IRISH FORESTRY

VOLUME XII — WINTER — NUMBER 2

AFFORESTATION OF BOG SOILS

By JOSEPH DITTRICH, Diplom-Ingenieur
Reg.—und Kulturrat, Botanist
Bog Research Station, Bremen, Germany

SUMMARY

THE AFFORESTATION of bogland is considered with special reference to the bog types of Germany, which are described in some detail according to a natural classification based on topography and climate.

The importance of structural differences among the peat-types, even within the Sphagnum peats, as a factor favouring or militating against successful reclamation for agriculture or forestry, is stressed.

Comments are made, based partly on the results from the analysis of peat samples from Ireland, on the prospects of success in the afforestation of bog in Ireland.

A. SCIENTIFIC FOUNDATIONS

The scientific foundations of afforestation of bog soils are primarily revealed by the study of the development of bogs as clearly illustrated by the profiles of Central European bogs. Simultaneously the bog types require investigation.

I. Bog Profiles

(a) The **low bogs of Northern Germany** normally show a sequence of layers as per fig. 1.

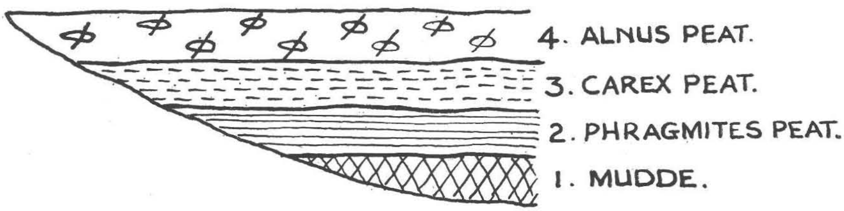

FIG. 1.

The process from purely limnic to telmatic and terrestrial formations is caused by gradual paludification of a water basin. This profile starts with "Mudde" (1) and via Phragmites peat and Carex peat it finishes up with Alnus peat (2-4). The sequence of layers need not be always the same. It depends often on the change in water level during the period of its formation, and there are instances in which a low bog starts with Alnus peat, finishing up via Phragmites peat with Carex peat; brown moss (non-Sphagnum species), even whole layers of it, may be included in the Phragmites peat, often even beneath the "Mudde."

(b) **The raised bogs of the Central German Hills and the foothills of the Alps** (Fig. 2).

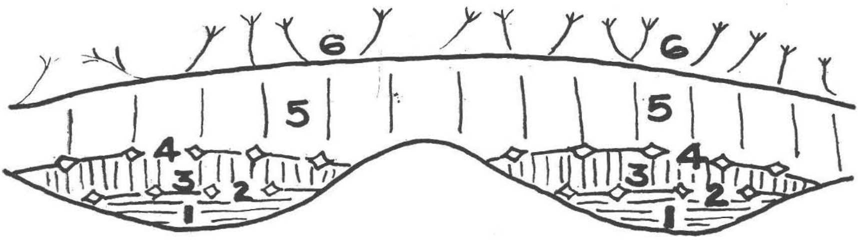

FIG. 2.

1. Phragmites peat.
2. Transition bog—older forest peat (Betula, Picea, Pinus silvestris peat) — *boreal*
3. Older Moss peat (older Sphagnum peat) — *Atlantic*
4. Border horizon—younger forest peat — *subboreal*
5. Younger moss peat (younger Sphagnum peat) — *Sub-atlantic*
6. Pinus montant forest—recent forest peat — *present age*

In this profile, after paludification of the water basin 1, boreal layers 2, 4 and 6 are found alternating with Atlantic layers 3 and 5.

This profile is by no means the one most frequently found.

In lower positions, mostly below 2,200 feet above sea level, it changes into

(c) **Picea bog of the Central German Hills and the hills at the foot of the Alps** (Fig. 3).

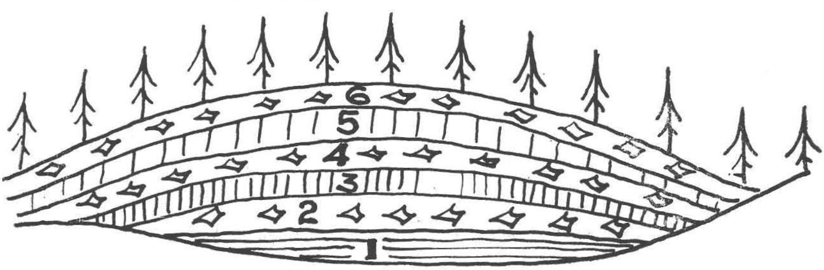

FIG. 3.

