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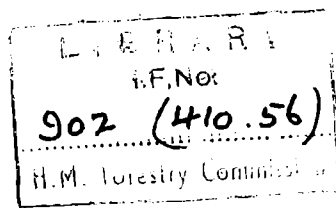
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HISTORY

of

GWYDYR

FOREST

1920 - 1951

NORTH (WALES) CONSERVANCY

FORESTRY COMMISSION

HISTORY OF GWYDYR FOREST

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## HISTORY OF GWYDYR FOREST

### CHAIRMAN'S COMMENTS

Mr. Hampson has written a very good and detailed history of the silviculture of the Forest.

My last inspection was made in April 1952 in the company of the Conservator Mr. Best, the State Forest Officer Mr. Cadman, and the local District Officers and Foresters. Thanks to the use of a Land Rover and the recent road construction I was able in a comparatively short time to get a good general view of the forest including the plateau land and plantings thereon.

The forest made a poor start and was described by our Chairman, Lord Lovat, in its early stages as our worst effort (with Monaughty a close second). There were various reasons for this: inexperience combined with over-optimism in handling the various types of land, too large planting programmes, inadequate supervision, sheep damage and impatience at the slow initial establishment of the new plantations. Sheep damage has been persistent and as lately as the middle of the war was excessive in Gwyndy, the tenant of which farm had ultimately to be turned out. Nevertheless there are large areas of excellent plantations which are yielding considerable quantities of valuable thinnings. The local economy has been greatly improved and the amenities also.

Optimism, apparently incurable, led to the planting of too much plateau land at a time when far too little was known of the reaction of the various species to the obviously difficult conditions. Only now from the results of the large scale plantations and the experimental plot established in Compartment 105, P.29, is a clearer view of the problems and their possible solutions being obtained. In this connection I have written and append a general note on what I have called the "Afforestation of hard-rock country" in North Wales of which the Gwydyr plateau land is one example.

Extraction remains a difficulty which requires more careful attention than it has received. Roads are essential but costly to construct.

It is of the utmost importance therefore that they are sited and constructed to the best advantage.

R.

July 16th, 1952.

## AFFORESTATION OF "HARD ROCK" COUNTRY IN NORTH WALES

The use of the term "Hard Rock" requires a little explanation. It is here used in distinction from the soft rocks, that is the shales which weather easily and normally provide a reasonably uniform cover of good soil and are commoner in occurrence as one moves southwards.

Lithologically the hard rocks are of various types which I do not propose to describe. The point is that they are massive, fissured but little, and weather slowly and frequently outcrop, so that the soil cover is discontinuous. The vegetation cover may not be so discontinuous because where the dip of the rock coincides with the slope of the land heather may grow on a thin peat layer. Where the dip of the rocks is broken across, soil collects towards the foot of the break and bracken may grow quite well. Between the successive breaks peat commonly forms and is characterised by the usual flora.

A great deal of hard rock country has been afforested at Gwydyr (plateau country) Beddgelert (igneous rocks) and Coed-y-Brenin (Fford Maesgwm section F.6. road). Apart, however, from the experimental area at Gwydyr (P.29, Compartment 105) and the "forest garden" at Beddgelert, it appears that little or no systematic experimental work has been done. Large scale afforestation has continued notwithstanding the fact that the earliest results have been so unpromising.

The tendency now seems to rely on Pinus contorta to a far greater extent for the solution of the problem, which may or may not in fact be soluble. In my view the whole position should be critically reviewed. This entails in the first instance a detailed investigation in which I would include the Hengwrt Section of Coed-y-Brenin which, though not situated on typically "hard rock" contains a number of interesting mixtures which should provide helpful information. These investigations must take into account not only the surface vegetation which can be most misleading if considered in isolation but also the soil characteristics.

As regards the relative merits of Scots pine and Pinus contorta I am by no means convinced that the latter is the more productive tree on the Gwydyr plateau up to 800 ft. or 900 ft., except on the completely exposed

tops where Pinus contorta grows slowly and in general does not seem to produce much timber. P.29, Compartment 105, should provide good evidence on that point.

As regards Coed-y-Brenin (Fford Maesgwm Section) a striking feature is the failure of spruces to develop in the dips where bog myrtle is now considered an indicator of difficult conditions. This seems to call for systematic mixtures and not the mere spotting in of a second species to bring along the checked spruces. Poor drainage is undoubtedly a factor and I was told that it is very difficult to rectify.

## HISTORY OF GWYDYR FOREST, NORTH WALES

### GENERAL DESCRIPTION OF THE FOREST

Gwydyr forest derives its name from the historic North Welsh estate which contributed the first section of 6,155 acres in 1920. Later substantial additions of land include those from Glyn Estate (1,075 acres), Penrhyn Estate (5,759 acres), Bwlch (682 acres), Cwm Penammen (1,815 acres), Hafod Gwennllian (592 acres), Hendre (626 acres), and Bennar (1,084 acres). There have been other, smaller acquisitions and altogether the forest now has a total area of 19,121 acres (September, 1950).

Points made by Mr. W. L. (now Sir William) Taylor and Mr. D. W. Young in their original acquisition reports included:-

- (a) The position is an ideal one for a State Forest, with ample scope for early extensions.
- (b) In some cases, the slopes are so precipitous that planting, felling and extraction will be difficult.
- (c) The higher ground is exposed for small plantations. Therefore the area of forest should be extensive and self-sheltering.
- (d) The position of existing small-holders was in doubt, but some had experience of forest work in the Estate woods, and it was advised that they be disturbed as little as possible.
- (e) The area lies in a favourite tourist resort. There had been public outcries at the wholesale clearances of woodland, including conifers, by a merchant during, and shortly after, the 1914-18 war. It was recommended that the Department should get in touch with organisations such as the National Trust regarding the re-planting of outstanding amenity areas.

#### Utilisation of Land (Sept. 1950)

		<u>acres</u>
Acquired economic woodland	...	490
Planted by F.C.	...	8652
Remaining to plant	...	2342
Nurseries	...	8
Agricultural	...	1882
Forest Workers Holdings	...	595
Unplantable land	...	<u>5152</u>
	Total	<u>19,121</u>



## Topography, Geology and Climate

The forest extends in a practically continuous block some 12 miles long by 6 miles wide, with Bettws-y-Coed at the centre. The approximate boundary points are:-

North	...	Dolgarrog
South	...	Conway lake
East	...	Conway river
West	...	Capel Curig

Elevation ranges from almost sea-level in the North at Trefriw, to 2,000 ft. at Penmachno in the South, and 2,600 ft. on the shoulder of Moel Siabod in the West.

The area is one of rocky moorland plateaux and peaks deeply divided by the three main rivers Machno, Lledr and Llugwy which join the Conway at Bettws-y-Coed.

The forest lies on Ordovician formations, mainly of slates and shales, which dominate the central and southern blocks and are workable at slate quarries in Capel Curig, Dolwyddelan and Penmachno. Volcanic extrusive lavas, ashes and tuffs of the Snowdon and Crafant series are widespread. Igneous intrusions cut through the sediments, particularly in the northern block, where mineralisation of these intrusions has produced workable lead deposits. Iron-ores, interbedded with black shales, and associated with sulphur, occur in the Trefriw area. Much of the forest soil is shaly loam of the podsollic group, often truncated on steep convex slopes to reveal the reddish "B" horizon. Mountain peats are frequent, and include Molinia moor, Calluna moor and Scirpus moor. The valley bottoms are of fertile alluvium and almost entirely devoted to agriculture.

Average rainfall varies from 50 in. on the low ground in the North to 80 or more inches on the high ground in the South and West. Rainfall is erratic and any month may be unusually dry or wet. It is on record that in the head waters of the Eigiau, some two miles to the north-west of the forest boundary, 26 in. of rain fell in five days in 1925. Snow is sometimes heavy at elevations over 1,000 ft. and exceptional falls of wet snow, as in 1938, may cause damage to plantations on the lower slopes. But the prevailing south-west winds from the sea fourteen miles away exercise a generally moderating effect and extremes of climate are rare. Spring frosts are often damaging, particularly on the plateau land and low elevation hollows. Gales in wet weather sometimes cause trouble from windfall, particularly on steep,

shaly slopes. At the bottom of deep draughty valleys in the South, wind exerts a limiting effect on tree growth.

### Types of Land and Vegetation

Within the forest boundaries, natural conditions for tree growth cover a very wide range, from fertile alluvial valley bottoms to exposed, craggy moorlands and extensive peat bogs. At the time of acquisition, a conservative overall production figure of 4,640 cu.ft. per acre was calculated for all recommended species, on a 70 year rotation. Forest land may be broadly grouped into five types: acquired economic woods, devastated woodland, slopes of non-peat land, peat land, and plateau land:-

#### (a) Acquired woods

The economic woods aggregate some 490 acres. These are grouped into the P.14-15 European larch, Norway spruce, Douglas fir and Scots pine in the Nant B.H. area (Compartments 16, 18, 27, 28), and the old oak at Bryn Engan and Bennar. There is a small plot of maturing Abies nobilis, Abies nordmanniana and Corsican pine at Gwydyr Uchaf.

In these acquired woods European larch shows moderate development on the lower slopes but is very poor on the higher ground and plateaux. Norway spruce, Douglas fir and Scots pine have done well on sheltered woodland sites, and specimens felled since the last war include:

(i) Norway spruce, Gartheryr, Compartment 129		
	Total Height	122 ft.
	Volume, q. g. o. b.	298 cu.ft.
(ii) Douglas fir	Coed Derw (private)	
	Volume q. g. o. b.	210 cu.ft.

The oak at Bryn Engan and Bennar is unusually fine for North Wales, when growing in sheltered pockets of deep woodland soil, but many trees are past maturity and are "shaken".

#### (b) Devastated woodland

These areas comprise most of the steep slopes rising from the river valleys, and the fringes of the plateaux. They are often very rocky with much scree, e.g. the slopes of the Lledr, Llugwy and West Conway valleys. The vegetation ranges from a rich woodland flora of ferns, fine grasses, bramble and honeysuckle, through bracken and gorse to heather and bilberry on the rocky outcrops. The timber was felled during, and shortly

after, the 1914-18 war. The woods were of mixed character, the conifer groups containing fine specimens of good quality Norway spruce, Scots pine, silver firs, Weymouth pine (90 ft. - 110 ft. at 90 years), and Thuja plicata (90 ft. at 55 years). All that remained after the felling, apart from (a) above, was the interspersed oak of poorer quality, a little beech and much birch. Damp gulleys and flats near the valley bottoms grew ash, alder and sycamore of marketable size and quality.

