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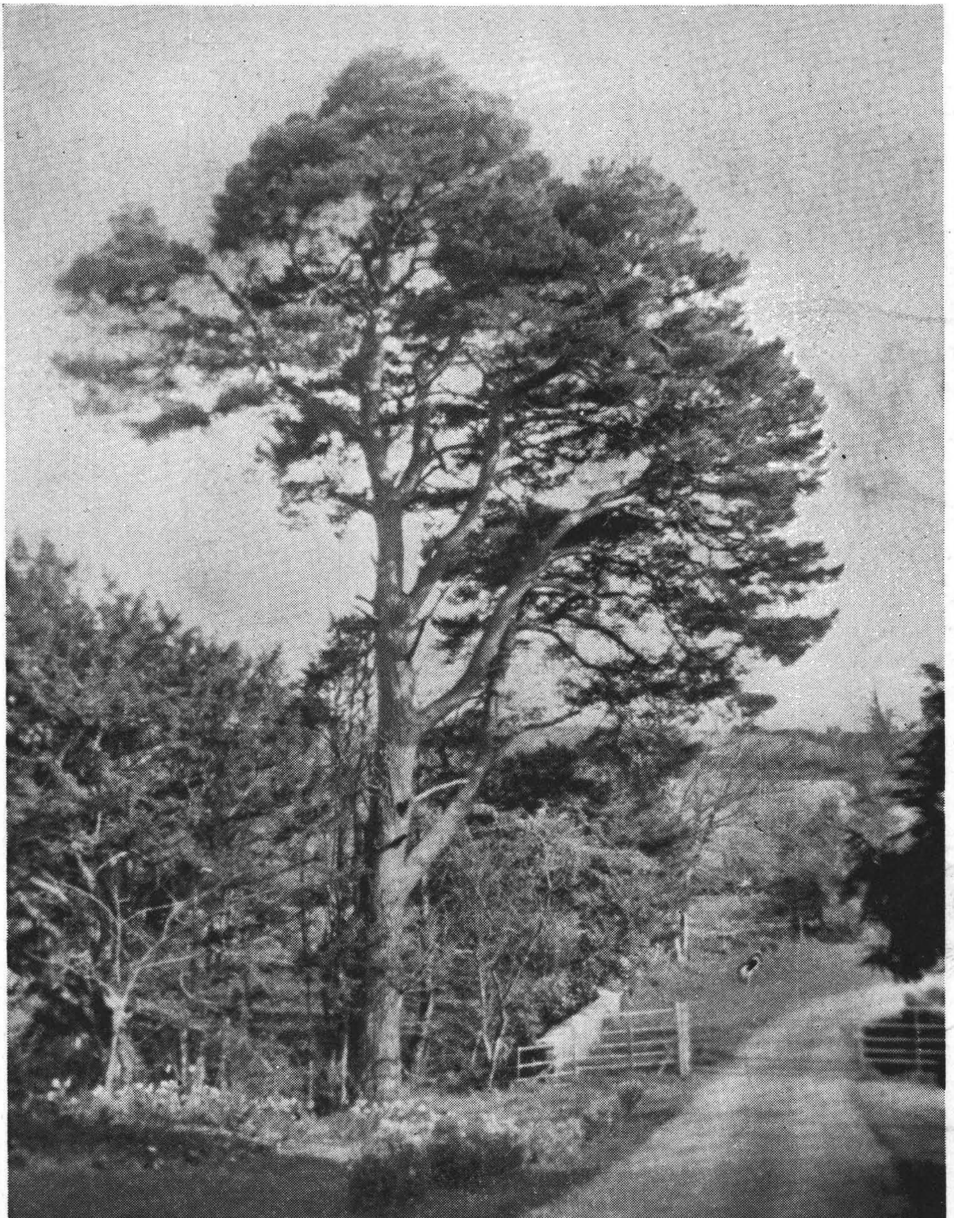

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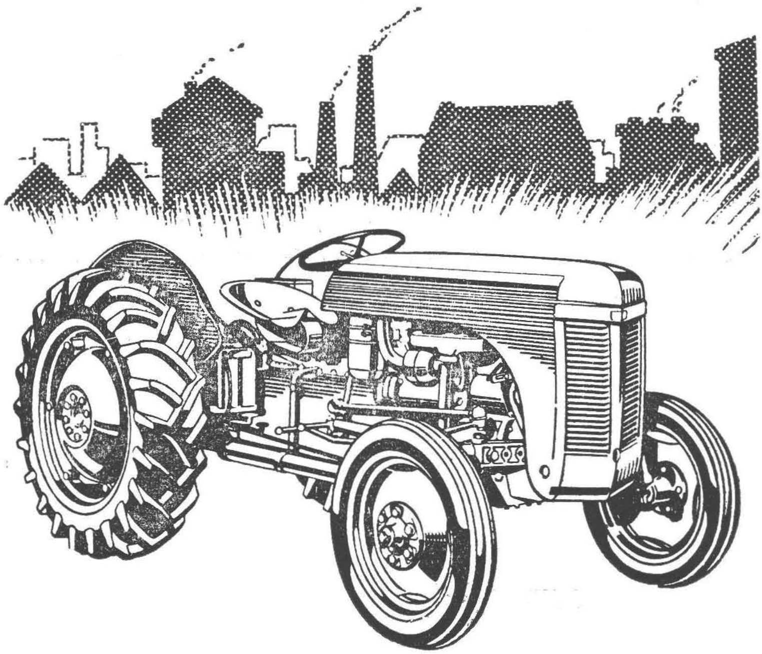

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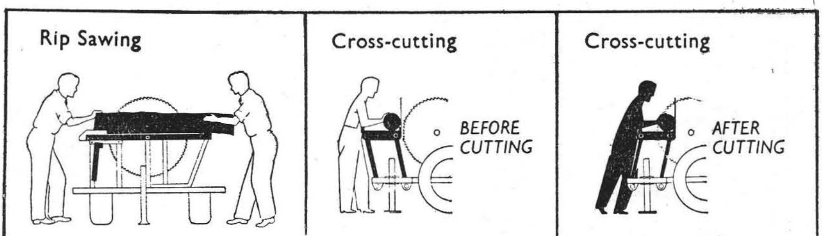

