FORESTRY COMMISSION

HISTORY

OF

THORNTHWAITE

FOREST

NW(E) CONSERVANCY

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HISTORY

of

THORNTHWAITE FOREST

1920 - 1951

NORTH WEST (ENGLAND) CONSERVANCY

HISTORY OF THORNTHWAITE FOREST

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HISTORY OF THORNTHWAITE FOREST

INTRODUCTION

When studying the following notes on the history of Thornthwaite Forest, the background to the earlier planting operations should be kept in mind.

Dating as it does from P.20, this unit is among the first of the Commission's new forests.

The original and most important acquisition included an area of some 800 acres mostly felled during the 1914 - 1918 war, a part of which had shortly before that war been the subject of a detailed investigation, the findings of which were recorded in the Journal of the Board of Agriculture for July and August 1910 (Coombe Plantation, Keswick, by R.L. Robinson and A. Lindsay Watt).

It is apparent in the light of subsequent development that the programme of work carried out during the initial period was based on an over assessment of the plantability of the more elevated portions of the area, due no doubt to an optimistic misinterpretation of the data presented in the above mentioned report.

Add to this the strong pressure during those early years for large planting programmes and it is not surprising to find that by the conclusion of P.24 the planting of this first acquisition had been practically completed and had provided a legacy of difficult problems for the years to come.

As assessment made for the Working Plan for the Thornthwaite Working Section dated July 1924 showed 251 acres of the 962 acres planted P.20 - P.24 to be above 1500 ft. and that this area should properly have been regarded as unplantable, or at best only experimentally plantable. In fact only 109 acres remained unplanted out of the whole acquisition.

The fact that from 1924 onwards, Working Plans were prepared for all sections of Thornthwaite Forest, is an indication that this early lesson was quickly learnt, and that programmes of work, including selection of species, were not embarked upon since that date without very careful consideration.

Choice of Species

The point about the earlier plantations which strikes a present day

forester very forcibly is that choice of species did not follow changes in vegetation and associated site qualities, but was just blocked in. As a result parts of each year's planting came away satisfactorily and others just stuck and were eventually replaced by something else. It would be easy to suppose that this was due to lack of knowledge by our predecessors but judging from the condition of similar fell land at the present day one is more inclined to think that the true character of the ground was masked by by the intensity of grazing. It probably all looked extremely uniform and no appreciable variations would appear until 5 or even 10 years after enclosure when the natural vegetation had begun to re-establish itself. This emphasises the need for caution on similar ground in future.

Apart from any difficulties which have arisen as a result of faulty site allocation, three potentially valuable species have proved unduly susceptible in this locality to climatic and pathological influences.

Corsican pine although growing well on private estates at low elevation, became subject to excessive wind-sway when planted on high exposed sites and was soon abandoned. These earlier plantations subsequently became infected with Brunchorstia and the progress of the disease is under periodic observation by Research Branch.

Scots pine is also prone to suffer from wind-sway unless planted on really firm ground, and on southern and western aspects particularly it is severely blasted every winter.

European larch at Thornthwaite as in many other localities is suffering a set back at the present time. In 1910 in the Coombe Plantation it was apparently remarkably free from canker despite high elevation and exposure, whereas practically all the European larch planted by the Commission is severely affected and in many places dying back. The causes of this misfortune are not fully understood, but suggestions that it is mainly due to unsuitable provenances are borne out by the fact that the natural regeneration from the Coombe Plantation is also remarkably canker free.

Beating Up

It appears from the Inspection Notes of the Chairman's visit of 2nd September 1944 that the report that Japanese larch had in the early years been beaten up with European larch was incorrect. European larch

was the original species and this had been beaten up with Japanese larch.

Thinning

One of the lessons to be learnt from the treatment of the Douglas fir plantations is the importance of early removal of wolf trees and the coarser co-dominants.

Extraction

During the war years and immediately after, recourse was had to various temporary expedients e.g. corrugated iron chutes and light wire ropeways (Mr. R. H. Smith's system). It was not possible to keep pace with the requirements of the thinning programme by such methods.

Protection

Trespass by sheep is not mentioned to any extent in the various Inspection Reports but there is plenty of evidence on the ground that it has been an important factor in delaying establishment e.g. the failure of beech in the European larch/beech mixtures and the many gaps on grassy knolls at higher elevations.

Amenity

The original block planting and in particular the system of straight rides running across the contours have seriously detracted from the amenities of the area and have undoubtedly been responsible for much of the opposition which has been aroused against afforestation in the Lake District. Future management should aim at gradually obliterating, not perpetuating, these harsh and incongruous outlines.

The straight rides have proved virtually useless and have been superceded in the recent lay-out of Darling How (P.49 and 50) by contoured and graded roads laid out and formed by bull dozer in advance of planting.

J.S.R. Chard

S.F.O., N.W.(E).

A.H.H. Ross

Conservator, N.W.(E).

6th August 1951.

HISTORY OF THORNTHWAITE FOREST

By District Officer C. D. Begley

Site

Situated in the County of Cumberland Thornthwaite Forest lies between the towns of Cockermouth and Keswick and on either side of Bassenthwaite Lake and the Whinlatter Pass. There are two outliers, one in Setmurthy parish and the other at Isel.

Name

This is taken from the village of Thornthwaite near which the first land acquired was situated.

Area and Utilisation

Area and acquisition details are given in the following tables:

TABLE I

From	By	Date	Plantations Acquired	Plantable Excl. Col. 4	Nurseries	Agricultural	F.W.H.	Unplantable Excl. Col. 4	Other Land: Land Permanently Transferred — Description	Other Land: Land Permanently Transferred — Acreage	Other Land: Land Temporarily Transferred — Description	Other Land: Land Temporarily Transferred — Acreage	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Thornthwaite Mines Ltd.	Lease	5. 7.20	59	967				89					1115
Holdsworth Robert Jackson	Lease	8. 1.21		39									39
Spedding Blanche Frances	Lease	17. 3.24		477				120					597
Pape Sarah Jane	Conveyance	22. 1.25		3									3
Taylor Jane Elizabeth	Conveyance	10. 7.25		190				53					243
Wadham Eliza Annie	Lease	3.12.25		105									105
Barnard Rt.Hon. C.W.Baron	Conveyance	31.12.25					11						11
Thompson Andrew Green	Conveyance	31. 3.26		179				180					359
Thompson Andrew Green	Conveyance	31. 3.26		1			6						7
Leconfield Rt.Hon.C.H. Baron	Conveyance	31. 3.26		200				172					372
Armstrong John	Conveyance	27. 1.27		3			17						20
Barnard Rt.Hon. C.W. Baron	Lease	13. 5.27		663			2	6	Resumption 24. 6. 35 Deed of Dedication. 14. 6. 47	3.880 .124			671
Wilson Joseph Hutchinson	Conveyance	13.10.28				9							9
Towers John Wilson	Conveyance	30.10.28				8							8
Fisher Geo. Forster	Conveyance	22.11.28	19	227									246
Clark Fred	Lease	24. 1.29		13									13
Lawson Sir Wilfred	Lease	26. 9.29		104									104
Gates Alderman Alfred	Lease	7. 2.35				5			Resumption 30. 3. 50	5.0			5
Lawson Sir Wilfred	Lease	25.11.35		92									92
Searle Wm. Radley	Conveyance	8.8. 38		42									42
Fisher Geo. Forster	Lease	11. 7.47		53				1					54
Pers. Reps. of Stanley-Dodgson S.D.	Conveyance	22. 7.47		354		88					Darling How Farm	324	713
Palmer John Fletcher	Conveyance	22. 7.47											53
			78	3712		110	36	621		9		324	4881
												Less Resumptions	9
												Net Area	4872

Area statement

Table II

		Area
(a)	Plantations	
	Acquired	39
	Formed by Commission	3448
(b)	In hand awaiting planting	
	For afforestation	181
	For re-afforestation	3
(c)	Tenanted, pending planting	
	For afforestation	114
	For re-afforestation	-
(d)	Nurseries	-
(e)	Agricultural Land	717
	Number of Tenancies - 3	
(f)	F.W.H.	55
	Number - 6	
(g)	Unplantable land	310
(h)	Other land	5
		4872 acres

Description of Acquisitions

Acquisitions began in 1920 with the Thornthwaite acquisition of about 1000 acres and continued until 1947 when Darling How was acquired.