Acquisition report assessments of the average quality of this type of land worked out as follows:-

<u>Species</u>	<u>Quality Class</u>	<u>Vol. per acre on 70 yr. rotation</u>
Norway spruce	70	8,100 cu.ft.
European larch	60	4,100 " "
Scots pine	50	4,470 " "
Douglas fir	80	6,900 " "

The figures are probably conservative, being based on inferior timber left standing by the merchants.

(c) Slopes of non-peat land

These usually carried a vegetation of bracken, grass and sparse scrub-woodland: the North Welsh "ffridd", as exemplified by the Machno and Glascwm valley slopes. The ground was previously devoted to sheep and summer cattle-grazing.

(d) Peat land (excluding plateaux)

These comprise the gentler slopes and flats in the highest rainfall areas, e.g. Bwlch, parts of Hafod Gwennlian, and the heads of the cwms in the Penmachno area. Vegetation ranges from rushes/moss to Scirpus/cotton grass associations; there are large areas of pure Molinia. Natural drainage is slow, but not unduly impeded by rock outcrops and shelves. The land was devoid of tree growth, but there are remains of birch and rowan in the peat. It was previously devoted to poor quality sheep-grazing, often infested with fluke as a result of neglected drainage.

(e) Plateau land

The plateau land is a complexity of rocky intrusions and shelves, causing corresponding variations in natural drainage and vegetation, from bracken/grass to cross-leaved heath/Scirpus. Typical areas are the uplands in the central and northern blocks, e.g. Llyn Elis, the Glyn, and Coed Mawr.

The plateaux formerly provided rough sheep-grazing on the systematically burnt heather/gorse area, with small patches of enclosed cattle-grazing on the bracken/grass associations.

This plateau land has been recognised from the time of the first acquisition report as a difficult and doubtful planting proposition. Most of it is heath and bog, broken up by rocky intrusions of "cheesy" peat which impede drainage and make ploughing uneconomical. At one time, it was suggested that a given area of such land could be regarded as plantable if 50% was reasonably good ground. The Chairman decided in 1937 that more than enough planting had been done on doubtful ground and that similar ground should be left alone until there was more evidence to go on. When all the definitely plantable land had been planted up, the proportions of good and bad land on the plateaux could be worked out by strip surveys before arriving at a decision. (Chairman 15.10.37 and minute of 13.7.38 covering Working Plan Part II Sect.19). Inspecting officers generally have given instructions on the same lines (Technical Committee 17.10.29, Assistant Commissioner 25.7.34).

However, much of this plateau land has been planted, notably Glyn P.28 - 32, Compartments 205-235; Cwm Celyn P.33, Compartments 158-165; Mynydd Bwlch-yr-haiarn P.22, 29-32, Compartments 101-111 and West of Parc Lake, P.23-33. Results are very patchy and seldom satisfactory but many of the worst areas are evidently caused by an incorrect choice of species and type of plant. There are records of the extensive use of seedlings, some of them Norway spruce, on the poorest sites at Glyn. The long period of check, and considerable failed areas, produce a grave fire hazard, and a large proportion of the poorest plantations have been destroyed in the bigger Gwydyr fires of 1938-51. General instructions are that no more money shall be spent on the remainder, except on maintenance of the best patches, and reasonable fire protection measures. Many references to the problem of the plateau land are made in Inspection reports, notably those of 26/27.10.29, 4.2.32, 19.12.32, 25.7.34, 15.5.35, 27.1.37, 30.6.37 and 15.10.37.

## Protection

### (a) Fire

A railway line runs for eight miles through the forest, mostly on a steep up gradient and using locomotives of ancient stock. The area is a favourite resort of tourists and hikers. The mountain boundaries adjoin grazing land which it had been customary to burn indiscriminately for generations. Therefore, fire protection has proved an unusually important feature of the work at Gwydyr. At one period it was estimated that expenditure on fire-protection had increased the cost of establishment and maintenance by 30%. In a bad year, Gwydyr has recorded up to 70% of the total number of fires in the Conservancy. The known risks, such as the railway and much frequented tourist areas can be adequately guarded against. But fires from adjoining land and from unknown causes have caused the greatest damage and proved most difficult to guard against within the bounds of reasonable economy. The Heather and Grass Burning Regulations (1949) have done an appreciable amount of good in reducing the danger of unnotified burning on adjoining land, particularly when a uniformed police officer is taken to investigate the outbreaks. The risks from unknown causes have been reduced by concentrating the approved expenditure on the provision and maintenance of a smaller number of efficient breaks strategically placed to break up the larger blocks of plantation. This is a difficult task in the Gwydyr terrain and the chief protection has always been the mobility and zeal of the forest workers and local staff.

### (b) Sheep

The Welsh mountain sheep is notoriously agile; the forest is intersected by minor public roads which cannot always be efficiently gated. The Chairman has said that sheep are the cause of many gaps in plantations, which become too tall to beat-up. Particularly troublesome was the Tyn-y-cwm (P.35 and P.36 area), and around Diosgydd uchaf (P.31).

### (c) Rabbits

Rabbits occur most frequently on the "ffridd" areas, particularly in the Penmachno district, where they did damage to young plantations at Bryn Eidal and Penybont in pre-war days; the "gappiness" of Penybont P.30, Compartments 624, 625, 626 may be partially attributed to this pest. They occur

occasionally throughout the plantation area, and need watching on mountain boundaries adjoining patches of rough grazing.

At present, two full-time and two part-time keepers are employed for general protection against sheep and rabbits, and in keeping down foxes and badgers.

(d) Brown hares

Brown hares are found on the upper boundaries, and have sometimes caused appreciable damage over small and limited areas of new plantation. Mountain (blue) hares were released about 60 years ago on the Carneddon and may now be seen in the Crafnant area.

(e) Foxes

These are numerous, particularly near the mountain boundaries, and the Department has been freely blamed by local sheep-farmers for providing breeding grounds and retreats within the young plantations. There is no conclusive evidence that foxes are more numerous in or near plantations than elsewhere, but the Department has found it expedient to meet the farmers' complaints by donating to local Fox Society funds, and providing beaters for fox shoots.

(f) Badgers

These occur in small numbers throughout the forest area, and have increased in recent years. Severe damage to fences is sometimes caused, and they have then to be destroyed.

(g) Insects

Insect pests have not, so far, caused permanent damage on an appreciable scale. Weevils sometimes attack young re-planted burnt areas and severe damage was caused in 1939 and 1941 on the re-planted P.39 Parc fire area by Strophosomus and Otiorrhynchus. It was noted that the attack was confined to ground carrying thin bracken, and that no attack was observed on the poorer peats that had been slagged; traps of small spruce and pine twigs were the most effective control. The Douglas fir chermes (Adelges cooleyi) severely checked young Douglas fir, but after a short period of retarded growth, recovery was satisfactory, (see also page 21 Choice of Species, "Douglas Fir"). The pine-shoot beetles (Mylophilus) and pine weevils

(Hylobius) are present, but no severe outbreaks are recorded and normal precautions and plantation hygiene have so far exercised satisfactory control. The green spruce aphid (Neomyzaphis abietina) has sometimes given cause for concern, particularly in 1948-49. In 1949 nesting boxes for insectivorous birds were erected on an experimental scale among the old oak along the banks of the Llugwy near Pool Mine. Records are kept by the Gwydyr Forester Training School. If colonised satisfactorily, it is intended to move them into the adjoining stands of pure conifers.

(h) Fungi

The most important is that of the canker on European larch (Dasyscypha calycina). The severity of the infection on the poorer and more exposed sites led to a discontinuance of European larch planting in 1935. Its incidence on Japanese larch is mentioned on page 20 (see "Choice of Species"). Honey fungus (Armillaria mellea) has been destructive to Thuja and Picea omorika, on some, but not all, old woodland sites. In 1948, incipient heart rot (Fomes annosus) was suspected in the Diosgydd and Maes Newyddion areas on P.21 Douglas fir and Norway spruce, and P.27 and P.28 Tsuga and Lawson cypress. About 8% infection was observed on the first thinnings of Lawson cypress and the second thinnings of Tsuga, 10% on third thinnings of Douglas fir and up to 50% on third thinnings of Norway spruce, some of which had a soft heart. Development is being closely watched. A high proportion of stems in some natural ash stands are affected by Nectria ditissima. Generally speaking, fungi damage is not an important factor; what trouble there is, is confined to limited areas of old woodland, where fungi of all types are so profuse that the areas are favourite ones for "forays" of the British Mycological Society, who recorded 175 different species of fungi in the Bettws-y-Coed area in 1924.

(i) Climate

General effects have been mentioned on page 6 ("Topography, Geology and Climate"). In 1948, longitudinal stem-cracks were observed in some of the most vigorous Norway spruce near Miners' Bridge, P.29, Compartment 172, and Sitka spruce in Coed Pencraig P.23, Compartment 83. It was thought that the cause was climatic - possibly the exceptionally hard winter of 1946-47, or the long droughts alternating with very wet spells during the period 1947-48

(the latter view is held by W. R. Day in his recent report on the subject).

(j) Trespass and Theft

In the post-war period thefts of Christmas trees became prevalent in the District, and it became necessary to patrol main roads adjoining the younger plantations. Long distance lorries and roving dealers were the greatest risk.

It is noteworthy that there is evidence that the biggest fires at Gwydyr (Parc 411 acres 1938, Aberllyn 108 acres 1942, Glyn 123 acres 1951 - and other seriously destructive fires) were caused by trespassers. A measure of the risks from trespass is given by the fact that up to 17,500 people have paid for admission to the Swallow Falls on a single day in 1950; the falls adjoin Forestry Commission plantations on one bank and are within 170 yards of plantations on the other.