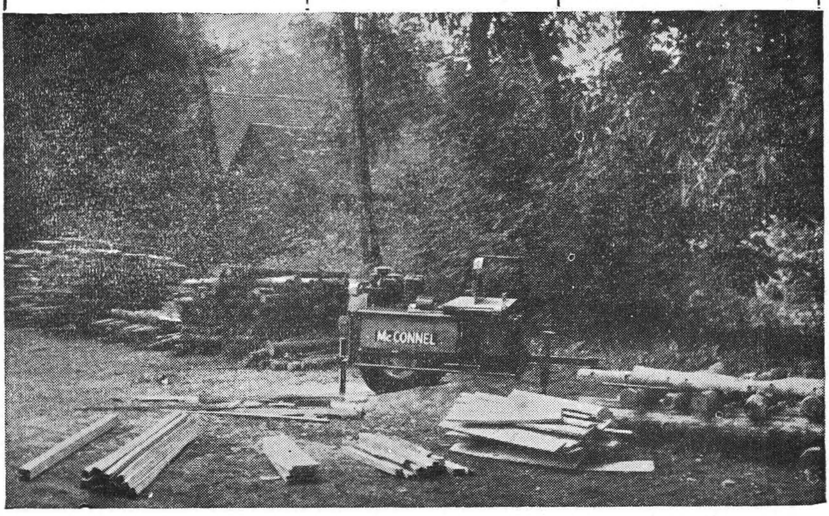

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IRISH FORESTRY

VOLUME XII WINTER NUMBER 2

AFFORESTATION OF BOG SOILS

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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.

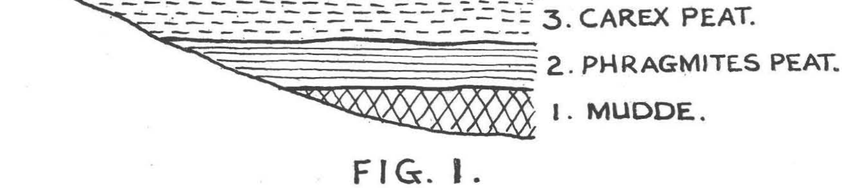

FIG. 1.

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).

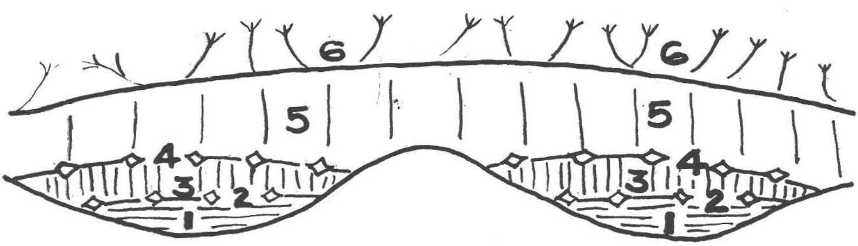

FIG. 2.

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).

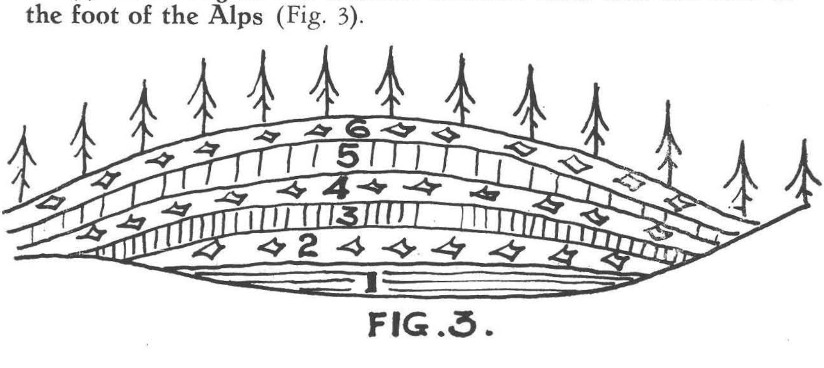

FIG. 3.

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 sub-boreal, 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

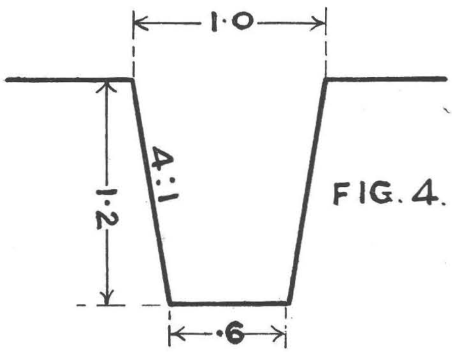

FIG. 4.

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.

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ACKNOWLEDGMENT

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A Further Note on Group Dying of Sitka Spruce and Rhizina Inflata

By R. McKay, D.SC., and T. Clear, B.AGR.SC.,
University College, Dublin.

THE authors first drew attention to the association of the fungus *Rhizina inflata* with group dying of Sitka spruce in a previous note to this Journal in 1953[1]. Since then, observations on this phenomenon have been continued, and as group dying in conifer plantations is of more frequent occurrence than has hitherto been believed, it seems desirable to furnish readers with more details of this trouble so that they may become conversant with its various features. It is also desirable that any occurrence of such group dying might be brought to the notice of the Forestry Division.

Group dying, as its name implies, is the death of the trees in groups. The number of dead and dying trees in a group may be only a few or several dozen, and affected trees may occur anywhere in the plantation. This trouble has usually be reported from established plantations of Sitka spruce 20 to 30 years old, although Murray[2] records its occurrence in a few younger and older plantations. Whilst Sitka spruce (*Picea sitchensis* Carr.) is the species generally affected by group dying, Norway spruce (*Picea abies* Karst.) has also been reported as liable to the disease in Great Britain, Murray.[2] In Ireland, up to the present time, besides Sitka spruce, group dying has only been seen in *Pinus contorta*. Death of this species has been observed by Mr. M. Swan and it occurred in a pine plantation 17 years old at Kilworth, Co. Cork. Here again, the association of the fungus *Rhizina inflata* with the disease was quite evident.

The sequence of aerial symptoms of group dying in Sitka spruce are as follows: The earliest symptom is the prolific formation of cones. This, perhaps, is most noticeable on trees on the edge of a diseased area, where only one or two trees are already dead and the trouble is in the process of spreading. This cone production generally occurs from 1 to 3 years before the death of the individual. Following an abundant, premature crop of cones, the crown of the tree becomes thinner and thinner in succeeding years. Many of the needles drop whilst still green, and finally, a complete shedding of the needles may occur suddenly in the middle of the growing season. Accompanying the sparseness of foliage, current season's growth is retarded, and there is a tendency for the ends of the top branches to develop several side shoots, leading to a slight witches' broom appearance. This effect is still obvious after the trees are dead, Fig. 1. The lenticels are very much enlarged on the trunk of the tree, Fig. 2, and resin exudes. This exudation most frequently occurs towards the base of the stem, but it may also occur as blobs of resin on the trunk up to a height of ten or

Fig. 1
Typical death of Sitka Spruce in early development of group dying.

twelve feet, and occasionally there may be a copious flow of resin down the trunk as in Fig. 2.

