

REPORT ON A FORESTRY TOUR TO THE  
UNITED KINGDOM

by  
W.C. Wilton



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NEWFOUNDLAND REGION  
ST. JOHN'S, NEWFOUNDLAND  
INFORMATION REPORT N-X-4



DEPARTMENT OF FORESTRY  
JANUARY, 1966

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INTRODUCTION

In November 1964 a party of four research officers from the Department of Forestry visited forest installations and experiments in Finland, Sweden, Norway and Great Britain. The party consisted of L.A. Smithers and A.W. Blythe from head office at Ottawa and D.E. Nickerson and the author from the Newfoundland Region. This report is a summary of observations and impressions from the United Kingdom portion of the tour.

The purpose of the trip was to observe and study certain aspects of silvicultural research particularly that pertaining to heathland and peatland afforestation. Because of climatic similarities the problems of afforestation in Newfoundland would appear to be more closely related to those of many parts of Northern Europe than they are to most of mainland Canada. Therefore, many of the forestry techniques in use in certain parts of Europe may have application here. Furthermore, there is much to be learned from the intensive forestry which has been practiced for a long time in some of these countries.

The party spent the last two weeks of November visiting the United Kingdom as guests of the Research Directorate of the British Forestry Commission. The tour began at the Research Branch Scottish Office at Edinburgh where the group was given an outline of the history, organization and policy of the Forestry Commission with particular emphasis on the Research Directorate. It ended at the Alice Holt Research Centre near Farnham in Surrey where discussions were held with the various section heads and senior staff officers. In between, a number of Commission forests and research experimental areas were visited in Scotland and North Wales. The party was guided on these tours by research officers who had carefully planned the agenda and did all possible to make it most interesting and informative.



Information circulars and Commission publications were provided in most instances which outlined the basic data on experiments visited, thus reducing the necessity for note-keeping and giving more time for observations. As a consequence most of the background information contained in this Report can be found in more detail in reports of the Forestry Commission.

On this tour the emphasis was placed upon the study of heathland and peatland afforestation techniques. In the course of travel however, a number of other interesting aspects of British forestry were observed, including such diverse fields as nursery practices, extraction methods, sand fixation and afforestation, and land use integration.

In both Scotland and Wales the Commission's forests are mainly being established on the poorer types of soils, the richer lands normally being used for agriculture. The utilization of these poor soils for afforestation has been aided in recent years by developments in deep ploughing methods. Afforestation research, regardless of the soil type involved, may conveniently be grouped under the three main headings of ground preparation, species trials, and fertilization.

In the United Kingdom a clear distinction is made between heathland and peatland. Peat soils develop on poorly drained locations; they consist predominately of the remains of Sphagnum mosses and usually Calluna. Deep peats are those having a depth of two feet or greater and in such cases the roots of planted trees are virtually isolated from the underlying soil. Heath soils are those which have a thick peaty raw humus layer of ericaceous origin which may develop even on well-drained slope positions as a result of excessive precipitation. The techniques for afforesting heathland are entirely different from those used on peatlands and the two will be discussed separately.

#### HISTORICAL BACKGROUND

The whole of Great Britain has been subject to the depredations of man for so long that very little of the natural forest cover remains. This original forest was largely composed of broad-leaved species of which oak (Quercus spp.)



was the most prominent. The only native softwood of commercial importance was Scots pine (Pinus sylvestris Linn.) which occupied extensive areas in the Scottish Highlands. By various social changes the bulk of the natural lands of Britain eventually became privately owned and it was these landed proprietors who first began the practice of establishing plantations and managing the new forests. The native Scots pine was the first coniferous tree to be used in planting but during the eighteenth century both Norway spruce (Picea abies (L) Karst.) and European larch (Larix decidua Mill.) were used on an increasing scale. About the turn of the century other conifers, mainly from western North America, came into prominence. Private woodlands were for the most part small and scattered but together they constituted a considerable reserve of timber which was of great importance to the nation during both world wars. Before the First World War the Government took little direct interest in forestry, but the war years showed that in time of crisis there was a need to reduce the country's dependence upon wood imports. Various means were tried to encourage the growing of timber and these eventually led to the Forestry Act of 1919 which established the Forestry Commission as the Government authority responsible for such work. Since its inception the Commission has established more than one and one-quarter million acres of woodland and has encouraged and assisted private owners to the extent that there is now a total of more than three million acres in productive forests. Land is obtained by lease or outright purchase and close liaison is maintained with the Department of Agriculture to ensure the most appropriate land use. The maximum purchase price of land is presently about ten pounds per acre. This represents about one-quarter of the average plantation establishment costs, including such items as ground preparation, fencing and planting. During the past ten years there has been an average of about sixty thousand acres planted annually.

