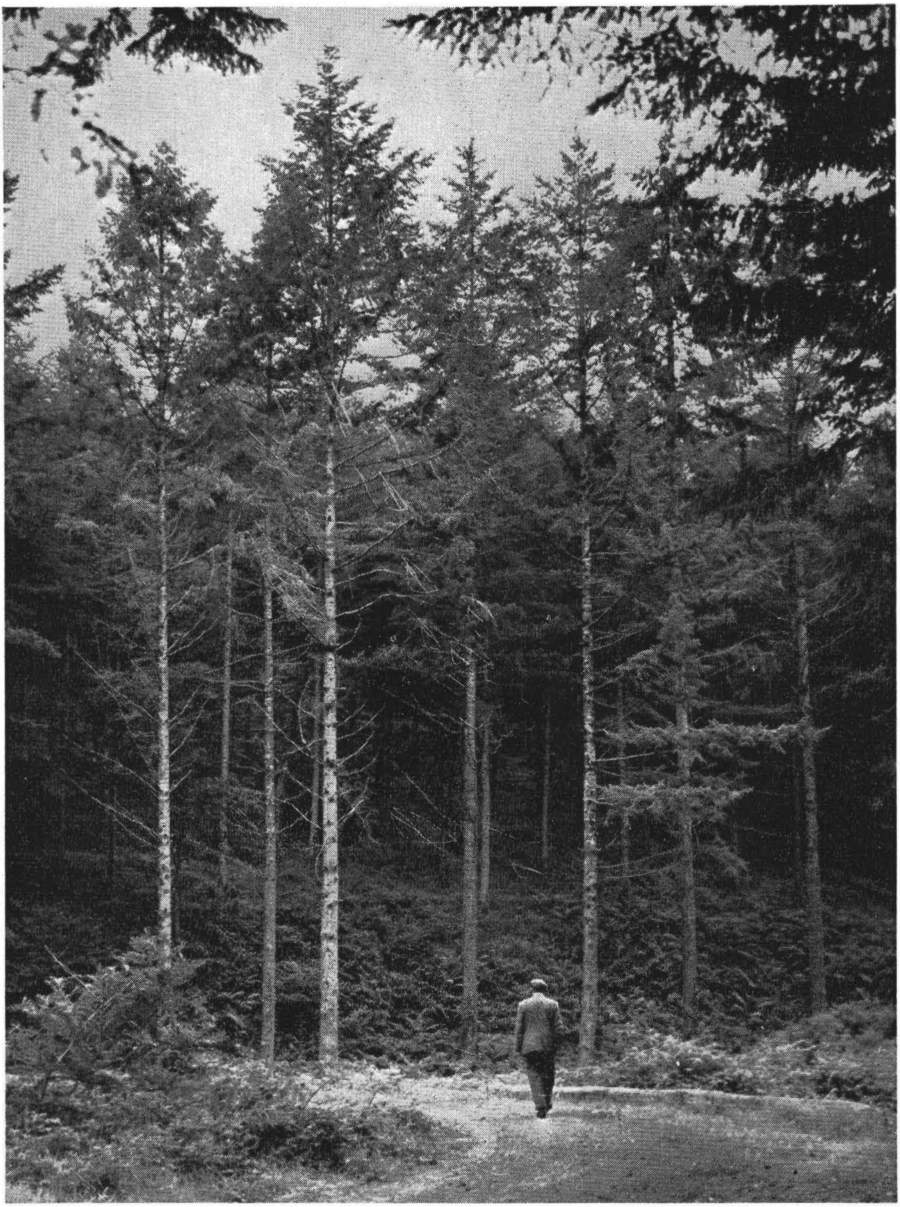
IRISH FORESTRY

Journal of the Society of Irish Foresters

Published Twice Yearly



Vol. XIV. No. 2. WINTER, 1957 Price 5/-

Membership Application Form

I desire to become a member of the Society of Irish Foresters, and enclose Cheque/P.O./M.O. for ...., being subscription for year ....

Full Name ....

Occupation ....

Postal Address ....

Signature ....

Date ....

Block Letters

To be forwarded when completed to the Secretary at Albert Agricultural College, Glasnevin, Dublin. For conditions of membership see over.

If you prefer to utilize a Bank Draft, kindly pass this portion of the form to The Secretary, Society of Irish Foresters,

Albert Agricultural College,
Glasnevin, Dublin.

* **The Manager of the** ....

....

Please pay to the Ulster Bank Ltd., Lower Baggot Street, Dublin, for the account of the Society of Irish Foresters, the sum of .... on the first day of January, 19......, and on every succeeding first day of January until otherwise instructed.

Signed ....

....

* Please insert the name and branch of your bank.

CONDITIONS OF MEMBERSHIP

(Excerpted from the Constitution)

Article V.—The membership of the Society shall consist of two Orders, namely: Technical and Associate.

TECHNICAL MEMBERS shall be persons desirous of promoting the object and at the time of election resident in Éire, who are employed for their whole time in forestry or any branch of natural science closely connected with forestry, or who have been so employed for at least five years, or who, though not so employed hold a degree or diploma in forestry of a recognised University or College, in all cases subject to the approval of the Council.

TECHNICAL MEMBERSHIP shall be divided into two grades, namely:—

Grade 1—Being Forestry Inspectors; professors, lecturers, graduates or holders of diplomas of Universities or Colleges; Head Foresters, and others of an equivalent status.

Grade 2—Being Foresters, Foreman Foresters and others of an equivalent status, including students at Universities or Colleges, not being restricted to Grade 1.

ASSOCIATE MEMBERS shall be persons desirous of promoting the object but not qualified for technical membership, subject always to the approval of the Council.

Members shall subscribe annually to the Society's funds according to the following scale of subscriptions:—

Technical Members, Grade 1, shall pay	£1	0	0
Technical Members, Grade 2, shall pay		10	0
Associate Members shall pay		15	0

IRISH FORESTRY

CONTENTS

(The views expressed in the articles and notes in this journal are not necessarily the views of the Editor or of the Society of Irish Foresters.)

SOCIETY OF IRISH FORESTERS

President:
O. V. MOONEY, 6, Brewery Road, Stillorgan, Dublin.

Vice-President:
D. MANGAN, 80, St. Aidan's Drive, Goatstown, Dublin.

Secretary and Treasurer:
T. CLEAR, Albert Agricultural College, Glasnevin, Dublin.

Editor:
J. J. DEASY, 11, Templeville Estate, Templeogue, Dublin.

Business Editor:
M. SHARKEY, "Kylemore," Hyde Park Avenue, Blackrock, Dublin.

Grade I Councillors, 1957-58:
T. MCEVOY, 17, Cypress Road, Mt. Merrion, Dublin.
M. MCNAMARA, 37, Collins Avenue, Ballymun, Dublin.
S. CAMPBELL, Teach Mhuire, Wicklow.
A. M. S. HANAN, Woodlands, Killarney Road, Bray.

Grade II Councillors, 1957-58:
SEAN DOYLE, Sunnyside, Kilpeddar, Co. Wicklow.
MYLES COSGRAVE, Ballydowling, Glenealy, Co. Wicklow.

Associate Councillors, 1957-58:
MISS S. CAHILL, 12, Waterloo Road, Dublin.
JAMES GALVIN, Park Cottage, Wexford.

Hon. Auditor:
D. M. CRAIG, 85, Harcourt Street, Dublin.

IRISH FORESTRY

Volume XIV WINTER, 1957 Number 2

Editorial

PROBABLY the most notable scientific event in Ireland in 1957 was the holding of the annual meeting of the British Association in Dublin after a lapse of half a century. Equally this was an event in the history of the Association which was meeting for the first time outside the United Kingdom.

Fifty years ago forestry was not of sufficient importance to be recognised as a separate entity by the Association but it has now become, as Section K,* an important part of the annual meeting.

The meeting of the Forestry Section in Dublin was universally regarded as a marked success, one of the best so far, thanks to a happy co-operation between the Forestry Division of the Department of Lands and the organising committee of the Association. A series of valuable papers was read—most of which we hope to print in this and the Summer, 1958 number—and a varied and interesting programme of tours was arranged to state and private woodlands in Co. Wicklow and to industrial concerns utilizing forest produce in Dublin. A Forestry Division exhibition illustrating excellently by statistics and photographs the progress of state forestry aroused considerable interest not only among foresters and botanists but members in general.

The Society of Irish Foresters, believing in the value of such intercourse, lent its support to this meeting of Irish and British foresters and we were glad to see so many of our members participating in the activities. Equally we were appreciative of the recognition of Irish Forestry implied in the strength of the British and Northern Ireland representation. It is to be hoped that the exchange of ideas and experiences, apart from its undoubted immediate benefits, will form the firm foundation for a continuing co-operation which could contribute enormously to the success of the afforestation projects in neighbouring countries with so much in common.

