The Progress of Peatland Afforestation in Northern Ireland

W. G. Dallas,

Forestry Division, Northern Ireland Ministry of Agriculture.

In this paper it is proposed to outline the progress made in peat afforestation to date in Northern Ireland. Current methods will be described and a description of future trends given.

The present ultimate target of the Ministry is to have approximately 150,000 acres in production by the year 2,000 A.D. The present reserve of plantable forest land is around 40,000 acres of which approximately 35,000 acres are on peat. Current policy is to plant about one-eighth of this reserve annually and the present planting programme is approximately 5,000 acres. It is estimated that, of this figure, 4,000 acres are on peat. Future planting programmes will depend on the rate of acquisition of land and will vary proportionately with it. To date an area of 58,700 acres has been planted, 25,000 of which is on deep peat.

It was not until 1949 that large scale attempts at afforesting deep peat were made. It is true that some small peat areas were planted prior to this date but most were on shallow peat. 1949 is, therefore, regarded as the beginning of the mechanized deep peat afforestation era in Northern Ireland.

Mechanization.

The economics of afforesting deep peat hinge largely on the machinery used and it is interesting to consider the pattern of machinery development in Northern Ireland.

In 1949 when 12 acres were experimentally ploughed at Ballypatrick Forest at 20 ft. spacing, a Fordson tractor with Rotaped conversion and a Turnall plough were used. Later in 1949 and in 1950 a Single-furrow Cuthbertson MK. I plough was used. Many will recall this unit with its characteristic rectangular transporter portal. 1951 saw a change to a Fowler Mark V unit with the same Cuthbertson plough. In 1952 a Beggs plough was purchased and used with the

Fowler. David Brown D.30 and D.50 Trackmaster Crawler tractors were used from 1953 with the Single-furrow Cuthbertson plough. The Beggs unit was also used during this period.

A Cuthbertson Water Buffalo was purchased in 1953 and with it Cuthbertson Single (Type F) and Double furrow (Type P) ploughs. This tractor was successful but found expensive to maintain. Its initial cost was high and the optimum drawbar pull of around 15,000 pounds was considered in excess of that required. The Water Buffalo has now given way to Fordson County Crawler wide gauge, swamp model tractors. These units first appeared in 1955 and modified versions are now in universal use. Present models have 30 inch wide extended length tracks, front mounted winches and ground anchor equipment. They still retain the 2.5 lb./in. ground pressure of the Buffalo but have a draw-bar pull of 10,000 pounds. The cost of the unit is approximately half that of the Buffalo. Cuthbertson ploughs, types P. and F. with minor modifications, are still in use.

Plantation Layout, Drainage and Ploughing.

In the early days of mechanized peat ploughing the ploughing was regarded more as an alternative to the old turfing method than a drainage method. Both aspects are now considered together. Formerly the practice was to produce a minimum number of plough scores which could be cut and spread as turves. Current practice now eliminates the cutting and spreading by providing turf ribbons every 5 or 6 feet. The change occurred because of economic comparison of the two methods.

Little heed was paid in the earlier years to forest planning and it was only around 1953 that a standard method of layout was developed. Great strees is laid on careful planation layout and much time has been spent on its development. The following layout system has been used for several years but will be replaced in 1962 by a method which will be described later.

Prior to ploughing, a combined drainage, road and extraction route plan was prepared and based on several basic principles :—

1. The economic extraction of forest produce.
2. Access to fire hazard areas.
3. The elimination of the necessity for cutting out, immediately prior to thinning, extraction paths which expose stand edges, and reduce the wind stability of the forest crop.

In addition the following principles were adhered to :—

(a) Drains were situated with full regard to effect and economy.

(b) Minor extraction routes were made easily negotiable—having a minimum length serving a maximum area.

(c) The forest was divided into management units or compartments averaging 25 acres within the limits of 15 and 40 acres.

