which the following points arose:-

1. No further action was to be taken where Scots pine had been planted in the same screef as Sitka spruce.

2. Sitka spruce had been used excessively. More use was to be made of hybrid and Japanese larches especially on unploughed ground.

3. Problems were to be listed so that these could be investigated by research.

The problems were:-

A. The best treatment for areas of diseased European larch

B. Disease in larch in relation to altitude, aspect and exposure.

C. What action should be taken in areas of diseased larch.

D. The best use of Sitka spruce in relation to frost.

E. The best method of planting Norway spruce on a mat of couch grass.

F. The best treatment where Japanese larch exists as a rough crop, but has killed off the heather.

G. How to weaken heather to prevent root competition with the spruces.

H. Study of late and early frost damage.

I. Cultivation of ground too steep to plough where direct planting is undesirable.

The selection of species was discussed in relation to ploughable and unploughable sites and the following table was drawn up:-

	Ploughable	Unploughable
6. Exposed high tops (reasonable soil with up to 6 in. of peat).	SS/Pine	
5. Upper slopes (drier Calluna slopes, almost pure Calluna. Still fairly sheltered).	SS/Pine J.L. or H.L.	J.L., H.L., or S.P. (Latter, if not too exposed).
1000 ft.		
4. Mid slopes (Still fertile but Calluna coming in, less subject to frost).	N.S., N.S/S.P. but SS/SP according to vegetation and intensity of frost.	S.P., H.L., or J.L. (Not spruce).
3. Lower Fertile Slopes	NS/SP where a proportion of Calluna is coming in.	S.P. especially with Calluna. N.S. on pure grass flush.
2. Valley bottoms (Grass and herb vegetation)	N.S. on pure grass flush.	
1. Flushes. (Grass and herb vegetation)	N.S.	N.S.

No further treatment was to be carried out for the present in diseased European larch areas. In future planting, only safe areas were to be tackled and meantime some of the failed areas might recover and research might reveal new factors improving technique on difficult areas.

It was agreed that Scots pine was a better auxiliary for Sitka spruce than Pinus contorta. More Scots pine could be planted. No Sitka spruce was to be used on unploughable ground.

(No comments - November, 1951).

APPENDIX II

Supervision

Divisional Officers

J. F. Annand	1929 - 1932
R. G. Forbes	1932 - 1933
H. M. Steven	1933 - 1938
F. Scott	1938 - 1939
L. A. Newton	1939 - 1946

Conservators

H. C. Beresford Peirse	1946 - 1947
F. Oliver	1947 continuing

State Forest Officers

T. H. Woolridge	1948 continuing

District Officers

R. Cowell Smith	1929 - 1934
A. Watt	1934 - 1938
T. H. Woolridge	1938 - 1939
I. H. Gillespie	1940 - 1947
R. J. Waterman	1947
B. R. Feaver	1947 - 1949
W. F. French	1949 - 1951
R. J. G. Horne	1951 continuing

