

## WASTE LANDS OF NORTH WALES

BY PROFESSOR G. W. ROBINSON

University College of North Wales, Bangor

IN any attempt to decide as to the relative advantages of sheep farming and afforestation it is important to know the characteristics of the soil and climate of the disputed area. Obviously there are some types of land which the forester would scarcely wish to wrest from the sheep farmer. Other tracts may be highly eligible for the forester, but are of such value for pasturage that they could not be economically diverted from their present use. Indeed, it is not an exaggeration to say that, so far as upland grazing is concerned, the more valuable the grazing, the more desirable it is for the purpose of tree planting, provided the shelter be adequate.

I shall attempt in the present paper to describe some of the principal types of uncultivated land in North Wales. Many of the types are probably common to other mountainous and hilly regions and their description may thus be of more than purely local interest. In the first place, however, it may be allowable to make some conjectures as to the past history of the soils of our area.

In prehistoric times North Wales was probably covered with deciduous forest up to about 1,700 feet above sea-level. The only areas free from forest were the swamps and marshes, the dune areas, and exposed coastal headlands. It seems likely that, as a consequence of deforestation and cultivation, wholesale erosion must have taken place, resulting, in many situations, in the almost complete removal of soil and subsoil, or, in less erodable areas, in the removal of the surface soil and the exposure of the subsoil. Large areas of soil in North Wales have the characters of a primitive subsoil. The original soil was partly washed away into the rivers and partly deposited in hollows which are to-day wet rushy bottoms of greyish soil, sometimes carrying a cover of peat. In time, the present system of grass husbandry with grazing was established. This led to the enrichment of the soil in organic matter and consequent protection against further erosion. It appears, therefore, that the soils of our area have been considerably modified from their primitive condition, but are now more or less stabilized owing to the prevalence of the artificial steppe conditions induced by grazing husbandry. It is, perhaps, worthy of mention that a process similar to that which has been suggested in the past for North Wales appears to be going on in parts of the eastern regions of the United States. There, wholesale deforestation has led to intense erosion, which is still in progress and which seems likely to modify considerably the primitive soil types. The establishment of artificial steppe conditions for the purpose of grazing might arrest the erosion and produce conditions similar to those in North Wales.

Before describing the principal types of uncultivated lands it may be well

to allude briefly to the character of the soil-forming processes in the area. The principal factors in soil-profile development in our area are (1) the climate, which is extremely humid and leads to intensive leaching of the soil horizons; and (2) the parent rocks, which are generally ancient sedimentary, igneous, or metamorphic rocks, considerably indurated and free from calcium carbonate. These conditions result in a profile in which the clay-humus complex is of a base-unsaturated or acid character throughout, and in which the superficial or A horizons tend to be bleached owing to removal of sesquioxides, which are accumulated in the underlying B horizons. Owing to past erosion, mature profiles are not common. Such profiles as are found may be secondary profiles developed in what was originally the B horizon of the original profile. Owing to the generally hard character of the parent rocks, upland profiles are rather shallow.

From the point of view of possible afforestation the soils of the heath series are probably the most eligible. I shall therefore mention these in the first place, and discuss them in greater detail than the other types, which are characterized by impeded drainage, high water table, or other circumstances which must depress their value from the forester's standpoint. The heaths form a series varying from the grass heaths, to which some of the land actually under cultivation properly belongs, to the poorest heather moorland. Heath is essentially a dry formation. Naturally in such a wet climate as that of North Wales heath soils are frequently very wet, but they are of such a character that a drought of even a few weeks in summer leads to conditions under which only plants of markedly xerophilous character can survive. The heaths in our area are also characterized by soil acidity, which becomes the more pronounced as the heath character is developed. The xerophytic character of certain plants on normally wet soils may be connected with the fact that such soils periodically suffer from extreme physiological drought.