In the Chairman's Address mention was made of the debt of Irish Forestry to the pioneer efforts of the Forestry Commission and the hope was expressed that we would in the future repay that debt in full. In the use of *Pinus contorta* in the afforestation of poor, exposed sites Irish experience is perhaps the more extensive and Mr. Mooney's paper on the subject was much appreciated by the visiting foresters and might be regarded as a first instalment in our repayment plan. In the course of the tours interest was particularly keen in the vivid contrast at Glenealy between coastal and inland provenances of this polymorphic species.

Again the extremely rapid growth and comparative hardiness of several eucalypt species in Co. Wicklow was surprising to British workers in this specialised field especially in view of their less fortunate experiences in such apparently favourable climates as that of Cornwall.

These few instances serve to illustrate the value of closer contacts and point the way to a greater economy of time and effort through a co-ordination of research programmes. It was a happy coincidence that the visit of the British Association should have been contemporaneous with the strengthening of the Irish Forestry Service in its general technical personnel and particularly with the establishment of a Research and Assessment Section here; and that it should have been followed by a visit of the Minister for Lands to study state forestry in Scotland.

We confidently predict that our successors in the next generation, when perhaps the British Association again meets in Dublin, will be able to record the case history of an extremely successful symbiosis!

ST. PATRICK'S OAK

This picture, which was taken in 1957, was sent to us by Forstmeister Peter Hantermann of Zwingenberg, Germany. A translation of the words on the plaque runs: "St. Patrick's Oak planted on 1st June, 1956 by members of the Society of Irish Foresters on the occasion of their visit to Zwingenberg."

Pinus Contorta in Irish Forestry.

By O. V. Mooney

(Paper read at meeting of the British Association for the Advancement of Science at Dublin in September, 1957.)

THIS paper sets out to convey a picture of the development of the use of *Pinus contorta* as a forest forming tree in the practice of silviculture in Éire during this century.

I will deal with the subject briefly in four phases. Firstly, the early history of the tree with reference to particular stands laid down in the first thirty-five years of this century and, later, to the lessons learnt from them.

Secondly, I will endeavour to trace the rapidly rising popularity of this species in recent years and relate that popularity to its causes.

I will offer some brief comments on modern trends and techinques in the silviculture and establishment of *Pinus contorta* and, finally, I will include some references to its future possibilities in our forestry in the light of experience gained over some thirty years or more.

The subject of *Pinus contorta* has become such a general one with foresters in this country in recent times that we tend to regard ourselves as experienced old hands in the cultivation of this species. In fact, though experience with other exotic species of conifers goes back well over a century, *Pinus contorta* was little known as a specimen tree in the demesnes in Ireland, and is mentioned in only six places in Fitzpatrick's "Trees of Ireland, Native and Introduced". There are few if any known demesne plantations. Thus relatively, our experiences in this species are new and really confined to the last thirty years or so.

In State forestry the first movement towards *Pinus contorta* was about 1916 when the then Director of Forestry, Mr. A. C. Forbes, had several groups or lines of *Pinus contorta* of different seed origins planted at Avondale. It is said that it was on the performance of these trees that Mr. Forbes ultimately selected the type best suited for this country. If this is so he must have selected a strongly coastal type, because all the earlier plantations are heavily branched with dark green foliage; there is no suggestion of an inland type in the plantations of the early twenties.

These Avondale trees are still in existence, but for a variety of reasons have lost their "raison d'être". The best specimen of these trees is 31 ins. B.H.G. $\times$ 59 ft. (approx.) in height and another specimen which has all the characteristics of the extreme "Shore Pine" type is 41 ins. B.H.G. $\times$ 50 ft. (approx.) high. However, the *Pinus contorta* stands from the pre-1930 era, and from the early thirties, have had such a profound influence on the subsequent development of Irish silviculture and policy concerning the acquisition of certain ground types that some of the more important ones are worthy of note.

Perhaps the best known stands are those that occur at the Ballintombay property of Rathdrum Forest, Co. Wicklow. These stands were planted in 1926 (31 years old) between 1,350 ft. and 1,450 ft. A.S.L. in full exposure on a site type which carried very strong, dominant, woody *Calluna*. The plants were put in at 4 ft. $\times$ 4 ft. spacing by direct pitting methods with the spade as was customary at that time. The underlying rock is silurian with mica-schist and quartzite stones abundant in the upper zones of the profile which latter, within the stand, may be described as follows: Surface layer of decomposed/semi-decomposed needles 3 ins; black peat $\frac{1}{2}$ in.—$\frac{3}{4}$ in; light grey indefinitely podsolised zone 4 ins.—6 ins.; brown shaley loam 6 ins. plus.

Visited recently, this *Pinus contorta* stand gave the following figures from a 1/10th acre plot at 1,350 ft. A.S.L.

Mean Tree Girth B.H.	...	19 ins.
Mean Tree Height	...	35½ ft.
Height of Tallest Tree	...	37 ft.
Stems per Acre ...	...	970
Volume per Acre (O.B.)	...	1,975 cubic feet (Hoppus)

About 15 per cent. of the trees in this stand are of fine form, branches at the first whorl 6 ft. to 7 ft. up being rarely more than $\frac{1}{2}$ in. in diameter. The remaining trees vary in coarseness with three to four branches up to 1½ ins. in diameter in six- to eight-branched whorls. Crown development is vigorous and healthy and current height growth varies from 1 ft. up to 1 ft. 8 ins.

Snow, with heavy wind did considerable damage to this stand three years ago and the phenomenal storm of February 4th, 1957 caused blow down, but these stands are mainly intact and can be regarded as standing up to the wind well in such a severely exposed position.

The most significant point about this stand is that Corsican pine and Scots pine planted on the same types in the same year at lower elevations have failed to form a crop down to 800 ft. A.S.L., and, in juxtaposition with the *Pinus contorta*, are dying back at 3 ft.—6 ft. height growth.

On Forth mountain in south County Wexford, at 500 ft. A.S.L., in an extremely exposed position some ten miles from the Atlantic Ocean which is to the South and South-West, and fully exposed to it, *Pinus contorta*, though growing slowly and closing canopy erratically on an extremely sterile site over Cambrian quartzite rock, gave the following figures when visited recently.

Age 24 years.

Mean Tree Girth B.H. ...		18 ins.
Mean Tree Total Height		27½ ft.
Top Height Tree	...	31 ft.
Stems per Acre ...	...	900
Volume per Acre	...	1,692 cubic feet (Hoppus)

These trees were planted in 1933 at 4 ft. $\times$ 4 ft. Windblow is unusual on this tight, compact soil, and occurs only occasionally as single trees.

The natural vegetation of this very poor site is sparse but shows mainly *Calluna, Ulex galii, Molinia, Erica tetralix* and a fairly consistent ground zone of *Cladonia.*

The profile under the closed stand in which there is no ground vegetation shows 1 in. of matted, undecomposed needles, 3 ins. of grey-black mineral peat, 2 ins. buff-humus coloured, loose soil layer; from 6 ins. down a tight, marly, stony, quartzite subsoil somewhat impervious to water. Establishment of any other species on this extremely poor type could not hitherto have been considered.

On the Old Red Sandstone types which form a very important potential mountain forest zone in the South and South-West of Ireland, the *Pinus contorta* plantations laid down in the twenties and the early thirties have also done well, or at least outdistanced any other species on difficult *Calluna Molinia, Erica-Cladonia,* exposed mountain heath types where the surface peat rarely exceeds 4 ins. in depth and where thin iron pans, or water holding colloidal clays, are found at 6 ins. or deeper down from the surface of the ground.

Such stands at Ballyhoura, Co. Cork, have mean heights of 37 ft. and top heights of 40 ft. in 30 year old stands on severely exposed sites at 550 ft. A.S.L. Unthinned, advanced, closed areas carry 1,030 S.P.A. with Mean Girth B.H. of 22 ins. and 2,500 cubic feet per acre where other pines, mainly Scots pine, Corsican pine, and maritime pine have failed to establish themselves at all. Such stands of *Pinus contorta* usually have healthy crowns and have grown vigorously at an average annual height of 19 ins. for fifteen years back.