Foresters

T. Allan	1929 - 1933
J. Edwards	1932 - 1938
J. M. Kennedy	1938 - 1940
G. Innes	1940 - 1946
J. M. Kennedy	1946 continuing

APPENDIX III

Tentative Schedule on Choice of Species

Drawn up by Technical Commissioner - September 1929

Type of Land	Vegetation, Soil etc.	Treatment	Species
(1) Reclaimed Land (a) Arable (b) Semi-derelict	Generally well drained clean land	Notching on plough furrows where possible	S.S., N.S., E.L., perhaps some J.L.
(2) Bracken (limited area)	Generally well drained deep soil. Little or no peat.	Semi-circular spades or notching	Exacting species can be used. E.L., D.F. etc.
(3) Juncus etc.	Wet. Some peat of a good type.	Draining or turf-planting.	S.S., N.S. in hollows
(4) The bulk of the uncultivated hill slopes (lower parts only) A. Damp Ground	Calluna, mosses, ladder fern, bearberry. 6" or more of peat.	Some draining and turf planting. Some mattock planting.	S.S., J.L.
B. Dry Ground	Erica cinerea/calluna/ sometimes whin.	Notching, some mattock planting.	Chiefly S.P., E.L.
	Doubtful to Useless Ground (Experimental (small scale)).		
(5) Tops of slopes generally exposed plateaux, elevation not sufficient to exclude otherwise	Dwarf heather with lichen; shallow peat over hard stony ground.	Various methods of cultivation to break up hard ground.	M.P., P.C., S.S. and others.
(6) Upper parts of 4A and 4B	Heather with increasing depth of peat, sometimes in hummocks.	Intensive draining mound and turf preparation.	S.S., P.C., M.P., and others.

APPENDIX IV

Acreage of Species and Mixtures by P. Years

P. Year	Total	S.P.	P.C.	M.P.	E.L.	J.L.	H.L.	S.S.	N.S.	C.P.	SS/SP	SP/EL	EL/SS	JL/SS	JL/SP	JL/PC	SS/PC	Others
30	200.	34.8	-	5.	70.5	-	1.	41.2	47.5	-	-	-	-	-	-	-	-	-
31	350.	44.9	8.3	16.3	42.1	45.7	1.3	95.	42.8	-	-	34.7	2	12	2	-	-	2.9
32	433.7	4.3	36.6	2.5	141.7	42.3	-	129.7	29.1	-	-	11.1	-	-	-	36.4	-	-
33	468.2	57.3	1.4	5.6	150.5	65.2	-	128.5	35.5	-	-	22.5	-	-	-	-	-	1.7
34	450.	56.2	-	5.3	147.2	29.6	.5	106.8	75.9	-	-	28.5	-	-	-	-	-	-
35	444.8	34.5	9.6	10.6	176.	57.1	-	54.5	98.1	-	-	4.4	-	-	-	-	-	-
36	449.	40.4	3.2	4.2	154.3	63.5	28.2	72.6	26.	-	-	48.9	-	-	-	-	-	7.7
37	316.	3.3	-	-	11.	-	1.	98.3	125.2	1.	41.1	9.3	-	-	-	-	19.	6.8
38	352.5	27.1	1.	9.2	29.5	-	-	77.8	119.5	-	30.9	29.8	-	-	-	-	27.1	.6
39	357.2	5.7	-	-	-	-	-	44.1	224.2	-	65.8	14.	-	-	-	-	-	3.4
40	184.4	10.1	-	-	-	18.	-	84.6	49.2	-	22.5	-	-	-	-	-	-	-
41	253.5	27.6	-	1.	-	4.3	-	100.4	96.2	-	24.	-	-	-	-	-	-	-
42	248.8	71.8	-	-	-	9.	-	78.	84.3	-	5.7	-	-	-	-	-	-	-
43	181.6	58.9	-	-	-	-	-	12.9	23.5	-	86.3	-	-	-	-	-	-	-
44	150	-	-	-	-	-	-	25.	23.5	-	101.5	-	-	-	-	-	-	-
45	42.	-	-	-	-	-	-	-	22.	-	20.	-	-	-	-	-	-	-
46	82.	-	-	-	-	-	-	-	-	-	21.	-	-	-	-	-	-	61.
47	300.	22.	-	-	-	-	4	15	-	-	220	-	-	-	28	-	-	11.
48	390	4.	-	-	-	-	-	32.	87.	-	267.	-	-	-	-	-	-	-
49	460	38.	4.	-	-	27.	6.	146.	118.	10	111.	-	-	-	-	-	-	-
50	773.	40.	33.	-	-	341.	14.	61.	39.	-	176.	-	-	-	-	60.	9.	-
51	702.	8.	170.	-	1.	269.	10.	12.	8.	-	87.	-	-	2.	-	-	120.	15.
TOTALS:	7488.7	488.9	276.1	59.7	923.8	671.7	66.0	1415.4	1374.5	11.	1279.8	203.2	2.	14.	30.	96.4	175.1	110.1