SILVICULTURE

Preparation of Ground and Planting Methods

(a) Old Woodland

These areas were reasonably clean for the first few years planting, and there was no unusual difficulty. Later planting areas often carried an ever-increasing re-growth of weed species, much mature scrub, and a little oak timber. When in full public view from main roads, amenity considerations made economic re-afforestation difficult to achieve. During the inter-war years, when there was little demand for the timber, areas were sometimes clear-felled, a process which led to an increase of dense re-growth and weeds, including gorse, and consequent heavy weeding costs. Occasionally, suitable timber was felled for fence-stakes etc., and the rest ringed; the results were satisfactory silviculturally, but led to criticism by the public.

Compromise instructions have been given from time to time, which give full weight to the amenity value of the area. To date these instructions may be summarised as follows:-

(i) Retain all stands, groups, belts and rideside trees of timber, for protection, or of outstanding amenity value. Silvicultural thinning of stands and groups may be required, followed by interplanting with suitable shade-bearers. Douglas fir has been most frequently used, but other species, notably Tsuga, Thuja, and Abies grandis have shown themselves more able to



withstand shade and leader damage (see "Selection of Species": Douglas fir, Tsuga, Thuja, Abies grandis). Where timber is to be felled and extracted at a later date, suitable rides must be left to tap it.

(ii) Clear isolated trees and utilise as far as possible.

(iii) Clear valueless scrub, if not too dense to be an uneconomic operation. Dense scrub to be rung and underplanted, except in places of exceptional amenity value, where the ringing and underplanting should be done in groups, gradually a little every year.

(iv) Dense young birch etc. to be either cleared and planted in lanes or groups, or left to grow on until big enough to underplant after thinning.

#### Waterloo Spinney, Compartment 112

The treatment of this small hardwood area can conveniently be mentioned here. It is a site of exceptional fertility for Gwydyr, being rich alluvium with an unusually high lime status and pH 5.45. By careful selection and treatment of the rough coppice, a productive woodland was achieved at very little cost.

By 1925 the devastated 1914-18 war clear-felling area consisted of very rough coppice of ash, sycamore, alder, oak and lime, with a few natural seedlings. They were dominated by rough birch.

A few Norway spruce and Corsican pine had been planted - possibly P.21 - and were suffering from birch domination.

In 1926 the area was taken in hand. The rougher birch were felled to give the conifers a chance, and about twenty poplars were planted (believed to have been 2-yr. rooted cuttings). These have been identified as Populus trichocarpa and Populus generosa.

In 1932 more of the dominant birch were felled. By 1936 it was necessary to remove some of the rough older standards of ash and sycamore which were interfering with younger and more promising coppice, which was given a light thinning at the same time to reduce the number of coppice shoots per stool. Draining was intensified and has since been maintained regularly, the south-eastern section in particular being very wet.

In 1943, a light crown thinning yielded 1,500 cu.ft. from about 6 acres. In 1945, a general thinning of the same area produced 1,600 cu.ft. A thinning now marked for felling (1950) is expected to yield an estimated

1,600 cu.ft. from 6 acres, with 1,440 cu.ft. from a clear-fall 2 acre alder plot (which is to be replanted with poplar).

In 1950, the ash and sycamore had an average top height of 60 ft. and q.g.b.h. of 7". Poplar measurements are given in the paragraph on "Choice of Species".

Planting on the old woodland areas was almost entirely done by notching with mattock, with and without screefing. Schlich spades were tried, but were useless on the very steep, shaley slopes. Planting labour was poor in the early years, and the Head Forester of that time reports many failures as a result of poor, shallow planting. On loose, shaley sites, this no doubt also aggravated the blowing of Douglas fir and is the cause of "sabre" growth of Corsican pine on the more exposed ground at Diosgydd.

(b) Slopes of non-peat land

Little trouble was experienced in establishing crops on this type of ground. Normal practice has been shallow notching and bastard pit planting by mattock, with and without screefing.

On the wet patches, turf draining, and planting with dibbler or in slits, commenced in 1929. The dibble method is the one now normally practised, being more resistant to the drying effects of a dry, early summer.

(c) Peat land

Turf-draining became standard practice in 1929. The broken nature of some of the ground, with rocky shelves and outcrops, made the problem of effective but economic drainage a complex one. Frequent references to unsatisfactory work occur from the start of the time this type of land was planted, in particular, Hafod Gwennllian, P.33. (Commissioners, 2/3.8.33, Inspection report, Mr. O. J. Sangar's report of 5.8.33, and Chairman's minutes of 29.8.33).

On the better types of peat slopes hinge-turfing was commenced in 1935 with an appreciable reduction in initial losses and weeding costs. In a dry season, results were sometimes superior to normal turf-draining as at Tyn-y-cwm, P.35 (D.O. 3.11.36).

Up to P.49, the land available for planting did not lend itself to large scale ploughing programmes with the type of equipment available. The first ploughing was carried out at Hafod Dwryd, P.42, Compartments 712, 714.

A contractor was employed using a wheeled Fordson and a 2-furrow Oliver. The improved results in establishment and growth are now apparent from over a mile away. In 1947, a few acres were ploughed at Cae Mawr, Compartment 200, and in 1948 a total of about 25 acres at Mynydd Bychan, Compartment 122, Rhiwgri, Compartment 112, and Gwyndy, Compartments 663, 665. This was on extremely difficult terrain during a period of acute machinery shortages. By F.Y.49, Cuthbertson tackle was available, and on the Director's instructions, 40 acres of deep peat bog were ploughed at Bwlch, Compartments 260, 261; and planted with Sitka spruce which were slagged. Hitherto regarded as unplantable the very poor bog vegetation of cotton grass, Scirpus, Erica tetralix and Calluna improved remarkably in the first season, and after two seasons there was a high proportion of fine grasses and an increase in Juncus. The Sitka spruce grew well from the beginning. By F.Y.50, more tackle was available, and some 140 acres of mainly peat land were ploughed at Bwlch-y-maen and in the cwm of Glascwm, together with considerable areas of advance P.51 ploughing.

A variety of planting methods were tried out on the Cuthbertson furrow-slice, including notching on top with mattock, Schlich and Mansfield spades; bastard pits with semi-circular spades; and notching in steps cut by Mansfield and garden spades. The results have depended on many other factors, such as type and condition of plant and the season, and all methods have succeeded. Evidence to date indicates that the most reliable method for large plants, particularly on exposed sites, is likely to be notching in steps by spades, but the labour cost is sometimes half as much again as the other methods.

Because of the broken nature of the terrain, and difficult accesses, it has proved necessary to guard against tackling uneconomically small patches of ground at Gwydyr.

(d) Plateau land

Normal Gwydyr planting methods have been employed according to site variations. Turfing and draining of these areas has been favourably commented upon, but much good work was undone by subsequently planting seedlings on unfavourable sites. Such an area was the Glyn, P.31 (D.O. 19.3.31, 4.2.32). The dense gorse areas have been the subject of detailed investigation and report (see report on the subject dated 6.7.38) and one suggestion

for dealing with them was to cultivate patches manually, to improve soil conditions and reduce gorse competition in the early years, (27.1.37).

Small plantations of Scots pine and Corsican pine have been established on rock, scree and quarry tips by carrying soil, or wrapping roots in moss, at the time of planting. A good example is that at Hendre Crafnant, P.37, Compartment 292.

(e) Natural regeneration

A small patch of Sitka spruce, Scots pine and European larch seedlings are formed in Nant B.H., (P.14, Compartment 16) which started in a storm gap. In 1939 the Chairman gave instructions for the area to be rabbit-fenced and carefully maintained.

At Gwydyr Uchaf, Compartment 300, vigorous regeneration of Abies nobilis, Abies nordmanniana and Corsican pine has become established in groups under the maturing parent trees. The Abies nordmanniana is regenerating more readily than the Abies nobilis, which is surprising as it has not proved possible to raise nordmanniana from home collected seed under nursery conditions. This may be because the seed must be collected just before the cone breaks up to get it at its maximum fertility. The undergrowth was cleaned and some hand cultivation done early in 1949, but there has been no appreciable increase in seedlings to date (Conservator 1/3.6.47).

Choice of Species

(a) General: The Early Years.

Original acquisition report recommendations for the first block were: (i) Spruce for "a large proportion of the area", mixed if possible with silver fir - with the proviso that late spring frosts might militate against the successful establishment of the latter species.

(ii) Scots pine or Corsican pine on about a quarter of the area. The introduction of these species was considered desirable also as shelter groups and belts. Mr. Young recommended that Scots pine should generally be replaced by Corsican pine "which grows well in these parts".

(iii) Douglas fir to be confined to well-sheltered and comparatively flat land. The danger of this species being laid low by snow or

their own weight on steep and shaly slopes was noted.

(iv) Larch (presumably European larch) could probably occupy no more than 10% of the area, being "those parts admirably suited to high quality production of the species".

(v) Beech should grow well on "most parts of the area" and would be freely mixed with other species.

In actual practice the species used on the early acquisitions were Douglas fir on the lower sheltered ground, European larch on the intermediate, Scots pine on top exposure, spruces on moist sites at all levels. A little Corsican pine was planted as windbreaks on Diosgydd (P.21). Experimental plots of Abies nobilis, Picea omorika and Sequoia sempervirens were planted in P.27, and Lawson cypress and Thuja plicata in P.32.

Hardwood planting was confined to maintaining roadside amenity belts with oak and beech at Maes Newyddion and along the Conway valley. American poplars, notably Populus trichocarpa and Populus generosa were introduced sporadically in 1926, mainly in Waterloo Spinney, Compartment 112.

The correct selection of species for the poorer land at Gwydyr was sometimes difficult because of intensive sheep-grazing up to the time of enclosure for planting. Gorse and heather, in particular, were not easily detected on grassland with rock immediately below the surface, but came up strongly after enclosure and overcame much of <sup>the</sup> Norway spruce and Sitka spruce planted on this type of ground. Typical areas of this type may be seen on the Glyn and Pencraig, (P.29 - P.31). Pines, particularly Pinus contorta were found to compete strongly with the gorse and heather, and eventually succeeded in forming a useful crop.

(b) Species used and the results to date

Scots pine

This species was selected for gorse areas, and the rockier and drier sites. It has also been extensively used for beating-up failed Norway spruce and Sitka spruce on these sites. Since the last war Scots pine has been used in row-mixture with Sitka spruce on ploughed heather ground, notably at Bwlch, P.49 and Bwlch-y-maen, P.50.