The land acquired consisted of two categories:

(i) Sheep walks or open fells.

(ii) Existing or devastated woodland.

Category (i) which consisted of what is termed "fell land" accounted for the greater part of the total area.

(i) Sheep Walks

This category covers a wide variety of terrain. The ground below 1500 ft. corresponded in fundamental soil characteristics to the woodland sites although generally, the better ground had formerly been afforested. As the altitude increased the soil tended to become shallower and rock outcrops were frequent. The vegetation was principally heather and heath with the heather (Calluna vulgaris) dominant on the rocky outcrops. There were also local areas of poor drainage due to a large extent to the topography rather than impedence in the structure or composition of the soil or parent

material. In these areas Calluna vulgaris, Erica tetralix, Eriophorum vaginatum and Sphagnum spp. were associated. Where the ground was readily susceptible of drainage, e.g. shallow peat overlying mineral soil or favourably sited, Molinia caerulea was dominant with Aira flexuosa becoming increasingly frequent with the improvement of drainage.

Where the soil depth and drainage were satisfactory there were Festuca-Agrostis associations which were formerly valued pastures. On much of the well drained slopes at lower altitudes (400 ft. - 1,000 ft.) which had been or were probably in historical times woodland, there were extensive associations of bracken.

(ii) Existing or devastated Woodland.

Two acquisitions, those of Thornthwaite and Dodd, were almost entirely in this category; the amount of standing timber on the acquired land was relatively small. The plantations which formerly existed were either of Scots pine and European larch and some spruces or of beech and sessile oak. In the devastated areas a similar crop had been carried but scrub birch, oak and sycamore with rowan and holly were succeeding. There was, however, some naturally regenerated European larch. Most of this land was plantable and in very few cases did it extend above 1500 ft. which is approaching the natural timber line.

Physiography.

The forest lies in typical Lakeland hill country. Wythop W.S., Dodd W.S. and that part of the Thornthwaite W.S. immediately above the village are on the hills which form the valley which contains Bassenthwaite Lake. The lake runs from north-north-west to south-south-east and the Thornthwaite and Dodd sections are situated respectively on the west and east sides at the southerly end.

Wythop lies on the west side and occupies about two thirds of the remaining length of this bank to the north of Beckstones and Thornthwaite village. Whilst the Wythop section rises almost immediately from the lakeside, the Dodd section is nowhere nearer than a third of a mile from the lake and at its north and south limits it swings eastwards until its boundaries are about a mile distant from the lake. It is more complicated in its physiography than the other sections. There is a steep slope to

the east rising to 1600 ft. at the bottom of the main part Skiddaw, with a conical hill west of Skiddaw and at the foot of the mountain, forming the Dodd proper. The southern face of this hill is split by a steep gill and the gradients are very severe. Exposure at the upper limits (about 1500 ft. - 1550 ft.) is considerable.

Wythop W.S. is on the shape of a dumbell with the gradients running parallel to the axis and concentrically around the ends of the dumbell. The gradients are fairly uniform and on the main axis are remarkably so. The southern end is more complicated and there are shelves of outcropping rock which make extraction very difficult.

The Bassenthwaite side of the Thornthwaite W.S. is a convex slope facing the east with a fairly uniform but steep gradient broken by outcrops and gills here and there. At about 1500 ft. the gradient decreases and there is a plateau like top to this section rising gently in a west-north-west direction towards the summit of Lords Seat (1811 ft.). The remainder of the Thornthwaite Section consists of the Coombe Wood and Aiken Beck compartments to the north of the Whinlatter Pass and the Hospital Plantation compartments to the south.

The northern compartments are on the contours which swing eastwards from the southern end of the section above Thornthwaite and facing the lake. The line of these contours is broken by Comb Gill which rises at about 1500 ft. and runs southwards towards the Whinlatter Pass. On the western side of the gill the contours run approximately north-south from where the Aiken Beck rises down towards the Pass, turning westwards a little above the Pass and so continuing the line broken by Coomb Gill. South-west of the source of Aiken Beck runs a narrow valley whose sides rise steeply from 1300 ft. to 1800 ft. (Lords Seat) in the north and 1600 ft. (Tarbarrel Moss) in the south.

The Hospital Plantation compartments, south of the Pass are on a hill, the plan of which is elliptical with the major axis at right angles to the Pass. The compartments therefore face east, north (parallel to the minor axis) and west. The summit ridge follows the 1500 ft. contour line and the base is bounded by the 1000 ft. line. The gradients are for the most part uniform and less severe than in the other sections already described.

There is next a narrow strip of compartments running westwards along the Pass with a northerly aspect and with a uniform gradient for a short distance of moderate inclination which then becomes severe. This is the beginning of the Swinside and Hobcarton Blocks. At its western end the contours turn south and the aspect is easterly. To the west of Hobcarton Gill the contours turn west again giving south and south-easterly aspects. The elevations here are from 800 ft. at the roadside to 1500 ft. on the fells.

The recent Darling How acquisition lies mainly on the smooth rounded hills to the north of Aiken Beck which rise from 800 ft. to 1600 ft. with steep gradients. The contour lines are sinuous and so the aspect changes direction quite frequently but it is always a southerly one, except for a small area to the south of the beck which has a northerly aspect. Finally there is Setmurthy W.S. This comprises Messengermire, a small hill north of Bassenthwaite Lake with a south-westerly aspect, gentle gradients of elevations from 500 ft. to 800 ft. and Higham, in Setmurthy parish. This has a mainly southerly aspect with reverse slopes here and there to the north; this north aspect is maintained at the sections northern limit. The gradients vary from moderate to severe but are uniform and the physiography is generally less dramatic than that of the rest of the forest; it is hilly rather than mountainous country with elevations varying between 300 ft. and just over 800 ft.

Geology and Soils

The geological formation is the Skiddaw Slates of the Ordovician series. The rocks are metamorphic and shaley. The lower slopes of the fells and Setmurthy W.S. are covered with a varying depth of glacial drift which was deposited during the movements of the Lakeland glaciers. As far as can be determined from the structure of the soils and the indicator erractics this drift originated in the Borrowdale Volcanic Formation. It is sandy in structure and is somewhat compacted, giving rise to impeded drainage in places.

At the higher elevations the soils are derived from the shaley parent material and are light, friable and freely draining. However, where the gradients are or the situation is unfavourable to drainage, peat has formed.

An extensive area of this type is on the top of the Thornthwaite W.S. On the very thin soils where there are frequent outcrops, a heath like peat has formed. The dry, heather areas provide typical examples of this.