A P P E N D I X V

Acreage of E.L. and E.L./S.P. on old arable and Calluna Sites

P.Year	Pure E.L.			SP/EL Mixture		
	Old Arable	Calluna	Total	Old Arable	Calluna	Total
30	39.3	31.2	70.5	-	-	-
31	38.	4.1	42.1	8.2	26.5	34.7
32	21.	120.7	141.7	-	11.1	11.1
33	-	150.5	150.5	-	22.5	22.5
34	32.2	115.	147.2	-	28.5	28.5
35	57.9	118.1	176.	-	4.4	4.4
36	-	154.3	154.3	-	48.9	48.9
37	11.	-	11.	-	9.3	9.3
38	-	29.5	29.5	-	29.8	29.8
39	-	-	-	-	14.	14.
	199.4	723.4	922.8	8.2	186.9	195.1

Summary of E.L. Seed Origin (incl. E.L. in mixture)

	Native	Swiss	Silesian (Sudeten)	Austrian (N. Tyrol)	Total
	Acs.	Acs.	Acs.	Acs.	Acs.
P.30	32.5	24.8	13.2	-	70.5
P.31	54.1	-	-	-	54.1
P.32	113.8	30.6	-	-	144.4
P.33	49.7	106.7	-	2.8	159.2
P.34	114.6	36.4	-	7.9	158.9
P.35	174.4	2.5	-	1.3	178.2
P.36	179.1	-	-	-	179.1
P.37	15.5	-	-	-	15.5
P.38	38.5	-	-	-	38.5
P.39	6.8	-	-	-	6.8
P.40-44	-	-	-	-	-
	779.0	201.0	13.2	12.0	1005.2

Age of E.L. Plants used by P. Years (incl. E.L. in mixture).

P. Year	Seedlings		Transplants					Total
	1 + 0	2 + 0	1 + 1	1 + 2	2 + 1	1 + 1 + 1	2 + 2	
								Acs.
30	7.3	-	-	1.3	24.9	-	37.	70.5
31	3.	5.	-	-	44.1	-	-	34.1
32	29.3	-	81.1	-	34.	-	-	144.4
33	-	3.	-	5.4	147.3	3.5	-	139.2
34	-	-	-	-	158.9	-	-	158.9
35	-	-	-	-	178.2	-	-	178.2
36	-	-	77.8	-	101.5	-	-	179.1
37	-	-	15.5	-	-	-	-	15.5
38	-	-	25.7	-	12.8	-	-	38.5
39	-	-	1.1	-	5.7	-	-	6.8
	41.6	8	201.2	6.7	707.2	3.5	37.	1005.2