*Grass Heath.* This type, broadly speaking, lies on both sides of the margin of cultivation, for much of the land actually enclosed and occasionally ploughed must be regarded as grass heath. The grass vegetation consists of bents and fescues. Bracken and gorse are frequently present in such amount as to appear dominant. *Galium saxatile* and *Potentilla erecta* are characteristic miscellaneous plants.

Whilst the grass heath soils are generally base-unsaturated, they do not show a high degree of acidity. There is no tendency to the formation of an actual peaty layer, although a matted turf is usual. The grass heath soils have probably been at some time under some sort of cultivation. From the standpoint of soil genesis, they are to be considered as showing incomplete profiles, the surface soil being probably an original B horizon marked by accumulation of sesquioxides.

The grass heaths would probably be the main bone of contention between the forester and the grazier, because they are at the same time the most likely of the waste lands to prove valuable for afforestation and are also the most valuable of the dry rough grazings. In this connexion it may be remarked that

much of the grass heath in North Wales does not appear to be utilized to the full as pasture, even making allowance for the depressed state of agriculture. Large areas are covered with bracken, although it is known that this pest can be exterminated by a limited number of cuttings.

*Heath.* There is no sharp line of demarcation between the grass heaths and the heaths. There is a type which may be regarded as transitional in which there is a vegetation of fescues and other drought-resisting grasses together with *Ulex Gallii*, *Erica cinerea*, and *tetralix*, and stunted bracken. The soil conditions are more acid and there is a tendency to the formation of a peaty layer. The presence of a peaty layer is generally accompanied by podsollic bleaching, as may be seen when the soil is treated with hydrogen peroxide to remove humic matter. I should be disposed to regard such rudimentary profiles as of secondary origin, developed in what was originally the B horizon. These transitional heaths are less valuable both to the grazier and the forester, for they are at the same time more acid, and more liable to suffer from drought than the grass heaths.

In the typical heaths the vegetation consists mainly of *Erica cinerea* or *Calluna vulgaris* together with *Agrostis spp.*, *Anthoxanthum odoratum*, *Carex panicea*, &c., and a high proportion of such mosses as *Catharina* and *Rhacomitrium*. The soil is thin and stony or gravelly, passing at a few inches into barren gravel or rock. The formation of a peaty layer is strongly marked and the soil is, as might be expected, strongly acid. The surface soil appears decidedly bleached when organic matter is removed by peroxide treatment. The B horizon, enriched in sesquioxides, generally extends into the parent rock. In some cases the bleached A horizon lies directly on the rock.

In these soils the conditions are such that only plants with small nutrient requirements and great ability to resist drought can survive. The fact that heaths occur most generally in those parts of our area with the highest rainfall does not exempt them from this liability to drought. Indeed, the wet climate has actually brought about these conditions, which are due to the shallowness of the soil and its peaty character, whereby physiological drought sets in even after a week or two of dry weather in the summer months.

We have seen that there is a gradation in the heath series from the desirable grass heaths on the fringe of cultivation to the poorest heather moors. It is of some interest to know whether the general tendency is to degeneration, i. e. the change of grass heath to the less desirable types. Information on this point is not abundant, but observations on the foothills near Bangor suggest that degeneration does occur. There are in the rough grazings of the College Farm, Aber, areas now under a poor vegetation of heather, bilberry, &c., with a pronounced peaty layer and a bleached A horizon which, from the conformation of the ground, must have been under cultivation within comparatively recent times and must, consequently, have passed through the stage of grass which is found over the greater part of these grazings. One may conjecture that the remaining grass heath of this area will in time suffer a similar degeneration unless steps are taken to check the process. The suggestion may

be hazarded that afforestation might prove the necessary check to further degeneration. On the lower levels of the grass heath in question there is a tendency towards the establishment of woodland conditions, for there is an increasing growth of hawthorn, birch, and hazel which will probably, in the absence of interference, result in the formation of a closed woodland.

*Sub-alpine Grassland.* This type of waste, which has in some respects affinities with the heaths, is scarcely of interest for afforestation. The soil is thin and rocky, and the only possible utilization which can be imagined is the summer pasturage of sheep.