This plan was then transferred from the map to the site. Road lines were laid out first, then followed a system of rides which with the roads formed the compartment boundaries. Within each compartment further extraction routes called racks were laid out. These together with the rides were left unplanted. Rides were approximately 35 feet wide and racks 15 feet. Racks were normally situated at intervals of 5 chains thus leaving a maximum extraction distance of around 160 feet from stump to rack edge. When all roads and ride positions had been carefully marked on the ground with survey posts, they were defined permanently with deep plough furrows (Cuthbertson F type). These furrows together with ,'cut-off" drains formed the basis of the main drainage system. "Cut-off" drains were constructed along the upper boundaries of the areas to be planted and so situated trapped all inflowing water.

Additional drains at 30 ft. spacing were then ploughed across the slope at right angles to the racking system. These emptied into the main drainage network.

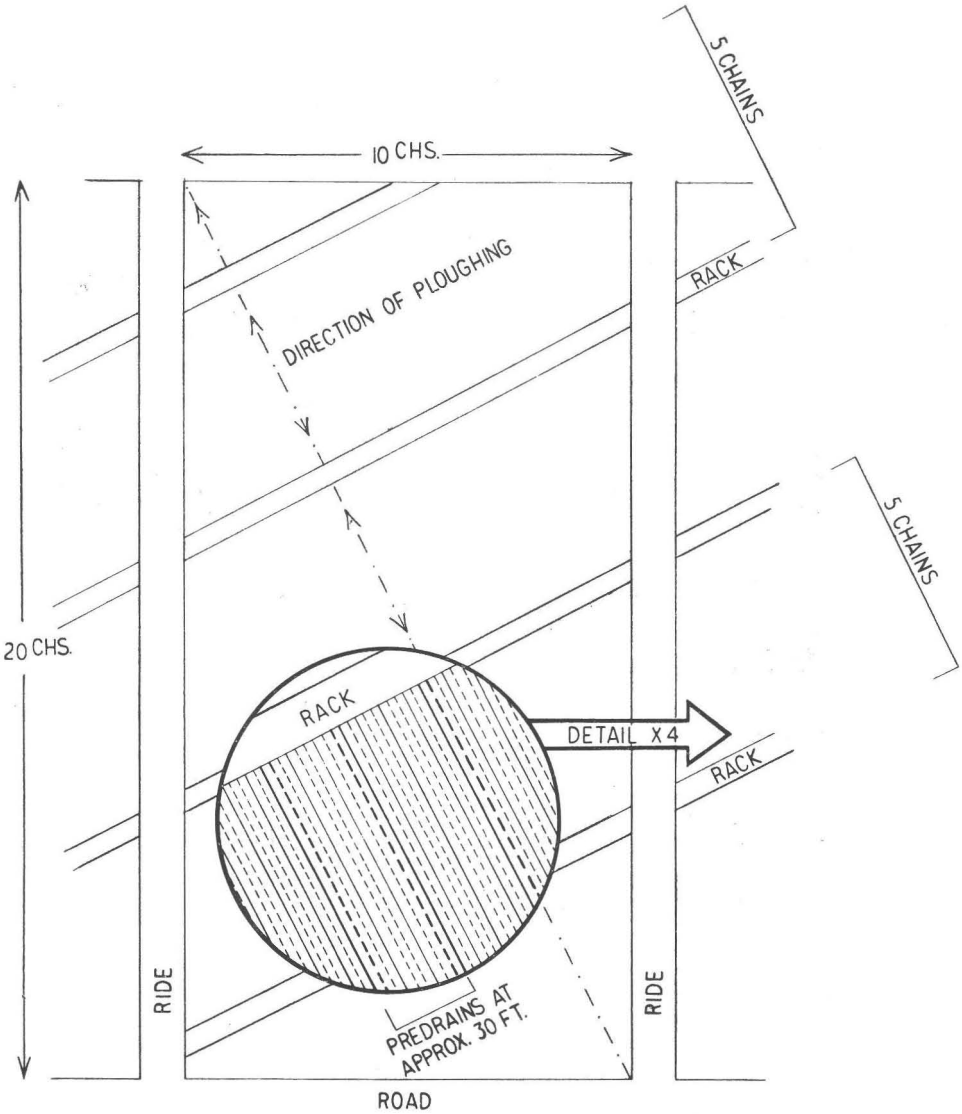
The ploughing described above was termed pre-draining because it preceded the later close pre-planting ploughing. The period which elapsed between pre-draining and planting depended on the wetness of the area. In relatively dry areas it preceded it by only a few weeks and in wet areas by as much as 5 years.