At Kilworth, Co. Cork, on similar extremely infertile, Old Red Sandstone sites typified by sparse vegetation in which *Calluna, Molinia. Erica, Scirpus* or *Juncus squarrosus* are mainly present with a mat of *Cladonia* on a thin peat surface *Pinus contorta* planted in 1933 in full exposure has produced closed crops giving the following figures:

Mean Tree Total Height	35 ft.
Mean Tree B.H. Girth ...	17 ins.
Stems per Acre	1,020
Volume per Acre (O.B.) ...	1,785 cubic feet (Hoppus)

Other species, mainly Scots pine, have progressed only to an average of 3 ft. with extremes of 2 ft. and 12 ft., a type of crop which is regarded now as having no future.

Another stand on a similar but better O.R.S. site at the same forest has given the following figures at 29 years old.

Mean Tree B.H.G. ...	23 ins.
Mean Tree Total Height	61 ft.
Stems per Acre	660
Volume per Acre (O.B.) ...	2,897 cubic feet (Hoppus)

In this stand, as in all the other stands mentioned, the crowns are vigorous and healthy and current annual height growths range from $1\frac{1}{2}$ ft.—$2\frac{1}{2}$ ft.

Increased use of Pinus contorta.

In the face of frequent complete lack of success with other species on similar types, as have been described, Irish foresters could not fail to be impressed by the early satisfactory progress of these stands and many other similar ones throughout the country. Their intepretation of these results could only be in one direction in the face of the increasing proportion of poor heaths and peat bogs which were presenting themselves for planting.

Conservative as foresters must be, it took them some time to transfer their faith away from the Scots pine and other European pines to the *Pinus contorta* of Western North America.

Thus, the impact of their judgement of the situation only became evident perhaps from 1945 onwards, very definitely so from 1950 onwards, though the change in favour had become evident in replacement or beating up work long before these dates.

In this connection figures indicating the trends in species used for planting may be of interest.

Year or Planting	Total Area Planted	Percentage of Species Planted *Pinus contorta*	*Scots pine*	*Sitka spruce*
1933-34	4,179½ acres	6½%	31½%	27¼%
1934-35	5,511 ,,	14¾%	27½%	21¾%
1939-40	6,815¼ ,,	20%	16¼%	14¼%
1944-45	4,230 ,,	24%	19%	11%
1949-50	7,736 ,,	14%	20%	20%
1952-53	12,488 ,,	39%	6%	28%
1954-55	13,845 ,,	31%	5%	33%
1956-57	17,500 ,,	30.8%	3.4%	40%

In recent years too there has been an important change in the ground types which have been acquired compared with those of pre-1950 years.

This may perhaps be illustrated by the following figures concerning land acquisition which show the sudden turn to the West and the climatic, deep peats.

Land owned by the Forestry Division in the following counties :

Year	Donegal	Galway	Mayo	Sligo	Total
1945	5,779¾ ac.	19,374¾ ac.	538½ ac.	4,249¼ ac.	29,942
1947	6,665¾ ,,	20,109 ,,	648½ ,,	4,245¼ ,,	31,668½
1950	10,987½ ,,	22,349 ,,	648½ ,,	4,445¼ ,,	38,430½
1953	17,180¼ ,,	35,665¾ ,,	8,649½ ,,	4,486¼ ,,	65,981¾
1957	23,616½ ,,	41,768 ,,	14,498¼ ,,	8,114¼ ,,	87,997

Previous to 1950 ground acquired in the West and North-West counties ranged generally from old demesne woodland to shallow mountain peats and poor soil types on the O.R.S., granite and other formations in the West and North-West mountain areas.

With the acquisition of the Cloosh Valley, property of some 8,000 acres, in 1951 a new era started for forestry and new and hitherto unknown problems of selection of species, of drainage and of planting techniques, faced the forester on the Western blanket bogs or climatic deep peats. He had had experience with the Midland, Wicklow and other unrelated deep peats, but the peat bogs of West Galway, Mayo, Sligo and Donegal, on the whole, were unknown to him as potentially suitable for growing crops so far west.

The Cuthbertson plough, the "P" model, proved an effective tool for providing ribbon mounds 5 ft. apart and mound drains to 12 ins. deep, while the Cuthbertson "F" model plough going down 2 ft. was used for drainage on these peats which range 6 ft. to 20 ft. deep and which are chiefly characterised by a surface vegetation of *Schoenus, Ryncospera, Calluna, Eriophorum* Spp, *Racomitrium* and *Sphagnum* species.

Mechanical ploughing was the only practical way of dealing with these vast areas where in any case manpower was often inadequate to cope with the situation.

Two species only, namely Sitka spruce and *Pinus contorta,* suggested themselves as having any possible hope of success on these unknown types.

The Irish forester had already abundant experience of the interminable check into which Sitka spruce falls on *Calluna-Scirpus* peat types and *Pinus contorta* appeared to him—fully conscious though he was of its limitations—to be the best possible pioneer species for the job, and so, at the start, it predominated the scene in the planting of these western peats.

Perhaps, here, I may break the continuity and consider briefly what seems to emerge from the performance of the earlier plantations of *Pinus contorta* and from a few of which I have already quoted.

Types of Contorta Pine.

Let me say at once that in Éire we have not been fortunate in having seed provenance trial plots such as have been laid down for some years in many forests under the British Forestry Commission.

Neither has it proved profitable to try to trace the origins of the seed from which some of our own more remarkable stands have been derived. Far be it from me to enter into a discussion on the Inland, Coastal and many intermediate forms of *Pinus contorta.* Suffice it for me to say that we seem to have a great range of types which in my view may be greatly added to—and complicated—by ignoring the influence of site and establishment factors. We have many plantations from Lulu Island, Olympic Peninsula and Mount Rainer seed, and other named localities the range of which is sometimes so great as to be quite useless for pinpointing site location and description. It might be safest for me to say that scarcely any of our *Pinus contorta* conforms to the idea of the extreme inland *Pinus contorta* (*Latifolia* or *Murrayana*) type. The main type in Éire is the heavily branched, dark green-foliaged type with many variants and some refinements. In individual plantations as many as three different forms are often evident but, as I have said before, these different forms may be, and probably often are, the outcome of very localised influences at establishment or after, or of their seed origin.

We have a few stands which were planted as *Pinus contorta* (*Murrayana*) mainly in 1932-1933; some of these stands are remarkable in regard to colour and form as contrasted with the coastal or intermediate types. The characteristics of some of these strongly inland *Pinus contorta* stands, however, are less contrasting and less easily defined.

On this extreme inland, grass-green, and sometimes even yellow-green, fine-branched type I hesitate to comment in view of the limited and uncertain subject matter available. It does, however, appear to me that whatever virtues of form and quality the type may have under certain conditions they are lacking in the fields of practical results under forest-establishment conditions here. Owing to its fine-branched form and want of vigour it lacks the capacity that the heavy-branched, more vigorous types comand in overcoming ground vegetation, particularly *Calluna vulgaris* and *Ulex gallii,* and because of this and its slower growth, it takes it a long time to close canopy thereby off-setting the advantages of its natural refinement of branch.