Instructions against using Scots pine too freely on exposed sites are recorded, and the Chairman has said that Scots pine is not likely to be

successful on the exposed ground at Gwydyr, with its high rainfall and risk of snowbreak in later years (15.10.37, the Chairman). It grows surprisingly well on the drier, broken rocky ground, and when these sites are associated with gorse/heather has succeeded where Sitka spruce has failed.

It is a disappointing species on the lower, old woodland slopes - notably at Craig-glan-Conway, Compartments 112, 114 P.25, where its volume production is noticeably less than other common species on similar sites. The comparatively poor results may be due to provenance, because surviving Scots pine of the old Estate woodlands are very fine near Nant Cottage, Compartment 13, and a specimen containing 160 cu.ft. is recorded. They also did well when grown in mixture with hardwoods.

#### Corsican pine

The incidence of Brunchorstia on Corsican pine at high elevations and under heavy rainfall conditions elsewhere, led to the discouragement of its being planted on a considerable scale at Gwydyr. It has been planted on a small scale up to 800 ft. on old woodland sites at Diosgydd P.21, Compartments 51, 52, 75; Coed-y-wern P.23, Compartment 6; and on rocky outcrops in the Lledr Valley, P.26. These are all growing vigorously to date and sample plot figures are of Quality Class I (see Appendix IV). A little Corsican pine was planted on weathering slate tips at Ty-isaf, P.50, Compartment 564 and as shelter belts P.49 and P.50.

#### European larch

Planted from 1921 to 1936 on the higher slopes of old woodland, where the exposure was considered too severe for Douglas fir and occasionally on the lower slopes where the ground was too soft for Douglas fir (e.g. Pentre du Compartment 153, Craig Lledr Compartment 121, Maes newyddion, Compartments 169, 170, 174). The generally sorry state of European larch on the higher ground was soon noticed, and eventually its use was not advised (D.O., 27.1.37). Plantations in the Glascwm Valley, P.36, Compartment 592, did not thrive and it was decided that no more European larch would be used in the Penmachno area because of the high rainfall and risk of disease (A.C., 30.6.47). The decision to abandon European larch at Gwydyr and to substitute with Japanese larch was confirmed by the Chairman (Chairman, 15.10.37).

In recent years there has been an appearance of improvement in European larch on the best sites (Pentre du, Maes Newyddion, Craig Lledr). No doubt the removal of the worst stems in thinning operations is partially responsible for this appearance, but the remaining stems show promise of forming a good final crop.

#### Japanese larch

This species has been planted consistently since 1921 to date but not on a large scale. It has been the quickest and cheapest species to establish on areas of heavy weed and coppice growth, and for this reason has been favoured for old woodland and bracken sites. It does not succeed on gorse (e.g. parts of Allt wen, P.29, Compartments 65, 66), or on thin, rocky scree slopes with a south aspect and liable to drought (e.g. the gappy P.30, 34, 35 Penybont and Bryn Eidal, Compartments 625-628). It develops poor form if too exposed (e.g. Glyn, Compartments 206-235) and does not stand firm on wet soils.

Although an excellent starter, Japanese larch is gradually being overtaken by more valuable species on similar sites (e.g. Coedcynhelier P.21, Compartment 51, adjoining and mixed with Sitka spruce and Douglas fir; Forest Lodge P.29, Compartment 172, Thuja, Tsuga and Norway spruce). A canker infection was observed in 1947-48 on Japanese larch at Glyn, P.28, Compartment 209 and Maesnewyddion P.21-22, Compartments 175, 188. Girdling by the infection had occurred in some cases, and there were a few deaths. Japanese larch has been valuable in meeting Gwydyr's unusually important need for fire-protection and amenity.

In 1941 the Chairman gave instructions for three plots of Japanese larch to be thinned normally, cleaned of undergrowth, fenced and underplanted with Tsuga at 5 ft. spacing, (28.6.41). This was done in P.42 at Coedcynhelier, Compartment 51, Maesnewyddion, Compartment 188 and Pen-y-Parc, Compartment 28. It soon became evident that the Tsuga required more than ordinary thinning of the Japanese larch canopy if it was to develop satisfactorily, and heavy thinning was started in the Maesnewyddion plot in 1946. The other plots have since been thinned heavily also, but the Tsuga in Maesnewyddion have so benefitted from the earlier opening of the canopy that they are now 10 ft. to 12 ft. high - more than double the height of the other plots. Measurements of the Japanese larch in the Maesnewyddion

plot are given in Appendix IV.

### Douglas fir

Douglas fir has been planted extensively on the steep lower slopes of old woodland areas, where it started well and was particularly successful in overcoming intense gorse competition on Diosgydd P.21. Many scrub areas were also underplanted with Douglas fir because of its ability to stand some shade and to get away quickly in competition with re-growth of weed species; examples are seen at Dolgarrog, P.35, Hendre Crafnant, P.37, Glyn Lledr P.38 Fedw deg P.40, Bryn Engan P.41. Douglas fir has not done well off old woodland sites, and at Pen-y-Bont P.30, Compartments 624, 626 shows extremely poor growth and form. This may be caused by severe local exposure along the valley bottom and the possibility that the type is an unsatisfactory intermediate between Fraser River and green Douglas fir.

The danger of Douglas fir being laid low by wind and snow on steep, shaly slopes was realised from the earliest days. Some Scots pine and Corsican pine shelter belts were planted to reduce the danger of windthrow, but there are many sites where Douglas fir rooted badly, notably Lledr Valley P.27 and Maesnewyddion P.21-22. (Chairman 26.6.46). Frequent reference has been made in Inspection Reports to the staking of young Douglas fir plantations (Commissioners 2.8.33; A.C. 6.3.35; D.O. 14.3.35). An age-of-transplant experiment in the Lledr Valley indicated that 2 + 1 gave less trouble from windthrow than 2 + 2, (D.O. 27.1.37). Near Coedcynhelier, P.27, Compartment 50, a small area was severely blown in 1937 and the District Officer carried out a "topping" experiment which left a gradation of stepped crowns facing the exposure. This was effective in saving the remainder from blowing.

Much of the Douglas fir was checked by Chermes in its early years, and it is recorded that the Fraser River variety, planted in Nant B.H., P.30, Compartment 17, and Lledr Valley, P.27, Compartment 120, grew very well and was free from Chermes attack, (Working Plan 1938, Pt. II Sect. 19). The Chairman in his minute on this subject (13.7.38) observed that the ill effects of Chermes should gradually disappear, and that though freedom from attack allows the Fraser River Variety to show up well at first, it was later liable to get Rhabdocline and die out; it must therefore not be used on a large scale.



In 1949 and 1950 heart-staining was observed on third thinnings of P.21 Douglas fir in the Diosgydd area. In 1948 a few P.25 Douglas fir died in the Craig-glan-Conway area, and came under observation by Forest Pathologist T. R. Peace.

Despite these minor setbacks, Douglas fir is generally successful, and forms some of the finest Gwydyr plantations on old woodland sites. Its volume production to date is not so high as Sitka spruce, Norway spruce, Corsican pine or Abies grandis on similar sites, (see Appendix IV). This may be explained by the Chermes check on height growth in its early years, together with comparatively low stocking as a result of windthrow, and under-cleaning during periods of financial stringency.

#### Norway spruce

This species has been planted throughout the forest on all the types of land described in the section headed "Types of land and Vegetation", page 7.

On the old woodland sites, it was generally recommended for the damp sites in preference to Sitka spruce, because of the danger of honey fungus to the latter. There is little evidence that this recommendation was taken seriously and Norway spruce has been used no more frequently than Sitka spruce. There was no difficulty in getting Norway spruce established on these sites, and its use was recommended for the slopes and lower ground where Japanese larch was not used, (Chairman 15.10.37). It was also used for beating-up poor European larch on rocky ground at Nant Newydd P.29 (D.O. 26.11.35).

On slopes of non-peat land, it has been used successfully on bracken/grass land which contained too many wet patches to make Japanese larch a safe choice. Good plantations of this type were formed in the Glascwm Valley, P.36, Compartment 616; lower Bwlch, P.32, Compartment 255; and Ty-coch, P.35, Compartments 543, 548, 549, 550.

It has succeeded also on the more sheltered peat slopes of Aira, Juncus and Molinia. Typical plantations of this type are those of Tyn-y-cwm, P.35, Compartments 683, 684, 687, 688; and on limited areas of Bwlch and Hafod Gwenllian. On the flatter Molinia peats, Norway spruce was very slow, but had advantages over Sitka spruce in its ability to withstand heavy weed competition and late spring frosts. Later, Norway spruce was prohibited on high, exposed ground, heathland, and Molinia if intermixed with inferior

indicators such as cross-leaved heath (Chairman 15.10.37). The failure of Norway spruce on shallow soils with impeded drainage and heather/grass vegetation is illustrated at Tyn-y-cwm, P.36, Compartments 681, 685. During the late 30's there was a serious shortage of Sitka spruce which led to the use of Norway spruce being extended beyond its normal limits.

On the plateau ground, Norway spruce had very limited success, but was preferred to Sitka spruce on the sheltered Molinia/bog-myrtle associations, where it grows very slowly, but steadily. It goes into complete check on the gorse/heather/Molinia peats on the rocky-knolls and is badly blasted if exposed to wind on the upper ground.

Heart stain was noticed on P.21 Norway spruce in the Maes Newyddion area in 1949 third thinnings. Over half of the thinnings in one stand were affected, and some showed advanced heart-rot. Root and stump specimens were sent to Dr. Day for investigation.

Volume figures for an old woodland site are given in Appendix IV.

#### Sitka spruce

This is the most important tree of the younger parts of the forest. It will grow on all plantable types except the heather peats on the rocky knolls of the plateau area.

On old woodland, it has been used as frequently as Norway spruce and did well from the beginning, and is remarkably free from honey fungus or any other troubles. An outstandingly successful plantation is that of Allt Isaf, P.23, Compartment 32, and sample-plot figures for the best stand in this plantation are given in Appendix IV.

On non-peat slopes, Sitka spruce was planted on the more exposed areas, and where there was an appreciable amount of heather or gorse. Plantations were sometimes patchy where the soil ran extremely shallow. A good example of the better plantations of this type is seen at Pen-y-bryn, P.36, Compartments 621, 622.

