
The Progress of Peatland Afforestation in the Republic of Ireland

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THE area of bogland in Ireland has been very approximately estimated at $1\frac{1}{2}$ million acres, of which less than one-third consists of midland raised bog, and the remainder of blanket bog (Miller, 1957). A small proportion of this blanket bog occurs at high elevations in the east, mainly in Wicklow, but its main development is towards the west coast, where it occurs right down to sea level. It is intended here to deal with the afforestation of the western blanket bogs because it is on these bogs that the most extensive plantings have been made and there that the greatest potentiality seems to lie, and because midland bogs have formed only a small proportion of our peatland plantings in the past, and are unlikely to increase in importance in the future. This is because in the case of the larger raised bogs exploitation for fuel has priority over afforestation, and in the smaller ones acquisition would be complicated

by extensive turbary requirements and rights, turbary being scarce in many areas.

In time large areas of cutover bog will become available for use either for forestry or agriculture. Should the decision be in favour of afforestation the problems presented will be totally different from those presented by the afforestation of virgin blanket bog.

The first government attempt at peatland afforestation, at Knockboy in West Galway, was begun in 1890 with the purchase of almost 1,000 acres, situated on an exposed peninsula with the sea about 2 miles away to North, West and South. The site has been fully described and the work carried out reported by Schlich (1908).

It seems quite likely that, were it not for the fires which have swept Knockboy on several occasions, many of the trees might have survived in a moribund condition but in fact only a few patches, about 15 acres in all, now bear a tree cover. These areas are relatively sheltered and well drained, often with an admixture of mineral matter in the peat, and consist mainly of mountain pine scrub. These small areas are atypical and too unlike the whole to give any indication of the potentiality of the surviving species with present day techniques. The only extensive surviving block is one of about 8 acres situated in a low lying part of the area. This block contains many species apparently distributed in a haphazard fashion. The dominant species at present is *Pinus radiata* which has reached a height of 50 ft. in places, closely followed by *Cupressus macrocarpa* and *Pinus pinaster*. After these come Sitka spruce and *Thuja plicata*. Sitka spruce appears to have grown well in the early years but annual leader growth is now only a few inches. Only one of the species mentioned above, *Pinus pinaster*, appears in the list of species originally planted. When these others were introduced is not exactly known except that it was later than 1900 when the area was disposed of by the Government, although ring counts suggest that it was not much later. Over most of the area not a sign of a tree remains, and even with present techniques the chances of establishing a satisfactory crop on the hill would be assessed as slight. It is an indication of the rashness of the original attempt that only now is a mere seventy acres of relatively less exposed ground in the area under consideration for acquisition by the Forestry Division.

The Knockboy fiasco has had an important place in the history of peatland afforestation in Ireland due to its usefulness as evidence against the possibility of expansion in that direction. It might also be taken, incidentally, as an example showing the danger of selecting the extreme of any problem as a subject for research. One possible advantage, however, is that the very completeness of the failure may have deterred further large scale efforts until techniques had been advanced to such a stage as to give reasonable hope of success.

Following Knockboy, peatland afforestation as a separate issue was not again considered until the late 1940's although during the decades

preceding this many areas with a shallow peat cover or smaller areas of deep peat were acquired and planted as part of the normal afforestation programme. The general practice in these areas was to use the Belgian turfing or mounding system introduced to Ireland by M. L. Anderson about 1930, possibly as early as 1928. Drains were 20 ft. to 30 ft. apart giving four to six rows of mounds spread out between them. The inverted mounds, into which the trees were planted, were usually 16 inches square and 6 to 9 inches deep. No fertilizers were used at this time.

But all during this period the vast areas of blanket bog were present as a nagging thought in the minds of foresters, and in the absence of a forest research organization in Ireland the progress of the Forestry Commission experiments on peat afforestation were closely followed. The methods evolved were first studied intensively in Scottish and border forests during the 1947 Commonwealth Forestry Conference and the impressions gained there were reinforced during a study tour in Wales organized by the Society of Irish Foresters in 1949. This was followed by a tour of Scottish peatland forests by officers of the Department in 1950 which led to the purchase in 1951 of 22 tractor and plough units, and this started the large scale peatland afforestation programme which is still proceeding. The progress since that time can be seen from the following figures showing the acreage of peatland planted in the years 1951 to 1960 in the west of Ireland;* peatland in this instance being defined as land bearing a cover of one foot or more of peat:

<i>Year</i>	<i>Total bare land planted acs.</i>	<i>Total peat planted in West acs.</i>	<i>Peat as % of total bare land</i>
1950-51	6,171	590	10
1951-52	11,825	2,290	19
1952-53	9,924	3,070	31
1953-54	10,201	2,880	28
1954-55	11,866	3,110	26
1955-56	13,035	3,910	30
1956-57	15,142	4,460	29
1957-58	17,999	5,340	30
1958-59	20,573	6,460	31
1959-60	23,020	7,160	31
1960-61	24,252	7,690	32
<i>Totals</i>	164,008	46,960	29

As to the types of peatland at present being acquired for afforestation there are no hard and fast definitions and rules, except that there

* Co. Donegal, the province of Connaught, Co. Limerick, Co. Tipperary west of line Roscrea-Tipperary, Co. Kerry, and Co. Cork west of Bandon-Macroon.

must be a reasonable prospect of establishing a tree crop. The usual limiting factors taken into consideration now are exposure and ploughability of site. To date it has been assumed that infertility is a factor which can be artificially adjusted if not controlled, so that in general the types of land excluded are rocky slopes where mechanical cultivation is very difficult or impossible, very exposed ridge tops or upper south and west facing slopes, and expansive flats, pool studded or not, where ploughing is particularly difficult and costly due to softness of the ground, or where drainage cannot be made effective due to lack of slope or lack of suitable outfall. It is thought also that the more extensive flats may be of value as fuel producing areas. This leaves as the modal type of peatland acquired the gentle slopes or undulating areas with a moderate to deep cover of peat and without extensive rock outcrop or free water. Land is only inspected with a view to purchase following an offer by the owner, and a rather small proportion of the land inspected is eventually purchased, the remainder being rejected as unsuitable for one of the reasons already given. Even allowing for this it is remarkable that no less than 70% of the total area at present on offer to the Forestry Division is in the west and it may be assumed that peatland forms a very high proportion of this.

As already indicated, in the acquisition of peatland for forestry only areas which are wholly or almost wholly susceptible to ploughing are considered. Any necessary pre-drainage is attended to first, by opening up natural watercourses, or in the case of very soft ground, ploughing at wide intervals with the Cuthbertson "F" or single mouldboard plough. Ploughing for planting is generally done with the Cuthbertson "P" or double mouldboard plough with drains spaced at 10 to 12 ft. giving ribbons for planting 5 or 6 ft. apart. In some areas it has now become standard practice to use the "F" plough exclusively resulting in deeper drains spaced at 5 or 6 ft. and a larger peat ribbon in which to plant. It is thought that this may reduce later drain deepening operations which, being done by hand, can be very costly. According to the configuration of the ground further drains may be necessary after the general ploughing has been carried out and these are usually put in with the "F" plough running across the previous furrows.

In an attempt to find a solution to the foreseeable difficulty in extraction of produce over the uneven ground resulting from present ploughing techniques and also the instability following the uneven root development induced by planting on ribbons, an experiment on rotation was laid down at Glenamoy (N.W. Mayo) in 1959. After three years' growth the technique shows little promise. Drainage has been poor and the only species showing any promise now are Sitka spruce and contorta pine; even these are inferior to neighbouring plantations of the same age established after orthodox ploughing methods. Possibly a more promising implement in this line is the tunnel plough developed at the Peatland Research Station of the Agricultural Institute, Glenamoy

(Anon. 1960) but this has only just been tried in afforestation experiments and no results are available.

Although only two species, Sitka spruce and contorta pine, are in general use in peatland planting, the selection of species remains one of the most confused and unsettled issues in the whole field. A common practice seems to be to vary the selection from 100% Sitka on the best types to 100% contorta on the worst, the proportions of Sitka and contorta respectively decreasing and increasing as the quality of the site drops. No general definitions of site quality have been adopted although a scheme has been suggested for the North West (Condon, 1960), but from observations it seems that pure Sitka is confined to peats carrying a vegetation of pure or dominant *Molinia*, or on *Juncus* flushes, while the proportion of contorta rises directly with the proportion of heather present and its dominance.

It is difficult to find any rational basis for this approach. If it can be established that an admixture of contorta can, by suppressing heather, benefit the spruce it is unlikely that the optimal proportion of contorta in the crop will vary very much with site vegetation.