Meteorology

The mean annual rainfall for Keswick (altitude 300 ft.) is 60 in. This is the nearest official station to the forest. With increased elevation the rainfall rises and it is estimated that above 1000 ft. the rainfall is between 70 in. to 80 in. per annum.

Snowfall is rarely heavy below 1000 ft. and normally lies for only a day or two. Above 1000 ft. there are often severe snow storms and in certain unfavourable sites deep drifts form. Snow at these elevations may lie for several days and above 1500 ft. for weeks. The freezing of light snow falls is not an uncommon difficulty encountered when using motor vehicles at these elevations and it is an annual occurrence for the Whinlatter Pass to be inaccessible to lorries for several days during the late winter months. The months of January and February are the worst ones for severe weather conditions.

Frost is not a serious matter, as yet, although exposure to severe cold winds is a decided limiting factor for certain species at particular elevations. Wind is the most general weather risk and perhaps the most serious obstacle to high elevation planting with suitable species. The prevailing wind is from the south-west with north-easterly gales becoming more frequent in the late winter and early spring.

Protection

An important cause of delayed establishment has been grazing following accidental ingress of sheep and all species have from time to time suffered equally. Fencing is thus a very important part of forest protection here.

Amenity

This is an aspect which has been insufficiently regarded in the past; there is no doubt that the layout of compartments on the Dodd for example, has not been very happily conceived. Management should not only pay great attention to any future actions which might affect this matter but should also consider modifying unsatisfactory, existing, features where possible.

A forest so easily viewed by virtue of its situation on steeply elevated hillsides and so near an important holiday centre should be managed with full regard to its appearance and the public taste. The road layout at Darling How is an excellent example of how this can be done without sacrifice of technical standards.

Roads and Extraction

These two items were linked from the earliest days of the forest in the minds of all officers and there are many recorded instances which indicate the awareness of this problem which existed. Little, however, could be done other than to ensure that reasonable alignments of rides and access routes were borne in mind and considerable modifications and innovations were needed when engineering work did begin in early 1947. The need for stacking and conversion sites, sensibly located was soon realised, but this has remained a problem of some magnitude up to the present due to the mountainous nature of the district. However, the provision of "all-weather" roads opened up new possibilities, particularly that of conversion at road side using mobile saws.

Extraction at an economic rate is becoming increasingly difficult on some sites with the increase in the size of produce, and recent trials of mechanical methods of extraction have not been too encouraging. However, the provision of a good basic roading system has greatly simplified matters and conversion by a mobile saw, on present showing, will exploit these roads to the full and give a valuable return in the form of reduced extraction and handling charges. The problem, however, is a constantly changing one and third, fourth and fifth thinnings may prove a considerable problem.

More recently, extensive experiments were carried out in mechanical extraction, using a power operated cableway. This was an extension of the research into a problem which has received a deal of consideration from the early days of thinning and which in this forest, on many sites, is a most urgent one.

Labour.

The existence of a well trained and mechanically knowledgable labour force would help considerably and there are signs that more attention may have to be paid to this question.

SILVICULTURE

Choice of Species

Some Factors affecting Choice of Species

Topography is of great significance in this forest. There is a wide range of soil types, aspects, elevations and micro-climates which occur over very limited areas and distances and make the choice of species, silviculture and management difficult. It is of great importance to have (a) the right species for the site, and (b) the right seed provenance. This of course applies to forestry anywhere but in a locality where extreme ecological limits are likely to be encountered frequently it is particularly important that these requirements are satisfied.

Special note should be taken of the effects of the siting of this forest in a heavily grazed area. In many instances the ground afforested had carried sheep for centuries until a very short time before the planting. This biotic factor had led to a climax markedly different from the climatic climax and thus may have given rise to a faulty reading of the ecological situation and a consequent inaccurate choice of species.

That this may well have been the cause of what can now be seen in some places to be faulty choice of site (e.g. spruce on dense heather on the Hospital Fell and Aiken) is a point that should be considered particularly in any future planting on similar ground. The mean annual rainfall in this area exceeds 56 in. and is an important factor in the choice of species. It is one reason for the suitability of both the spruces in a variety of sites at this forest. However, it is thought by some to be an adverse factor in the case of Corsican pine and may have contributed to the prevalence of the disease, Brunchorstia.

This forest is situated on the western limits of the Lake District and so enjoys a maritime influence. Snow does not normally lie for more than two or three days below 1,000 ft. and falls are generally infrequent and not severe. There has so far been little or no snow or ice damage. Exposure to strong westerly winds is a common feature on many of the sites but browning-off of the pines which occurs under somewhat similar circumstances at Ennerdale (Lowther Park) does not occur here.

Sitka spruce

This species was at a very early stage observed to be hardy and resistant to exposure; it was also the most useful species at high elevations and has continued to be so to the present day. It is most successful on the Molinia type of ground but it does well also on the poorer peats being least satisfactory on the dry heathery rocky ground. In its early stages it is a risk on insolated, well drained slopes, especially in periods of drought and it might be advisable to leave grazed land for a season before planting in such sites in order to obtain some cover. Turf planting is generally advisable particularly on poorly drained ground and extensive, intelligent draining is vital if the tree is to get an early start. The drains should be well maintained and if possible thoroughly cleaned before the trees close canopy so that there is a reduced risk of windfall when they receive their brashing and cleaning. Long delayed thinning in an area of poor drainage will result in windblow. So far this species has suffered little from disease although it has been affected by Neomyzaphis, in regard to which drought appears to be a predisposing factor. The absence of signs of attack from Chermes (Adelges cooleyi) has been commented on recently.

It has been the expressed view of several officers that this species is brashed and thinned at a too early date. One of the principal reasons given by local officers for early thinning is their anxiety to prevent windblow. This has fortunately not been serious but where it has occurred poor drainage has been an obvious contributory cause, and it is generally agreed that in such areas careful attention to this problem is necessary. The intensity of thinning is still a matter for discussion, but the standard used in the past has not to-date given rise to much adverse criticism.

Norway spruce

Exposure and high elevations are inimical to the success of this tree, although it proves more successful in frost pockets than Sitka. It checks severely on dry heather ground and is happiest on Juncus or Molinia ground providing it has been well drained. It is generally a less tolerant species than Sitka but more shade tolerant and can possibly survive as a two storied crop.

It is less wind firm than Sitka and so more care must be taken with the

drainage and siting of this species.

If it is planted in exposed situations a nurse of Scots or mountain pine is advised. The use of the 1 : 2 mixture is not advised since the nurse tends to smother the principal species. At Thornthwaite, this species also, has been relatively disease free but has suffered from Neomyzaphis under the same conditions as Sitka spruce.

Douglas fir

In the early days at Thornthwaite this species was in some cases planted above 1,000 ft. It is now considered that 600 ft. is the sensible limit although it will grow at higher elevations. It is unstable in the sapling stage on the thin shaly soil which is found extensively on the steep slopes at this forest, but once it becomes wind-firm it grows well. It is undoubtedly best suited to the more sheltered lower slopes, where the soil depth and drainage are good and the old woodland sites are particularly favourable. In such localities its height and volume growth have proved very rapid from an early age.

Unfortunately most of the Douglas fir at Thornthwaite is very coarse in its habit and the relatively heavy thinning which it seems to require does not improve matters. High pruning has been recommended but apart from questions of policy, this is still a matter for controversy. It is strongly held that the strain of seed from which these trees came was unsatisfactory and this is a problem which is likely to perpetuate itself if and when natural regeneration is employed. It is particularly necessary therefore that great care is taken as thinnings progress to select the trees of ostensibly good form and growth habit and much more precise information on the gross morphological features which are guides to the right type of strain is desirable if the risk of regenerating a poor quality tree is to be lessened.