The aerial symptoms just described and the ultimate death of the tree are the result of a diseased root system. It is well known that cankers on fruit and forest trees or artificial girdling of their stems tend to induce heavy fruiting. So also in group dying of Sitka spruce, the death of the cortex of the roots interrupts the downward flow of manufactured food material and this is diverted to cone production. However, the death of the roots is progressive, and the supply of water

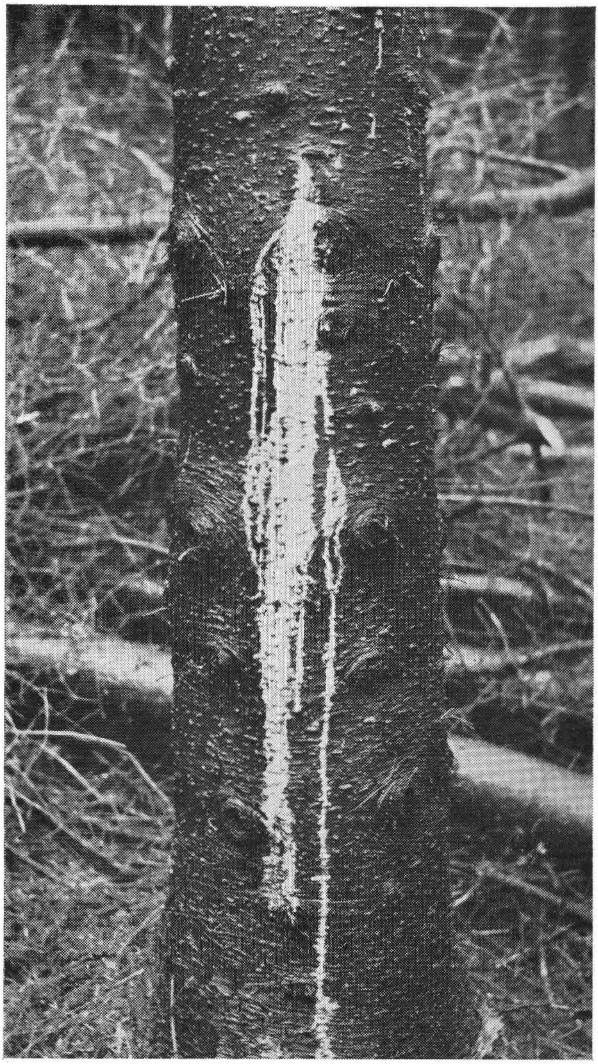

Fig. 2
Stem of dying Sitka Spruce showing enlarged lenticles and copious resin flow.

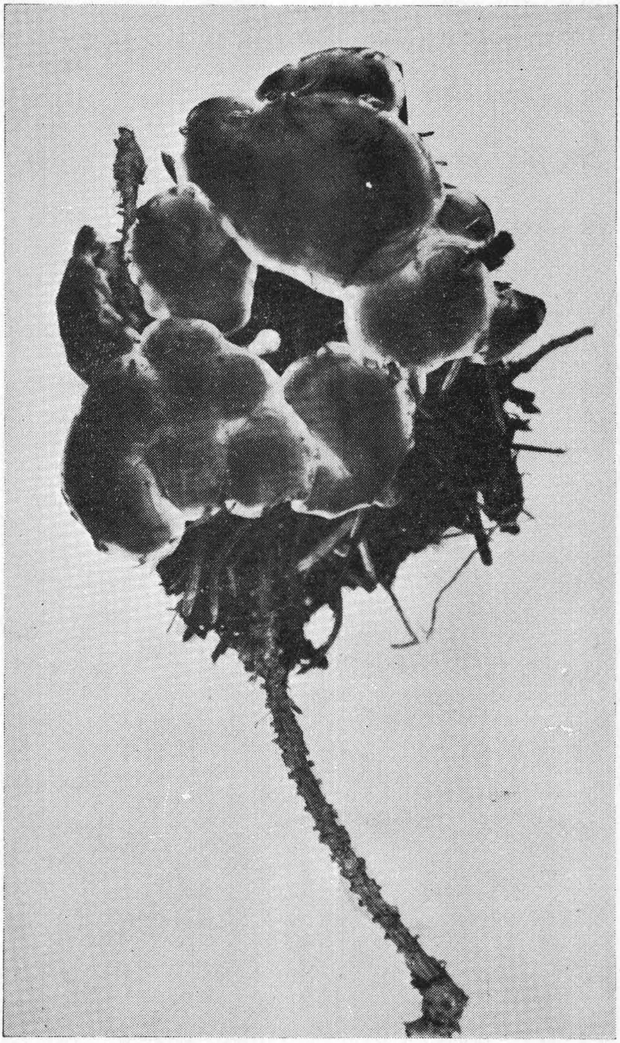

Fig 3
Typical colony of fructifications of *Rhizina Inflata* on needle debris over dead root in group dying area. (Natural size).

and nutrients to the top gradually diminishes and finally ceases altogether. The crown has no recourse but to fall back upon the remaining water in the stem, and when this is exhausted the needles drop and death of the tree ensues, Fig. 1.

The close association of the fungus *Rhizina inflata* with group dying of Sitka spruce has been noted in Great Britain[2] as well as in Ireland. The fungal fructifications are most abundant in the month

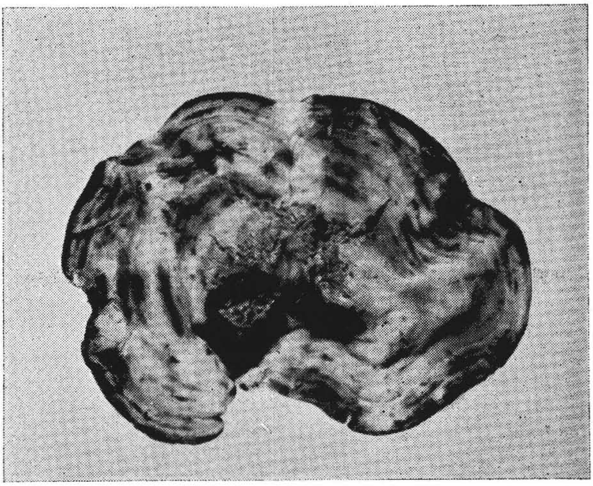

Fig. 4
Under side of single fructification of *Rhizina Inflata.*
(Natural Size).