More simply it is often suggested that the mixture is a safe bet, since if one species fails a crop of the other will remain. Since the contorta is unlikely to fail on ground where Sitka will grow, this means that we are deliberately running the risk of having a widely spaced crop of contorta on our hands, and, of all species, contorta is unlikely to form an economically attractive crop under these conditions. Contorta has also been suggested as a stabilizing influence in Sitka. While its ability to produce deep going roots under very wet or waterlogged conditions can be observed in mineral soils this has not yet been extensively demonstrated on peats, and in any case the increased rooting depth is quite possibly counterbalanced by its heavier and denser crown.

In the past contorta pine has been the species used most extensively on peats but with varying degrees of success. Almost all of this variation, however, seems to be safely ascribable to provenance which is a very important factor in this species. When contorta began to be used in quantity in Ireland in the 1920's the coastal form was picked as the most likely to succeed, and this decision has been amply justified on the poor mineral soils and shallow peats of the old red sandstone areas. Where an inland form has been used, usually from inland British Columbia, prospects of producing a closed stand are poor (Mooney, 1957). While none of these older stands are located on the deep climatic peats which are being considered here it seems reasonable to avoid the use of the inland form and in fact no seed from truly inland regions has been purchased since 1948. But still the problem was not solved. Quantities of seed were purchased during the early fifties whose origin was given as Lulu Island, off the coast of British Columbia, and without known exception these have proved to be slow growing and light foliated, unable to suppress vegetation.

Lulu Island contorta seed, being from young stands, or stands stunted by disease, is cheap to collect (Roche, 1961), and it is quite likely that if its purchase had continued it would have had an effect on peatland afforestation nearly as bad as that of Knockboy.

In recent years there has been an increasing tendency to favour Sitka spruce on peats. While this species has in many cases shown considerable early promise there are cases among the earlier plantings, now up to 10 years old where its present condition does not promise a future as good as its past. As yet, and with present establishment techniques, there are no grounds for optimism with this species on deep peats in general.

Many other species have been tried in various places, usually in a small way, in recent years. Three species which have shown considerable early promise are *Pinus radiata*, *Pinus pinaster* and *Abies nobilis*. *Radiata* has been planted in many areas in the west, and although initial failures have been high, early growth has been very good. In the north-west, in particular at Glenamoy, in addition to the initial deaths, further deaths have occurred during the subsequent winters, but these are ascribed to severe climatic conditions. *Pinaster* is in a rather similar position as far as its early survival is concerned, but again the survivors show considerable vigour. That this early growth can be kept up for sixty years or more is shown by the results at Knockboy, mentioned already. The promise of *Abies nobilis* is along rather different lines from the other two. Although early growth is very slow, survival is usually close to 100% and the individual plants look completely healthy, well balanced and sturdy. Many other species have been tried in one way or another, but as yet none has given any indication that it may supplant any of the species already mentioned.

Routine manuring of newly planted trees on peat came into effect in the early fifties following the introduction of ploughing techniques and the beginning of the large scale expansion of peatland afforestation. Basic slag was used in the first years followed by a change to ground North African phosphate which is now standard. Dressings of 1 to 1½ ozs. per plant are given to contorta pine and 2 to 3 ozs. to Sitka spruce and other species. Areas left unmanured for observation have shown clearly the need for phosphate applications but the optimum rate of application is, of course, not yet known nor is it known whether repeated applications will be necessary. Work on these questions is being carried out by the Research Section of the Forestry Division, and also on the necessity for applications of fertilizers other than phosphates, but there are as yet no positive indications in this field.

A common practice after two or three years growth of the crop, is to deepen by hand every second or third plough furrow to a depth of 2 ft. or more, the sods so obtained being used to mulch the young trees. This seems to produce an improvement in growth, particularly of Sitka spruce, in the years immediately following the operation but there are

indications that the improvement may be of a quite temporary nature. The effect of increased drainage is a question which still seems completely open. It is thought that the amount of drainage provided by ploughing is essential—planting on individual sods turned up without a continuous drain have not been successful, but whether this amount of drainage is sufficient, or whether increased drainage will be beneficial, or harmful or have no effect at all is a question on which there are many different personal opinions, but where there seems to be little or no evidence to support a firm conclusion.

We can now consider the results apparent from our decade of peatland afforestation as manifested in the actual growth of the trees. Contorta pine, as the most important species has given no cause for doubt as to its future, where a good provenance has been used. The only exception to this is where it has been planted in conditions of extreme exposure where many trees have shown a tendency to heel over in the early years, and then grow upright, but not always straight. Such crops will have very little commercial value, even for pulp where straight lengths are required, but considered purely as pioneer crops they may be doing a valuable job in preparing the site for a more wind resistant species such as Sitka spruce. It may be doubted, however, whether this job could not be done more quickly, efficiently and economically by artificial methods. How this might be done will be considered later.