The coarse growth of this species appears to be aggravated by high elevation planting although accurate information on this is not available, it is reasonable to conclude, however, that a naturally coarse habit with a greatly reduced rate of growth will result in persistent branch traces and an increased frequency of whorls over a given length of stem. This circumstance has in fact proved a considerable economic handicap with this species at

Thornthwaite when conversion has been attempted and it severely limits the markets for early thinnings.

It is doubly important therefore that if there is little choice as at present, in the matter of races or strains, that this species is only planted on relatively favourable sites.

European larch

An important study on the growth of the European larch in this forest was made by Lord Robinson (then Mr. R. L. Robinson) and Mr. A. Lindsay Watt as early as 1910. It was published by the Board of Agriculture and concerned the records of past and existing larch stands in the Coombe Wood situated in what is now the Thornthwaite W.S. The wood was 61 years of age and lay between 900 ft. and 1500 ft. with aspects varying from east to south. It was an almost pure stand of larch. Some of the conclusions of the report are particularly worthy of mention. It was evident that exposed situations were to be avoided unless adequate wind breaks were provided. The trees were apparently unscathed by the canker, Dasycypha calycina, and were all sound and free from heart rot. There is no doubt from the statistics collected (which although lacking in some respects are complete for the purpose of judging the site value) that a satisfactory crop of larch could be grown above 900 ft. However, increase in altitude was shown to have a marked effect on form and development and 1500 ft. appeared as a very definite top limit to the planting of this species. At one particular site the natural regeneration of larch in dense heather and in open canopy (windblown seed from an adjoining stand) was at that date quite evident. This can be seen as a healthy crop to-day.

An examination of the sites where this species was planted in the early days at Thornthwaite, indicates that well drained, bracken covered slopes were judged to be the more favourable sites. Little attention has been paid, however, to aspect or elevation and it may well be that this has been a considerable factor in the unsatisfactory history of the species. The worst example of die-back and failure is at 1,000 ft. on the Wythop section and that the best results with artificially regenerated trees have been obtained at little over 200 ft. on the Dodd section. The history of most of the plantations seems to be the same. There were few indications

in the early days of the impending failure and at one stage European larch was being used to beat up Japanese larch the reverse of current practice. From the records the date of the beginning of die-back, or time at which the various adverse factors appeared to begin to operate, was about 1933 when the crop was in the thicket stage and in some places was beginning to close canopy. Canker (Dasycypha calycina) was an obvious defect and the height growth was visibly affected. The condition of most of the crop deteriorated, and at the moment considerable areas appear devastated with a high proportion of dead, dying and diseased trees. In recent fellings it has been discovered that many of the living trees have butt-rot.

It was early realised that heavy thinning was an expedient treatment and it seems at this stage to be paying a return for stands so treated are ostensibly improving. It is important to note that even amongst the diseased stands there are degrees of failure and a careful examination on these lines may confirm that choice of site was an important contributory factor to this matter. In this connection it is worth remarking that in one case very small changes in the topography have resulted in a marked difference in the condition of the crop, the trees in the shallow depressions or channels having suffered less seriously than those on more exposed or elevated ground.

Enquiries locally from Mr. W.M.F. Vane whose ancestors afforested considerable areas in the neighbourhood show that a century ago successive failures of the planting of European larch were experienced and there are existing stands in the locality of the same age as the crop under discussion, which exhibit many of the signs of failure seen at Thornthwaite.

On the question of seed provenance little is known by the local officers, but again it has been conjectured that the explanation may well lie in that quarter.

Japanese larch

It may be said that many sites where formerly European larch was planted are now afforested with Japanese larch. Well drained slopes seem to suit it best and it can be taken to quite considerable elevations. Canker does attack the trees, but so far not on any extensive scale and even on old woodland areas, where the growth rate appears to be very rapid, there are no signs

of widespread butt-rot although some isolated cases have already been reported and it seems likely that it may develop after the second or third thinning. This is, however, largely conjecture. It is inferior in form to well grown European larch and there are indications that the growth rate in some of the earlier planted stands is beginning to decline. This is not as yet confirmed. The planting of this species must be done as early in the year as possible and it must be done well with good plants or failures are likely to be heavy. Thinnings in a crop of Japanese larch must not be delayed and should be relatively heavy or whips are likely to develop and like European larch underthinning seems to predispose this species to disease.

Scots pine

This species has proved most tolerant. It is undoubtedly a useful nurse for spruce particularly on heather ground and once established is very wind firm. Its importance in this locality may well have been undervalued. Snow damage might be an increasing risk however and more attention is needed to choice of race in this connection.

Corsican pine

In view of the prevalence of Brunchorstia in the existing stands, this species is not a good proposition particularly at high elevations.

Mountain pine

The question of seed provenance with its bearing on form and growth habit is of considerable importance as this is regarded as a useful species for high elevation planting and may be exposed to considerable risk from snow damage once it reaches the pole stage. So far this tree has done well at high elevations.

Pinus contorta

The remarks for the previous species apply here also. There has been some disappointment due to the very poor form of some of the small stands of this tree, but it had proved very tolerant and hardy.

Other Conifers

Of these Tsuga should receive the most attention as it is a valuable species which is very useful for underplanting purposes and tolerant in its

soil requirements. It is, however, inclined to be very frost tender. It is important that where possible species such as this should be introduced as they provide valuable information as to possibilities for the next rotation should it be necessary or desirable to effect a change of species. In addition underplanting may be used on an increasing scale particularly in the case of the larches.

Hardwoods

For commercial purposes these species have so far played a very small part in the life of this forest. However, at low elevations, wild cherry, beech, red oak, and birch have all done well and from a silvicultural point of view it may be of considerable value to introduce some of these species into the next rotation. This, however, is a very complex problem which cannot be dealt with summarily. Ash, at low elevations and on fertile ground has shown that it may have a useful but very limited part to play in this locality. There is no doubt, however, that the treatment of this exacting species has not been well understood.

Beech has had a limited success at low altitudes particularly in the roadside amenity belts at Wythop and Dodd W.S. and this success has been shared by the American red oak which has been used almost exclusively for amenity purposes. There is a small block of this species at Messengermire which has been planted for commercial purposes and is so far satisfactory. Birch has offered no difficulties but it has been regarded as something of of a weed. Sycamore has been found as a species occurring naturally and sporadically throughout the forest and has proved capable of competing with Douglas fir in close canopy, notably at Wythop. It forms however a negligible proportion of the crop. Wild cherry, planted in the amenity belts has prospered.

Natural Regeneration

There exists, in the form of a naturally regenerated crop of European larch, in the Coombe (Thornthwaite W.S.) evidence that this method of regeneration is feasible given suitable conditions. Furthermore, there have already been signs of Sitka spruce regenerating itself. From an amenity point of view alone this is a vital question in this neighbourhood but comment at this stage would be largely in the nature of speculation.