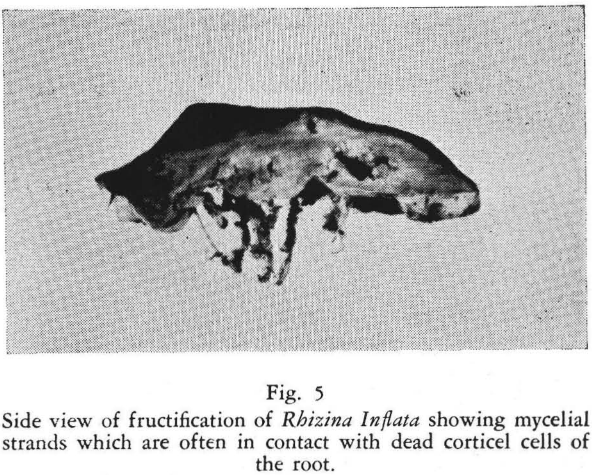

Fig. 5
Side view of fructification of *Rhizina Inflata* showing mycelial strands which are often in contact with dead corticel cells of the root.

of September, but apparently their development is largely dependent upon climatic conditions. As mentioned in our previous note[1] they were abundant in 1953; but in the wet cold year of 1954 a careful search of the same areas in the woods at Glendalough revealed only a single poorly developed fructification. In 1955, after the very warm months of July and August, the fructifications were again very numerous in diseased areas in September. As well as occurring around the collar of dead trees, frequently the fructifications were found growing up in colonies along the length of diseased roots for a length of two feet or more. A description of these sporulating bodies has already appeared in this Journal[1] and it need not be repeated here. However, a typical colony of fructifications of *Rhizina inflata* is illustrated in Fig. 3, and the under side of a single unit is shown in Fig. 4; while Fig. 5 shows a side view of a fructification with the hyphal strands hanging down which are often found in contact with dead areas on the cortex of diseased roots.

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ERADICATION OF GORSE AND BRIARS

By EDNA BURNS, B.AGR.SC.

ONE of the most difficult problems in planting waste land, such as that covered by gorse, briars and blackthorn is the eradication of that scrub at the lowest cost. In years gone by such methods as burning and cutting were tried, but the cost per acre was high, and also these operations could not be regarded as being entirely satisfactory, because, as is commonly known, these types of scrub re-shoot after cutting.

The soil types on which one finds the gorses i.e. Ulex Europaeus, Ulex Gallii, and Ulex Nanus, are in most cases quite fertile, and the same applies to the briars and the blackthorns. Taking this country on the whole we find that a lot of our plantable land comes into the category of brushwood covered land. One generally finds heaths whose common associates of calluna include dwarf furze (Ulex Nanus), together with vaccinium, Erica and bracken, and these cannot be regarded as being poor from the forestry point of view.

Trial No. 1.

GORSE ERADICATION WITH PHORDEX

Within the past few years new chemicals have come on the market, some of which have proved themselves in the eradication of gorse. These chemicals gain entrance through the stomata of the leaves or spines. Then during the process of respiration the chemical is taken into the leaves, stems and roots of the plant and in this way kills it.

Phordex is one of these new chemicals which according to the trials carried out at Johnstown Castle eradicated gorse completely. This chemical is a mixture of *2, 4, 5—trichlorophenoxyacetic acid* (2, 4, 5 T) and *2, 4, dichloro phenoxyacetic acid* (2, 4D). Phordex controls quite a number of plants which form most of our scrub.

OUTLINE OF TRIAL—GORSE

A small area was treated. 15 yards $\times$ 20 yards. i.e. approximately 1/16 of an acre. The gorse in this plot was about three feet high, and was so thick that in order to facilitate spraying, paths had to be cut through the area.

Rate of application (1—100) i.e. one gallon of Phordex in one hundred gallons of water.

Time of application : 3/9/'53.

Six days had elapsed before the gorse showed any signs of being affected. The flowers, spines, etc. turned brown and on cutting sections at the base of the stems, it was discovered that the chemical had affected this part also. These sections showed drying and discolouration of the cells. Four weeks later the gorse was completely burned, and showed no signs of recovery. It was thought that at this stage there might be a tendency for the plots to reshoot at the base, but fortunately this did not occur.

For comparative purposes half of the plot received a second application at the same rate (1—100) but there was little or no difference between the results of the two treatments.

Two years have elapsed since this trial was carried out and at the present day the gorse shows no sign of recovery, but is in a state of complete decay. On taking up some of the roots it was discovered that these too were rotten, and brittle, and presented no difficulty in pulling by hand. At this stage it would be a good practice to plough through the area, so as to get rid of the roots.

The spraying was done in this trial, as in the rest, with an ordinary knapsack sprayer using the high volume nozzle. An important point to note is that the spraying be carried out during fine weather, but not during excessively hot weather, nor should it be done during drought.

The approximate time taken to spray 1/16 of an acre was fifteen minutes.

The cost of one gallon of Phordex is £5 10s. 0d. and the concentration 1—100 (water) is sufficient to treat one acre.

Trial No. 2.

BRIAR ERADICATION WITH PHORDEX

The rate, strength, and time of application were similar to those of the gorse trial. The briars were much easier to spray since they were only two feet or less high, and for that reason could be easily walked through. Burning of the leaves and stems occurred after two days and two weeks later the plot was completely burned. Here again there was no sign of recovery nor was there any tendency to reshoot. The area was 1/16 of an acre and the time spent in spraying was eleven minutes. The rate 1—100 (water) was sufficient to treat one acre.

Trial No. 3.

GORSE ERADICATION WITH S.B.K.

S.B.K. which is also a comparatively new chemical was tried on the eradication of gorse. It contains the chemical 2, 4, 5 T, that is 2, 4, 5—trichlorophenoxyacetic acid. The spraying was carried out on 1/16 acre plot on 24/8/'53, at a strength of 1—50 using T.V.O. The results were somewhat quick to show up since on the third day after spraying the spines showed signs of burning. Twenty days later the area was the same as the Phordex trial as it was completely dead and showed no sign of recovery. The roots and stems are at the present day dried up and brittle, and for that reason S.B.K. can also be regarded as being successful.

The cost of one gallon of S.B.K. is £7 10s. 0d.

Trial No. 4.

BRIAR ERADICATION WITH S.B.K.

Rate of application : $\frac{1}{2}$ gallon of S.B.K. to 50 gallons of water (1-100).

Time of application : 28-8-'53.

The plot tried out was similar in area, and height of briars to the Phordex plot. Burning of leaves, and stems took place on the third day, and on observations made last July ('55) it is quite obvious that the briars have been eradicated.

SUMMARY

As the reader has seen a number of trials have been carried out to investigate the potentialities of Phordex and S.B.K. for the eradication of gorse, and briars. Both Phordex, and S.B.K. proved successful in eradicating gorse, and briars at their respective strengths. The machine used was a knapsack sprayer and this should be thoroughly cleaned after each operation. Another point of importance is that the spraying be carried out during fine weather. As with most sprays it is wise to use rubber gloves while handling these chemicals. Neither Phordex nor S.B.K. are poisonous, nor have they shown any ill-effect on soil fertility.