Where Sitka spruce is concerned we cannot be nearly so confident. Most of our Sitka on peat seems to be living a life only bordering on healthy. Most of it is still putting on height growth but possibly only under the influence of the initial impetus given by ploughing and phosphate. In fact one rarely sees on deep peat a crop of Sitka spruce with that fully healthy glaucous appearance one gets on ideal Sitka sites on mineral soil. If he would only admit it the Irish forester's attitude to Sitka spruce on peat is much like that of Dr. Johnson to performing dogs—he is surprised not so much that it grows well, but that it keeps growing at all.

With present techniques of ground preparation and manuring the prospects of success in our peatland afforestation programme seems good, but it is not certain that we have reached the ultimate in such techniques. A very striking example of what can be achieved by intensive ground preparation is to be seen at Cloosh Valley, in South Connemara. A large area acquired here by the Forestry Division about 1950 contained some acres of deep peat which had been reclaimed about 1941. This, and adjoining unreclaimed ground was ploughed by Cuthbertson "P" plough and planted with Sitka spruce in 1952. The then standard dressing of 3 ozs. of basic slag per plant was applied. Both the reclaimed and the unreclaimed areas were treated exactly alike. The present position is this. On the unreclaimed area the trees are an average of 2.6 ft. high and in a state of almost complete check. The

few remaining needles are chlorotic and many of the new shoots die back every year. On the reclaimed area, by contrast, the trees average 6.7 ft. in height, or over $2\frac{1}{2}$ times the height of the others with current leaders of up to 30 inches and averaging about 18 on the good trees. Colour is very good, though not perfect, and over much of the area canopy has almost closed. The exact method of reclamation used here is not easily available from records but the method seems to have been as follows: Main drains 4 to 5 feet deep were first opened wherever necessary. Subsidiary drains $2\frac{1}{2}$ ft. deep were then opened at intervals of one chain. These were left open for a time and then covered over leaving a channel at the bottom. The bog surface was then dug to a depth of 8 to 10 inches, left to weather for a while and then dug again. After this an application of 2 tons of burnt lime and 12 tons of local granite gravel per acre was given, although up to 20 tons of gravel may have been used in the later reclamation on the area with which we are now concerned. The ground was then rolled and treated with 2 cwts. sulphate of ammonia, 5 cwts. potash and 6 cwts. of ground mineral phosphate per acre. Either a grass clover mixture or a crop of potatoes was then sown.

A method such as this may sound completely out of the question as far as Forestry is concerned, but on this particular area it is abundantly clear that it has meant the difference between success and failure. It must also be remembered that this reclamation was intended for agricultural purposes and a less intensive and less expensive method might give equally good results in forestry.

At this stage brief reference may be made to the start which has been made in the experimental afforestation of cutover midland bog. In 1954 an area of $9\frac{1}{2}$ acres was leased in Co. Offaly and planted the following Spring using 17 species. After seven seasons' growth the indications are that depending on the depth and type of peat remaining after cutting over, and the degree to which it is then mixed with the underlying mineral soil, it will be possible to grow valuable crops of pine, spruce or Douglas fir on these cutover bogs.

An account of the progress of peatland afforestation in the Republic of Ireland would not be complete without reference to its social impact. In its most simple and obvious form this is shown in the change in direct employment level in the counties where peatland afforestation is concentrated. Thus in the four counties Kerry, Galway, Mayo and Donegal, forestry employment between the years 1952 and 1960 increased by 69% whereas in the other counties the increase was only 27%. This difference is perhaps exaggerated by the fact that natural expansion of direct employment in the older established forest areas is somewhat reduced by the limitation of direct labour work on thinning and some other operations. Another and more important effect, although one which is less susceptible to assessment, is the effect on the inhabitants of the western counties when they see that large areas which formerly might as well not have existed except for the occasional

grazing beast, are being put to gainful use. In the report of a one-man F.A.O. mission to Ireland in 1950 a separate social afforestation programme in the west of Ireland was proposed (F.A.O., 1951). This was to have as its main purpose the stabilising of employment by means of a capital investment which would pay its own operating costs, rather than unproductive investments such as road-building. In this programme, the planting of peatlands mainly, was envisaged. Although this was not adopted as a separate programme it is clear that the aims set out in the report are being achieved by normal development of afforestation following improved knowledge and experience.

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