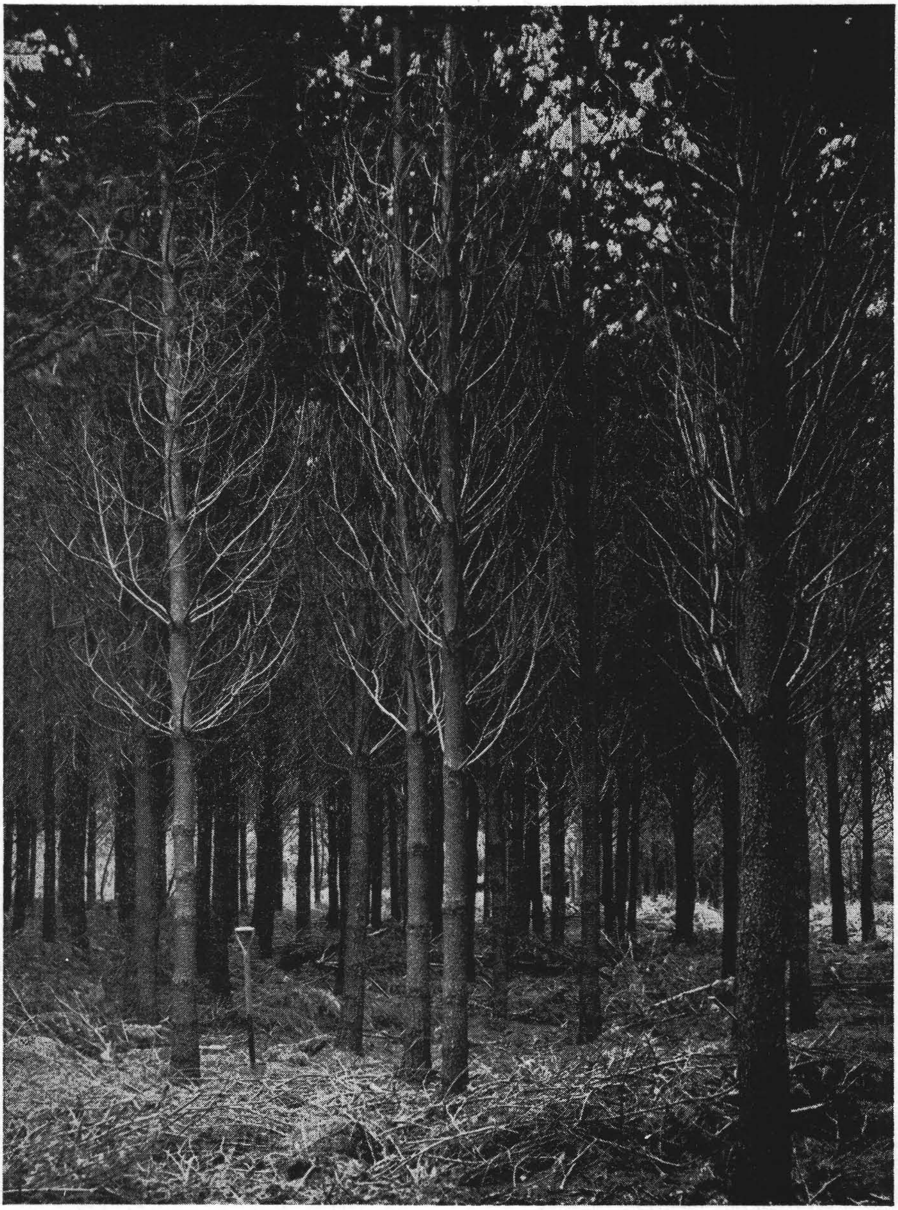
An illustration may be quoted from what seems to be one of our best defined *Pinus contorta* (*Murrayana*) plots. The seed was supplied by the Associated Foresters of Canada and the provenance was given as Salmon Arm, British Columbia.

At Bansha Forest this plantation was laid down in 1932 as *Pinus contorta* (*Murrayana*) at 4 ft. × 4 ft. with 4,800 1 + 2 year plants. The following is information regarding the site:

Elevation.	920 ft. A.S.L.
Aspect.	Slightly north but site is almost on the crest of a ridge.
Exposure.	Full and severe.
Vegetation.	Strong *Calluna, Vaccinium Myrtillus,* over spongy mass of *Sphagnum.*
Soil.	Fibrous red brown peat for 2 ins. overlying stony, leached sand with O.R.S. stones and quartzite abundant.

The present condition of the plantation may be described as follows: The crop is not nearly closed at 25 years being 8 ft.—18 ft. high on the higher and 20 ft. max. on lower ground. Ground vegetation is unchecked and woody *Calluna* is waist high.

Beside this inland type is a stand of ordinary coastal type standing in greater exposure at the same elevation some 16 ft. away. This stand which has closed canopy ranges from 25 ft.—30 ft., 10 ins.—16 ins. G.B.H. It has been pruned and is ready for first thinning. This contrast is not an isolated case, and so far as can be judged from the limited



In a stand of 24 year old *Pinus contorta* at compartment 49, Kilworth State Forest. Origin of seed was recorded as "Mt. Rainer". Note straight stems and fine, fastigiate branches.
Photo by courtesy of the Department of Lands (Forestry Division).

number of extreme inland types we have there is very little to recommend them either silviculturally or from a utilitarian point of view over the coastal types and, indeed, they may not even be climatically suited to the local environment with its oceanic climate. From what one can observe most south coastal types of *Pinus contorta* give a sufficiently high percentage of trees of good form and refined branch in the stand to form a final crop, whilst at the same time giving far greater yields than the inland type of *Pinus contorta* and, of course, it is capable of suppressing the competing ground vegetation—particularly *Calluna,* at an earlier stage.

Planting Distances.

On infertile hard ground types I myself believe that 4 ft. × 4 ft. planting is silviculturally the ideal spacing but many, particularly those who view *Pinus contorta* as a pulp crop only, would prefer to go further than the orthodox 5 ft. × 5 ft. to 6 ft. × 6 ft.. There is considerable difference of opinion on this subject.

Pruning.

If *Pinus contorta* is regarded as a crop grown to produce timber—and I do not see why this should not be—then I think that pruning on the refined straight types which are present in most stands of the species should be done up to 8 ft. on some 300 per acre at a stage previous to the closing of the canopy i.e. when the trees are between 15 ft. and 20 ft. high.

Thinning.

Considerable difference of opinion exists here as to the proper approach to thinning of *Pinus contorta.* Much, of course, depends upon the initial espacement.

I believe it should be most restrained in early years after canopy closure and should not be so much a crown thinning as a removal of stems of poor form.

Perhaps I may quote the stocking of some stands which appear ideal on poor, compact ground types.

Age	24 years	
S.P.A.	1,020	
Top Height	37 ft.	(V.P.A. 1,785 Hoppus ft.)

This type, incidentally, is the strongly fastigiate one but comes under the general description of intermediate type.

On exactly the same type and under similar conditions a stand at 24 years with a similar top height has been reduced to 690 S.P.A. The stocking in this stand does not look quite right and suggests that room has been left for the crowns to develop very coarsely more than half way down the stems.

Another stand on the same ground type but established at 4 ft. × 4 ft. at 50% with mountain pine is, at 24 years, stocked with 620 S.P.A. with top height at 40 ft. This stand has a high proportion of rough and leaning trees and has suffered a good deal from wind due possibly to the uneven and fluctuating top surface presented by the canopy.

On the other hand a stand of *Pinus contorta* aged 24 years on hard, compact, iron-pan soil in another district looks understocked with 900 S.P.A. at top heights of 31 ft. after thinning.

It may be of interest to record that the B.F.C. yield tables for Corsican pine quality class 2 give stocking of 1,100 S.P.A. at 20 years, 890 S.P.A. at 23 years and 730 S.P.A. at 26 years. *Pinus contorta,* however, has apparently an almost unlimited capacity for bearing close, lateral crown competition—probably to a far greater degree than Corsican pine or other familiar pines.

I should also repeat that in all closed stands of coastal-type *Pinus contorta* that I have examined there is great crown health and vigour and current leader growths are rarely less than 1 ft. and more often are $1\frac{1}{2}$ ft. and up to 2 ft. no matter how poor the site. Restricted growth being usually confined to the formative years.

Not all of our stands are easy to look at many being very coarse, heavy-branched and sabre-butted, but in the better stands the tree form is very much more refined than most Scots pine crops of similar dimensions.

The Timber.

Limited experience in the sawmill has shown *Pinus contorta* timber at 25 years to be surprisingly good. It kiln dries well without check or distortion under the *Sitka spruce* kiln schedule. It saws well on the break-down benches and finishes satisfactorily in the planing and T. & G. machines, and in the finished state looks the makings of a good, general-utility wood. Knots are coarse—but need never be—often big, but they are as solid as a part of the board or scantling.

Contorta when felled and piled under forest conditions is regarded here as one of the poorest risks as regards deterioration; sapwood fungi and blue stain run through it quickly and it is always desirable to get it into the pulp- or saw-mills as rapidly as possible.

The knobby whorls on coarsely grown Contorta pine are a serious obstacle to debarking, whether by hand or mechanical means, and, when debarking is a necessary prerequisite to a pulping process, this might be a serious drawback.

Effects of Storms.

In recent years Irish foresters have watched with considerable apprehension the performance of *Pinus contorta* under pressure from gale force winds. There is mounting evidence that *Pinus contorta* is very vulnerable to snow followed or accompanied by a freezing, gale-force wind. Such winds in December, 1954 did considerable damage on high ground. This year (1957) on 4th February we had a phenomenal gale all over Ireland which did serious damage in the *Pinus contorta* stands already damaged in 1954, and to a lesser extent in other *Pinus contorta* stands which were caught just after thinning. This storm in which gusts up to 108 M.P.H. were recorded, and in which gusts of 80-90 M.P.H. were quite usual, might have blown down any stand of any species, but it left many stands of *Pinus contorta* unmoved.

To explain these differences one looks to the texture of the soil or surface peat. The stand I mentioned earlier in this paper which at 1,350 ft. A.S.L. grows straight up out of the mountain to 36 ft. was damaged but much of it remained intact in this extremely exposed position. This, while stands on lower, less exposed ground were blown flat.