Planting

a) Method of Planting

Initially direct planting was employed and there was some difference of opinion as to whether shallow or deep planting for spruce was advisable. For many years mattock, Schlich and garden spades were used on all types of ground for both L and T. notching and after the earlier planting screefing was done in varying amounts. Finally after 1928 turf planting became more extensively used on the wetter sites and mattock planting was restricted to the shallower soils.

b) Annual Rate of Planting

The mean annual rate of planting was 122 acres. In the first twelve years, however, the rate varied between approximately 200 acres and 300 acres with the exception of the fourth and fifth years (115 acres and 15 acres). From the thirteenth year onwards the rate rarely exceeded 100 acres per annum. Only 2 acres were planted in 1947 and there was no planting in 1951.

Drainage

Drainage at this forest is not the critical problem that it is for example in the Border forests. Nevertheless, lack of experience in the beginning resulted in the haphazard cutting of turfs without attention to the drains and it was soon realised that more care and thought on this matter was needed.

Improved methods of Ground Preparation and Extraction of Timber

The advent of ploughing as a standard method of ground preparation did not result in the wide application here that it received elsewhere, again because of the nature of the terrain. However, it has been used where at all possible, the recent ploughing for planting at Darling How being the sole example. The Cuthbertson plough with an R.4 crawler tractor was employed.

Beating-up

This was continued for what would now seem an excessive number of years, but there are some instances of a lack of beating-up resulting at a later stage in poor stocking. In some cases the original species were changed and there is one interesting example of Japanese larch beaten up with European larch. Scots pine and Norway spruce were both replaced by Sitka spruce at high elevations and Norway spruce was beaten up with Scots pine on heather

ground. European larch was beaten up with almost every species found in the forest. It may be said that the history of beating-up at Thornthwaite constitutes an interesting indicator or record of the experience gained in the selection of species for particular sites.

Weeding

Here again, for various reasons, there was some neglect and some strong criticism was made in the early years as a result of the adverse effect of this lack of treatment.

Cleaning

This became a matter of interest at a comparatively late stage in the life of the crop. There is one point of considerable interest, however, which is the need which arose at quite an early date for the pruning of the Scots pine nurses in the Norway spruce/Scots pine mixture in which the former were tending to become suppressed by the nurse species. The other concern with this item was that of cost and there has consequently been a great deal of discussion and investigation about it

Mixtures

The history of the development of mixtures due to beating-up with species other than those originally planted, is rather complex. Furthermore the records are rather inadequate particularly with regard to comparative growth rates and vegetation. The following notes are based on (a) written records (compartment records, etc.), (b) reports from staff present during the operations in question (Forester Wells), (c) examination of the existing crop.

European larch

(a) P.20 Compartments 4 and 5. Elevation 1000 ft. Aspect easterly.
Vegetation fell pasture grasses and bracken.
(50%) beat up in P.39 with Lawson's cypress.
Condition in 1938; larch badly cankered, many dying back, height 6 ft. to 20 ft.
Condition in 1951; Larch badly shapen, small crowns, showing some signs of improvement, height 20 ft.
Lawson's cypress healthy, height 15 ft.

(b) P.21 Compartment 23. Elevation 1300 ft. to 1500 ft.
Aspect east-south-east.

Vegetation fell pasture grasses and bracken.

Heavy beat up in P.23 with Japanese larch.

Condition in 1938; European larch dying back and cankered.
Height 4 ft. to 15 ft.

Japanese larch established

Condition in 1951; European larch little remaining.
Height 15 ft. to 25 ft.

Japanese larch well grown, height 25 ft. to 30 ft.

Beaten up with Sitka spruce in P.30 (wet patches).

Condition in 1938; Larch failed.
Sitka spruce height 6 ft. to 10 ft.

Condition in 1951; Sitka spruce height 25 ft.

(c) P.21 Compartments 26 and 27. Elevation 1000 ft. to 1250 ft.
Aspect south-east.

Vegetation fell pasture grasses and bracken.

Beat up (50%) in P.28 with Japanese larch and Corsican pine in Compartment 26, and Japanese larch and Sitka spruce (wet patches) in Compartment 27.

Condition in 1938; European larch dying back and cankered; height 6 ft. to 20 ft.
Japanese larch satisfactory, height 15 ft. to 20 ft.
Corsican pine satisfactory, height 10 ft. to 15 ft.
Sitka spruce satisfactory, height 6 ft. to 12 ft.

Condition in 1951; European larch badly shapen and stocking heavily reduced, height 15 ft. to 25 ft.
Japanese larch satisfactory, height 25 ft. to 35 ft.
Corsican pine satisfactory, height 25 ft.
Sitka spruce satisfactory, height 25 ft. to 30 ft.

(d) P.21 Compartments 24, 25, 26, 30 and 31, and P.22 Compartment 23.
Elevation 1250 ft. Aspect easterly.

Vegetation fell pasture grasses and bracken.

Beat up (66%) in P.39 with Lawson's cypress and Tsuga and/or Douglas fir and Tsuga and/or Douglas fir and Sitka spruce.

Condition in 1938; Not known accurately, but records indicate that European larch was badly diseased and of irregular height; growth from 6 ft. to 20 ft.

Condition in 1951: European larch badly shapen and stocking much reduced, height 20 ft.
Lawson's cypress satisfactory, height 12 ft. to 15 ft
Tsuga satisfactory, but much damaged by sheep and deer in Compartments 30 and 31, height 12 ft. to 15 ft.
Douglas fir satisfactory, height 15 ft.
Sitka spruce satisfactory, height 15 ft. to 20 ft.

Douglas fir.

P.20 Compartments 1 to 4. Elevation 1000 ft. and Compartments 6 to 8, elevation 1250 ft. Aspect northerly.

Vegetation fell pasture grasses and bracken with damp patches carrying Juncus spp.

Beat up (40%) in P.30 with Sitka spruce.

Condition in 1938: Douglas fir suffering from exposure to wind, height 4 ft. to 10 ft.
Sitka spruce satisfactory, height 3 ft. to 6 ft.

Condition in 1951: Douglas fir very coarse and high proportion of wolves height 30 ft.
Sitka spruce of superior form, height 25 ft. to 30 ft.

Japanese larch

There is a rather unusual instance in Compartment 28 where Japanese larch P.21 was beaten up with European larch in P.23. The European larch is now growing indifferently and is about 20 ft. to 25 ft. in height. It is, however, better than comparable European larch elsewhere. Elevation 1000 ft. Aspect southerly. Vegetation fell pasture grasses and bracken.

Scots pine

Scots pine is mentioned in the records as a species which was used for beating-up. However, in most cases it was used to replace other species and no mixture followed. All the instances were on heather ground where either European larch, Japanese larch or Norway spruce had failed completely.

Treatment of Mixtures

The treatment of these areas of mixtures was an empirical one based on the condition of the trees at the time of thinning. There are no recorded instances of inferior trees being favoured in the hope that they might, at a future date, succeed. The consequence of this is that the original species has tended to fall in numbers as thinnings and cleanings proceeded. There has been a tendency of late to maintain the remnants of the European larch where it was the original species and wherever there has been a reasonable hope of success the European larch has been favoured. Signs of improvement in the condition of the better class survivors has encouraged this policy.

Rate of Growth

The following table includes such data as available at the present time and gives as far as possible a representative picture for several species and sites.