A P P E N D I X VI

COMPARISON OF HEIGHT GROWTH

in

SELECTED STANDS

of

CLASHINDARROCH FOREST

APPENDIX VI

Species	Cpt. No.	Yr. Planted	No./ Acre	Average Total Height	Last 3 yrs. Average (i) & Maxima(ii) Per Year *	Geology and Soil	Elevation	Aspect	Exposure
Sitka spruce	4	1930	940	36' 3"	(i) 2' 3" (ii) 3' 4"	½" of undecomposed humus overlies an old arable brown earth. Incorporated humus to 18". Traces of podsolisation. No rocky material in top 30".	1020'	N.	The crop is on a north facing, fairly gentle slope and is surrounded by similar high forest.
Sitka spruce	13	1930	1270	33' 6"	(i) 2' 8" (ii) 3' 2"	½" of undecomposed leaf litter overlies an old arable brown earth, with schists and slatey rocks at 18". There is no surface vegetation.	950'	E.	The crop is completely sheltered on all sides.
Norway spruce	4	1930	1260	27' 7"	(i) 2' 3" (ii) 2' 8"	½" of undecomposed humus overlies an old arable brown earth degrading into a grey sandy podsolised soil at 12". Soil is moist with a light vegetation of moss.	1000'	N.	The crop is exposed to bare agricultural land to the north but on all other sides, there is similar high forest.
Norway spruce	20	1931	890	19' 4"	(i) 1' 6" (ii) 2' 4"	1" of undecomposed humus overlies an old arable brown earth. The canopy is fairly open and there is a matted ground flora of grasses and moss.	1100'	N.	The stand is sheltered on all sides by similar high forest.
European larch	78	1933	1520	25' 5"	(i) 1' 7" (ii) 2' 1"	1" of undecomposed leaf litter overlies a stony brown earth - grading to ochre at 24". There is a sparse ground flora of bracken, foxglove and mosses.	800'	S.E.	The crop is exposed to the north, east and south-east. On all other sides there is similar high forest.
Japanese larch	94	1933	980	24'11"	(i) 2' 1" (ii) 2' 4"	Undecomposed layer of 1½", over a dry sandy brown earth. Ground flora of heather; ling and bilberry is sparse. A. nobilis now 6' average height has been underplanted.	980'	S.E.	The crop is sheltered on all sides by similar high forest.
Hybrid larch	164	1936	1560	28' 4"	(i) 1' 6" (ii) 2' 0"	1" undecomposed leaf litter covers a shallow brown earth, with much disintegrated schists and slate. The soil is fairly dry. Sparse ground flora of mosses, ferns and foxglove.	750'	N.E.	The crop is exposed to north and south and partially to east and west where there is poor, fairly open coniferous forest.
European larch	13	1930	1050	18' 4"	(i) 1' 1" (ii) 2' 1"	1" of undecomposed leaf litter, over an old arable brown earth. There is a ground flora of matted grass and mosses. Sitka spruce has been underplanted.	1000'	E.	The crop is exposed to the north but is sheltered on all other sides.
Japanese larch	41	1933	1260	20' 3"	(i) 1' 7" (ii) 2' 6"	1" of undecomposed leaf litter overlies a reddish brown earth. There is a very sparse ground flora of moss and grass.	1100'	N.	The crop is on a fairly steep slope, exposed to the north-east but sheltered on all other sides.
Hybrid larch	20	1931	1330	36'11"	(i) 2' 2" (ii) 2'10"	1" of undecomposed leaf litter Oxalis on old arable brown earth. There is a sparse ground flora of grass and bracken.	1100'	S.E.	The crop is slightly exposed to the south-east but is surrounded by similar high forest.
Scots pine	77	1933	1320	22' 9"	(i) 1' 9" (ii) 1'10"	1½" of undecomposed humus overlies a stony reddish brown earth. There is a sparse ground vegetation of heather, bilberry and mosses.	1000'	E.	The crop is exposed to the east. On all other sides there is similar high forest.
Scots pine	92	1934	1540	15' 3"	(i) 1' 2" (ii) 1' 4"	1½" of undecomposed leaf litter over a reddish brown earth, with a 5" humus stained layer. There is a fairly dense ground flora of heather and ling.	1000'	E.	The crop is on a hill crest but is sheltered on all sides by similar forest.
Pinus contorta	9	1931	1960	21' 1½"	(i) 1' 3" (ii) 1' 7"	1" of undecomposed leaf litter overlies a 6" compact peat layer, with evidence of podsolisation. The underlying soil is a pebbly, sandy, clay. Vegetation is generally absent.	1100'	N.	The stand is near the crest of a hill, but is surrounde by similar high forest.
Pinus contorta	16	1931	1520	12' 9"	(i) 1' 2" (ii) 1'10"	2" undecomposed layer overlies 12" of fibrous peat. Parent material is a sandy clay with schistose and slaty rock. The vegetation of heather, ling and bilberry is dense.	1250'	S.E.	The crop is exposed to a bare hilltop to the north and is also exposed to south-east. On all other sides it is sheltered.