On peat slopes it was widely used on the more exposed areas and where there was little indication of heath vegetation mixed with the better types. It suffered prolonged check when planted on the poorest heather peat associations, and sometimes failed on and near rocky outcrops of gorse/heather. Satisfactory plantations of this type are established at Tyddyn-du,

P.34, Compartments 608, 610; and Tyn-y-cwm, P.35, Compartments 684, 688, 690, 689. On the Molinia flats Sitka spruce occasionally suffered severely from late spring frosts. Notable in this respect was Bwlch, P.32, Compartments 255-288, but much of this was burnt in 1941 and re-planted with Norway spruce, which is slower getting away but does not suffer repeated checks from frosting as do the re-planted Sitka spruce. Under very exposed or other unfavourable conditions, aphid attacks have been severe, sometimes killing a few individuals on sites like the lower Hafod Gwennllian area.

On the plateaux, Sitka spruce was planted freely in the early years, but succeeded only on the better patches of moist bracken, grass and Molinia. It grew quite well on the deep peats providing there was enough gradient for intensive draining and turfing to take effect; slagging was recommended as standard practice for this type of ground (Chairman 15.10.37). Sitka spruce proved useful on gorse with a good depth of soil, providing big strong plants were used and the gorse weeded intensively from the beginning.

#### Tsuga heterophylla

Small areas have been planted since P.27 on old woodland sites and through scrub, notably at Miners' Bridge, P.27, Compartment 50; Glyn Lledr, P.38, Compartment 511; and Soflen, P.41, Compartments 720, 721. Together with Thuja and Abies grandis, it shows evidence of being well suited to overcoming in an economic manner the difficulties inherent in re-afforesting old woodland areas in a district of high amenity value to the public. It stands partial shade well, and the leaders are less liable to damage than those of Douglas fir which is the species that has been most frequently used.

In 1949-50 heart stain was observed on about 10% of the second thinnings of P.27 Tsuga.

Volume figures are given in Appendix IV.

#### Thuja plicata

Small plantations have been established on old woodland areas. There was evidently some difficulty in establishing Thuja at Glyn, P.30, Compartment 212; and Graig Forys, P.36, Compartment 198. (W.P. 1938, Pt.II, 19). The latter is beaten-up with Japanese larch but the Glyn plot has done well, and also a plot at Diosgydd, P.32, Compartment 21. Thuja was also used for re-afforesting patches of the denser scrub slopes such as that at Dolgarrog,

P.35, Compartment 1, but here there has been a heavy deathrate from honey fungus since 1947.

### Pinus contorta

Pinus contorta has been planted in small groups on a variety of the poorest ground, particularly on the plateaux, and used extensively for beating-up checked gaps among the spruces on the poorest peats and rocky gorse/heather/Molinia knolls. Plantations are hardly extensive enough or old enough for any conclusions to be drawn, but so far, Pinus contorta has shown itself to be the most tolerant and reliable of all the pines for the poorest plantable ground; it also forms a crop where nothing else will grow. Good examples of these qualities are seen at Alltwen, P.29, Compartment 65; and Diosgydd Uchaf, P.31, Compartments 89, 90. It also resists drought on the thinnest grassland soils over rock, where Japanese larch so often fails; e.g. Llanerch Elsi, P.30, Compartment 124.

Comparison with other species on poor sites have been incorporated in a separate report elsewhere, but one striking example may be quoted here as it is a specially laid-down species trial on a poor site of gorse/heather/Molinia Aberllyn, P.39, Compartment 61. Height assessment in 1950 gave the following results:

Pinus contorta	9 ft.	
Corsican pine	8 ft.	(few survivors)
Lawson cypress	7 ft.	( " " )
Sitka spruce	2½ ft.	
Norway spruce	failed	

### Abies grandis

There is a small P.27 plot on old woodland at Miner's Bridge, Compartment 50, which has grown exceptionally well from the beginning and is the biggest volume producer for its age at Gwydyr. Sample plot figures are given in Appendix IV.

It is also very useful for planting through scrub and stands shade well without much loss of vigour. So far, it has not proved susceptible to honey fungus or heart-rot, and for this reason has proved more reliable than Thuja and Tsuga. It withstands more shade than Douglas fir, and is thus more suitable for planting through scrub in amenity areas, where heavy fellings or ringing are frowned upon.

### Abies nobilis

Very little has been tried, but there is a good plot on an old woodland site at Miner's Bridge, P.27, Compartment 50. This started very slowly and is still uneven. It withstood intensive weed competition exceptionally well in its slow, early years. Sample plot figures are given in Appendix IV.

A high-elevation trial plot was planted at Tyn-y-cwm, P.51, Compartment 691, as there is evidence elsewhere that Abies nobilis is able to succeed in poor, exposed situations. It has also been suggested for trial on the plateau gorse/heather (D.O. 15.3.35).

Much of the acquired Abies nobilis has developed well, but appears to be "shaken". The value of Abies grandis and Abies nobilis as timber trees has been questioned by the Chairman (13.7.38), and neither species has been planted on an appreciable scale. It is interesting to note, however, that there has been no difficulty in disposing of the timber for all general purposes during the post-war period. A Norwegian visitor to Gwydyr in 1950 said that silver firs, including Abies grandis and Abies nobilis were commanding the highest price of all conifers in Norway that year, because of their unique sound-insulation qualities which made them most suitable for tenement house-building.

### Picea omorika

A little is found under plantation conditions and growing successfully on an old woodland site at Nant B.H., P.27, Compartment 14. It is about equal to Norway spruce on this type of site. A small plot at Miners' Bridge, P.27, Compartment 50, has suffered heavy losses from Honey-fungus.

Small belts and groups have been planted in P.49 and P.50 to test exposure and frosting effects, but no results are yet available.

### Picea alba

A few acres have been planted at Tyn-y-cwm, P.36, Compartment 685 on a grass/Molinia peat slope. They are superior to most of the Norway spruce in this plantation and are of better form, but slower than the Sitka spruce.

On an old woodland slope at Bwlch-y-maen, P.43, Compartment 522, Picea alba are thriving, and far superior in vigour and height to adjoining Norway spruce.

### Mountain pine

A little of an erect type was planted on an old woodland bilberry/heather site in Coed Cefn-maenllwyd, P.27, Compartment 12; where it succeeded in rapidly suppressing the ground vegetation and now reaches a top height of 20 ft.

A small patch of a more prostrate type is found by Llyn Sarnau, P.29, Compartment 105. This is now up to 5 ft. high and just closing in and beginning to suppress the heather; adjoining Pinus contorta and a few Corsican pine have formed canopy and average 15 ft. of vigorous growth.

### Sequoia sempervirens

There is a small plot at Miners' Bridge, P.27, Compartment 50. It is very uneven and there have been some deaths, probably from honey-fungus, in recent years. The best stems, however, equal the average Douglas fir adjoining, and the group makes a pleasing amenity feature. Other small groups are found at Nant B.H. P.30, Compartment 17, and below Diosgydd Nursery, Compartment 81.

Redwood has proved a difficult species to raise and transplant under ordinary forest conditions; but for this fact, there are many sites at Gwydyr where it might have been grown as a valuable timber and amenity crop.

### Lawson cypress

Plots of this species were planted near Diosgydd nursery on an old woodland site, P.32, Compartment 21. It is superior to adjoining Thuja in volume production and is surprisingly productive for its age, as will be seen from the sample plot figures in Appendix IV.

There is a considerable amount of stem forking, but much less than is normal in this species elsewhere.

There is evidence that it will succeed on the poor plateaux gorse/heather sites, and some figures are given under Pinus contorta.

### Hybrid larch

A small area of old, rocky woodland is planted at Tan-aeldroch, P.38, Compartment 518. The plants were ex-Glamis stocks and have done remarkably well. First thinning was carried out 12 years after planting in 1950, when 302 stems per acre were taken out, producing 271 cu.ft. per acre. There is

now left standing 1815 cu.ft. per acre; the tallest trees reaching 32 ft. and the biggest  $4\frac{1}{4}$  cu.ft. q.g.o.b. (T.Y. sample plot data).

#### Cryptomeria japonica

A small plot was planted in a clearing on old woodland behind Forest Lodge, P.44, Compartment 171, and on Bwlch-y-maen old woodland slope, P.43, Compartment 522.

So far, it has shown itself to be one of the most vigorous conifers on this type of ground.

#### Other conifers

A considerable variety of the less common species has been planted as specimens on old woodland areas. The oldest of these are around Diosgydd Nursery, Compartment 81, where Pinus radiata and Pinus ponderosa are worthy of note, growing vigorously and cleanly under plantation conditions.

#### Mixtures

(a) Scots pine/spruce. Experiments to test the nursing effects of Scots pine on Sitka spruce and Norway spruce were laid down on the Chairman's instructions in Mynydd Bwlch-yr-haiarn, P.22 and 32, Compartments 105, 106, 107. The site is a plateau heather/gorse/bracken one; with outcropping rock and shallow soil. The spruce have failed to keep pace with the Scots pine except on the bracken patches. The area has been under the general supervision of the Research Branch.

Mixture of Scots pine and Sitka spruce on ploughed heather ground has been standard practice since ploughing started on a considerable scale in P.49.

(b) Japanese larch/Scots pine. These species have been planted also on Mynydd Bwlch-yr-haiarn, P.29, Compartments 104, 105, as alternate row mixture. The site has a high proportion of bracken/bilberry and there is little difference in growth between the species, which are going up well together.

(c) At Crafnant, P.34, Compartment 279, Sitka spruce and Scots pine were introduced in rows among Japanese larch after the original planting of Japanese larch was seen to be unsatisfactory on this steep gorse slope. To date, the Sitka spruce have failed to get away, but some of the Scots pine are growing vigorously.

(d) A European larch/oak row mixture was planted on an old woodland site at Coed-y-Plas, P.31, Compartments 602-4. The mixture was beaten up in 1937, when the District Officer considered that the lower half would make an oak crop, but the upper half would not<sup>and</sup>/beat up with beech and larch respectively. By 1949, the lower half was mainly very good and much, but not all, of the upper half promised to make an oak crop. Instructions were given:- "give this plantation careful and detailed treatment, as it is the only oak plantation of any age in North Wales". (Conservator 11.1.49.)