Many of the *Pinus contorta* crops which have been badly damaged by wind stand up high above the surrounding crops and bear a direct blow of the wind on the weighty upper third of their stem. In fact this comparative rapidity of growth on poor types is a quality that makes *Pinus contorta* vulnerable to wind. This, however, is a factor that can be overcome by careful planning in selection of species at initial establishment.

In fairness it may be said that it does seem that fully exposed marginal stands of *Pinus contorta* are usually wind firm. Nevertheless general opinion tends to avoidance of the too-fertile, loose-soiled sites and shallow peats with loose undersoil where rock or gley is within about 1 ft. of the surface because of the fear of wholesale wind blow.

Pinus contorta stands, because of uneven establishment history, or because of a heavy crown thinning have a broken canopy, seem more vulnerable to wind. I believe that if the crowns can be kept narrow and light as a result of very moderate thinnings and possibly by close planting espacement, say 4 ft. $\times$ 4 ft., much more wind-resistant and, what is more important, snow-resistant stands would be formed. If this condition were combined with compact, firm, infertile soil types which reduce the rate of growth, particularly in the first ten years, I feel quite sure that straight, wind-firm stands of *Pinus contorta* could be grown.

I do not think that anyone here would like to give vent to positive views on the stability of the crops that will develop on the western deep peats, but these deep, homogeneous peats may well prove—if properly drained—to be a tough and resilient rooting medium for *Pinus contorta,* perhaps considerably firmer than some of the different zoned, loose profiles one meets elsewhere.

Diseases and Insects.

We are not conscious of any serious pathological conditions in *Pinus contorta* in Ireland as yet. Several cases of the incidence of spruce group die-back on *Pinus contorta* are known but are very confined and of no immediate consequence.

The Pine Weevil and the Pine Saw Fly are always active. Though attacks by Pine Saw Fly caterpillar are sometimes very severe and may check growth for many years, particularly on poor sites, the crops usually struggle through to recovery. There is, however, at least one case where this caterpillar seems to have achieved complete destruction of the crop, though in such cases the other factors having a detrimental bearing on the subject are not clearly understood.

The Pine Shoot Moth (*Evetria buoliana*) is also well known on *Pinus contorta* here, particularly along the Old Red Sandstone types across the South of Ireland. Attacks of this caterpillar can be very severe and seemingly completely mutilating to young crops up to about 10 ft., and there is no effective measure of control in operation here as yet. Combined with an attack of Saw Fly caterpillar the Pine Shoot Moth can be well nigh ruinous.

Manuring and Mixtures on Poor Sites.

In the present Irish foresters must deal with large areas of difficult ground, and to this task—though they must leave their minds open to all possible new species—they can only bring two species with any confidence, Sitka spruce and *Pinus contorta.*

On the western blanket bogs these two species are being used on a big scale in varying mixtures and in pure crops according to site variations, and at the conventional spacing of 5 ft. × 5 ft. As I have said before drainage and ribbon mounding ploughs are being used and artificial manures, at first basic slag and now ground mineral phosphate (P_2O_5), have been applied.

Mixtures, particularly intimate mixtures of *Pinus contorta* and Sitka spruce give rise to very early silvicultural problems. The rapid and maintained get-away of the former often gives rise to a condition where even 4 years after planting it may stand at 6 ft. high and only 5 ft. away from the Sitka spruce which may be just 2 ft. high. In order to correct this undesirable discrepancy in growth rates the ground mineral phosphate is often administered in appropriate proportions, say 3 ozs. to Sitka spruce and 1 oz. to *Pinus contorta.* This treatment has temporarily modified the relative growth discrepancy, but the effect of such a method of control may not be maintained, neither does such establishment silviculture appear ideal. These intimate or single line mixtures of *Pinus contorta* may create serious and costly early silvicultural problems, and mixtures, where mixtures are unavoidable, may be more effective if each species is planted pure to the extent of a certain number of lines in depth.

The refinement of using *Pinus contorta* from the same seed source as the Sitka spruce in mixture as suggested by Mr. Wood in his "Species of North-West American Forests in Relation to Silviculture in Great

Britain" may offer a solution but co-ordination of the facets of large scale planting may not yet have reached a stage where this could be brought effectively into practice. Mixtures, of course, under such conditions are indicative of the inherent uncertainty of the problem and must be accepted as a necessary "don't put your eggs in one basket" approach, but in thinking and planning in relation to *Pinus contorta* and Sitka spruce, avoidance of the mixture seems desirable.

The general consensus of opinion is, however, that establishment on the deep western climatic peats has been successful far beyond the expectations of foresters here. This success has been maintained over five years' height growth up into fierce, continued and salty winds off the Atlantic, and our hopes are high. If wind is the determining factor it may well be possible to take pulp-wood crops off these peat types before the wind can bring about catastrophic blows. As it is, more restraint in height growth should definitely be an aim with *Pinus contorta.* However, I believe that most of us would prefer to see Sitka spruce used wherever possible on these blanket bogs.

Of the other difficult main type that the forester has to face in large areas there is less need for doubt or speculation. Certain crops on the compact-surfaced, sterile, Old Red Sandstone types have already proved successful over nearly thirty years, and I think we have but to study the conditions surrounding these successes to work out techniques which will enable the forester to cover these extensive and barren wastes with useful timber crops. I use the word timber because, I believe, that the prospects with *Pinus contorta* on Old Red Sandstone types go far beyond just pulpwood crops. Whether the Cuthbertson double mould board plough or the R.L.R. type are really the right method of cultivation, or the sub-soiling tine plough, towards which my preference would strongly incline, has not yet been decided. The tine plough will not only cultivate the soil, break the pan and produce conditions which reduce the washing away of artificial manures but it should give a more natural and wind-firm rooting medium. Where *Pinus contorta* alone is the problem on these types it is, in my view, worth while weighing well the apparent advantages of artificial manuring against the less spectacular progress of the naturally established crop.

I think too that we have reached a stage here where we might well concentrate on collecting seed from our elite *Pinus contorta* stands rather than try to find the ideal seed provenance over the wide ranges in Washington and British Columbia.

Many feel that we should not go beyond these hard compact types with *Pinus contorta* because there only will stability be achieved by the firm-rooting soil zones and the slow, restrained height growth due to infertile soil conditions.

Upon these circumstances, and upon many others, which should have the full and unrelenting attention of the highest skill in forestry, much of the future of our forestry depends because if *Pinus contorta* can be grown successfully on either or both of the types I have discussed, and if home grown *Pinus contorta* can be proved a tree of average utility value both as timber and as pulpwood—and that can be put to the test in the immediate future—then the Irish forester can do something really big for the economy of this country, because these ground types which so far over the centuries have proved hard and unrelenting to men and agriculture will be theirs for the taking.

In preparing this paper the writer derived great help from the Records of the Department of Lands, Forestry Division, amongst which Mr. Roger Lines's (Assistant Silviculturist, B.F.C.) Report on his visit to Ireland, in October 1956, was of particular value.

The writer would also like to acknowledge invaluable practical aid given by Mr. Swan, Inspector-in-charge Research, Department of Lands, Forestry Division, Éire.

REFERENCES.

B.F.C. Bulletin No. 25.

Studies of North American Forests in relation to Silviculture in Great Britain. By R. F. Wood.

Trees of Great Britain and Ireland. Vol. V. Henry & Elwes.

A Summary of Information on Pinus Contorta. By M. V. Edwards.
Published by Commonwealth Agricultural Bureau,
Farnham Royal, England.

Revised Yield Tables for Conifers in Great Britain.
F. C. Hummel and J. Christie.

Some Considerations Affecting the Bogs of Ireland and their Peats.
By T. A. Barry (Irish Forestry, Vol. XI, No. 2).

Afforestation of Peat Soils. By T. McEvoy, M.Agr.Sc.
(Irish Forestry, Vol. XI, No. 2).

Pinus contorta as a forest tree in Ireland. By P. F. O'Kelly.
(Irish Forestry, Vol. IX, No. 1).

Possibility of Afforesting Soils of Old Red Sandstone in Ireland.
By Walter Wittich.
(Irish Forestry, Vol. VI, Nos. 1 & 2).

Violet Root Rot *(Helicobasidium purpureum)* on Douglas Fir *(Pseudotsuga Taxifolia) and Pinus Contorta.*

By R. McKay, D.Sc. and T. Clear, B.Agr.Sc.,

University College, Dublin.

IN the second week of November 1957, a complaint was received from a nursery in Co. Wicklow that something was wrong with a large plot of three year old transplants of Douglas fir, and an inspection of the nursery in question showed that many transplants both of Douglas fir and *Pinus contorta* were sickly and obviously infected with some parasite.

Aerial Symptoms.