1. Phragmites peat.
2, 4, 6 Forest peat formations of boreal periods.
2 boreal as in (b), much developed, extending into Atlanticum.
4 Picea peat with Sphagnum, starting formation in atlantic periods (e.g. Atlanticum) and ending formation in Sub-atlantic periods (e.g. Subatlanticum).
6 Picea peat with Sphagnum and recent picea forest.
3.5 Atlanticum and Subatlanticum (moss peat), developed as small belts only at the climax of these periods.

In dryer conditions, with decreasing precipation and increasing annual mean temperatures, the moss peat layers decrease, while, within the vegetation range of picea, picea peat with strong Sphagnum content forms, which at length can form a bog by itself down to a depth of several metres. [NOTE: On level ground, such as the high plain of Swabia and Bavaria, raised bogs form, while on steeper slopes, as in the Central mountains, picea bog prevails.]

II. Natural Forest Growth on Raised Bogs

(a) Due to Continental influences and transition to forest bog.

In Europe, forest growth on bogs increases towards the Continent, that is, towards the east and south of the region where bogs are found. Forest peat formations and forest bogs are predominantly Continental, representative of the dryer stages of bog formation. The boreal and sub-boreal layers of our raised bogs may be regarded as the results of dryer periods. The sub-boreal stage of the raised bogs in Atlantic North-Western Germany, for instance, is more or less clearly distinguished as a border horizon with Ericaceous growth (Calluna). In the Central mountains and the foothills of the Alps it appears already as *Pinus montana* forest, as it does in the present boreal period. Below the hoar-frost zone in the Sudeten mountains, i.e., below 2,300 feet above sea level, it carries *Pinus montana* Mill. in its upright form, e.g., in the Fichtel Mountains, Kaiserwald, partly also in the Erz Gebirge and in Southern Bohemia. The invasion of *Pinus montana* forest by Picea can here be observed, i.e., the beginning of the Continental forest raised-bog type. In Central and Eastern parts of Northern Germany and in the Northern parts of European Russia forest raised bogs appear as *Pinus silvestris* forests with *Ledum palustre*. Topogenous forest bogs and low bog are the formations most frequently found in Europe at the transition to the bog-less parts. In Sudetenland, picea bog is the last outpost of bogs, as it were, on the way to the interior of the country which has practically no bog.

In the Central mountains, the border zone of forest bogs and ombrogenous raised bogs deserves special attention. All the raised bogs of the Erz Gebirge are surrounded by a belt, varying in width, of picea bogs. With increasing height above sea level, this belt becomes narrower and in the soligenous conditions at about 3,100 feet above sea level it disappears altogether. Below 2,200 feet above sea level in these regions, raised bogs are replaced by picea bog. This fact is confirmed by the bog profiles. While in Northern Germany border horizons are more or less distinct, in the Central Mountains and the foothills of the Alps, we have the clearly distinguished timbered strata of *Pinus montana* in the subboreal, described by H. Schreiber[1] as "younger forest peat." The vegetation of forest raised bogs with *Pinus montana* (or, in lower positions, even *Picea excelsa*) forms what we know as "recent forest peat" (Schreiber), in North Western Germany again replaced by a stratum of Ericaceae (*Calluna* in accordance with a recent border horizon). This stratum has grown naturally and is by no means due to drainage exclusively. In conjunction with the raised bog, the forest bog has played a part varying in importance from place to place and correspondingly it appears in the bog profile in forest peat layers varying in thickness. The Atlantic periods with their moss peat formation are not always clearly represented, as moss peat belts more or less distinct of broad strata. In most instances, it is picea peat that prevails at the beginning and towards the end of the Atlantic period, giving the bog the character of transition or forest bog.