*Upland Peat.* This type occurs in irregular distribution throughout the mountain area. It develops in situations where the soil is continually waterlogged by seepage water from higher ground. The vegetation includes *Eriophorum vaginatum*, deer grass, *Nardus*, clumps of *Molinia* (on the borders of heath), and a fugitive vegetation of *Carices*. The peat is often of considerable depth. Measures of improvement are rendered difficult or impossible by the presence of rock and boulders and by the irregular character of the drainage. Where, however, drainage can be effected by ditches it is possible that such soils might prove afforestable. The fate of the plantings on this type of land near Beddgelert will be of great interest in this connexion.

*Lowland Peat.* There are in many parts of North Wales areas of lacustrine peat. On account of the general poverty of the waters in mineral matter, these peats are not to be regarded as typical fen. From the point of view of the forester, they call for little consideration, except possibly for willow growing. There are certain stretches of peat over boulder clay which, although occurring in the lowlands, belong more properly to the upland peat type. They are found in many of the mountain valleys and also in stretches in West Carnarvonshire. The peat is of the upland type, of variable depth, and is frequently cut for fuel. In the Lley district there is an expanse of poor clay soil resulting from the removal of thin peat from boulder clay. This carries a type of vegetation including *Ulex Gallii*, *Erica cinerea*, and *Molinia coerulea*. It is subject both to excessive wetness and drought. The improvement of the boulder clay peats is extremely difficult on account of the boulders and the irregular drainage conditions. In the Lley district the proportion of boulders is not great and improvement is not so difficult. It is possible that some land of this type might be considered for afforestation.

The principal types of waste land in North Wales have now been discussed. It is obvious that many of these types are not of immediate importance for the issue, forestry versus grazing. The soils of the heath series appear to be those over which the issue must be fought. As a layman in forestry, I naturally speak with great diffidence as to the suitability of any particular type of land for afforestation, but my general impression is that value for grazing and value for afforestation run generally parallel, and it is not possible to look for really desirable areas for afforestation in those sections which are of little or no grazing value. In other words, the forester cannot be expected to take the leavings of the sheep grazier.

The decision between forestry and grazing seems to elude a general statement unless some weight is given to future possibilities. If it is to be assumed that rough grazings will be indefinitely maintained at their present value and that the return from forest is to be at its present level, then it would appear that each area is a problem in itself to be settled in the light of local conditions.

There are, nevertheless, certain considerations which, in my view, should be taken into account in any attempt to arrive at a conclusion to this issue. In the first place there is the probability, about which foresters are better able to judge, that the price of timber and therefore the return from forest will rise considerably in the future. In the second place there is the possibility, in many cases the probability, that deterioration will take place in the more desirable hill grazings. There are many grazings in our area which, it seems to me, must decline in value both as pasturage and as potential woodland. There are, on the other hand, localities on the margin of cultivation where trees are establishing themselves on poorly managed grazings. I can only offer suggestions with great reserve, but the conclusion at which I have arrived is that there is a *prima facie* case for afforestation with coniferous timber on the poorer grass heaths now threatened with deterioration to heath, and with deciduous timber on those areas where woodland is now establishing itself. It does not appear, however, that there are any very extensive blocks of land in North Wales which can be readily spared from grazing and which are at the same time highly desirable for purposes of afforestation.

A Soil Survey of Wales is at present being carried out. As the work is being undertaken primarily on account of the advantages which may be expected to accrue from it to practical agriculture, it is not possible to devote much time and attention to waste lands. From the point of view of possible schemes of afforestation, however, a survey of the waste lands of Wales seems very desirable. As there is a marked correlation between vegetation and soil conditions, such a survey would not be so laborious as a survey of cultivated soils. Indeed, when a little experience had been acquired, aerial photography might be of service, and it would thus be possible to obtain a map of the waste lands of Wales in a comparatively short time.