Most of the Commission forests are less than forty-five years old and the bulk of the present produce is consequently in the form of thinnings. However, in the early days of the Commission a number of purchases were made of forested land and these established forests include most of the better quality land presently



under control. Supervision of thinning and some felling is undertaken by Commission staff but trees selected for removal may be sold in the standing condition to timber merchants. Sale value of this material together with other Commission revenue presently represents about one-quarter of the annual operating costs, and in about ten to fifteen years, as more and more forests reach maturity, the Commission should be in a position to pay its own way on an annual basis.

#### THE RESEARCH DIRECTORATE

The Research Directorate is organized under a director for administration and policy and a conservator for research direction. The various disciplines, - silviculture, genetics, soils, pathology, entomology, and work study - are each organized under a section head. The Directorate is divided territorially into Scotland (North) and England and Wales (South). Both regions are further subdivided into conservancies, divisions, districts, and forests which are subdivisions for the entire Commission but also serve as working units for the Research Directorate.

Graduate foresters, called Research Officers, are assigned territorially either to north or south. These function as project leaders and, subject to section control, are free to carry out their research projects anywhere on Commission land within their territory.

The various working units are each in charge of a head forester for research who is assisted by a number of research foresters. These are non-graduates, equivalent to the Canadian Forest Technician, but must undergo two years of training in a Commission forestry school. One of the strongest impressions gained from this tour was the obvious high calibre and initiative of research foresters. They direct all field activities with an apparent minimum of instruction, leaving the research officers free for project planning and analysis.

Commission research is mainly empirical. The field of fundamental research is largely left to the universities while Commission personnel concern themselves primarily with species trials, establishment methods and site improvements.



Research personnel are in the fortunate position of having the results of their work eagerly awaited and quickly put into practice. Undoubtedly this is because the Commission's program of reforestation and afforestation is comparatively new and also because this program is so extensive that work is being undertaken on increasingly more difficult areas where planting techniques and species trials must first be tested and proven by research methods.

#### UPLAND HEATH AFFORESTATION

The areas visited included the Glencoe and Teindland forests of Scotland and Gwydyr forest of North Wales. Probably the most typical of these forests and the one which most nearly resembles eastern Newfoundland conditions was the Teindland area.

#### Teindland Forest

This forest is situated on the western slopes of the Spey Valley near Elgin in Morayshire at an elevation of about 700 feet. The underlying rock is old red sandstone conglomerate overlain by deep boulder till largely derived from the parent material. Annual precipitation is about thirty inches. The natural vegetation is ericaceous with Calluna vulgaris being dominant. The soils are peaty gley podzols with hardpan on boulder till. These are not unlike many of the eastern Newfoundland soils except that at Teindland the hardpan layer is usually more pronounced while the organic layer is usually better decomposed.

The first experiments were started in 1925 when it was realized that the area was not reclaimable by direct planting. Experimentation has followed along the lines of determining the effects of different cultivation and fertilization treatments on the growth of various tree species. The experiments visited at Teindland consisted of various combinations of these trials. Cultivation experiments, which have progressed in accordance with the mechanical means available, have now advanced to the stage where most ground preparation is accomplished by the use of especially designed forest ploughs. The aim in soil disturbance is to break the tough peat layer and allow water to percolate through the soil and also to



penetrate the lower compact layers for better soil aeration and root penetration. Experimentation in recent years has progressed from deep spaced furrow ploughing to shallow spaced furrow ploughing combined with subsoiling by means of a tine attached to the plough. Trials have also been undertaken to compare furrow and ridge planting on land ploughed by the single furrow method. Results show that survival and early growth of seedlings is generally better with furrow planting, but wind loosening is usually more severe than in ridge planting. In general single furrow planting on exposed heaths has led to poor root development and consequent instability in the trees. Recent trials of complete ploughing seems to have given better results.