(b) Due to topogenous conditions

In the present boreal period natural forest growth on raised bog has become rare, owing to the operations of man. Yet to a limited extent it can still be seen. In Atlantic periods, the upper moss peat layers of raised bogs were better provided with water than they are now and could maintain themselves on slopes with gradients up to 5%. The present boreal period reduced the water supply to the moss peat and on slopes it became unable to retain the water, which runs off underground through cracks and swallowholes forming simultaneously. This is the cause of erosion beneath the bogs, a phenomenon which I have shown to be dependent on the gradient.[2] This phenomenon promotes aeration and thus, even on the deepest raised-bog peats, *Picea excelsa* and other trees can grow. In raised bogs such spots can be recognised from a distance by the wedge-shaped invasion of *Picea* from the edge of the bog towards the interior of the raised bog.

In cases (a) and (b) forest growth on raised bogs or their transition into forest bogs has become possible owing to *decreased water supply* (under Continental or topogenous conditions).

III. The Importance of the Structure of Peat Types

I have pointed out the importance of this in an earlier paper.[3] It has long been known that a coarse structure of the peat, permitting a certain aeration, has a most beneficial influence on all types of bog vegetation. For example, little-decomposed Phragmites peat and forest peats facilitate by their coarse structure the growth of forests. By spontaneous drainage to some extent, due to the strong rhizomes and woody remains, sufficient aeration is provided and thus bacterial action as required for any bog cultivation becomes possible.

A point hitherto scarcely considered is the structure of the various moss peat types. Fr. Overbeck[4] published a map of the sub-fossil Sphagnum types in peat moss (younger moss peat). It appears from this map that in the Sub-Atlanticum near the seas, peat moss was formed mainly from the moss peats of the Cymbifolia group (*Sphagnum imbricatum, S. papillosum, S. magel lanicum-S. medium*), whereas in the interior (South-East of the line Meppen/Ems, Bremen, Lunebürg) *Sphagnum acutifolium*, i.e., the Acutifolia group, prevails. Describing the peats of the Cymbifolia group as "large leaved," Overbeck noticed that they have a higher absorption than those of the Acutifolia group ("small-leaved").

The difference in the size of moss peat leaves in peat moss can be clearly seen with the naked eye; e.g., a leaf of *Sphagnum magellanicum* has an area of 2 square mm., while that of *Sphagnum acutifolium* covers only about .25 sq. mm. Moreover, the leaves of the Cymbifolia group are not flat, but boat-shaped with rolled-in edges, while the leaves of the Acutifolia group appear almost flat with edges rolled-in a little in places. Thus it is obvious that the structure of Cymbifolia peat must be different from the structure of Acutifolia peat. Cymbifolia peat is loose and bulky, while the Acutifolia peat is dense. In the 'twenties gardeners in Sudetenland recognised this difference when preferring local Acutifolia peat as litter and mull on account of its greater resilience and lower acidity. Similarly, at present in the United States, good Cymbifolia peat from Northern Germany (Oldenburg) has superseded Canadian peat.

It has been shown that in raised-bog peats the movement of water is neglible. This movement however increases with better (looser) structure. It therefore is obvious that Cymbifolia peats have a better water movement than Acutifolia peats and in their dehydrated state have better aeration.

IV. The Occurrence of Cymbifolia Peats

Considering the fundamental difference between Cymbifolia and Acutifolia peats we have to consider the regions where these two principal peat types prevail. Ombrogenous bogs (raised-bogs, Sphagnum bogs) are confined to two relatively small belts on the earth, the Northern one extending through the European-Asiatic Continent and the North American Continent, the Southern one recognised only in fragments at the Southern tip of South America and in New Zealand. While both moss-peat groups require Atlantic climate for their formation—we speak of Atlanticum and Subatlanticum—this is more particularly the case for Cymbifolia peats. In Europe, Cymbifolia peats as mass growth are found only in regions around the North Sea, Acutofolia peats prevailing in the interior of the Continent. It cannot be assumed that in the interiors of the Continents of Eurasia and North America Cymbifolia-peats have formed to any considerable extent, and it is an established fact that on the Northern hemisphere Cymbifolia peats are practically confined to the region around the North Sea.