* Taken from one felled tree which was the mean of a one-tenth acre sample plot, and two other standing trees of mean girth at breast height, and average form for the stand.

A P P E N D I X VII

VOLUME AND C.A.I. YIELDS

for

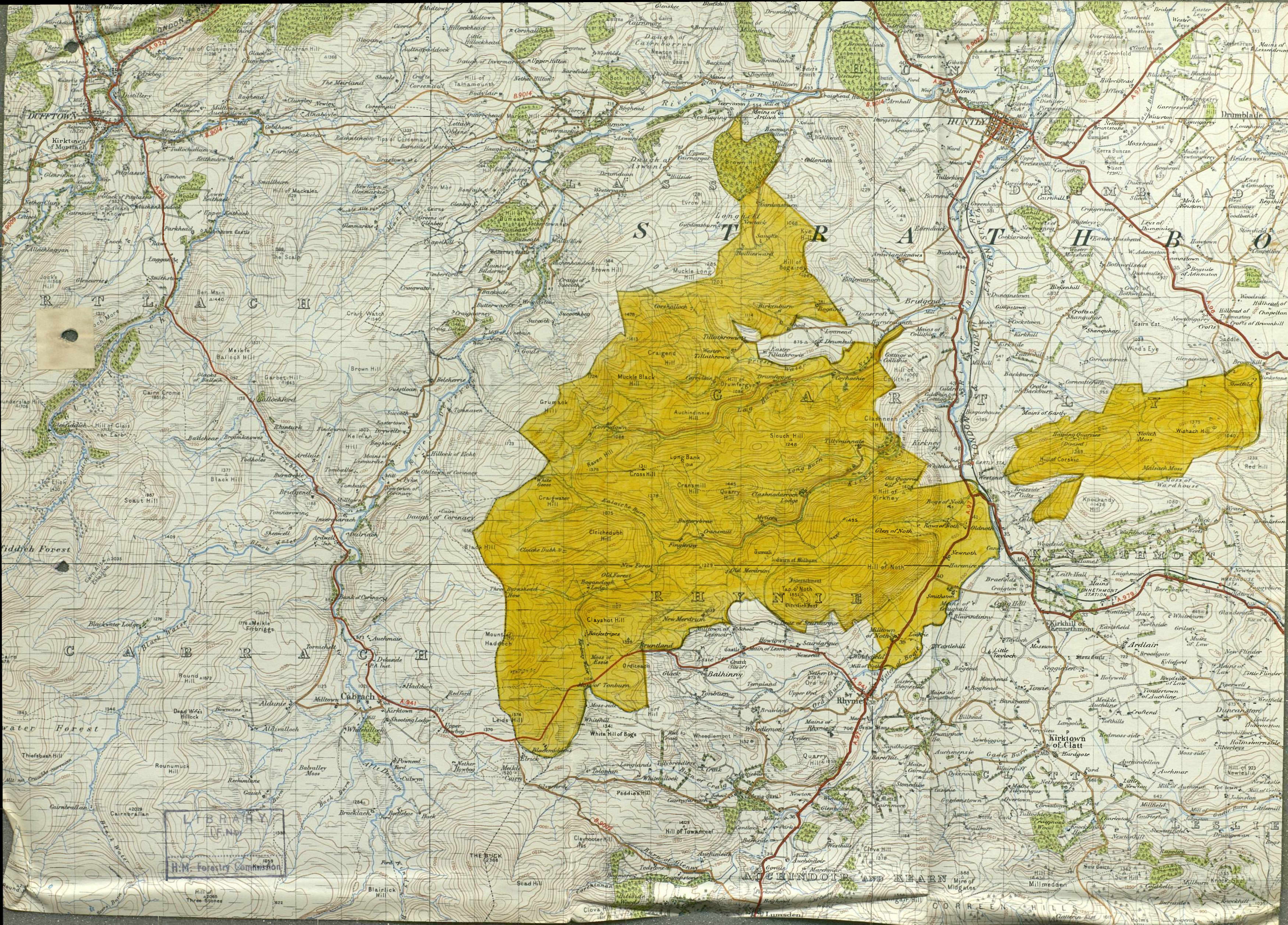
SELECTED STANDS

of

CLASHINDARROCH FOREST

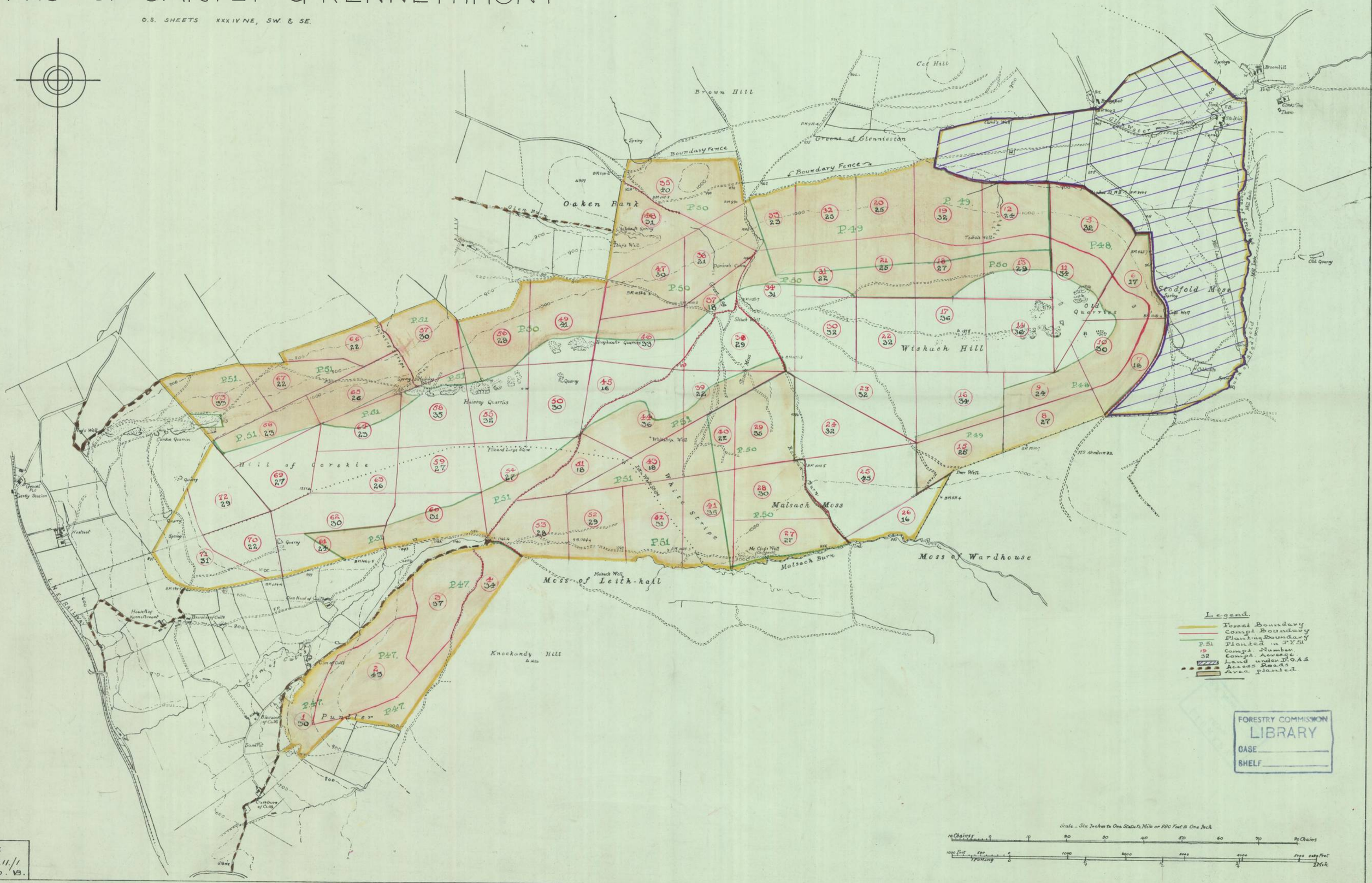
APPENDIX VII

Species	Year Planted	Cpt. No.	Vol. to 3" Diameter (H.ft.O.B./ acre).	Vol. Removed in Thinnings to Date (H.ft.O.B./ acre)	Total Vol. to Date (H.ft.O.B./ acre)	C.A.I. Based on last 3 yrs. Growth (H.ft. O.B./acre)	No. of Trees/ acre	Geology and Soil	Altitude	Aspect	Exposure
Sitka spruce	1930	4	2490	950	3440	260	940	½" undecomposed humus overlies an old arable brown earth. Incorporated humus to 18". Below 18", traces of slight podsolisation. No bedrock or rocky material in top 30".	1020	N	The crop is on a north facing fairly gentle slope, and is surrounded by similar high forest