The main purpose of pre-draining was to remove surface water and consolidate the peat surface. This enabled the narrower tracked tractors to be used for the close ploughing. Pre-draining was carried out using Cuthbertson F type ploughs which produced a 30 in. furrow. Some of the drains, after an initial drying out period, were further deepened by hand to 36 inches and in very wet areas considerably widened to prevent closing due to peat flow. Pre-planting ploughing was carried out at 10 ft. spacing using Cuthbertson double furrow ploughs (Type P). The result was a peat planting ribbon every 5 feet. This ploughing was carried out at right angles to the racks which enabled eventual extraction to take place along the tree rows on to the racks and eliminated crossing the irregular surface caused by ploughing. The shallow double furrow drains were deepened by hand where necessary and connected to the main drainage system. This layout system is illustrated in Figure 1.

The main factors responsible for the change in layout and drainage practice were :

(1) The benefits of pre-draining were considered limited and once efficient wide gauge, extended length, tractors capable of negotiating water-logged peat were available, it was found that these could plough satisfactorily at close spacing. The main benefit of pre-draining in the past was simply the removal of surface water.

(2) The eventual difficulty of extraction from stump to rack, entailing an estimated maximum haul of around 160 feet.



LEGEND

———	Cuthbertson Type "F" Ribbon
— — —	" " " Furrow
— — —	" " "P" Ribbon
———	" " " Furrow

Fig. 1.

The method currently in use differs from the previous method in the following ways :—

(1) There is no intense pre-draining. Pre-draining consists purely of the clearing of existing watercourses and the tapping of flushes and pools.

(2) Deep ploughing is done at approximately 16 feet spacing using an 18 inch single furrow plough. Between each pair of single furrow drains a double furrow P type Cuthbertson plough is used maximum depth. The present Cuthbertson P type ploughs plough only to a depth of about 12 inches and the development of an 18 inch P type implement is being considered. Ideally the aim is to provide a rooting depth of at least 18 inches for a rotation. The water table must, therefore, be lowered to this level by drainage, evaporation and transpiration. This could best be achieved by using an F type plough every 6 feet, but until this plough can be modified to produce a 9 inch, instead of an 18 inch planting ribbon, the present combination of P and F type ploughs will continue. F type peat ribbon will be "stepped" to produce a satisfactory depth for planting. The machinery section of the Forestry Division of the Ministry is at present working on such a modification.

(3) Every 13 rows one double furrow run will be omitted to form a rack. The distance between racks will, therefore, be about 24 yards giving an approximate maximum stump-to-rack haul of 36 feet. The rack width will be between 16 and 18 feet. In actual practice the rack will be left by omitting one double furrow plough run every 13 rows. This obviously greatly reduces the stump-to-rack haul compared with that of the previous system. It will be seen that in this case the irregular surface produced by ploughing will have to be traversed at thinning to load a machine on the rack but it is thought that this will not present a serious problem over the short distance. This system of ploughing layout is illustrated in Figure 2. The direction of ploughing is not very important from the tree growing or drainage point of view but since the racks are to be parallel to the plough scores it is important that the ploughing should take the shortest line to a road or ride which gives a negotiable rack.

(4) Greater use will be made of natural barriers to extraction, such as streams and main drains, as compartment boundaries. As explained below racks will be left along such barriers. These will provide sufficient area for future extraction and rides will be unnecessary in these circumstances.