B. BOG CULTIVATION FOR AFFORESTATION PURPOSES

Bog cultivation for afforestation purposes in Europe is more extensive than is generally known. In particular, bogs with shallow peat layers or boggy soils have been used for this purpose for many years or even centuries past, their bog character being well known to the forester, though not apparent from statistics. Only when in dry summers such forests catch fire are the public aware of the fact that they are forests on bog! Although forest-bog-soils continue to be the mainstay of bog utilisation for afforestation purposes, forests are by no means absent from the bogs of the more or less Atlantic zone. On low bogs (*Phragmites* peat and *Alnus* peat), considerable forests are found. This is the reason why bog utilisation for afforestation purposes has developed primarily in the Eastern parts of Central and Northern Europe. In this sphere, Finland is the classical example; a high percentage of its area being bog, mainly forest-bog, suffering from excessive water accumulation. Given the proper choice of forest-bog tree-species, the problem is here primarily hydrological. This is also the case at the higher elevations in the German Central mountains, where in the natural zone of Picea growth, forest-bogs prevail, mainly owing to the steeper gradients providing the natural water maintenance required for forest-bog timber growth.

I Drainage

The importance of drainage in bog afforestation is as great as in the case of the agricultural utilisation of bogs. Both agricultural and silvicultural cultivation call for soil aeration, brought about by lowering the ground water level which, in general, is too high in bogs. Deep-rooting trees, however, require an even more marked lowering of the ground water level than does agricultural cultivation. It has been shown in Chapter (A) that this condition is fulfilled in many cases, especially where rainfall is little and infrequent and where the subsoil has a steep gradient. Experience has shown that the required lowering of the ground water level varies with the types of timber to be grown. With low-grade trees, such as *Picea, Pinus* and *Betula,* the ground water level must be lowered to at least $1\frac{1}{2}$ ft. below surface. With higher-grade trees it must be lowered to a greater depth.

For afforestation purposes no drainage network other than open trenches should be considered and this network must be dimensioned in accordance with type of peat, gradient of subsoil, precipitation and annual mean temperature. The occurrence of such a great number of possible combinations of those factors leads to a variety of conditions. By way of example, I shall confine myself to the drainage of a picea forest bog in the Central German mountains, very similar to a picea forest bog in Southern Finland.[5] Let us assume that this bog consists of picea forest peat containing Sphagnum, that the subsoil slope is favourable and that precipitation and average mean temperature are in accordance with medium-size mountain-range conditions, i.e., 36″ rainfall, 4-5°C mean temperature, therefore rain factor 200. In these conditions a principal drain network to a depth of 3 to 4′, bottom width 2-2½′, with a steep slope (4:1 in peat containing Sphagnum), mean gradient not more than 1% and 200 metres apart, has proved successful (Fig. 4). The drains should be at right angles to the greatest

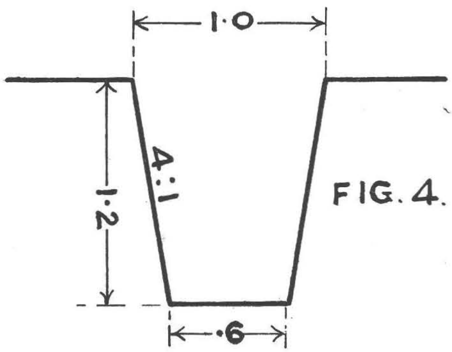

FIG. 4.

gradient, so that they have the effect of contour drains. In case of new afforestation, the spoil can be used very well for hill plantation to prevent frost damage. Secondary drains correspondingly smaller are laid only where swamp holes must be completely drained. The position of the outfall depends on local conditions. If its gradient is excessive, as is often the case, the bottom should be secured by wooden boards or waste wood.

The drains here described have proved most successful, and in the years after they have been laid picea growth has increased considerably. Similar results have been reported from Finland.

When in certain cases owing to dewatering considerable shrinkage and densification in structure occurs, the existing drains must be deepened or even intermediary drains inserted. In the lowlands, owing to unfavourable gradient conditions, drainage is more difficult and indeed sometimes unfeasible. In the lowlands, therefore, after initial successes, bog afforestation has often failed owing to lack of aeration in consequence of subsequent bog shrinkage.

II Significance of Peat Types

From the point of view of soil science, the variation in the behaviour of the different peat types is considerable. In general the younger peats are better cultivation-soils than are the older ones, because the former are looser in structure and permit easier water movement.

Regarding the *Glumiflora* peats, Phragmites peat has the coarsest structure, draining almost automatically by means of its strong rhizomes. Apart from forest peats, this is the best cultivation peat. When adequately drained, Phragmites peat affords excellent growth of most species of trees, not only in the plain with deciduous trees such as *Fraxinus excelsior* on Phragmites peat, but also in medium size mountain ranges, where Phragmites peat often forms sloping bogs of varying steepness. On such soils *Picea,* deep green in colour, is found to a considerable extent, an indication that nitrogen supply is adequate. On Phragmites peat afforestation will never fail, if water conditions and climate are suitable. The only point to be considered is the possible presence of substances harmful to plant growth, which, however, are found only locally (e.g., iron sulphate combinations).

