Some Problems arising in the Afforestation of Peat-land in Northern Ireland.*

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Introduction.

AS you have just heard, a large part of the activities of the State forest service in the 'North' is devoted to the establishment and maintenance of forest on peat-land. A few of us in the Botany Department at Queen's, during this year, have been concerned with some of the ecological problems arising in this work. I should like to mention briefly three of these problems; three problems which at first may seem quite distinct, but which are in fact closely related.

Vegetation.

I do not, I am sure, have to remind the foresters among you to what extent forestry operations are carried out on the basis of appreciation of site conditions and to what extent these appreciations are based on observations of vegetation. In the primary afforestation of peat-land in particular great reliance must be placed on the vegetation as an indicator of environmental conditions; in deciding for example, whether an area is plantable or not, in deciding the price to be offered for it, the species to be planted on it, the draining and manurial treatments which will be required, etc.

We found that afforestation of peat-land in the 'North' was running into difficulties because of the absence of a satisfactory scheme of vegetation classification and site evaluation for silvicultural purposes. The difficulties were made more acute by the high proportion of blanket bog included in the afforestation programme and the great extension of peat planting in the western counties where the types of vegetation differ most markedly from those found in Britain. Little was known, for example, of the silvicultural potentialities of *Schoenus nigricans* or *Carex lasiocarpa* flushes.

We have set out to do what we can to remedy this situation. Our aim is to study the vegetation of peat-land in relation to variation in environmental conditions and successional changes, so that the silvicultural potentialities of the land might be more accurately estimated and more fully realised. In addition, we have undertaken to develop a mapping method, not only of use to ourselves but also the Ministry's officers. The methods which we have adopted possess some novel features and perhaps deserve a mention.

In surveying a particular area, following a general reconnaissance, we define a small number of broad units so that between them they

*Text of illustrated lecture given at the annual meeting of the British Association for the Advancement of Science held at Dublin in September, 1957.

cover the whole range of vegetation present. A map is then constructed in the conventional way—jig-saw fashion—and colour washed. These broad units are defined on the basis of environmental and floristic characters, the correlation between the two being important. This sort of classification and map have considerable practical value but their research value is very limited. In order that our study should be progressive, we now examine the area for a number of well defined plant communities showing relatively little variation. These communities become the bases for another set of vegetation units selected because of their constancy in floristic composition, constancy in the cover-abundance of their constituent species, and because of their recognisable physiognomy. They are recognised at first by eye and their validity as phytosociological units is later tested by methods closely similar to those advocated by Poore; their limits are adjusted at the same time. As might be expected, these *noda* fall within the broader units already recognised and fit into the mapping scheme quite neatly, their occurrence at any point on the ground being indicated on the map by an appropriate symbol. In fact, we have used a simple binomial nomenclature.

The *noda* are defined phytosociologically, by means of tables, like association tables, made up of a number of stand descriptions. No assumptions concerning environmental conditions are included in these definitions, but because of the well defined composition and structure of these units we are confident that they occur only over a definable range of conditions. Thus, our investigations of the environment are concentrated on the *noda:* it is from them that we take pH measurements and our peat samples for analysis. When we come to consider successional changes or changes due to major environmental alterations we find it useful to think in terms of *noda*—we use them as a reference framework.

Check in Sitka Spruce.

My second problem is that of 'check' in Sitka spruce a few years after planting on poor peat. Up to the present, this trouble has arisen mainly on areas where the trees have been planted on hand-placed turves or where re-planting has been carried out following forest fires; but it is now beginning to show up on ploughed ground. The trees look healthy enough for a year or two and most of them put on a little growth. After this their shoot growth slows right down, the needles produced are short and their colour changes to dull yellow.

What can be done about this condition? When it was first observed the foresters concerned tried their two main weapons, drainage and phosphates. Neither of these had conspicuous success although both produced some improvement locally. It was noticed, however, that in some plantations where the drains had been deepened, the trees around which the sods from the drains had been placed showed vigorous response, at first in colour and later in growth rate.

The process of drain deepening and turf placing has become more or less standard on the wetter sites but it is expensive and if applied to deeply and closely ploughed land might result in dangerous over drainage. Clearly another solution is desirable.