Norway spruce	1930	4	1802	Nil	1802	137	1260	½" of undecomposed humus overlies an old arable brown earth, degrading into a grey sandy clay at 12". No rocky material in top 30". Soil condition moist, with a light moss covering.	1000	N	The crop is exposed to bare agricultural land to the north. On all other sides there is similar high forest.
European larch	1933	78	532	Nil	532	84	1250	1" of undecomposed humus overlies a stony brown earth - grading from dark brown to ochre at 24". There is a sparse ground cover of bracken, foxglove and mosses.	800	S.E.	The stand is on the north slope of a valley running east to west, and is exposed to north east and south east. On all other sides, similar coniferous forest.
Japanese larch	1933	94	2038	Nil	2038	204	980	Undecomposed layer of 1½", over a dry sandy, brown earth. There is a light ground vegetation of heather, ling and bilberry. A.nobilis, now 6' average height, has been underplanted.	980	S.E.	The crop is sheltered on all sides by similar high forest.
Hybrid larch	1936	164	1076	Nil	1076	148	1560	1" undecomposed leaf litter covers a shallow brown earth, in which there is much disintegrated schists & slates. The soil is fairly dry, but there is a ground cover of mosses, foxglove and fern, which is generally sparse.	750	N.E.	The crop is exposed to north and south and partially exposed to east and west where there is poor coniferous forest.
Scots pine	1933	77	898	Nil	898	125	1320	1½" of undecomposed humus overlies a stony reddish brown earth. There is a sparse ground cover of heather, bilberry and mosses.	1000	E.	The stand is exposed only to the east. On all other sides it is sheltered by similar forest.
Lodge-pole Pine (Pinus contorta)	1931	9	902	Nil	902	118	1960	1" undecomposed leaf litter overlies a 6" compact peat layer, with evidence of podsolisation. The underlying soil is a pebbly sandy clay. Vegetation is absent except for sparse mosses.	1100	N.	The stand is near the crest of a hill, but is surrounded by similar high forest.