Items of Interest

TREES TO KEEP BUDAPEST CLEAN

Budapest is to plant a forest belt in a semi-circle round its eastern and southern environs during the next few years to block dust clouds which come annually from the Great Plains.

The belt, part of 2,400 acres of tree-planting to keep the air of the city pure, will run from Vác, some 20 miles north of the city centre, round to the southern limits of the city.

Other parts of the scheme include more than 500 acres of plantations, parks and avenues within this semi-circle on the left bank of the Danube. The work will be begun before next spring.

(*Hungarian News and Information Service*).

HOW EFFECTIVE IS A SHELTER BELT

It has been calculated that a broad-leaved shelter belt, when in leaf, can cut wind velocity as much as 50% at distances up to 14 times its own height. When defoliated, in the winter, however, the effective shelter area is reduced to about 8 times the shelter belt's height. A shelter belt of trees causes no draughts as does a solid body and it breaks the wind without the formation of gusts.

Proper shelter belt protection can effect considerable saving in the fuel costs of maintaining a comfortable temperature in the house. An unprotected house exposed to a 20 m.p.h. wind can take $2\frac{1}{2}$ times as many B.T.U. to heat as the same house exposed to a 5 m.p.h. wind, other conditions being the same.

RINGS OF MYSTERY YIELD VITAL SECRETS

By John Westbury

PUZZLING over the cause of sunspots and their possible effect on the weather, a young astronomer one day in 1902 suddenly recalled to mind the odd appearance of the pine-forest on a nearby mountain-side in northern Arizona. Hitching his horse to a wagon, he drove to the forest, noting again with inward excitement the changes in the forest as the road led him down to the desert.

From that outwardly inconsequential wagon-ride the astronomer, whose name was Andrew Douglass, returned home to formulate a new theory on sunspots. The climate, he reasoned, affects the growth of all plant life, including trees; if (as we believe) sunspots in turn affect the climate, should we not be able to find a history of sunspots written in the slow growth of trees?

Investigation soon proved that his theory was soundly based, and the scientist and anthropologist interested in the story of human life and climate down the ages, found opened to him new 'history' of these things, written by nature in 'code' in the world's trees.

Science has adequate proof that sunspots are linked with the great magnetic storms which sweep the earth at regular intervals, interrupting radio communication and making telephonic and telegraphic transmission almost unintelligible. Until Douglass interested himself in sunspots and tree-calendars scientists had few if any reliable 'tools' whereby to seek the cause of sunspots and their effect upon the earth's climate. Now, after more than fifty years intensive study of tree-rings, some of the mysteries of sun and earth (especially the latter) are being slowly yet significantly revealed.

But you may wonder, what link is there between tree-rings and sunspots? How can an examination of the former tell us what kind of climate was experienced, say, 500 years ago in some part of Canada or Britain or New Zealand?

Studying the 'ring-calendars' of thousands of trees in many different climates, Professor Douglass soon discovered that the width of these rings varies with climate, especially in those regions where temperature and rainfall are factors vitally affecting plant growth. In widely separated regions having the same climate, ring patterns were found to match exactly.

Further investigations revealed many other secrets. It was found, for instance, that by tracing the rings back through over-lapping lives of generations of trees (a process known as "crossdating") a chronology of hundreds of years could be constructed. Moreover, the ingenious idea of examining closely the beams of wood from ancient buildings as well as long-buried logs enabled the experts to take the story back still further centuries.

By carefully collating and analysing results of investigations carried out in many part of the world, but especially in Gt. Britain, the United States, Alaska, Scandinavia and Europe generally, Professor Douglass and his associates established that the rythms or cycles of tree growth correspond closely with the 11-year sunspot cycles.

It was this new science of ring-tree studies which enabled experts to discover the exact date of origin of the pre-Columbian Indian settlement known as Pueblo Bonito, in Chaco Canyon, New Mexico. Studying its many ancient timbers, they found that the earliest timber was cut in 919 A.D. The settlement, they found, was still occupied in 1127. This knowledge helped the world's archaeologists to fit into the pattern of history more than 40 other Indian settlement ruins, so that they knew exactly when each settlement had been founded and when it more or less ceased to exist as a place of the living.

It is fascinating to learn, also, that the tree-ring research experts have a tree calendar, written by desert conifers, which goes back to the year 11 A.D. Another tree calendar has been traced in the giant sequoias of California to a period before 1,000 B.C.

By studying the rate of growth, the distance between the rings, their appearance and width, and other factors, the experts can give a fair summary of the climate experienced for centuries back in the region where the tree (and its ancestors) stood. In the same way a knowledge of man (his methods of building, knowledge of tools, customs and other information) can be deduced from expert examination of ancient timbers taken from centuries-old buildings.

Day Excursions for 1955

THE Society's pratice of organising day excursions to places of forestry interest was continued during the year. The first excursion was to Mountrath Forest on 1st May to study the cause and effect of the extensive windblow which occurred at the forest over the previous twelve months.

On 26th June we visited the estate of Captain Tottenham at Ashford, Co. Wicklow, where we had the opportunity of studying modern and progressive management of woodland areas on a private estate.

Our next excursion on 31st July was to Castlepollard Forest where the topic of discussion was the establishment of hardwood crops on limestone land with heavy hazel scrub.

Our last excursion was to Thomastown Forest on 18th September where we discussed the technique of establishing hardwoods by group planting in a matrix of conifers.

The Society wish to express their thanks to the Minister for Lands for permission to visit the State Forests and to the officers of the Forestry Division, particularly the foresters, on whose shoulders the main burden of these excursions rests, and whose enthusiasm and hard work, mostly behind the scenes, is so largely responsible for the success of these outings. We would mention in particular Mr. M. Dalton of Mountrath, Mr. McCarty of Castlepollard who was ably supported by Mr. Finnerty, who previously had charge of this forest, and Mr. Forde who is in charge of Thomastown Forest with his assistants, Mr. Aherne and Mr. Leonard.

We would also like to express our thanks to Captain Tottenham for a very instructive visit to his woodlands and for the generous hospitality we received from him and from Irish Forest Products on that occasion.

Lastly we must express our thanks for and appreciation of the generous hospitality we received from Mr. and Mrs. Dalton when we visited Mountrath Forest, and from Mr. and Mrs. McCarty at Castlepollard and from Mr. Forde at Thomastown.