In order to standardize drainage terminology and to clarify instruction, three distinct types of drain will be recognized.

(1) *Main drains*—these will be existing watercourses such as rivers and streams.

(2) *Leader drains*—these will be main watercourses formed by mechanical or hand drainage and will include (a) "cut off

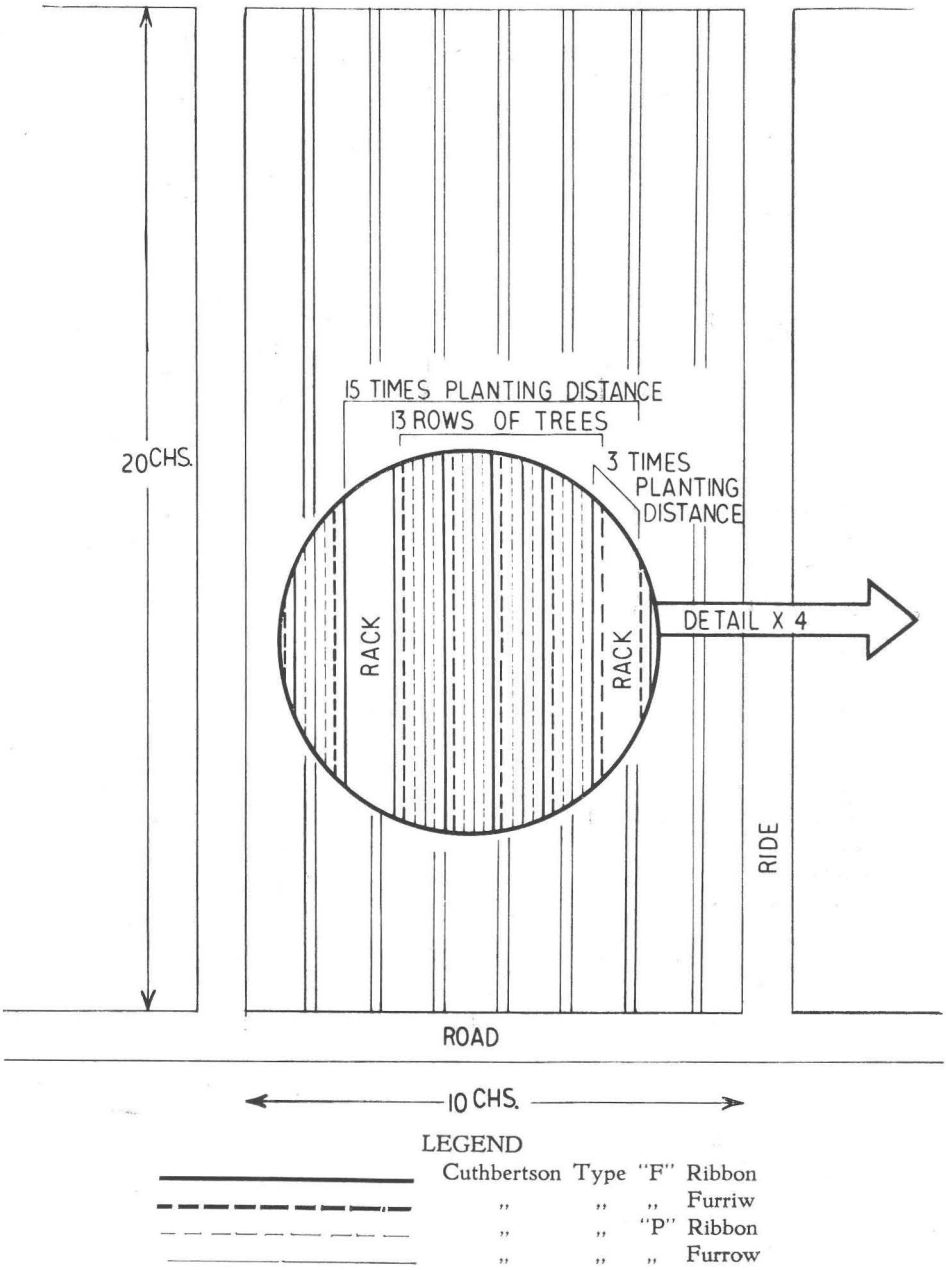

15 TIMES PLANTING DISTANCE
13 ROWS OF TREES
3 TIMES PLANTING DISTANCE
20 CHS.
RACK
RACK
DETAIL X 4
RIDE
ROAD
10 CHS.
LEGEND
Cuthbertson Type "F" Ribbon
" " " Furriw
" " "P" Ribbon
" " " Furrow

Fig. 2.

drains" which trap inflowing water to planting areas and (b) drains which top flushes and pools. Occasionally a leader drain with a particularly high flow may be classified as a main drain. Where practicable these drains will be opened after ploughing for planting has been completed.

(3) *Plough drains*—these will be the F type and P type plough furrows—which may be deepened where necessary to ensure a flow.

It is being assumed that maintenance of many main and most leader drains will be done mechanically and with this in mind racks approximately 7½ feet wide will be left on each side of the drains to facilitate the future use of machinery. Experience in the past has illustrated forcibly that erosion of main and secondary drains can be a serious problem especially where the drains have been ploughed or deepened on to the underlying soil layer. This fact will be carefully considered when siting such drains and definite optimum gradients will be calculated for each soil and peat type.

Coupled with this problem is one of drain "closure" on slopes where the extreme "fluidity" of the peat may, within less than twelve months, render a normal F type drain ineffective. On such areas the tendency is now to excavate the uphill slope to as much as 45°.

Both these problems are still under observation in the field but there is a definite trend towards wider drain bottoms and more gradual side slopes to counteract the trouble.