Working Section	Cpt.	Species	P.Y.	Elevation (feet)	Aspect	Standing Crop Av. B.H.Q.G.	Standing Crop Height	Date of Measurement.	Stocking Before Thinning	Stocking After Thinning	No. of stems Remvd.	Average Height of Thinnings
Wythop	3	D.F.	25	300/600	Northerly	6^2	50'	Jun.1949	415	267	148	40'
"	5	D.F.	25	250/600	W. of N.	6'	54'	Jun.1949	510	325	185	44'
"	15	S.S.	33	800	N.	5'	42'	Nov.1948	1110	920	190	28'
Dodd	(4	D.F.	28	300/800	S.W.	5'	40'	Mar.1949	760	670	90	27')
"	(4	D.F.	28	"	"	5'	42'	Jan.1951	670	590	80	32')
"	(5	D.F.	28	300/800	S.W.	5^2	42'	Dec.1948	655	575	80	35')
"	(5	D.F.	28	"	"	6	45'	Feb.1951	575	467	108	41')
"	14	N.S.	26	1150/1300	Southerly	3^2	28'	Nov.1949	1250	1060	190	18'
"	15	N.S.	26	1250/1270	Easterly	3	27'	Dec.1949	1885	1335	550	17'
"	26	S.S.	29	600/800	Westerly	4'	32'	Nov.1948	605	530	75	29'
Sethmurthy	3	S.S.	29	600/700	S.W.	3^2	29'	Apr.1949	1875	1440	435	18'
Whinlatter	21	S.S.	20	1000/1150	Easterly	5	50'	May 1949	1047	757	290	33'
"	22	S.S.	20	1050/1160	"	6	42'	Jul.1949	790	540	250	36'

Thinning

This has been the latest stage in the history of the forest to date. Systematic thinning operations began in 1933. Again methods were tentative to start with and there was a wide difference of opinion as to the timing of the operation and its intensity. It was, however, generally agreed that Douglas fir would tolerate a heavier thinning than the other species with the notable exception of the larches.

Considerable discussion arose on the question of the removal of the small number of hardwoods which existed in the coniferous crop and it was thought by some that sycamore in particular was proving harmful. This view was countered by those who were keenly aware of the importance of the amenity question in this locality, a matter which was to be a continual source of criticism from many quarters.

The thinning of plantations formed by the Forestry Commission started in F.Y.37 although previously there had been a small amount of work in the acquired plantations.

The following table gives details of work done:-

Forest Year	Area, Acres			Volume Hoppus Feet O.B.	
	1st	Subs.	Total	Total	Per acre
37	45	21	66	Not recorded	-
38	24	44	68	"	-
39	18	26	42	"	-
40	7	45	52	"	-
41	81	33	114	"	-
42	57	56	113	"	-
43	93	10	103	"	-
44	30	34	64	6,700	105
45	44	151	195	54,500	280
46	97	91	188	Not recorded	-
47	114	18	132	"	-
48	302	52	354	55,000	155
49	161	305	466	117,500	250
50	167	254	421	118,000	280
51	141	399	540	192,000	355

Types of Produce

Until recently produce has been confined to the following:-

Pit props, all sizes
States and fencing material
Rustic poles
Firewood

In recent years, particularly since F.Y.49 the range has increased to include:-

Pulp wood
Wood wool
Round wood (an increasing amount)
Butt ends for conversion

Telegraph and ladder poles continue to play little or no part in the consumption of our thinnings.

Decorative foliage has been a useful outlet for the tops of Thuya and Lawson's cypress. Christmas trees have been sold on a large scale for many years now.

Thinning Grades

Previous to 1951 the normal grade of thinning for all species was light to moderate. The establishment of Research Branch permanent sample plots in each of the main producing species (Japanese larch, Norway spruce, Sitka spruce and Douglas fir) was then accepted as a pattern and recent thinning has been moderate to heavy in Japanese larch, Sitka spruce and Douglas fir, and in Norway spruce at low elevations. At the higher elevations Norway spruce has been thinned to a light crown grade with the object of producing a two storied canopy as protection against wind and snow damage. The only other principal species, European larch has largely thinned itself, the constant removal of dead, dying and diseased trees operating in effect as a heavy grade.

The early thinnings were undertaken here and there, wherever access and extraction were possible and the crop ready. Development of the forest road system since 1948 has enabled the work to be organised more systematically, and the whole forest is now covered progressively, block by block, on a three year cycle. The intention is that the faster growing stands will thus be thinned every 3 years and the slower growing stands every 6 or 9 years.

Notes by Research Branch

Permanent Sample Plots at Thornthwaite Forest

Permanent sample plots were first established in Thornthwaite forest in September 1950, when six single plots were laid down, one of Sitka spruce in the Higham section, one Japanese larch in the Whinlatter section, and two plots of Douglas fir, and one plot each of Sitka and Norway spruce in the Dodd section. The following table shows the results of these measurements:-

Thinning Grade	Age of Crop	Main Crop					Yield from Thinnings			Total crop Yield to Date	
		Number of trees per ac. after thinning	Height: Av. of 100 largest trees	Height: Av. of Crop	True Girth at 4'3"	Basal area per ac. after thinning	Vol. per ac. (under bark) Q. G.	No. of trees	Basal area per acre Q.G.	Vol. per ac. (under bark) Q.G.	Basal area Q.G.	Vol. (under bark) Q.G.
	yrs.		ft.	ft.	ins.	sq.ft.	cu.ft.		sq.ft.	cu.ft.	sq.ft.	cu.ft.
		Plot No. E. 261 Sitka spruce Q.C. IV. Cpt.3. Higham Section										
C/D	22	795	35	32	17½	104.5	1287	695	46.6	498	151.1	1785
		Plot No. E. 262 Japanese larch Q.C. I. Cpt.41 Whinlatter Section										
D	29	273	54½	52½	24	67.3	1420	333	38.6	783	105.9	2203
		Plot No. E. 263 Douglas fir Q.C. II Cpt.24 Dodd Section										
C/D	21	396	50½	48	23	90.6	1633	305	42.7	746	133.3	2379
		Plot No. E. 264 Douglas fir Q.C. IV Cpt.23 Dodd Section										
C/D	21	620	41	39	19	95.2	1394	290	31.0	398	126.2	1792
		Plot No. E. 265 Sitka spruce Q.C. V Cpt.17 Dodd Section										
C/D	24	878	28½	26½	15½	93.0	1031	602	49.3	498	142.3	1529
		Plot No. E.266 Norway spruce Q.C. III Cpt.15 Dodd Section										
Light crown	25	1338	32½	28½	14	114.9	1191	449	37.8	389	152.7	1580

Plot E.261 Sitka spruce, is situated 650 ft. above sea level on a slope of about 5°, the aspect is west-north-west and the plot is fully exposed. The crop was planted 5 ft. x 5 ft. in 1929, with plants ex Hamsterly 2 + 2 and Allerston 3 + 2, Ident. No. 24/15. In 1931 the crop was beaten up with 3 + 1 + 1 and 2 + 2 transplants and in 1935 was further beaten up with 3 + 2 transplants which were planted on mounds. The crop was brashed in 1949.

The soil is a medium loam over a parent material of slate and hard shale, roots of crop descend to about three feet. There is no ground vegetation in the plot, but the following grasses, Agrostis, Holcus, Deschampsia and Dactylus appear in the rideside adjoining the plot, along with Viola, Carduus, Galium saxatile and Hylocomium loreum.

Before thinning treatment, stocking was dense and distribution very groupy. The crowns on the dominant trees were deep but inclined to be flattened and those of the lower classes were much shallower and very compressed due to dense stocking. Many forked leaders and deformed tops were in evidence, which may be attributable to wood pigeon damage and exposure. Stem form was moderately good among the dominants, but waviness was frequent throughout the other classes. Girth and height growth are uniform throughout the plot. Height growth had averaged 18 in. to 24 in. per annum over the past five years. After thinning the stocking was full but the distribution remained groupy and there was a moderate break in the canopy.