The native Scots pine was used extensively for afforestation of heaths in earlier years of the Commission but more recently it has been replaced by lodgepole (Pinus contorta Dougl.) particularly the coastal variety (Pinus contorta var. contorta). The latter species can produce approximately twenty-five per cent more volume and is of equivalent quality. The provenance of lodgepole however is important as there is considerable variation in the growth rates and habits of the two varieties and numerous races of this species. At Teindland a number of provenances are being tested both in direct comparisons and intimate mixtures with other species. While certain provenances are generally acceptable, most appear to have certain undesirable characteristics and improvements are being sought through the breeding of more satisfactory varieties.

Sitka spruce (Picea sitchensis (Bong.) Carr.), because of its usually superior growth qualities, has been widely used by the Forestry Commission and considerable research has been devoted to its establishment on heathlands. Although some success has been achieved it is now generally considered unsuitable for the Teindland locality, where annual precipitation is less than forty inches. However, it is still used on superior sites.

Fertilizer trials which have been in progress for some time have shown that phosphates are beneficial. Most earlier fertilization experiments at Teindland involved different intensities of basic slag; all showed significant



results. Later trials have been designed to compare various phosphatic fertilizers and to develop the techniques of application. Trials of other fertilizers with the exception of nitrogen have not shown any growth increase. Nitrogen gave a significant response but only on a short term basis.

#### Glencoe Forest (Rannoch Moor)

Rannoch Moor, in the Glencoe Forest, is an area recently acquired by the Commission which is considered on the borders of plantability mainly because of ploughing difficulties on rocky boulder-strewn terrain. Elevation is 1,050 feet and the area is severely exposed from south to east. Precipitation is about eighty inches annually.

This area provided a good demonstration of "The use of flags to estimate the relative exposure of trial plantations" as explained in Forestry Commission Forest Record No. 51, by Lines, R. and Howell, R.S., published in 1963 under the above title. This publication describes a method whereby the amount of tatter of standardized cotton flags is used to define the degree of exposure as determined by correlation with the growth of trees, particularly lodgepole pine.

In trials at Rannoch Moor the tine plough proved unsuccessful but some success was achieved with a single mouldboard Cuthbertson. This is a heavy forestry plough which was originally designed for use on deep peat. The original features were later incorporated in other models so that Cuthbertson ploughs of different types are now available for various tasks on many sites including heathland. At Rannoch Moor a considerable number of species were tested in trial plantings in 1957 and of these lodgepole pine has shown most promise. This species has been successful on all planting sites except the tops of rocky knolls. In all plantings each seedling received one and one half ounces of ground mineral phosphate at the time of establishment.

#### Gwydyr Forest

Gwydyr forest is located on the eastern foothills of the Snowdonian Range in North Wales. The total area covers about thirty-two square miles but the



forested portion is somewhat smaller and broken up into blocks because of differences in terrain and the prevalence of fertile valley areas which are still retained under agricultural use. Some forest blocks are located in the lowlying fertile valleys, thus affording opportunities to see British forestry under conditions approaching optimum. However, the bulk of afforestation has taken place on the high plateau where conditions are difficult. Almost the entire area is located on Ordovician shale and slate formations. In the plateau country the soils are usually thin with rocky ridges and outcrops alternating with bogs. Precipitation varies from fifty to eighty inches annually and snow is frequent. Peat occupies much of the high ground and while the heavy rainfall and impeded drainage have given rise to innumerable bogs, the intervening ridges usually have a thin mineral soil layer which supports an ericaceous vegetation largely made up of Calluna.