Possible adverse wind effects following intensive use of the 18 inch plough have been considered. In a departmental report produced following recent field investigations Jack and Forbes (1961) described the rooting habits of Sitka spruce and contorta pine in similar conditions. They do not agree that roots will not cross these drains; and on the contrary they found in all cases investigated that there was strong root development across the drain bottoms. These roots were, however, confined to the litter layer and also to developing *Sphagnum* layers. In some cases the roots had commenced to ascend the opposite drain side. It is probable that with the continuing lowering of the water table, due to evaporation and transpiration, the roots will penetrate deeper and provide increased anchorage. Jack and Forbes in most of the cases investigated discovered roots extending to distances approximately twice the height of the trees excavated—up to the "closing canopy stage".

Roads.

Until recently a road intensity of up to 8 miles per square mile (planted) was planned and most of this was often constructed at the pre-establishment stage.

In future the intensity of metalled roads will be low—approximately 2 miles per square mile (planted). Supplementary road alignments will, however, be left at the 8 mile per square mile intensity in

case future technical developments should demand the additional metalled surface.

Fire Breaks.

Where the potential fire risk is high on extensive peat areas which are to be afforested, the forest will be broken into blocks of approximately 250 acres by fire breaks. These fire breaks will consist of a 50 ft. wide cultivated area without vegetation in the centre, with, where possible, 50 ft. wide strips of hardwood trees or fire-resisting vegetation on each side. Fire breaks will follow road alignments and rides where possible. Birch and alder species are at present used experimentally and are being fertilized to ensure early establishment.

Planting Methods.

Practice to date in the majority of forests has favoured the 4 inch semi-circular spade with only local preference for notch planting. Evidence, however, appears to be accumulating in favour of notching but no immediate changes in practice are envisaged. In earlier years planting was carried out at a 5 ft. × 5 ft. spacing but this has now changed to 6 ft. × 6 ft.

Several years ago the practice of planting up to the sides of main drains was prohibited. No planting is now allowed within 5 feet of these drains. This prevents the cutting of many roots during maintenance operations and results in a more wind firm tree crop.