DUFFTOWN
Kirktown of Mortlach
Distillery
LONDON &
A.920
A.941
B.9014
B.9022
B.9002
A.96
A.97
A.979
Tips of Clunymore
Carran Hill
The Meirland
Glack of Pitglassie
Goodman's Knowe
Auchindown Castle
Hill of Mackalea
The Scalp
Ben Main
Meikle Balloch Hill
Garbet Hill
Ballochford
Brown Hill
Craig Watch
Cairn Crome
Hill of Clais nan Earb
Glenfiddich Lodge
Jock's Hill
Black Hill
Soaut Hill
Tor Elick
Fiddich Forest
Kelman Hill
Tomnavowin
Bank of Corinacy
Daugh of Corinacy
Meikle Firbriggs
Round Hill
Dead Wife's Hillock
Thiefsbush Hill
Rounumuck Hill
Cairnbrallan
Balvalley Moss
Hill of Three Stones
Blairlick Hill
Cabrach
Milltown
Kirktown
Shooting Lodge
Aldunie
Aldivalloch
Blackwater Lodge
Black Water
Water Forest
Hill of Talnamounth
Daugh of Cairnborrow
Newton Hill
Both Hill
River Deveron
Daugh of Aswanley
Evron Hill
Longhill
Hill of Dumeath
Market Hill
Muckle Long Hill
Hill of Bogairdy
Craigend Hill
Tillathrowie
Muckle Black Hill
Grumack Hill
Auchindinnie Hill
Slough Hill
Raven Hill
Long Bank
Cross Hill
Cransmill Hill
Quarry Hill
Clashnadarroch Lodge
Craigwater Hill
Cloichedubh Hill
New Forest
Old Forest
Clayshot Hill
Mount Haddoch
Leids Hill
White Hill of Bogs
Wheedlemont Hill
Tap o' Noth
Vitrified Fort
Hill of Noth
Glen of Noth
Hill of Kirkney
Clashneen Hill
Hill of Collithie
Rhynie
Peddies Hill
Hill of Towanreef
Clayhooter Hill
THE BUCK
Scad Hill
Clova Hill
Lumsden
HUNTLY
Hill of Greenfold
Drumblade
Battle Hill
Bridgend
Gartly Sta.
Hill of Corskie
Wishach Hill
Slouch Moss
Malsach Moss
Moss of Wardhouse
Knockandy Hill
Red Hill
Saddle Hill
Wind's Eye
Leith Hall
Kennethmont Station
Wardhouse Sta.
Kirkhill of Kennethmont
Ardlair
Kirktown of Clatt
Duncanston
Hill of Newleslie
Sune Hill
Hill of Millmedden
Mire of Midgates
CORREEN HILLS
S T R A T H B O G I E
G A R T L Y
R H Y N I E
K E N N E T H M O N T
D R U M B L A D E
H U N T L Y
C L A T T
L E S L I E
C A B R A C H
AUCHINDOIR AND KEARN
G L A S S
M O R T L A C H
LONDON & NORTH EASTERN RY.

GARTLY MOOR FOREST
COUNTY OF ABERDEEN
PHS. OF GARTLY & KENNETHMONT

O.S. SHEETS XXXIV NE, SW. & SE.



REF.
R. 211/1
SGND. VB.

22 x 20

CLASHINDARROCH FOREST

COUNTY OF ABERDEEN

PARISHES OF HUNTLY, GARTLY & RHYNIE

Scale Six Inches to One Statute Mile

Feet 1000 0 1000 2000 3000 4000 5000 Feet

N

— Legend —

- Forest Boundary
- Compartment Boundaries
- Compartment Number & Acreage (e.g. 269)
- Planting Year (e.g. P50)
- Area Planted
- Land under Direction of D.O.A.S.
- Land Tenanted
- Forest Workers Holdings
- Forest Roads & Tracks.

CLASHINDARROCH FOREST

COUNTY OF ABERDEEN

PARISHES OF HUNTLY, GARTLY & RHYNIE

Scale Six Inches to One Statute Mile

Feet 1000 0 1000 2000 3000 4000 5000 Feet.

— Legend —

- Forest Boundary
- Compartment Boundaries
- Compartment Number & Acreage (e.g. 543 / 37·0)
- Planting Year (e.g. P47)
- Area Planted
- Land under Direction of DOAS
- Land Tenanted
- Forest Workers' Holdings
- Forest Roads & Tracks

N

REF. R 78 / No 34
Init. JB

OVERLAP