Carex peats have a somewhat finer structure than coarse Phragmites peats; still, if general conditions are favourable, they are also suitable for afforestation.

All forest peats are very good forest soils, the eutrophic ones of course being better than the mesotrophic or oligotrophic ones. Here, too, the main point is the draining effect of the timber remains, that is to say, the coarse structure of the peat. Nutrient conditions play a certain part but not as important a part as may appear at first. Alnus peat, adequately drained, is of course an excellent soil for deciduous growth, suitable for any species of tree except those which are totally averse to peat. Picea, Pinus and Betula peat, i.e., mesotrophic transition bog-peat, is suitable in varying degrees for most coniferous species and also for low-grade deciduous ones. Even on oligotrophic *Pinus montana* Mill. peat, low-grade trees such as *Picea, Betula* and *Sorbus* can grow, provided the hydrological conditions are favourable. In this respect the natural growth of a forest raised-bog from a *Pinus montana* Mill. bog under suitable conditions is of interest.

On the younger moss peats (Sphagnum peats, peat-moss types) afforestation is far more difficult than on Phragmites and Carex peats. Yet on these peats it is by no means impossible, as is often claimed. What is required is adequate aeration of the soil, which offers some difficulties owing to the denser structure of these peats. To emphasize the importance of the various types of mosspeat, in the beginning of this chapter a section has been devoted to the Cymbifolia and Acutifolia moss peat types.

In the Atlantic zone of Lower Saxony it has been observed that on reasonably drained Cymbifolia peat *Quercus Robur, Betula pubescens,* *Pinus silvestris* and other species can grow well and that fruit trees (apple, plum and even peach) can thrive. These conditions are not found on Acutifolia peats. I refer to the experiments made by the bog horticulturist A. J. Weerth in Teufelsmoor near Bremen. These experiments have been supported by purely scientific observations : in Lower Saxony Cymbifolia peats carry a different and more eutrophic vegetation than do Acutifolia peats. In contrast to Acutifolia peat, Cymbifolia peats produce :

(1) higher natural vegetation;

(2) better peat moss for litter and mull with higher absorption and lower acidity, therefore better growth promotion in horticulture;

(3) better cultivation possibilities for both agriculture and silviculture.

These facts have so far not been considered to any considerable extent because they appear only in the small Atlantic section of North Western Germany, where silviculture is a minor point. However, in that district for some time past, even for raised bogs, the following species have been grown for shelter belts and utility timber for raised bog settlements : *Larix leptolepis* Gord, *Pseudo-tsuga Douglasii* Carr (requiring high humidity), *Picea sitchensis* Carr, *Pinus Strobus* L., *Quercus rubra* L., etc. Reports on the growth of these species are in the main satisfactory, but it was rarely stated or noticed that the successes were due to the presence of Cymbifolia peats.

Moss peats (white peats) must first reach that degree of drainage, obtained by high aeration in Acutifolia peats (through effective artificial drainage or through natural drainage on steep gradients), and by marked dewatering in Cymbifolia peats, also before they become capable of afforestation. Then, however, in spite of high acidity and low nutrient contents, they afford suitable conditions for forest growth. There are cases, apparently most often with Acutifolia peats, where the cost of drainage makes afforestation uneconomical.

Older, highly decomposed moss peats (black peat types) in their grown profiles are less suitable for afforestation, owing to their highly colloidal and irreversible nature. So far I have seen, on older moss peat, only individual specimens of *Betula* and *Pinus silverstris* in Callunetum. I have no information on afforestation experiments on these peats. These peats are, however well suited for the cultivation of *Ericaceae*. Older moss peats are not so suitable for agricultural reclamation, neither are Scheuchzeria and brown moss (non-Sphagnum) peats which break down easily and dry out quickly and more or less irreversibly.