TWELFTH ANNUAL STUDY TOUR

Report by M. McNamara

SINCE 1949 the Forestry Division of the Department of Lands has opened several new Forests in Connemara. Most of them are on areas of blanket bog with exposure moderate to severe for tree growth. The problem of establishing forests on such sites is a difficult and complex one. When the Council of the Society decided to make Galway the headquarters of the 1955 Annual Study Tour, with a number of the new forests on the itinerary, they felt that they were arranging a Tour of more than ordinary interest. In this they were fully justified by the large attendance and the keen interest and the vigour of the discussions.

The party travelled in two special buses, and as might be expected, our first stop was at Knockboy, the scene of the first attempt at State Forestry in Ireland. Mr. McEvoy welcomed the members and expressed the hope that the Tour would prove to be an interesting and educational one. He thanked Captain R. B. Donovan, the present owner of Knockboy, for granting us permission to visit the property.

Mr. H. M. Fitzpatrick outlined the history of Knockboy. It was started in the reign of Queen Victoria, as a result of pressure from Dr. Fisher, M.P. for forestry in the congested districts of Ireland. Arthur Balfour said that there was no land available for forestry. In reply, Father Flannery, P.P. Carna, wrote about the end of 1880, and said that 1,000 acres were available on the Knockboy Estate at a price of £1,000. It took about six years to get the scheme under way. In 1890, when the area had been fenced and drained, the Congested Districts Board took over. By 1899, an area of 820 acres had been planted, at a cost for the project of £9,000. The scheme was stopped that year, as the area planted was not doing well and funds had run out. In 1895, Sir William Schlich described the area as 914 acres of bog 10 feet deep over granite, and according to him, the trees (which were notch planted) were nearly all dead at that time.

The property occupies a low hill 50′ to 250′ elevation, in extreme exposure, on a peninsula jutting out from the west coast. The underlying rock is granite, with mineral soil occurring only in pockets, while peat development is general.

Mr. P. White said that from conversations he had with locals who worked on the scheme, he had formed the opinion that the trees had suffered from exposure to salt spray while being transported by boat from Galway, and while they lay on the shore awaiting planting.

Only a few scattered clumps of C.P., Maritime Pine, Birch, Alder and Beech now remain. Mr. J. J. Maher remarked on the dying back of the Norway Spruce, which he said was characteristic of the species when exposed to winds bearing salt spray. He suggested S.S., P.I. and C.P.

as the trees which we would now consider most suitable for western climatic conditions.

In recent years, fires from adjoining land have killed some of the remaining trees and endangered the residence. The surviving clumps of mixed species are now practically confined to shallow depressions, with some local shelter; where flush effects provided better than average soil conditions, heights of 30′ to 40′ have been attained. Individual specimens of P.I., which are believed to have been introduced by a subsequent private owner, have attained heights of 50′. About half the original area planted is now owned and used for grazing purposes by Captain Donovan. The other half, which consisted largely of deep peat, was eventually developed for turbary purposes.

Mr. McEvoy conveyed to Captain and Mrs. Donovan the Society's thanks for the privilege of visiting Knockboy, and for the hospitality extended to our members.

Our second stop was at Ballinahinch Forest, where Mr. N. Diver welcomed the party on behalf of the Minister for Lands, and introduced Mr. G. Coupar, Forester-in-Charge.

Ballinahinch Forest was acquired four years ago. It had been developed in the early part of the century by an Indian, Prince Rangit Sanghi, as a fishing and sporting property. The total area of the Forest is 1394 acres and it contains the remnants of some natural sessile Oak and a number of middle-aged plantations, mainly Austrian and Maritime Pine, J.L., and Spruces including some Picea Alba. The total woodland area was 225 acres, the remainder consisting of a number of peat types varying from Molinia, Rush to Shoenus, Scirpus and Rhyncospora types.

These middle-aged plantations (approximately 50 years old) were of poor rough quality when planted on good mineral soil, and were mostly failures on the peat types typical of the district. By contrast, a 50 year old S.S. plot in a sheltered valley gave very heavy yields, with heights of over 100′ and mean Q.G.B. H. $16\frac{3}{4}''$. Apparently the good growth of this Spruce encouraged further planting of this species in pure blocks some 35 years ago, and these plantations on good soil were very productive and of high quality, with a mean annual increment of up to 200 c.f. per acre. Unfortunately, thinning had been neglected (600 stems per acre at 70′ high) and the stems had become whippy and extensive wind blow has taken place since acquisition. Natural regeneration of Sitka is frequent on the blown areas, and is being encouraged.

After lunch and a brief inspection of the acquired plantations, the party proceeded to inspect the modern technique of establishing plantations on deep blanket bog. Particular attention was paid to an area of extremely poor blanket bog, which had been the subject of an experiment. Mr. White, who was in charge at the time, outlined the treatment. It was ploughed in 1952 and planted with P.C. and S.S. in ratio of

3 to 1 in February, 1954. The area was treated with 2 ozs. of basic slag per plant. The slagging was done in May at the beginning of the growing season. The cost of the slagging operation was 15/- per acre. Mr. T. Groonell said that surface application of the manure had no detrimental effect on the plant, even when it came in direct contact with the stem.

Mr. T. Barry stressed the importance of studying plant associations when assessing the fertility of bogs. Mr. McEvoy emphasised that there had been a considerable development in the plant association resulting from enclosure, drainage and manuring. All plants were vigorous, and several members felt that it might be desirable to increase the percentage of S.S., but it was admitted that nothing conclusive could be decided at this early stage.

Second Day.

On the second day we made our first stop at Ross Property. This property contained 360 acres when acquired twenty-six years ago. The total area of the Forest has now risen to 2,103 acres.

Mr. McGuire, Forester-in-Charge, met us at Roscahill Property and having given a brief history of the Forest provided us with details of Roscahill Property which was the original "take". He said that the property was situated on limestone, overlain by deep local drift, including granite from the nearby hills at its western end, which became progressively shallower until limestone pavement appeared along the lake shores at the eastern end of the area. The deeeper soils appear to be of the "brown earth" type with no evidence of free lime judging by the vegetation.

A good deal of discussion centred around an old Spruce stand which Mr. McGuire said contained 350 stems per acre with an average height of 45′ and volume per acre 4,700 c.f. The first thinning was carried out when the crop was 19 years old. Three thinnings took place in the following eight years. Thinnings were disposed of locally but the disposal of the heavier thinnings was slower. Messrs. Hanan and Clear were in favour of a heavier thinning policy but Mr. McGuire held that the removal of 50 stems per acre next year would leave the crop sufficient growing space. Mr. McEvoy said that according to British Yield Tables for Quality Class II, 300 stems per acre would be the correct stocking for the stand.