The Japanese larch plot in the Whinlatter section is 300 ft. above sea level on a slope of 30°. Its aspect is east-north-east and the plot is fully exposed. The soil is a medium to heavy loam with many stones in admixture over a parent material of slate and hard shale. Roots of crop descend to about 40 in. There is a complete covering of ground vegetations in the plot consisting of, Festuca ovina, Agrostis canina, numerous mosses, including Sphagnum acutifolium on wet outcrop areas, bracken, bramble seedlings, Oxalis and Ajuga reptans. The crop had been lightly thinned twice, in 1936 and 1942, prior to its establishment as a sample plot, but these had not affected the density to any great extent, overstocking was still existent prior to treatment, and several whips were present. There was a light break in the canopy and the majority of the crowns were flattened and shallow except for a few well shaped crowns in the larger dominants.

Distribution was fairly even, and stem form was fairly good. Girth and height growth are uniform throughout the plot but there is a slight falling off at the south-west edge of the surround on outcrop areas. Height growth has averaged 12 in. - 18 in. per annum over the past five years. Whips and defective trees were removed at this thinning. 40% of the thinnings showed stain, and in 6 trees this had advanced to rot.

Douglas fir plot number E.263, is 400 ft. above sea level on a slope averaging 24° facing west-south-west. The plot is fully exposed. The crop was planted in 1930 with 2 + 3, 2 + 2 and 2 + 1 transplants ex Thornthwaite and was lightly beaten up in 1931 and 1933.

The soil is a medium to heavy loam, containing many stones. Loose shaly stones and boulders are present on the surface. Roots of the crop descend to about 36 in. There is no vegetation in the plot but bracken, bramble and mosses and some sycamore, oak and birch seedlings are evident on the rideside.

The plot had been lightly thinned twice in 1947 and 1949 prior to the establishment of a sample plot but stocking was still dense and the distribution was regular, with a light break in the canopy before thinning treatment. Crowns are moderately deep, stem form fairly good, especially among dominant trees. Girth and height growth was fairly uniform but there was a slight tendency of a fall off in height growth with a few of the dominants. Over the past five years, height growth had averaged about twenty-four to thirty-six inches per annum.

After thinning there was a moderate break in the canopy and occasional gaps where defective dominants have been removed. Half of the thinnings revealed stain. This plot is for comparison with the other Douglas fir sample plot number E.264 which stands higher up the hill at an elevation of 600 ft. with the same aspect, and degree of exposure.

The soil is not so deep and roots of the crop descend to about thirty inches. Again there is no vegetation in the plot but on the side of a newly constructed road near the crop Hypnum filiforme, Thuidium tamariscinum, and Galium aparine are found.

The crop was planted in 1930 at 6 ft. x 6 ft., with 2 + 1 transplants and was beaten up in 1933 with 2 + 1 year old plants. This crop had received only one light thinning in 1947, prior to the establishment of a

sample plot, but stocking was full and distribution was irregular before treatment this time. Many stems were wavy, the crowns were deep and flattened on the upper side of the stem. Girth and height growth were uniform throughout and although past height growth has not been so vigorous in this plot as in E.263, there being almost 10 ft. difference in the respective mean heights, height growth over the past five years has averaged from two to three feet per year, the same as in the plot lower down the slope. Between the years of growth 1945 to 1947 it was noticeable that certain stems had suffered defoliation and this may have affected the height growth of the plot to some extent.

Plots E.265 and E.266 are at considerably higher elevations than any of the other plots at Thornthwaite. Both of these plots are at an elevation 1250 ft. on slopes averaging 20° - 25°, and are situated on opposite sides of a hill. Both plots are fully exposed, the Sitka spruce plot E.265 to the north-north-west and the Norway spruce to east-south-east.

The Sitka spruce is on a medium loam, about 18 in. deep, below this is a slate formation of the parent material. Roots of the crop descend to 18 in. There is no vegetation in the plot but in the rideside adjoining the plot are found, Festuca ovina, Calluna, Vaccinium, mosses and lichens.

The crop was planted in 1927 at $5\frac{1}{2}$ ft. x $5\frac{1}{2}$ ft. with 2 + 2 year old transplants ex Rothbury. Brashing took place in 1950 and in August of that year the crop also received a light thinning removing 222 stems per acre. On establishment as a sample plot in September 1950 a further 380 stems were removed. Prior to this second thinning the stocking was full and distribution irregular, grouping being common. Deformed tops were common due to missing leaders, this may possibly be due to exposure. Many deformed stems were present, the worst being removed in this second thinning. Height and girth growth are fairly uniform throughout the plot, but there is a slight tendency to fall off at the top of the slope. Height growth has averaged from one to two feet per year over the past five years.

The Norway spruce plot No.266 is growing on a heavy loam about 20 in. deep, below which is the parent material of slate and hard shales. The lower 12 in. of the soil was tending to be waterlogged but natural drainage occurs over the top of the parent material. The soil vegetation along the rideside bordering the plot is Festuca ovina, bracken, Calluna and

Vaccinium, with mosses.

The crop was planted in 1926 at 5 ft. x 5 ft. with 2 + 3 transplants ex Rothbury. It was brashed and received a light thinning in 1949. Before receiving a second thinning, the distribution was regular and canopy complete. Crowns were deep and symmetrical on the dominants but tended to be flattened on the lower canopy classes. Stem form was good throughout. Height and girth growth are fairly uniform except for a slight dropping off in height on the south edge of the plot. After thinning there was a light break in the canopy with occasional moderate breaks where defective dominants had been removed.

The drainage in this plot is very free but the shallowness of the top soil may subject the plot to windblow. In addition a new road is being made, passing close to the eastern edge of the plot, the road having been cut in the direction of the prevailing wind may also increase the risk of blow in the plot.

"J. M. Christie"

March 1952.

APPENDIX I

Notes from Inspection Reports 1922 - 1949

Date	Inspecting Officers
June 22nd & 23rd 1922.	(Technical Commissioner with (Messrs. Long & Hopkinson.
June 4th, 1925.	Technical Commissioner
December 6th, 1927	" "
April 18th, 1930.	" "
September 19th, 20th, 21st, 1930.	Mr. O. J. Sangar
July 1931.	Divisional Officer - Mr. Hopkinson
July 1932.	Mr. O. J. Sangar
July 26th, 1932.	Chairman and Assistant Commissioner and others.
April 6th, 1934.	Chairman and Assistant Commissioner
July 1934	O. J. Sangar
October, 1935.	Assistant Commissioner
" 7th, 1936	Chairman
December 17th, 1938	Technical Commissioner & Assistant Commissioner.
January 7th, 1940.	Acting/Assistant Commissioner
May 25th, 1942.	Chairman
February 7th, 1943.	Acting/Assistant Commissioner
May 31st, 1943.	Chairman
September 2nd, 1944.	Chairman
May 18th, 1945.	Chairman and Guests
July 27th, 1946.	Director (E)
September 9th, 1946.	Chairman
November 8th, 1948.	Conservator State Forests
March 25th, 1949.	Director (E)
June 6th & 7th, 1949.	Chairman

1. Most of the early reports were concerned with the suitability of the various species employed and the choice of sites for them. In 1925, the present Chairman (then Technical Commissioner) commented on the relative success of the spruces and observed that Sitka spruce was probably the best tree over the whole area and that it showed successful growth even at the highest elevation.