#### Ash

Ash occurs naturally, in small groups in the damp gulleys of old woodland areas. Some useful stands have developed, notably in the Craig Glan-Conway area, Compartments 112, 114, where sample plots were put in by the Research Branch in 1948, using grade C and E thinnings which left 723 and 403 (respectively) stems per acre with an average top height of 40 ft. and average true girth of 11 in.

#### Beech

A little has been planted on roadsides, at Maesnewyddion, P.21, 22, Compartments 171, 173, Allt Goch, Compartments 44, 45, Pentop P.37, Compartment 596. It grows vigorously, and a single roadside row at Fronheulog, P.27, Compartment 49, equals in height growth the adjoining Douglas fir, but is of a coarse forking type.

#### Birch

Very little birch has been planted, but it occurs frequently as a natural crop, usually of a poor type. It was suggested for trial on the poor plateau land (A.C. 27.1.37).

#### Oak

The only pure oak stand planted by the Forestry Commission is at Plas glascwm, P.36, Compartment 592, on an old woodland slope. The site faces south and is rather dry, with light shaly soil. Development to date is satisfactory, and the average height is 9 ft.

#### Poplar

Poplars have been raised and planted on selected sites, on a very small scale, from 1926 onwards. The most notable specimens are found in Waterloo Spinney, Compartment 112, where the remarkable disease-free growth of



Populus trichocarpa and Populus generosa have frequently been commented upon.

Measurements (1950) were as follows :-

<u>P. trichocarpa</u>	(the biggest: top broken three times)	
	Top height	- 90 ft.
	Clean height to first fork	- 30 ft.
	q. g. b. h.	- 18 in.
	est. mid q. g.	- 16 in.
	est. vol. to first fork	- 53 cu. ft. q. g. o. b.
<u>P. generosa</u>	(biggest)	
	Top height	- 70 ft.
	q. g. b. h.	- 13 in.
	Est. vol.	- 22 cu. ft. q. g. o. b.

Most of the other poplars of these species in this spinney have clean, unbroken stems averaging 65 ft. in height and 20 cu. ft. in volume.

The area is dealt with more fully under "Preparation of ground and Planting".

Black Italian poplar has occasionally been planted as single trees in odd corners of apparently suitable ground, but has usually failed to grow satisfactorily.

#### Sycamore

Natural sycamore occurs sporadically throughout the forest on the valley slopes of the old woodland. It sometimes forms useful stands, particularly on the steep, rock-strewn areas such as that behind Bettws-y-Coed Church, Compartment 129.

#### Oregon alder

This species has been planted in small groups on damp old woodland sites in the Lledr Valley, P. 30, Compartment 17, Allt Isaf, Compartment 81, and elsewhere. It started to grow well and was favourably commented upon (Commissioners 2.8.33). But it began to die back in 1935, and existing plots are now thinly stocked.

#### Other Hardwoods

Apart from red oak (planted recently on old woodland amenity areas) no other hardwoods have been planted on an appreciable scale.

#### Plantation Work

##### (a) Cleaning

As a result of the heavy failures of Douglas fir in the initial P. 21-23 plantings (e.g. Maesnewyddion, Allt Goch and Fedw Hendre) heavy beating up was necessary (up to 45%) until 1926, which resulted in an unusually

prolonged period of scattered coppice weeding and cleaning. At the height of this work finances were cut owing to national economies and instructions issued that no weeding was to be done in areas planted 1921-26. As a result, coppice got on top and was not mastered until 1939 in the oldest plantations. By this time, the remaining coppice growth was big enough to form part of the canopy, and often contained useful stems of oak, sycamore, beech and ash. Subsequent treatment became a delicate operation, and great care was needed to prevent over-cleaning which made dangerous wind-gaps in the canopy, and sometimes removed valuable hardwood components of the crop.

Cleaning instructions may be summarised as:-

- (i) Accept useful hardwoods and remove in good time all coppice and inferior species interfering with the planted crop, especially just before the thicket stage is reached, when double leaders, whips, leaning and wolf trees should also be dealt with.
- (ii) At a later stage, leave all coppice and maiden growth where it is needed to fill gaps. (D.O. 29.7.36, D.O. 25.5.37, Conservator 9.7.48).

The difficulties in relieving Douglas fir planted through and under scrub and coppice have been referred to in the section on "Preparation of ground and Planting Methods". The intensity of the planting under large-crowned scrub has led to an acute problem in letting the plants through the overwood economically and without excessive damage being caused by felling and lopping. In most cases, it has been too late, on amenity grounds, to ring the old oak. Considerable areas are affected at Dolgarrog, P.35, Hendre Crafnant, P.37, Glyn Lledr P.38, Fedw Deg P.40, Bryn Egan P.41. At Coed Soflen P.41 the problem has been most acute with interplanted Japanese larch. The worst of the areas have been dealt with gradually since 1949, largely as hard-weather employment, and apart from the high cost, surprisingly little permanent damage has occurred to the new crop.

(b) Thinning and Produce

Thinning of Forestry Commission plantations started in 1934, but did not top the 100 acres per annum figure until 1938. Since then it has risen gradually to over 500 acres per annum, and in recent years had yielded an

overall average volume of 300 cu.ft. per acre per annum. Sample plot volume figures for a variety of species growing on old woodland sites are given in Appendix IV. During, and immediately after, the 1939-45 war 17,000 cubic feet of pitwood was transferred to the Timber Production Department, and in addition, other forms of produce were fencing stakes (300,000) and selected poles for wireless, scaffolds, ladders and transmission.

There has been a steady local demand for agricultural fencing stakes and rustic poles for manufacture into garden furniture on the North Wales coast residential areas.

Extraction to begin with was fairly simple by hand and horse tushing. Gravity wire-rope systems were developed with considerable success in the war years. But with the reaching of the third and fourth thinning stages something better was needed to handle economically the larger timber coming out. The road-construction programme started late in 1950, but in the more precipitous rocky areas, it has been suggested that power-driven cable-ways may be the only economical answer.

Christmas trees have been in keen demand since the war; 30,000 being sold in 1949, to merchants as far away as Covent Garden. Most of the trees were produced from the tops of thinnings, rack cutting and road widening.

Moss grows in profusion in such a damp climate, and the collecting rights are at present let at £70 per annum.

Research - Note by Research Branch

There are very few experiments at Gwydyr and really nothing that is at the moment suitable to write up.

The following is a list of the experiments:

Five spacing experiments as follows:-

- |    |                |        |      |       |          |   |
|----|----------------|--------|------|-------|----------|---|
| 1. | Sitka spruce.  | Compt. | 640. | P.35. | Spacings | 3' x 3', 4½' x 4½', 6' x 6'<br>and 8' x 8'. |
| 2. | " "            | "      | 688  | " "   | "        | 3' x 3', 4½' x 4½', 6' x 6'<br>and 8' x 8'. |
| 3. | Norway "       | "      | 640  | " "   | "        | 3' x 3', 4½' x 4½', 6' x 6'<br>and 8' x 8'. |
| 4. | " "            | "      | 543  | " "   | "        | 3' x 3', 4½' x 4½', 6' x 6'<br>and 8' x 8'. |
| 5. | Japanese larch | "      | 627  | " "   | "        | 4' x 4', 6' x 6' and 8' x 8'.               |

It is at present too early to give any useful data on these plots.

Expt. 1.P. 50. (Penmachno area)  
Sitka spruce provenance.

Expt. 2. P. 50. (Bwlch-y-mean area)

Extension of Sitka spruce plants from Amphill Expt. L.P. 49 on steam and formalin sterilisation treatments.

Project No. 5. P. 51. (Compartments 21 and 97)

Preliminary trial of chemical removal of bark from standing poles of Sitka spruce and Japanese larch.

It is too early to make any comments on these experiments.

M. NIMMO

Asst. Silv. (S)

## Conservator's Comments

Gwydyr was the first forest started in North Wales and it remains the largest.

In writing the history, Mr. Hampson has been able to obtain notes from Mr. J. L. Shaw whose knowledge of the forest dates back to 1925.

Exposure has been found to be a less serious factor than originally anticipated and it has been found possible to plant higher up the hillside in the southern block than was expected but this has been to a great extent assisted by improved planting methods and further experience in the correct selection of species. The comparatively low plateau land has, however, proved more difficult than originally expected and areas originally classified as plantable have since been ruled out but it is clear that too much reliance has been put on Sitka spruce and there has been too much hesitation in the use of pine. Sitka spruce has suffered badly from spring frosts in the bogs on the plateau and Norway spruce has shewn up better even on quite bad heather types, but early growth has been very slow.

Both Corsican pine and Scots pine have succeeded better than anticipated on the drier types of very poor heath ground on the plateau and as the elevation is not great it may be that there has been too much fear of Brunchorstia and snow damage, but it is clear that much of the plateau ground is too poor for any of these species and it may yet be that more of the unplatable ground can be successfully planted with Pinus contorta which is the only species able to survive on the worst ground.

No research plots were laid down but in P.22 a very interesting divisional experimental plantation was made to see whether Scots pine would grow on the plateau land. Valuable data was provided and the Research Branch has carried out some work in this plantation.

Pinus contorta was of course not known as a forest species in the early years, but a separate report on the growth of this very promising species in North Wales has just been written. There is evidence at Gwydyr (Glyn, Crafnant, Bwlch, Llyn Elsi, Coed Mawr, Cwm Celyn) that Pinus contorta will grow vigorously at high elevation and under extremely poor conditions where other species will either not grow at all or do very poorly. It is now clear (Crafnant) that we have at least two different forms and that what is believed to be the coastal form or true Pinus contorta is the better tree for Gwydyr.

The whole forest is a very dangerous one for fires and a total of nearly 1200 acres has been destroyed of which over 900 acres were on the plateau land which represents about a third of the plateau land planted. The prolonged period of check, the very dangerous type of vegetation, the difficult access and expense of road construction, the extremely difficult terrain for fighting fires and the popularity of this ground for hiking render planting this kind of ground an uneconomic proposition and our difficulties may well be increased by the establishment of the Snowdonia National Park.