Ten per cent. of the young trees were visibly affected. These either occurred in small groups or were scattered indiscriminately throughout the plot. The most striking feature on the Douglas fir was the wilting and down-curvature of the top two or three inches of the main stem, Fig. 1. More or less browning of the needles occurred on this wilted portion, with a tendency for the discoloration to spread downwards. In very severe cases, the cluster of dead, brown leaves on the extreme apex remained attached, but the needles immediately below the apical cluster had dropped off, leaving five or six inches of the stem bare.

Examination of the base of the stems just above soil level showed in many cases, not all, a close mat of drab cinnamon-coloured, sterile mycelium, encircling the stem to a height of a couple of inches, and spreading out to some extent over the adjacent needles, Fig. 2. The cortex underlying the mass of mycelium was found to be more or less rotten and easily detached from the stem.

Underground Symptoms.

The most obvious feature on pulling up diseased plants was the decortication of the roots. This destruction of the cortex was frequently found to be well advanced even on wilted plants which were devoid of any mycelial collar Fig. 3. Microscopical examination of the root system revealed numerous strands of purplish mycelium; and on some remaining portions of the cortex the characteristic bodies known as "corps miliaries", Fig. 4. The presence of the "corps miliaries" together with the purplish mycelium provided sufficient evidence to identify the fungus as *Helicobasidium purpureum* Pat.

With the exception of the down-curvature of the top, the disease symptoms on *Pinus contorta* were similar to those on Douglas fir, with a greater tendency for the needles to become chlorotic or yellowish.

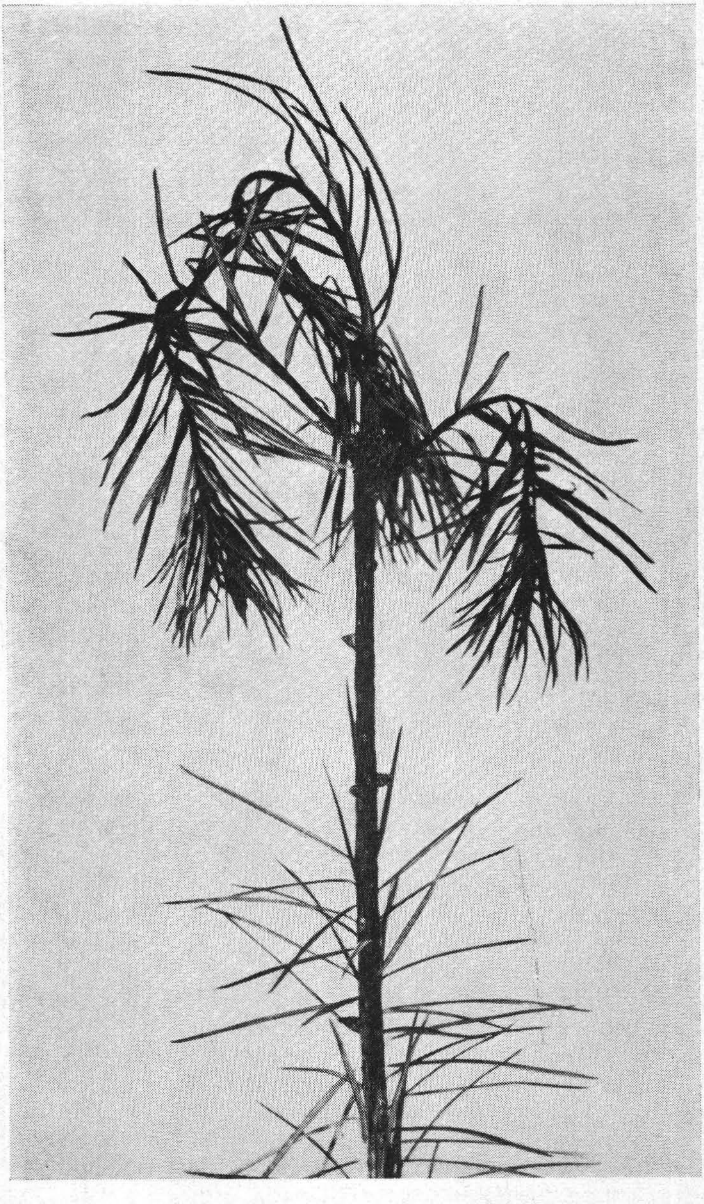


Fig. 1. Wilting of top of Douglas fir, due to attack of *Helicobasidium purpureum*. (Natural size).

Helicobasidium purpureum was also found on the following plants growing in the affected plot :—Silver weed, clover and several grasses.

The ground occupied by the nursery had been under ordinary cultivation and rotation up to four years ago, when sugar beet was grown as a cleaning crop. During the intervening years, failures of seedlings had been rather common, but these were simply attributed to ordinary damping-off.

So far as the authors are aware, this account is the first record of the Violet Root Rot fungus attacking Douglas fir and *Pinus contorta.* It has, however, been previously recorded on Sitka spruce in Scotland by Watson (5). The only point of difference between the Scotch account and the Irish one is, that in the former the violet coloured weft of mycelium was found around the collar of the plants in April, whereas in the latter account it was found in November. The chemical T.V.O. had been used in the Co. Wicklow nursery for controlling weeds, and dead weeds were in layers between the rows of transplants. The autumn of 1957 was exceptionally wet in Ireland, and these layers of weeds may have been a contributory factor to the development of so much aerial mycelium at the collar of the plants late in the season.

In the account by Watson (*ibid.*), it was suggested that severe frosts prior to the outbreak might have been a predisposing factor to the attack on Sitka spruce. Now the past 2—3 winters in Ireland have been very mild and the occurrence of frost negligible. Therefore, frost as a predisposing factor to attack can be ruled out, and in future we must consider the fungus *Helicobasidium purpureum* as a serious parasite of young conifers.

As many foresters may not be familiar with the Violet Root Rot fungus, a short outline of the history and life-cycle of the organism follows :—

Historical.

Prior to 1924 the vegetative or sterile stage of the Violet Root Rot fungus, which occurs mainly below-ground, was generally known as *Rhizoctonia crocorum* (Pers.) DC., or as *Rhizoctonia violacea* Tull. The fungus was first mentioned in 1728 as causing a destructive disease of the saffron crocus (*Crocus sativus*), but almost two hundred years were to elapse before its method of fructifying was finally explained. It is true that the sporulating stage, which occurs above ground, had been more or less familiar to botanists since 1862 under the name of *Helicobasidium purpureum* Pat. This, however, was considered to be an entirely different organism, and the connection between the aerial and subterranean stages was not realized until their relationship was demonstrated by Buddin and Wakefield (1, 2, 3).

The Violet Root Rot fungus can occur on all types of soil and under widely diverse conditions. Ducomet (4) in 1926 stated that plants belonging to twenty families containing forty-four genera and fifty-nine

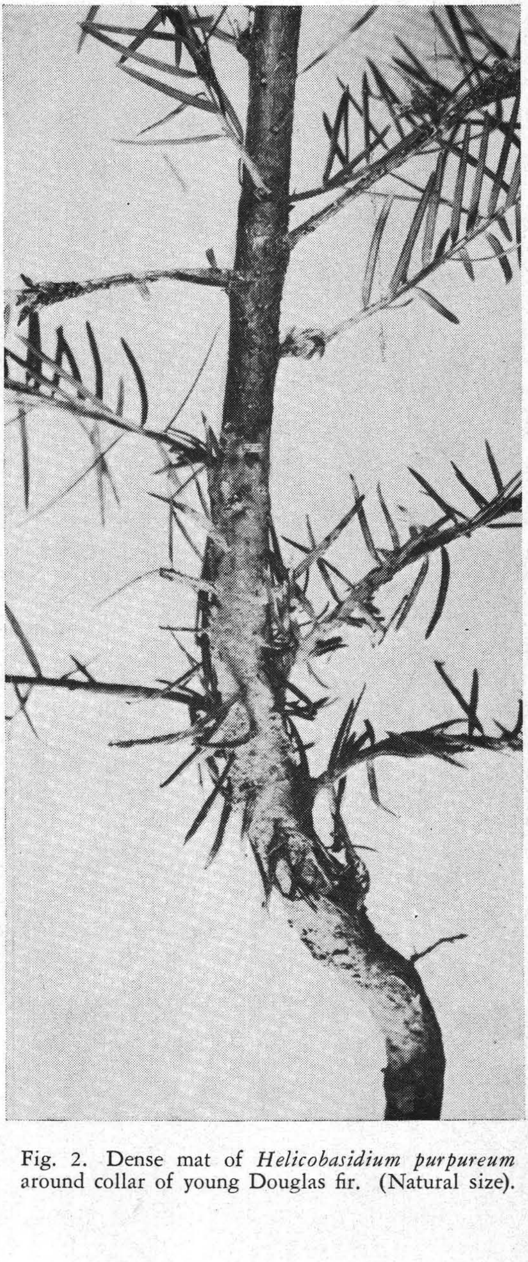


Fig. 2. Dense mat of *Helicobasidium purpureum* around collar of young Douglas fir. (Natural size).

species had then been listed as susceptible to attack in addition to woody hosts. In Ireland sugar beet has been the crop most frequently attacked, but the disease has also been noted on asparagus, carrots, chicory, clover, mangolds, potatoes and seakale.