2. Mention of the failure of European larch was first recorded in 1927 by the Chairman and in 1934 Mr. O. J. Sangar recorded that the European larch was most disappointing with the trees unhealthy almost without exception. There must have been a marked change in the crop from 1932 to 1934 for in his report at the earlier date his comments on the European larch indicate that it compared not too unfavourably with the other species, although he does mention that a good proportion of it has been beaten up with Sitka spruce, Douglas fir and Japanese larch.

3. In 1930 the Chairman again drew attention to the superiority of Sitka spruce at high elevations but the failure of Douglas fir at similar altitudes is first mentioned here. In this report also the Norway spruce/Scots pine mixture on Swinside is first mentioned and the Chairman had some adverse criticism to offer on this point with particular reference to the instability of the pine; he also commented on the fact that the Norway spruce were in check. It is interesting to note that the mixture was put in in the absence of a supply of Sitka spruce, the Scots pine being used to nurse the Norway spruce.

The question of planting methods is first considered in this report and the Chairman stressed the need for shallow planting with spruce, and instructed that deep notching with a mattock or spade was not to be used. In Mr. O. J. Sangar's report of 1930 he refers to the increase in the amount of turf planting (commencing in P.29) carried out, although planting with a Schlich spade still continued. There is also the interesting comment that there was very little drainage at this stage.

4. In 1932 a detailed survey was made by Mr. O. J. Sangar in which he relates that in the early history of the forest there was extensive damage from sheep and mice. Other causes of failures which he listed were, planting methods, type of plant, exposure and insufficient

drainage.

Several reports by other officers including Mr. Sangar mention rabbit and mice damage at Setmurthy, the beech and Japanese larch being particularly susceptible. There are some interesting comments about the success of various species and that on the favourable height growth of the Douglas fir, below 1,000 ft. is noteworthy. The European larch which is described as having suffered from windblast was said to be improving with the canopy beginning to form in places. The Corsican pine had suffered badly from windblow and the disease Brunchorstia had just made its appearance. Again the superiority of Sitka spruce at high elevations is commented on and the planting of Norway spruce in dry Calluna areas is criticised.

A most important note on the European larch (P.25 to 28) on Wythop and Dodd appears in this report. It is stated that on similar ground the European larch is closely comparable with the Douglas fir in its progress and on the more exposed slopes it is markedly better.

In reporting on the Norway spruce/Scots pine mixture in the Swinside W.S. the Norway spruce on the ground other than the dry Calluna areas is described as healthier than the Scots pine although the latter still lead in height growth. There is adverse criticism of the Norway spruce/Scots pine mixture (P.29, 30) where the Norway spruce had suffered heavy losses and the Scots pine had been badly damaged by wind. However, in 1932, on an inspection of this mixture by the Chairman, the Norway spruce were seen to be emerging from check and the Scots pine were now described as windfirm.

5. Mr. O.J. Sangar carried out another detailed inspection in 1934 and it is this report which indicates with some exactitude the date at which the European larch began to suffer badly. Mr. Sangar's comment that the European larch were almost without exception unhealthy and that canker was prevalent is noted by the Divisional Officer as being probably temporary as the European larch were looking well in 1933. This corresponds with Mr. Sangar's own report in 1932 and indicates that 1933/4 was the critical period for the European larch. It is in this report that the term "die-back" first appears and it is applied

to trees of up to 15 ft. in height. Unfortunately, the age of the crop is not specified but from the text it would appear to be mainly F.Y.25 to 28 planting.

Of the Swinside Norway spruce/Scots pine mixture the first favourable comment appeared in this report and the P.26 Norway spruce were said to be growing vigorously with the P.27 out of check. The Scots pine still lead but the Norway spruce were said to be catching up. There were some interesting comments on the ecological changes in this area since 1932. The P.29 and 30 Scots pine/Norway spruce mixture was still criticised and further beating-up with Sitka spruce was recommended. Comments were also made on European larch/Scots pine mixtures on the Calluna areas which were generally unsatisfactory; Douglas fir on similar ground was not prospering but was doing very well in old woodland sites. The Scots pine/Sitka spruce mixtures on Erica areas were reported on with the Sitka spruce described as still in check; where the Erica was absent the spruce were out of check.

6. In a report on the Chairman's visit of 1936, the Norway spruce/Scots pine mixture at Swinside was again discussed and the Chairman here recommended the pruning of certain Scots pine which were tending to suppress the Norway spruce.

7. Inspection reports continued to speak of the unsatisfactory condition of the European larch and at the Chairman's inspection of 1942 the question of the underplanting of the existing crop was first discussed. Thuya, Tsuga, and Lawson's cypress had been the species employed. It was advised that the best stems of the European larch should be retained.

8. Brashing and thinning of the Douglas fir was first mentioned at an inspection by the Acting/Assistant Commissioner in 1940 and the question of the retention of the hardwoods, particularly sycamore, was discussed then and at several subsequent inspections.

9. In 1943 the Chairman considered that the Norway spruce/Scots pine at Swinside was satisfactory and that pruning of the Scots pine need not proceed; thinning would be the next operation.

10. In the report of the Director General's visit in 1946 the P.27 European larch at Hospital Fell was thought to be improving. The die-back of the P.20 Corsican pine was said to be continuing. In 1948 the question of felling some of the Corsican pine (at Wythop) thought to be affected by Brunchorstia was raised but subsequently it was decided to leave the crop for more detailed examination by the Research Branch.

11. A detailed policy for the diseased European larch was outlined by the Director on the occasion of his visit in March 1949. It included among other measures the removal of dead and dying trees, after which the crop would be left for two years to determine the reaction of the remaining trees.

Hardwoods

12. Relatively little is said of the various hardwoods which form so small a proportion of the crop at Thornthwaite. However, the state of the red oak and beech in the amenity belt is commented on favourably and the beech in Compartment 5 at Dodd is particularly noted in the report on the Chairman's visit of 1944.

The small amount of ash at Messengermire is discussed at some length in the report of the Chairman's inspection of June 1949. In the early days there was some optimism about the beech/European larch mixtures which has not been justified by events.

APPENDIX II

Supervision

Conservators	1946-1947	Mr. G. W. Backhouse
	1947-	Mr. A.H.H. Ross

Divisional Officers	District Officers
1. Mr. A.P. Long	1. Mr. G.J.L. Batters
2. Mr. A.D. Hopkinson	2. Mr. J.R. Thom
3. Mr. A.H.H. Ross	3. Mr. A. Watts
4. Mr. G.W. Backhouse	4. Mr. E.E. Dixon
5. Mr. G.I. Mackenzie	5. Mr. C.D. Begley
6. Mr. J.S.R. Chard	

Thornthwaithe

THORNTHWAITE

CUMBERLAND

River Derwent

To Cockermouth

To Cockermouth

Higham Big Wood

Messenger Wood

Kilnhill

MURTHY

BASSENTHWAITE

BASSENTHWAITE LAKE

EMBLETON

WYTHOP

Beck Wythop Village

WYTHOP WOOD

Dodd Wood

LORTON

Darling How

Aiken

Lord's seat

Tarbarrel Moss

Coombe Plantation

Hospital Plantation

Buckstones

Thornthwaite

To Keswick

Hobcarton

Hobcarton gill

Swinside

High Lorton

West Beck

Braithwaite

To Keswick 1 mile

Braithwaite Bridge

BOUNDARY OF FORESTRY COMMISSION

PLANTED AREA

SCALE = 2½" TO ONE MILE.