There is no doubt that hardwoods can be grown in limited areas on the lower slopes and then on areas, particularly under European larch, when hardwoods are coming in naturally, and in view of the importance of amenity in this area efforts are now being made to get in more hardwoods on old hardwood areas.

A Ministry of Labour Training Centre was established in the forest in 1937 and some road work was carried out at Gwydyr Uchaf and at Glyn but the scheme terminated on the outbreak of war and the camp was taken over as a Foresters' School in 1948. Both trainees and students formed a useful fire fighting squad but the quality of the former was low. A section of the forest is managed by the students but the Head Forester exercises fire control measures on the whole forest and the students form a most valuable fire fighting squad for use in any part of the forest as well as in adjoining forests.

An arboretum was started in 1951 largely for the benefit of the school. It is aimed to establish small groups rather than single specimens of all available species.

F. C. BEST

Conservator.

## History of Gwydyr Forest

### APPENDIX I

#### Inspection Reports

References to Inspection Reports are incorporated in the text of the History as they occur, and are indicated by the date and name of the senior officer present, inserted in brackets at the end of such references. It is hoped in this way to avoid the risk of unnecessary repetition.

The following Inspection Reports were available and consulted:

<u>Date</u>	<u>Inspecting Officers</u>
24.8.29	Assistant Commissioner
26 & 27.10.29	Technical Commissioners
19.3.31	Divisional Officer, Mr. A.P. Long
18.4.31	The Commissioners
20.11.31	Divisional Officer
4 & 5.2.32	Divisional Officer
14.10.32	Assistant Commissioner & Divisional Officer
17.12.32	Divisional Officer
17. & 18.3.33	Divisional Officer
2 & 3.8.33	The Chairman & Commissioners
13.12.33	Divisional Officer
25 & 26.7.34	Assistant Commissioner
14 & 15.11.34	Divisional Officer
6 & 7.3.35	Sir Alexander Rodger & Assistant Commissioner
11.4.35	Divisional Officer
14 & 15.5.35	Divisional Officer
10.7.35	Divisional Officer
26.11.35	Divisional Officer
21.2.36	Divisional Officer
29.7.36	Divisional Officer
2 & 3.11.36	Divisional Officer
23-29.1.37	Divisional Officers' Hand over, Mr. A.P. Long to Mr. A.H. Popert.
24-26.5.37	Divisional Officer
29 & 30.6.37	Snowdonia National Forest Park Committee with Assistant Commissioner
6 & 7.10.37	Divisional Officer
15.10.37	The Chairman
2.3.38	Divisional Officer
4.5.38	Divisional Officer
11.5.38	Divisional Officer
16.5.38	Assistant Commissioner, Mr. W.L. Taylor
10.7.38	The Chairman with Research Advisory Committee
10.10.38	Divisional Officer
11 & 12.1.39	Assistant Commissioner, Mr. O. J. Sangar
23.2.39	Divisional Officer
30.9.39	Divisional Officer
18.10.39	Divisional Officer, Mr. C.E.L. Fairchild
9 & 10.11.39	Assistant Commissioner, Mr. A.P. Long
3.4.40	Divisional Officer
24.3.41	Divisional Officer
26 & 28.6.41	The Chairman
2 & 3.9.41	Divisional Officer, Mr. R.H. Smith
14.1.42	Divisional Officer
14 & 15.4.42	Divisional Officer
15.9.42	Divisional Officer
5 & 6.5.43	Divisional Officer
28.9.43	Assistant Commissioner

<u>Date</u>	<u>Inspecting Officers</u>
6.6.44	Divisional Officer
11.10.44	Divisional Officer
28.11.44	Divisional Officer
20.3.45	Divisional Officer
10.10.45	Divisional Officer
21 & 22.4.46	The Chairman
30.7.46	The Conservator - Mr. R.H. Smith
4.9.46	The Director - Mr. A.P. Long
15.10.46	The Conservator
23.1.47	Divisional Officer - Mr. W.A. Cadman
13.3.47	Divisional Officer
11.4.47	Conservators' Hand over, Mr. R.H. Smith and Mr. F.C. Best.
15 & 16.4.47	The Conservator
7.5.47	Divisional Officer
1 & 3.6.47	The Conservator
5 & 6.6.47	The Conservator
6.11.47	Divisional Officer
11.11.47	The Conservator
16.12.47	Divisional Officer
14.1.48	Divisional Officer
6 & 7.2.48	The Conservator
13.2.48	The Director
13.4.48	The Director
8 & 9.7.48	The Director
5 & 6.8.48	Divisional Officer
23.8.48	Commissioner - Mr. W.L. Taylor
9.12.48	Divisional Officer
29.12.48	Divisional Officer
11.1.49	The Conservator
18.3.49	Divisional Officer
4.5.49	Divisional Officer
31.5.49	Sir William Taylor
2.6.49	Sir William Taylor
21.6.49	Divisional Officer
5.10.49	Divisional Officer
1.2.50	Divisional Officer
13 & 14.3.50	Divisional Officer
23.5.50	The Conservator
30.6.50	Divisional Officer
18.7.50	The Conservator
3 & 4.1.51	Divisional Officer
25.4.51	The Conservator
16.5.51	The Conservator



History of Gwydyr Forest

APPENDIX II

Supervision Details

Divisional Officers

1921-25 D.W. Young  
1926-30 O.J. Sangar

1931-37 A.P. Long  
1937-39 A.H. Popert  
1939-41 C.E.L. Fairchild

1941-45 R. H. Smith  
1947- W. A. Cadman

Conservators

1946-47 R. H. Smith  
1947 F. C. Best

District Officers

1924-25 J. Simpson  
1925-26 - Rayden  
1925-26 R.G. Broadwood  
1927-28 G. Lowe  
1928-29 J. McEwen  
1929-36 R.H. Smith  
1936-39 F.C. Best

1939-46 J. L. Shaw

1946- J.R. Hampson

Head Foresters

1925-39 J.L. Shaw

1939- P. Harrison

C.F.

C. Dick  
W. Taylor 1976? -

DFO's cont'd

B. Walbank

F. Savage -76

D. Foot 1976-78

G.I. Mayhead 1978 -

## History of Gwydyr Forest

### APPENDIX III

#### Points of General Interest

##### 1. Historical (vide: The new Naturalist "Snowdonia")

When Leland came riding through the district in 1536-39 he reported that the best wood was to be found in the vales of the Lledr and Llugwy, with "meately good woods" to be seen in the Machno valley. Among the earliest records of forest operations in the Gwydyr area are those of Walter Davies written in 1810. He mentions that from the Gwydyr Estates in 1754-60 no less than £50,000 worth of oak was floated down the Conway, while in the parishes of Ysbytty and Penmachno 85,000 trees were planted in 1795-97.

Early attempts at re-afforestation in the district were those by the Vawdrey Estate in the Gwynant valley between Penygwryd and Beddgelert, where 261 acres were planted between 1804 and 1810 on land which was described as being composed chiefly of "mountains, declivities of hills or dingles incapable of being improved by ploughing. Part of the land of a thin boggy nature.....and part a nut-brown soil of middling depth". In fact, conditions very much the same as the first acquisition areas at Gwydyr.  $1\frac{3}{4}$  million trees were used on the 261 acres; Norway spruce and "Gilhead fir" (presumably Abies balsamea) being mentioned. Pennant in his "Tour of Wales" (1778) mentions that "noblest oaks in all Wales" at Carreg-y-gwalch, between Bettws y Coed and Gwydyr Castle. The traveller Hall (1809-11) noted the sylvan beauty of the scene as one descended the Llugwy from Capel Curig "To the neighbourhood of Gwydyr House.....despite continual attacks on it by cattle". At Gwydyr there were proper fences and "the rocks and eminences on the west side of the valley are most beautifully covered with plantations in a very thriving condition. The firs are particularly prosperous." There were two nurseries near Llanrwst Bridge "one for public accommodation; the second for the use of Gwydyr property".

At meetings of the newly formed Agricultural Society of Caernarvonshire held early in the 19th century, the larger owners, including Wynn of Gwydyr, gave demonstrations of new practices and methods, and discussed the

possibilities of experiment; at this time, in the county generally "afforestation of the waste lands became the pastime of the well-to-do". In 1881-95 there were 1,068 acres of plantations in Caernarvonshire, which sank to 187 acres in 1905-15.

## 2. Snowdonia National Forest Park

In 1937, the Forestry Commissioners appointed a committee to advise them as to the formation of a National Forest Park in the vicinity of Snowdonia. The forest areas of Gwydyr and Beddgelert were selected, and the first permanent committee of the Park met in 1938, when it was decided to provide a camping site with water supplies, sanitation and shelter buildings at each forest, together with other light camping-sites providing simpler facilities.

The Beddgelert main site was completed early in 1940, providing accommodation for caravans as well as tents, together with a common-room and warden's house built in a traditional Welsh manor-house style. Excellent sanitary arrangements for the campers were provided in separate buildings.

Difficulties were encountered in finding a suitable site at Gwydyr, and to date only unofficial light camping sites are available, most of which are on tenanted Forestry Commission land.

During the war years, the site at Beddgelert was not used very much. In Forest Year 1947 the camping site was used by 482 people. In 1948, a press tour was arranged to coincide with the publication of the Guide Book, and with the easing and lifting of petrol restrictions campers increased rapidly, numbering 1,274 during the period April to September 1950, despite the very bad weather of that year.

Other facilities provided for visitors to the Park area have included the labelling of tree species along much frequented roads and paths, the establishment of arboreta, and a display of tree pictures etc. in the Common-room at Beddgelert.

With the formation of the National Forest Park and the setting up of a National Parks Commission, the provision of facilities for the public, and amenity considerations, began to take on a fresh importance. How far the latter requirements have been met in the past may be judged

by a quotation from the New Naturalist "Snowdonia" (1949).

"Now, however, the sparing of marginal scrub and the existence of larger (coniferous) woods alongside the Forest boundaries has resulted, round Bettws y Coed, in a blending of native and planted woodlands which is as yet quite unusual in Britain, and in which the green fields of the hill-farms and forest holdings stand out like continental "alps". "

J. R. HAMPSON  
District Officer  
May, 1951.

### 3. Fauna and Flora of Interest

In addition to those animals mentioned under the section on "Protection", it is worth noting that a herd of wild goats exists on Moel Siabod; they sometimes come down into the scrub.