The correlation between the early check of Sitka spruce and the presence of vigorous *Calluna* was striking; the *Calluna* plants from the original vegetation vigorously exploiting the double layer of rooting vegetation below the ribbon, in direct competition with the trees. It seemed clear that this was a form of the '*Calluna* problem' investigated by Dr. Leyton and others. A quick trial of nitrogenous fertilisers and manures was envisaged but with the co-operation of the Chemical Research Division of the Ministry of Agriculture and Queen's University, Belfast, a more comprehensive experiment was laid down in June 1956: we tried just about everything. N was the only element common to the treatments which showed significant improvement by the autumn and there was some indication of the superiority of insoluble organic N. Accordingly, this experiment was extended in October 1956 with treatments using various forms of N, both organic and inorganic. The present state of these plots confirms the initial effectiveness of N but gives little information on the relative value of the different forms.

Encouraged by these results a more comprehensive experiment was laid down this spring to test the effectiveness of a larger number of different N sources, most of them animal products easily obtainable in Northern Ireland. Some of these treatments have already shown remarkable responses—notably fish meal.

We do not know whether these treatments will produce a big enough response to bring the trees to the stage where they will dominate the *Calluna*. Time will tell; meanwhile it seems worthwhile to carry out more extensive trials under a variety of conditions.

Sphagnum Menace.

The natural limits and practical importance of my third problem cannot yet be seen; in its more restricted sense it is concerned with the fate of certain plantations, now at about the second-thinning stage in which several species of *Sphagnum* appear to be growing and spreading rapidly: in its broadest sense it may prove to be a challenge to the present practice or even the whole policy of afforestation of poor peatland.

Reconnaissance has shown the existence at a number of State forestry centres in the 'North' of plantations in the 25-30 year age class with deep carpets and/or mounds of *Sphagnum* moss actively growing and accumulating on the forest floor. At Baronscourt, Co. Tyrone, beneath what is now a light *Pinus contorta* canopy, arising through the failure of the Sitka spruce in a 1:1 mixture planted in 1928, there is a vigorously growing carpet, rapidly enveloping 'lop and top'. Here and there the spruce have survived, mainly where they were planted on material from deep drains; these too are surrounded by the *Sphagnum* carpet.

At Tardree, Co. Antrim, the growth of Sitka spruce on shallow peat has been locally poor, and after thinning, *Sphagnum* is returning. At both Springwell and Gortnamoyagh, Co. Derry, *Pinus contorta*/Sitka spruce mixtures are affected.

The distribution of the *Sphagnum* provides a good deal of information concerning the environmental factors important in determining its appearance and growth. Light is usually limiting, the *Sphagnum* appearing only when and where the intensity is adequate. This is perhaps best illustrated in thinned plantations; the *Sphagnum* often being concentrated around the stumps of the trees removed. The supply of water and perhaps also of nutrients in the drip from the trees' crowns is also thought to be of importance but soil wetness seems relatively unimportant; *Sphagnum* mounds and carpets being initiated under conditions of good drainage and on layers of porous litter.

In places the condition has not been reached by the invasion of a forest floor which has once been cleaned by more intense shade but has come about through the gradual change in composition of the living vegetation. In many checked stands between 10 and 15 years old there are mounds of *Sphagnum* beneath and between tall *Calluna* bushes. As the canopies close the *Sphagnum* continues to thrive while the vascular plants are suppressed. The result is a stand in which the only or at least the most abundant plant is *Sphagnum.*

What significance is the growth of this *Sphagnum* to the growth of trees? Excavation of the mounds has shown that the accumulation of a a water-retaining moss layer on the soil surface leads to the death of the tree roots below with the development of new roots within the moss layer itself. The worst that can happen is that a continuous accumulation of moss material brings about the death of the trees and the embedding of the stumps in a new peat deposit. This reminds us that several feet below the root systems of our planted stands of exotic *Pinus contorta* and Sitka spruce are often the fossil stumps of native Scots pine forests. If the trees are not killed by suffocation of their root systems they are likely to become more liable to windthrow; signs of this are already apparent at Springwell. More important than this, however, are the repercussions on nutrient supply. Studies of the nutrient requirements of forest stands in relation to the nutrient status of their soils are still in their infancy but it is becoming increasingly clear that on the poorest peats for tree growth to continue without manurial treatment conditions must be established in which the nutrient capital of the peat is utilised over a period of time by its gradual breakdown. These conditions cannot be produced while fresh peat is being formed.

It is not yet possible to say over what range of conditions this growth and accumulation of *Sphagnum* will occur. My fear is that a considerable proportion of the more vigorous Sitka spruce stands now casting too dense a shade, but soon to be opened up by age and further thinning, will be affected. There are already some signs of this at Springwell.