Species.

For many years the main species used was Sitka spruce with fluctuating proportions of contorta pine. Until 1955 considerable areas were planted using mixtures of these two species but the results of this proved so unhappy that the practice was abandoned. Invariably the Sitka spruce fell behind the pine and the ultimate result was an almost pure pine crop which contained many openings. The danger of these openings has been well described by Parker (1957). Divisional policy now prohibits the use of contorta pine except on shallow peat over rocky ground and Sitka spruce is being planted almost exclusively. This choice of species is in direct contrast to that in use on similar sites in the Republic of Ireland. It is justified on the following grounds :—

(1) There is no evidence in Northern Ireland, apart from initial heather check, that contorta pine will grow better than Sitka spruce on deep peat.

(2) There are preliminary indications that re-invasion by *Sphagnum* at the pole stage may be much more difficult to control with a light-demanding pine crop. (Parker 1957).

(3) Market trends suggest that it will be difficult to sell contorta pine in Northern Ireland whereas there is a ready market for spruce.

(4) The potential timber production of a high quality contorta pine crop is considerably less than a Sitka spruce crop.

Fertilization.

Phosphatic fertilizer has been in constant use in various forms for the past 12 years. Basic slag has been most widely used with some local preference for ground rock phosphate and Semsol. Slag is now, however, in use on all forests. Experiments until recently have not provided any conclusive evidence which conflicts greatly with practice.

Fertilizer application has, according to local preference, been "in the hole" or "around the plant". There are, however, indications that greater success can be obtained by (a) applying the fertilizer under the ribbon or (b) spreading it broadcast over the area but only a few small areas have been treated in these ways. Referring again to the investigation of Jack and Forbes (1961), these workers, during their rooting studies, discovered a large solidified portion of basic slag still intact after 6 years. This slag lump was penetrated by a few active roots. Analysis showed a phosphate content of 18%. This discovery is no recommendation for the "in the hole" method. Both the under ribbon and the broadcast methods will be used during the coming year. A recently acquired Bombardier Muskeg tractor will be used for the broadcasting.

Growth Check.

The problem of growth check is well known throughout the British Isles and much experimental work has been done which includes several experiments in Northern Ireland. Present belief is that this early check is induced by the presence of *Calluna.* Many remedies have been and are being tried to prevent the check.

The most efficient, although by no means the most economic, method in use is the hand spreading around plants of material dug from drains. The remedy here appears to lie in the physical suppression of the heather.

In 1958 aerial application of a concentrated NPK compound fertilizer was tried on an experimental basis and following its success it is proposed to treat similarly a 300 acre area with the same fertilizer. It is estimated that on a large scale the cost of aerial treatment per acre will be many times cheaper than that of any other known method.

At this stage it may be pertinent to consider the growth response to the various methods and types of ploughing tried to date. It is now apparent that planting done in the early years when ploughing was carried out at wide spacing and the ribbons cut and spread, is producing poor crops. Development is also poor on deep peat areas ploughed by Beggs plough only. In both cases the poor response may be attributed to inadequate drainage. Methods subsequently used which provide

better drainage are more successful and it is difficult to detect any significant difference in the rate of establishment.

This paper has stressed forest policy and practice on deep peat areas. Something, however, should be said of the progress made in the development of the Division's research programme. Several bodies are now co-operating on forestry research in Northern Ireland. These include the Botany and Geography Departments of Queen's University, Belfast, and the Chemical Research Division of the Ministry of Agriculture. The Forestry Division acts as a co-ordinating agency for these bodies and is also conducting many investigations on its own. Apart from a few research projects the greater part of the combined research programme is devoted to problems of afforestation on deep peat. The Ministry constantly changing policy and practice as a result of research developments.

References.

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Parker, R. E., 1957. Some problems arising in the afforestation of peatland in Northern Ireland. *Irish Forestry,* **14.** No. 2.