Heathland afforestation practices have been somewhat similar to those at Teindland and although soil compactness and hardpan formation does not appear to be so pronounced here as in the north the same problems have been encountered. Similar solutions are being sought and several recent experiments in complete ploughing were observed.

At Gwydyr there is more diversity in planting than was apparent in the north. A large number of species has been used on a small scale and both Douglas fir (Pseudotsuga taxifolia (Poir.) Britt.) and European larch were used extensively on the lower slopes. Norway spruce and Scots pine were formerly the preferred species on the higher ground and some excellent stands are in evidence. Recently, however, their place has been taken by Sitka spruce and lodgepole pine. Because of the high rainfall Sitka is successful on most heath sites and considerably more is used here than in the north. In general it would appear that Sitka is now preferred on the better sites in areas of high rainfall whereas lodgepole is used on poor sites and where rainfall is less than forty inches annually.



## DEEP PEAT AFFORESTATION

Experiments in tree planting on deep peat were visited at Lon Mor in the Inchnacardoch forest of Scotland and again in the Gwydyr and Clocaenog forests of North Wales. Peat afforestation practices are becoming somewhat standardized and the description will be confined to the Inchnacardoch area which is the main experimental area in Britain for work on acid peats.

### Inchnacardoch Forest (Lon Mor)

Inchnacardoch forest lies to the west of Fort Augustus at the head of Loch Ness in Inverness-shire. Lon Mor (Gaelic for big bog) is situated at an elevation of 550 feet on the northeast side of the Great Glen. The surrounding hills rise to over 1500 feet so that except for southwest and northeast winds which blow up and down the Glen the Lon Mor may be considered as relatively sheltered. The annual precipitation is estimated at sixty inches. The bedrock is a foliated gneiss. The area consists of three basins of peat up to twenty feet in depth separated and enclosed by rocky or morainic ridges on which the peat may be only six inches deep. The original vegetation was that characteristic of the poorest peat bogs and was dominated by Scirpus caespitosus with frequent Calluna vulgaris and Myrica gale. The drainage was poor and pools of open water occurred throughout the area. The earliest work consisted of the construction of main drainage ditches for the removal of surface water.

Approximately one hundred and fifty experiments have been undertaken at Inchnacardoch since work started in 1921. Successful afforestation on peat can only be accomplished by removing excess water through drainage and by inverting peat to provide a successful medium for tree growth. Early experimentation was based upon hand working methods and it was not until 1945 that mechanized equipment came into general use. The specialized Cuthbertson plough pulled by standard wide-treaded tractors now makes it possible to afforest the poorer peat bogs. Furrows are spaced at intervals of five to six feet with the furrows being about 16" deep and serving as lateral drains. The plants are inserted in steps cut in



the plough ridges with their roots near the two adjoining original surfaces formed by the inverted turf and the original peat. A number of early experiments demonstrated the superiority of turf planting over direct planting.

Various spruce species were widely used in early experimentation but most were unsuccessful although Sitka is still used to some extent. The pines, particularly Scots and lodgepole, grew better than the spruce on poor sites and are now being used on an increasing scale at Lon Mor. Lodgepole from British Columbia and Washington State were generally more vigorous than Scots pine and have produced excellent volume in the comparatively short time since planting. However, the same difficulties and differences with provenances are being experienced on peat lands as are experienced on heath soils and solutions are being sought similarly through genetics.

Fertilizing with phosphates is a beneficial treatment on all peats and it is a necessity on the poorer ones. These facts have long been accepted and experimentation has since gone on to study the form and quality of phosphate and the time of application. Basic slag and ground mineral phosphate have been found to give almost identical results. The normal application is about one and one-half to two ounces per tree applied at the time of planting. Experiments with other fertilizers, including trace elements, have not shown advantageous results.

Very few plantations on deep peat have so far reached the thinning stage; thus it is difficult to forecast the behaviour of mature stands on wind susceptible areas. It is known that some peat shrinkage takes place after stand closure and consequently the tree roots become somewhat exposed with time. The hazard of windthrow is thus ever-present on exposed areas and the Forestry Commission are presently conducting extensive trials to measure and attempt to reduce this hazard.