III The Suitability of Individual Tree-Species for Bog Afforestation

Space forbids me to make reference to more than the principal species to be considered for bog afforestation. On all bog types whether in moist or in dry positions, *Betula* does best—in particular, *Betula pubescens.* It is found in low bogs in Phragmites habitats; with Pinus silvestris in transition bogs (which are its natural habitat and where it thrives best) and in raised bogs in Callunetum. In spite of its general occurrence on bogs, it prefers, like other trees, the dryer parts, a point particularly obvious from its thriving along bog-drain edges. However, it ventures forth also on to undrained raised bog, where it does not reach a great age; many dead betula of recent date testifying to this.

In the same positions and on the same peat types, *Pinus silvestris* is almost as common and as resistant as *Betula.* Therefore it can be treated together with *Betula. Pinus silvestris* enters in dwarf forms the undrained raised bog and prevails there often over considerable areas with various Ericaceae, particularly in the forest bogs of North Eastern Germany with *Pinus silvestris Ledum palustre* vegetation.

The third most common bog tree is *Picea excelsa,* which however is confined to the South and South-East of Germany where there is higher rainfall. In these parts, *Picea excelsa, Betula pubescens* and *Pinus silvestris* make up the older forest peat in the boreal state. In contrast to the peat layers of Betula pubescens and Pinus silvestris, which are shallow, *Picea excelsa* and its concomitant vegetation form thick strata of picea forest peat, a very excellent cultivation soil for both agricultural and silvicultural purposes. Where in the Central mountains above 750 metres above sea level *Pinus silvestris* cannot subsist owing to breaking risk by hoar frost, *Picea excelsa* is still found, competing at the edges of raised bogs even with *Pinus montana* Mill. Schreiber[6] speaks of a battle zone of these two species. Dwarf forms of both *Pinus silvestris* and *Picea excelsa* occur in raised-bog up to the snow-line. In Sudetenland up to 750 metres above sea level *Picea excelsa* takes part in the formation of raised forest bogs and the same applies to the Erz Gebirge and to Egerland (Kaiserwald). *Picea excelsa* is almost insensitive to soil acidity; many of its locations have pH values even lower than those of raised-bogs. It is the tallest tree in Central Europe and owing to its shallow root system it is subject to overthrow by storms. In valleys its sensitivity to frost often causes trouble, though this danger can be countered to some extent by using late-budding strains.

These three primary bog tree species formed a habitat even in the boreal period and occur together to this day. They are often joined by the oligotrophic *Sorbus aucuparia,* which ventures forth from low bogs into the border regions of raised bogs mostly in shrub form. Also *Populus tremula* should be mentioned among bog trees, being in high esteem, as are all poplar species. Its nutrient requirements are higher than those of *Sorbus aucuparia;* it is prevalent in low and transition bogs but occurs also on drained raised-bogs. By their dead foliage both *Populus tremula* and *Sorbus aucuparia* make a valuable contribution to soil improvement. It is not surprising to find on the better peat-types of low and transition bogs also *Quercus pedunculata,* which in the mixed forest bogs of *Pinus silvestris, Picea excelsa* and *Betula pubescens* of mountainous and hilly districts is quite conspicuous. Still its occurrence on raised-bog peat is remarkable. In Germany, *Quercus-Betula* forests on poor soils are a well-known habitat. *Quercus pedunculata* can endure high acidity. In Atlantic North West Germany it grows well on Cymbifolia peats, so far as they are well drained. On Cymbifolia peats of lower acidity our native oak and also the faster growing American *Quercus rubra* L. thrive, the latter being particularly recommended for bog plantations in the coastal area along the North Sea.

The most important low-bog tree is *Alnus glutinosa,* which is the bog tree enduring the highest water level, though, like willow, adverse to permanently stagnant water, as it requires good nutrient conditions. On alluvial soils these trees are most suitable where the ground water level changes frequently. On drained low bog (Phragmites and Carex peat) and on Alnus forest bog the high-grade ash (*Fraxinus excelsior*) can be grown with advantage. Also the popular species which nowadays have become valuable (*Populus nigra, P. alba, P. tremula* and others) thrive on low bog if the ground water is not stagnant. We should not forget the Salix types, especially so far as they are suitable for wickerwork (for instance, *Salix viminalis*) and thus particularly valuable.

There are many exotics suitable for bog afforestation. A few of them have been mentioned in this paper. Shrubs should not be neglected because in afforestation they contribute to the natural forest habitats. The botanical literature gives ample information on the species to be recommended from the plant-ecological point of view in bog afforestation.