Life Cycle of *Helicobasidium purpureum.*

The fungus is mainly a soil-inhabitant and attacks the underground parts of the host.

Infection arises from sclerotia, and probably also from mycelium, left in the soil from a previously diseased crop. Beginning as a few strands of reddish-violet hyphae ramifying over the surface of the roots, the fungus soon forms felt-like patches of mycelium which infest the underground parts of the plant completely. As the hyphae age their colour changes to a violet brown and they become brittle.

"Corps Milliaries".

Scattered about amongst the hyphae, or more often aggregated on depressed areas of the host, numerous minute bodies occur which are about the size of a pinhead and of a deep violet or almost black colour, Fig. 4. These are the "corps miliaries" or infection cushions. By the aid of a hand lens, purple strands of hyphae may be seen radiating from these bodies over the surface of the host and extending out into the soil. The "corps miliaries" develop from fine colourless hyphae which enter the cortical tissues of the root and form compact stud-like masses of mycelium at the point of infection : internally the basal hyphae of the body diverge into the neighbouring cells, Fig. 5. By this means nutriment is transferred from the host to the external mycelium. At the same time the cortical tissues of the root are destroyed, particularly the cambium and young phloem regions. The "corps miliaries" may therefore be looked upon as feeding organs or "suckers". In advanced stages of the disease, these bodies will be found to extend considerably into the cortex.

As a result of the underground attack, occasionally there may be a slight pallor of the foliage, with or without wilting, but very often the presence of the disease is not realized until the plants are lifted. Diseased fleshy roots come up very dirty, as soil particles are held in the weft of mycelium which covers the affected parts. The violet coloured hyphae are very diagnostic and cannot readily be mistaken for any other species.

Sclerotia.

At one time the "corps miliaries" were looked upon as sclerotia, but the true sclerotia are flattened or rounded bodies varying in diameter from a few millimetres to several centimetres. Sclerotia are seldom seen on fleshy roots, but in leguminous crops where the hyphae form loose strands of mycelium along the roots of the host, sclerotia may be quite abundant. They may also be found on hyphal strands in the soil some distance from the host. The sclerotia are the chief means by which the fungus is perpetuated in the soil, and they may retain their vitality for several years in the absence of a suitable host.

Fructifications.

As already stated, the sporulating stage of *Helicobasidium purpureum* occurs above ground. The fertile condition is found only during a limited period of the year, viz. from the end of March until the latter part of May. Its ideal environment seems to be at the base of closely growing herbaceous plants, shady woods or where roots become exposed in places like rabbit burrows. The fungus grows up from the subterranean mycelium and covers the base of the plant with a dense, thick felt of beautiful Corinthian-purple mycelium. Erect branches arise from this weft, and their free ends become bent over crozier-like and develop cross walls. The curved top is the basidium,

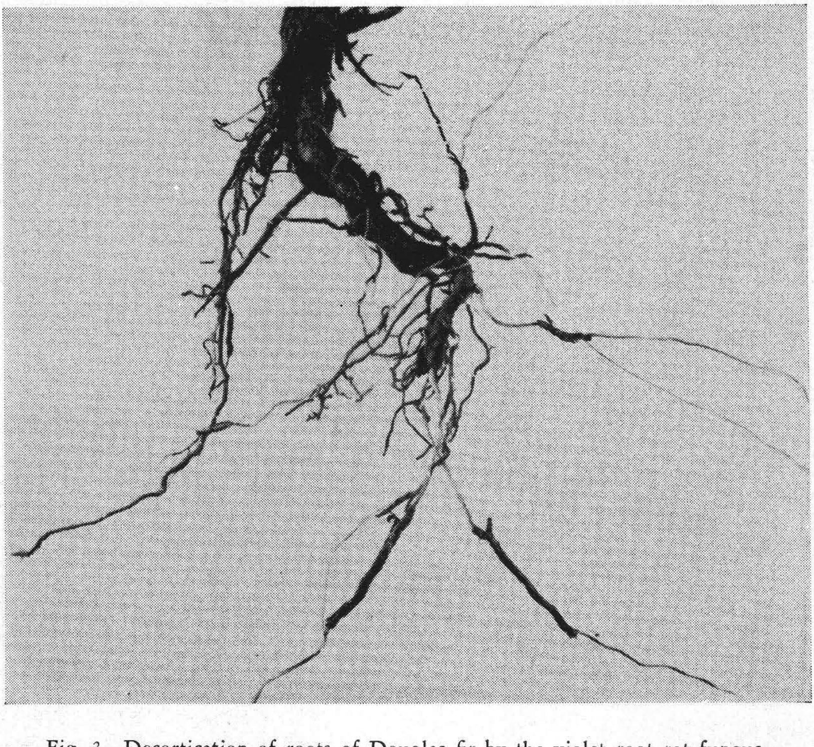


Fig. 3. Decortication of roots of Douglas fir by the violet root rot fungus.

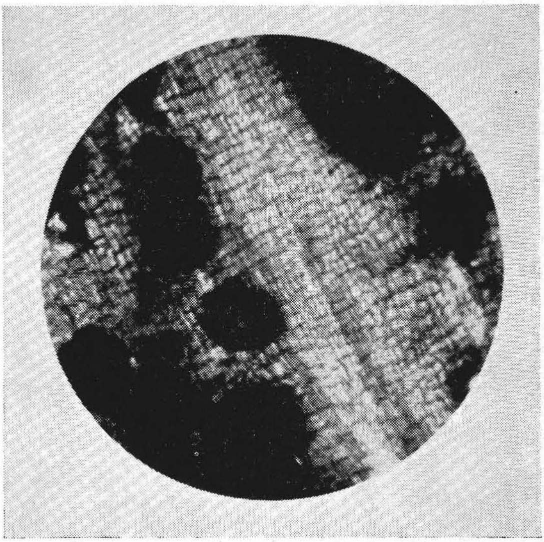


Fig. 4. Surface view of "Corps Miliaries" of *Helicobasidium purpureum.* X 36.

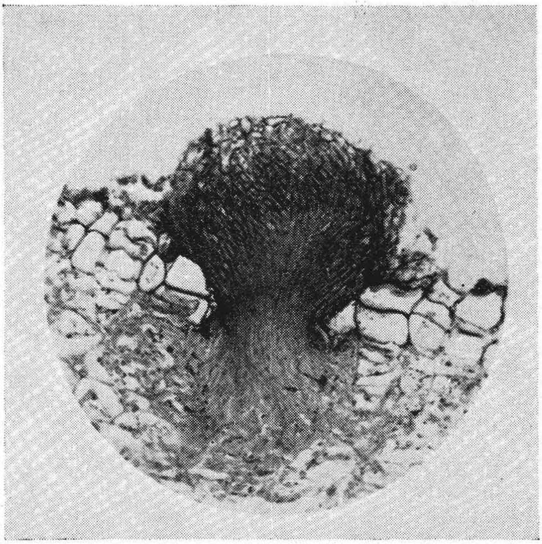


Fig. 5. Section through single infection cushion of *Helicobasidium purpureum.* X 175.

and it produces two, three or four reniform shaped spores, the basidiospores, each borne on a small stalk, the sterigma. The spores serve for the distribution of the fungus to new localities. Germination of the spore is by means of a germ-tube.

The aerial portion of the fungus is very sensitive to hot sun or hot drying winds. With age or in dry weather, the whole growth above ground loses its bright purple colour and acquires a drab-like hue.

Control.

Owing to its omnivorous habit and the fact that *Helicobasidium purpureum* is a soil fungus, its control is not an easy matter. Rotation of crops is the main method of keeping the disease in check, avoiding those crops which are most susceptible to attack on land known to be contaminated by the fungus.

In market gardens where a long rotation of crops is not possible, chemical treatment of affected areas is sometimes resorted to by growers: solutions of formaldehyde or mercuric chloride being employed to eradicate the fungus. A similar procedure might be possible in forest nuresries and would be economical if carried out in the early stages of an outbreak.