## FOREST OPERATIONS

Demonstrations of normal harvesting practices were seen in Scotland at the Great Glen and in North Wales at the Gwydyr Forest in Caernarvon and the Newborough section of the Mon forest at Anglesey. Because the forests are mainly immature, most forest operations take the form of thinnings.

The first thinning usually takes place at about twenty years and thereafter interventions occur at three to ten year intervals depending upon the species and the site. The first thinning is normally preceded by brashing or low pruning for ease in tree marking and felling, and also to improve the quality of the residual stand. First thinnings will usually yield about 300 poles per acre, averaging about one cubic foot per pole. An operation was observed at Newborough where an eighteen year old stand of Corsican pine (Pinus nigra var. calabrica (Schneid) on better than average site was being thinned, yielding 425 cubic feet per acre with a residual stand of 800 cubic feet per acre.

In Wales the crown thinning method seems to be favoured. In Scotland a procedure called eclectic thinning was developed locally for employment in Norway spruce stands; it has since gained favour for treatment of other species, especially Sitka spruce and is now widely used. Essentially eclectic thinning attempts to combine the merits of crown and low thinning regimes. At about the time of the first thinning, a number of the best stems in the stand are selected and marked as the final crop trees. All thinnings are thereafter marked so as to favour the development of these elite trees. The total volume removed through thinnings is estimated to account for half the total yield since their aggregate volume will about equal the final crop.

Cutting methods do not differ widely from those used in Eastern Canada. The power saw is in general use for felling but has not yet gained favour as a limbing tool. The extraction phase is generally less mechanized than in Canadian operations possibly because thinnings do not lend themselves to the same degree of mechanization. A demonstration of the Isaacson Winch was observed at



the Great Glen but this was on difficult terrain and the operators had not had time to standardize the operation. Thus the demonstration was not as impressive as it might have been.

In thinning operations all stumps are creosoted at time of felling because of the high incidence of Fomes annosus which is particularly damaging to planted stands.

#### NURSERY PRACTICES AND GENETICS

All planting stock used by the Forestry Commission is produced in its own nurseries and most of these are large establishments, usually one or two in each conservancy, any one of which may produce up to ten million transplants annually. The Research Directorate carry out investigations on their own, usually small nurseries, and may also conduct experiments on the main Commission ones. Visits were made to a small research nursery at Bush near Edinburgh and to a large Commission establishment situated at Newton near Elgin.

In normal nursery practices both broadcast and drill sowing methods are used with the latter method gaining prominence because of better adaptability to mechanization. Coarse sand or grit is always used to cover seed, the particles normally being at least three or four times the diameter of the seed. An organic manure in the form of spent hops is usually added to the soil mainly as a conditioner but, as this is poor in nutrients, a balanced inorganic fertilizer is also added in forms and qualities prescribed by the Research Directorate.

A seed orchard which is now coming into production is located at Newton Nursery. Here and elsewhere the genetics section has been engaged in a programme of selection and improvement within species by grafting from plus trees and of selection of desirable tree characteristics by crossing between and within species.



CONCLUSION

This visit tended to confirm the impression long held in the Newfoundland Region that on this island we are much closer to northern Europe, both in climatic and ecological conditions and forest problems, than we are to the greater part of mainland Canada. For this reason a much closer liaison should be established and maintained. United Kingdom foresters are cognizant of this and they are willing and eager to co-operate and engage in an exchange of ideas. At the present time, in both reforestation and afforestation, it would be mainly a one-way exchange; they obviously have had more experience and know more about the subject than we do. However, in forest operations, particularly extraction methods, the circumstances are somewhat reversed and United Kingdom foresters might benefit from the wider experience of eastern Canadian foresters.

This tour was in the form of a reconnaissance trip; a great deal was seen in a short period but insufficient time could be devoted to any particular aspect of forestry. As such it well served its purpose but any such future liaison could be in the form of problem studies carefully planned for one or two persons to work in close co-operation with their United Kingdom counterparts on a particular research problem.