C. SOME OBSERVATIONS ON BOG AFFORESTATION IN IRELAND

It is hard to speak of bog afforestation in Ireland without having seen that country. However some points have been obtained from *Die Pflanzenwelt Irlands* (The Flora of Ireland), Results of the Ninth Excursion of the Plant Geographical Society 1949, and from Dr. W. Baden, Director of the Bog Research Station, Bremen.

Forest bogs particularly suitable for afforestation purposes cannot be expected in Ireland owing to climatic conditions. Also low bogs suitable for afforestation are said to be rare. We are therefore left with raised bogs and blanket bogs. From the outset it would appear that the best afforestation chances in Ireland are after excavation of the raised-bogs, i.e., after winning of the younger and older moss peat. Beneath these moss peats Irish bogs frequently have Phragmites peat which is a first-class forest soil (see the results of botanical peat analysis carried out at Bremen). Where Phragmites peat is not available, the peat left behind from excavation mixed with the subsoil will produce a reasonably suitable forest soil, of course after adequate drainage.

Without peat excavation we are dependent on younger and older moss peat, the former being by its structure more suitable than the latter. Afforestation on younger peat moss is quite feasible, as is proved by the natural forest growth on raised bogs, that is to say, their transition to a forest raised-bog. Systematic dewatering is required which in raised bogs in Ireland can be achieved only by drainage. In most areas of Central Europe, except the Atlantic ones, such systematic drainage is uneconomical, since drainage to the point required by afforestation is too expensive owing to the density of pure Acutifolia peats. In this respect conditions are more favourable with Cymbifolia peats, which owing to their lighter structure probably admit of afforestation as easily as in Atlantic North Western Germany. These Cymbifolia peats occur also in Ireland; *Sphagnum medium* was established by the botanical peat analysis at Bremen. The final results will have to be established by experiments, first of all on well drained younger moss peat near the main drains.

Almost certain success can be predicted with raised bogs with considerable subsoil gradient and in particular with blanket bogs. Where the subsoil gradient is 2% or even more, natural drainage should have progressed so far that trees can be grown on moss peat. Whole belts of blanket bogs should be suitable for afforestation without drainage.

The choice of timber should be determined first of all by the natural habitats occurring in forests in Ireland. In his report on "Fragments of Forest Studies in Ireland," W. Lüdi, Zurich, refers to the *Quercus robur-Betula pubescens* association, which is also found in Cymbifolia raised bogs in North Western Germany. It comprises in Ireland also *Arbutus unedo, Sorbus aucuparia and Ilex aequifolium.* Moreover it is remarkable that in many places the Oriental *Rhododendron ponticum* shows magnificent growth. Ericaceae, Arbutus and Rhododendron will certainly be suitable for raised bog peat cultivation, in particular as the annual temperature is higher and more equable and the humidity considerable. The culture of *Ericaceae* should have good prospects in Ireland.

Among the high-lying blanket bogs in dry peat deposits with considerable subsoil gradient the deeply rooting *Pinus silvestris* together with *Betula pubescens* are recommended. *Picea excelsa* otherwise suitable for these localities is subject to overthrow by winds. Finally, it should be noted that Ireland's favourable climate with insignificant late frosts and high mean temperatures (compared with Central Germany) offers special advantages for afforestation.

REFERENCES

[1] Schreiber, H., Moorkunde, Berlin 1927.

[2] Dittrich, J., Die Moore Nordostböhmens, Sebastiansberg 1933.

[3] Dittrich, J., Wird die Wasserführung im Moorboden mit der Fortschreitenden Zersetzung der Torfe reger oder träger? Deutsche Londeskulturzeitung, Berlin 1941.

[4] Overbeck, Fr., Das Känozoikum in Niedersachsen, 4. Abt. Die Moore.

[5] Dittrich, J., Zur Entwasserung der Gebirgsmoor. Verhandlungen der 6. Kommission der Internationalen Bodenkundlichen Gasellschaft, Zurich 1937, Ref. 39.

[6] Schreiber, H., 10. Jahresbericht der Moorkulturstation Sebastianberg im Erzebirge.

ACKNOWLEDGMENT

This paper was first presented to the International Peat Symposium held under the auspices of Bórd na Móna, July 1954, and is published by kind permission of the Bórd.