A deer of unknown species was reported some years ago but none are believed to be present now.

Pine marten are recorded from time to time and there is every reason to believe that they are present in small numbers. Polecats do not normally occur.

Of the birds, ravens and peregrins nest within the Forest and buzzards are present. Choughs used to breed at Crafnant, but were shot out by a local farmer because of their "blood-covered beaks" ! A pair is, however, frequently present elsewhere within the Forest.

Blackgame and red grouse are present in small numbers. Crossbills are believed to have been present in 1950/51. Siskins have been reported and pied flycatchers breed in several areas.

Adders are common.

The alpine flora of the higher parts of the Snowdon mountain is not found in the forest but Saxifraga stellaris occurs on certain sites near or above the planting line.

W. A. CADMAN.

S.F.O..

GWYDVR SAMPLE PLOTS

APPENDIX IV

Measurements taken August 1948

+ Removed before 1948. Differences in Basal Area totals due to exclusion of poles under 8 1/2".  
 ø Heavily thinned and underplanted.

Site	Species	Qual. Class	Age yrs	Main Crop						Intermediate Yield from Thinnings				Total crop yield to date			
				No. of trees per acre	Av. Height of crop ft.	Form Factor	True girth at 4'3" ins.	Basal area per acre sq. ft.	Vol. (under bark) cu. ft.	Crown %	No. of trees	Av. Ht. ft.	True girth at 4'3" ins.	Basal area per acre sq. ft.	Vol. (under bark) cu. ft.	Basal area sq. ft.	Vol. (under bark) cu. ft.
Conway Valley	D. F.	IV	21	678	36 1/2	.378	17 1/2	90.9	1256	61 1/2/13	266	-	9 1/2	10.7	47 +	110.9	1392
"	D. F.	III	21	538	40	.392	19 1/2	86.9	1354	58/13 1/2	114	30	13	8.4	89 +	117.2	1702
"	D. F.	III	21	619	38	.402	17 1/2	79.8	1212	53/13 1/2	277	-	11	14.6	152 +	1138	1620
"	D. F.	III	21	422	40	.386	18	59.8	919	60 1/2/13 1/2	121	-	19	16.3	167 +	98.8	1401
Miners' Bridge	C. F.	I	28	450	43	.388	24 1/2	117.9	1958	53/17 1/2	214	40	15 1/4	22.5	315 +	186.5	2924
"	Ts.		22	621	43 1/2	.405	18 1/2	91.7	1607	57 1/2/11 1/2	538	-	13 1/2	43.3	597 +	98.8	1401
"	A. Nob		22	966	30 1/2	.423	18	136.5	1771	70/10	182	40	16	19.9	314	131.2	2171
"	A. Gran		22	519	50 1/2	.385	21 1/2	106.3	2077	65 1/2/10	310	-	13 1/2	23.7	331 +	138.3	1771
Dioesydd	D. F.	IV	28	302	52	.393	25	82.3	1676	52 1/2/14 1/2	250	40	17 1/2	32.4	571 +	162.6	2979
"	L. Cyp.		22	1169	32 1/2	.421	17	146.4	2015	54 1/2/11	450	-	14	38.1	473 +	149.6	2684
Allt Isaf	S. S.	I	26	317	68	.410	30	122.6	3416	54/10	183	42 1/2	19	29.2	535 +	168.3	2265
Maes- Newyddion	S. S.	II	27	450	56 1/2				2969		219	31	15	21.1	250 +	1268	6044
"	N. S.	I	27	580	50				2902		589	-	17	74.3	1360 +	249.3	6044
"	J. L. ø	II	27	260	46 1/2				1062		192	62 1/2	25	52.4	?	?	?

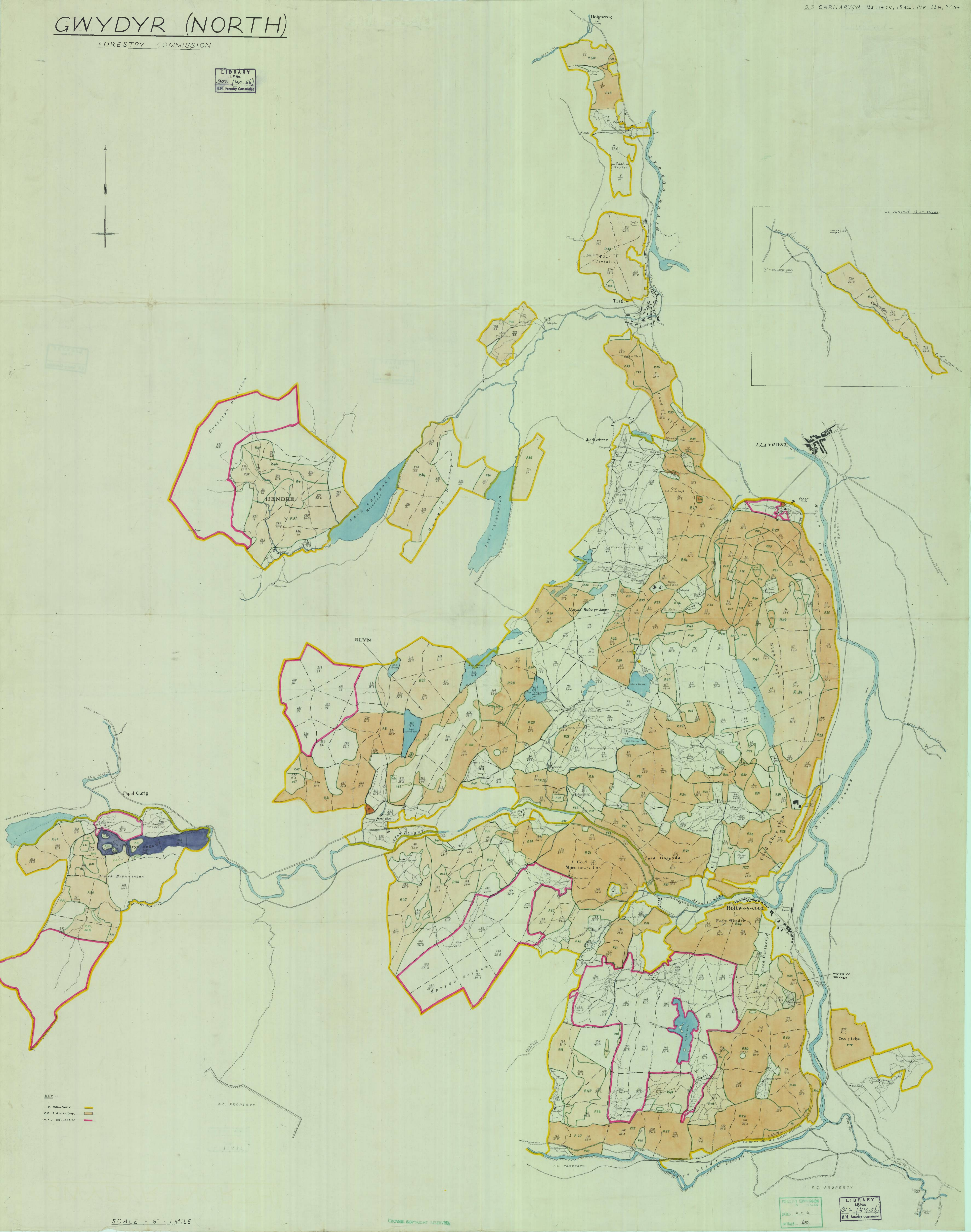
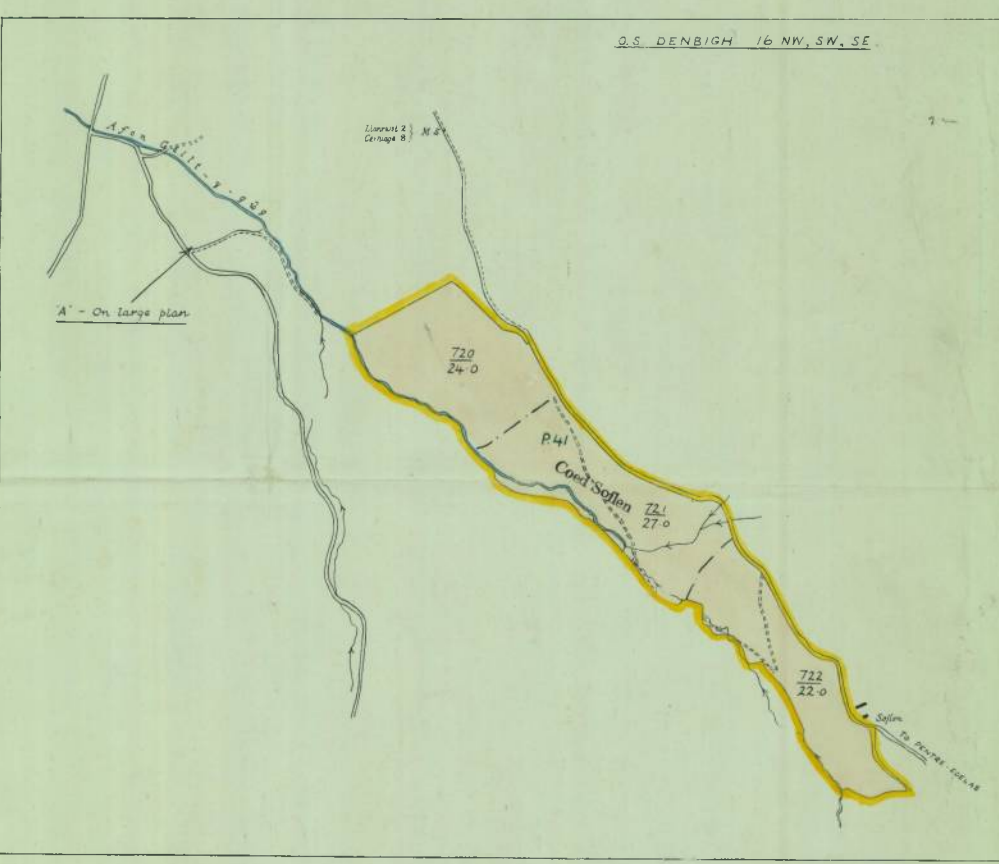
Gwydyr

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