The deeper soils were very productive, giving high yields of J.L. and S.S. The party moved on through the Property and examined results on the shallower limestone soils, where selection of species was more restricted by soil conditions. Natural Ash was very much in evidence in this part of the Property and the discussions turned very largely on its treatment and utilisation. There seemed to be general agreement that shade bearers should accompany Ash, especially on the shallower drier sites. Species such as Beech, Tsuga, Thuya and various Silver Firs were recommended. The current high values of sports Ash from butt lengths with wide annual rings was emphasised, and it was suggested that the crown should be given every encouragement to develop on stems of up to 20′ by thinning to 20′ spacing at an early age, giving maturity in a short rotation. Some particularly fine stands of almost pure Ash were seen in moister glens or valleys where good results could be obtained without any admixture.

Several patches were observed near the exposed western margin in which considerable defoliation had occurred and growth had stagnated. A discussion ensued as to whether this could be attributed to the die back fungus Rhizina inflata. The typical symptoms were not apparent on the roots and collar however, and the trouble was attributed to Armellaria mellea.

Messrs. McGuire and McMenamin were thanked for the comprehensive information which they had compiled on the history and crops of this Property.

On the afternoon of the second day we visited Cloosh Valley Forest. Almost the entire Forest, which comprises 8,684 acres, is on peat of varying depth and fertility. Approximately 4,000 acres are considered unplantable, and a substantial percentage of the remainder is regarded as experimental, as no previous knowledge of the behaviour of trees in this type of peat under modern methods of establishment is available, and no definite results can be forecast. The area was acquired from the Irish Land Commission in 1951. The range of elevation is from 300′ to 900′, with exposure moderate to severe for tree growth over most of the area.

Mr. Groonell, who has been the Forester-in-Charge of the area since its acquisition, outlined the work done to date, and the results achieved from different treatments. To date, he said, 1,200 acres had been planted, the main species being P.C. and S.S. The ground was ploughed and the trees were planted on the ribbon. Tests to ascertain the effects of different manurial treatments and time of application were carried out, and the results to date may be summarised as follows—P.C. seedlings planted without fertiliser resulted in 100% failures. Vigorous growth, by comparison with control plots, resulted when plants were treated with 2 ozs. of Basic Slag or 3 ozs. of G.M.P. The delaying of manuring until the growing season resulted in an increased number of failures. The best results achieved to date were from an application of 3 ozs. of G.M.P. per plant.

Messrs. P. Ryan (Johnstown Castle), Clear and Deasy contributed to a discussion on the effect of the application of the fertiliser on the peat. Mr. Ryan held that 2 ozs. of fertiliser could only keep the tree going for a year or two, giving a starter effect only.

Mr. McEvoy referred to the marked development of Molinia (which existed as a weak-growing, diffused constituent on the original vegetation) throughout the entire manured area, but more particularly by vegetative development around the point of application of the fertiliser.

Messrs. McEvoy, Barry, Clear and Ryan contributed to a discussion, in which it was generally agreed that a puzzling feature of the western blanket bogs was the wide distribution and general frequency in the vegetation of molinia and Scheonus nigricans. Elsewhere in Ireland, as well as in other European countries, these plants are of more limited distribution, and have been associated in the minds of ecologists with sites of intermediate fertility, for instance they do not occur on the virgin high bog of the Irish midlands, except in local flushes or otherwise improved parts. In the middle east, Shoenus forms a typical community on alkaline salt marsh. Shoenus is also associated with a constantly high water table, which is typical of the western bogs. The association of these plants with some degree of fertility seems to be confirmed by some recent comparisons of surface samples from various Irish bog types, in regard to mineral content. This suggested that the western bog had a higher mineral content at the surface, than typical high bog of the midlands, which in turn, gave a higher figure than high level Wicklow mountain bog. It is impossible to indicate at present, to what extent such factors may influence the development of a tree crop, but obviously their investigation should yield results of fundamental importance.

Mr. T. Barry, Bórd na Móna, described with the aid of maps, stain charts and Hiller Borer, the methods adopted by Bórd na Móna in surveying and assessing bogland for its purposes. Maps of top and bottom contours of the bog are prepared, from which figures for average depth and total volume can be ascertained. From this an estimate of total production can be made, and drainage pattern laid down. In addition, sample profiles of peat types are taken on a grid system, from which fuel quality of peat, moisture content (usually 90-95%) and timber content can be calculated.

Third Day.

On the third day we visited Cong State Forest where our President introduced Mr. Leonard, the Head Forester.

Cong Forest was acquired in 1939 from the Hon. Arthur Guinness. A large proportion of its 3,164 acres was under timber, mainly hardwoods, at the time of acquisition. The hardwood stands provided excellent cover for game birds. Mr. Leonard informed us that the shoot, which was still regarded as the finest woodcock beat in the country, is let to Lord Oranmore and Browne. Our first stop was at a Scots Pine stand which was planted in 1943, on a shallow mineral soil over limestone rock, almost at lake level. A lively discussion took place in which Messrs. Mooney, Leonard, Diver, McEvoy and McGlynn argued the relative merits of Spruce and Pine on this type of site.

Further on, the site deteriorated until only a covering of moss overlay the limestone, but pockets of fertile soil occurred in crevices. Mr. McEvoy invited a discussion on the feasibility of planting Beech or Silver Fir in the crevices, and leaving any existing scrub cover over the shallow areas. A crop of 80 trees per acre, giving 40′ of clean timber, would justify planting. Mr. Maher argued that the quality of the scrub in this site would suggest that there was adequate soil for the production of an open conifer crop.

An 11 acre plot of S.S. 27 years old aroused a good deal of interest. The crop was first thinned in 1948 and it received a second thinning in 1953. The total volume of thinnings removed was 5,900 c.f. The present stocking was 500 trees per acre with a volume per acre of 5,250 c.f. The average height was 59′ and the average Q.G.B.H. was $8\frac{3}{4}''$. Mr. Leonard pointed out that the crop was originally laid down as a mixture of S.S. N.S. with some S.F. J.L. Mr. Shine favoured heavier thinning but Mr. Leonard argued that even growth with close rings gave high quality timber which made up for any loss in volume. Mr. Clear maintained that ring width from 20 years onwards did not materially affect the strength quality of the timber. A nearby J.L. crop on similar soil compared very unfavourably with the S.S., having less than half of its volume per acre. In Cong Forest generally, J.L. and E.L. crops were disappointing by comparison with Spruce. Mr. Leonard pointed out that game preservation and availability of species were factors which were taken into consideration when plantations were laid down by the previous owners.

After lunch at Ashford Castle Hotel, we visited Cong State Sawmill where Mr. Mooney introduced us to Mr. Flynn, Forester-in-Charge of the mill. Mr. Mooney said that this new sawmill had been operating for a year, and drew its requirements of round timber from Cong, Ballygar and Mountbellew Forests. The intake was 60 tons (1,800 c.f. per week), or in other words about $\frac{1}{3}$ of an acre of fully stocked woodland.

Mr. Flynn then arranged a demonstration of the various saws and machines. A vertical log band mill was set to work planking a Scots Pine log 18′ long and $14\frac{3}{4}''$ Q.G. While the work was in progress a discussion on different methods of sawing round timber took place. Mr. Clear favoured the canting of the log and cutting parallel to the bark rather than to the core, thereby utilising more of the closer ringed outer wood, and leaving a central core of knotty open grained timber. Higher quality boards with uniformity of shrinkage would be thus obtained.

This concluded our Study Tour and our President, Mr. McEvoy, supported by Mr. Mooney expressed the Society's appreciation and thanks to the Minister for Lands, the Department officers, private woodland owners and all who had contributed to the success of the tour.

Film Show

By arrangement with THE IRISH WALLBOARD CO. LTD. a special showing of films of forestry interest was given to members of the Society and their friends at *Mills' Hall, Merrion Row, Dublin,* on Wednesday, 5th October.

The films shown included :

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After the film show we had a very interesting discussion on the "Utilization of Forest Produce" in which the speakers were Mr. C. O'Loughney, Mr. Cusack, Mr. R. Shackleton of Irish Wallboard, Mr. T. Clear, and our President, Mr. T. McEvoy.

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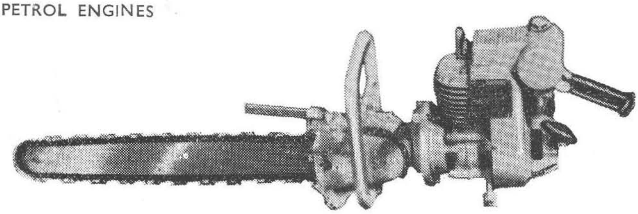

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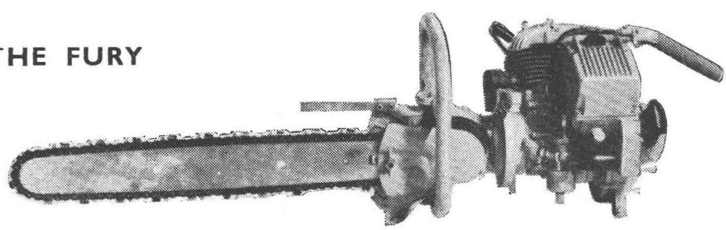

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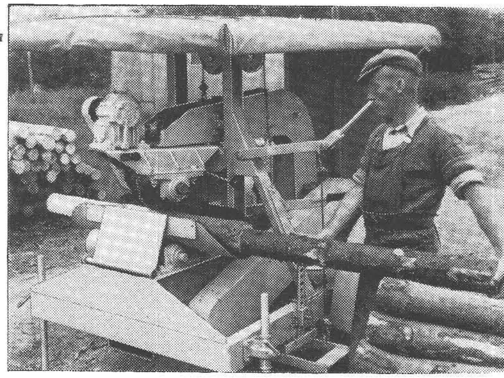

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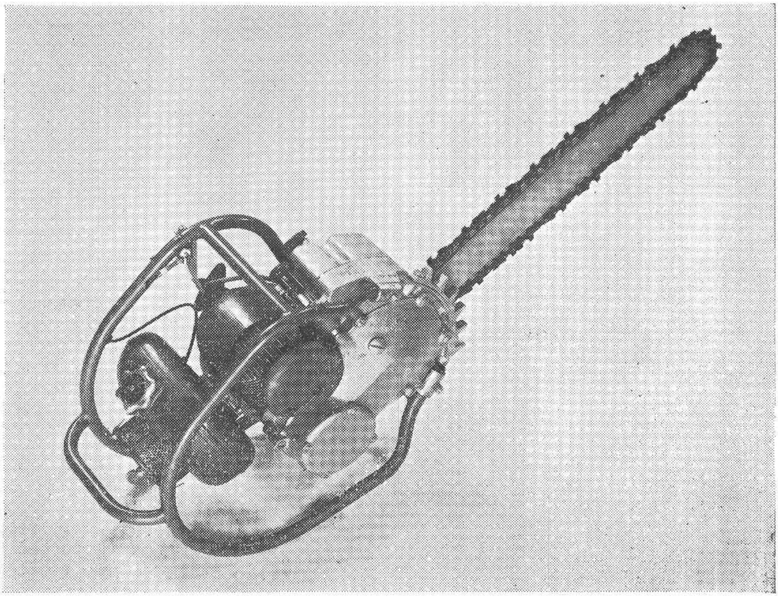

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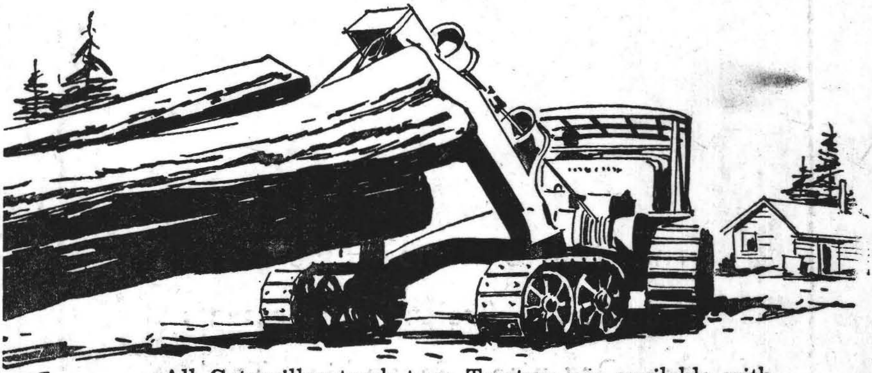

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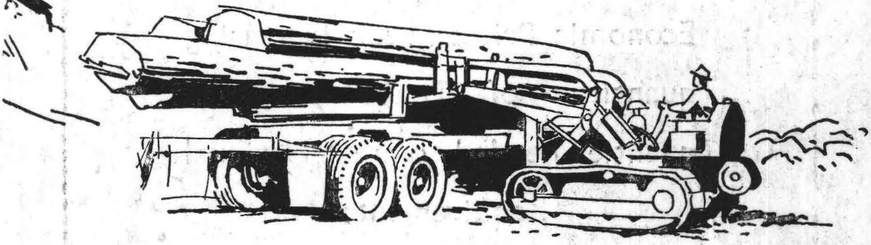

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