Young conifers which have their roots decorticated or partly decorticated by the fungus should not be transplanted, as they will not only contaminate fresh land, but are unlikely to survive. Plants growing in contaminated ground but free from fungus, as a precautionary measure, should have their roots up to soil level, immersed in a strong solution of copper sulphate for 20 minutes before being planted elsewhere.

REFERENCES

1. Buddin, W. and Wakefield, E.M.—Some Observations on the growth of *Rhizoctonia crocorum* (Pers.) DC. in pure culture. *Ann. of Appl. Biol.* Vol. XI, pp. 272-308, 1924.

2. Buddin, W. and Wakefield, E.M.—Studies on *Rhizoctonia crocorum* (Pers.) DC. and *Helicobasidium purpureum* Tul. Pat. *Trans. Brit. Mycol. Soc.* Vol. XII, pp. 116-140, 1927.

3. Buddin, W. and Wakefield, E.M.—Further notes on the connection between *Rhizoctonia crocorum* and *Helicobasidium purpureum*. *Trans. Brit. Mycol. Soc.*, Vol. XIV, pp. 97-99, 1929.

4. Ducomet V.—*Le Rhizoctone violet* et ses hôtes. *Rev. Path. Veg. et Ent. Agric.*, XIII, pp. 33-38, (*Abst. Rev. Appl. Myc.* Vol. V., p. 672, 1926.)

5. Watson, H.—Notes on Attack by *Rhizoctonia crocorum* on Sitka spruce (*Picea sitchensis*). *Scottish Forestry Journ.* Vol. 42, pp. 58-61, 1928.

Note on Malformation of Sitka Spruce due to Drift from Hormone Weed Killer.

By R. McKay, D.Sc.,
University College, Dublin.

IN recent years, damage and abnormalities of various types have become increasingly prevalent on many crops due to the use of hormone weed killers. The chemicals were not necessarily applied to the crop in question but on adjacent crops, and the present note is to draw attention to a case of this kind on young trees.

Picture on opposite page is typical of malformed shoots of Sitka spruce (*Picea sitchensis*) submitted for examination in October, 1957. The specimens were forwarded by Mr. P. O'Shea, Horticultural Instructor, Co. Waterford. He reported that about 0.5 per cent. of eight year old trees growing in a shelter belt were affected in this manner. The coiled, twisted shoots were very brittle, but no parasitic organism was present. Investigations revealed that hormone weed-killers had been used in the vicinity of the trees. Furthermore, those most affected occurred in thin parts of the shelter belt, where air currents had evidently carried the drift from the spray deep into the shelter belt.

Cover Photograph

Our cover photograph shows 47 year-old Douglas fir trees growing at Glenseskin property, Kilworth State Forest, Co. Cork.

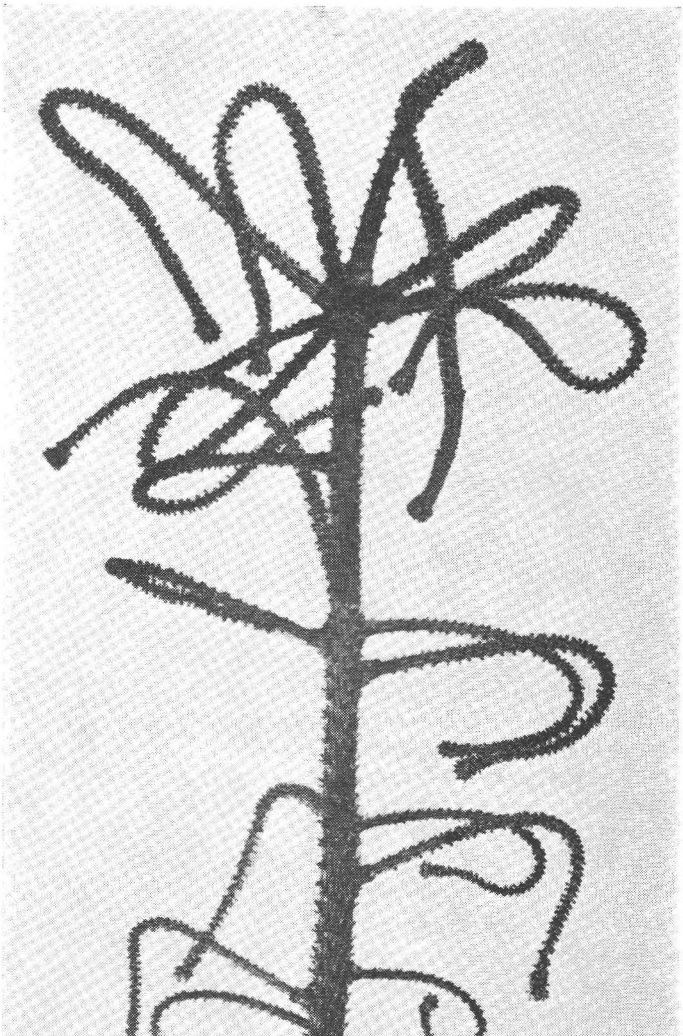
One of the trees blown by storm and regarded as average for the stand gave the following measurements:

Total height	107	feet
Q.G.B.H.	15¼	ins.
Vol. over bark	67.55	Hoppus feet

The photograph is printed by kind permission of the Department of Lands, Forestry Division, Dublin.

Notice to Members

Members who change their addresses are requested to notify the Secretary of their new addresses as soon as posible. Failure to do this may result in the non-delivery of the journal and other matter sent out by the Society from time to time.



Malformed shoot of Sitka spruce due to drift from weed killer.

Yield Regulation and Forecasts of Production

By F. C. Hummel (Forestry Commission)

(Paper read at meeting of the British Association for the Advancement of Science at Dublin in September, 1957)

THE title of this paper 'Yield Regulation and Forecasts of Production' embraces a very wide subject but I propose to deal mainly, although not exclusively, with one aspect of it which is of special interest to foresters in Great Britain and Ireland at the present time. I refer to the question of forecasting the yield from thinnings in new forests. An exchange of experiences and views on this particular aspect of the subject should be to our mutual advantage and the present meeting of the British Association affords an exceptional opportunity for the purpose.

In countries where there has been afforestation on a large scale, the volume of forest produce available for marketing will increase rapidly and will change in quality. In particular, thinnings will yield large quantities of small sized produce for which there may be no established markets within easy reach. The establishment of new wood-using industries may be called for, but this needs to be carefully planned if the industries are to flourish while paying an adequate price for the raw material. The right type and size of plant must be selected and it must be put up at the right place and at the right time. This careful planning is only possible if reliable forecasts of production are available.

Although forestry conditions are, in many respects, similar in our two countries it may be useful to start by giving a very brief summary of our forestry position in Great Britain.

Our total forest area is 4,000,000 acres, or about 7% of the total land surface; 1,000,000 acres are managed by the State Forest Service while most of the other 3,000,000 acres are in private ownership. There are but few large tracts of forest and the greater part of our forest area is made up of many small woods which are widely dispersed throughout the country but readily accessible by road. Most of the State forests consist of forest crops less than 40 years old in which conifers predominate. The private woods, on the other hand, contain a large proportion of old stands, mainly broadleaved, and also large areas which are not fully productive as a result of war-time fellings. At present the State Forest Service plants between 50 and 60 thousand acres a year most of which is on land not previously under forest and consists of coniferous species, except in the relatively small areas where growth conditions for broadleaved species are favourable. Private owners, of whom there are about 40,000, are planting between 25 and 30 thousand acres per year mainly on old woodland sites. Technical advice and financial assistance is made available by the State which, however, exercises some control over the level of fellings.

In both the State and private planting the most common species are Scots pine, Corsican pine, Sitka spruce, Norway spruce, Japanese larch, European larch and Douglas fir, but several other species such as *Tsuga heterophylla, Abies grandis* and *Pinus contorta* are gaining in popularity.

Generally speaking, there are three broad approaches to the preparation of production forecasts in forestry.

First, there is the felling plan which consists of a programme by which a certain volume of produce is felled each year. These volumes may be arrived at after considering the requirements of industries and silvicultural and other relevant factors, but the essential feature is that the actual volume that is to be felled is definitely prescribed. For a country as a whole this approach is only possible if the economy is strictly controlled. The Soviet Union has prepared production forecasts of this type.

The second possible approach is to forecast consumer demand. A forecast of this type, which takes into consideration such factors as probable changes in the size of population, in the standard of living, and of technical developments which may either lead to new uses for wood or to its substitution by other materials, has recently been prepared by the United States. This approach is particularly appropriate where the central forest authority exercises little or no control over the level of felling.

The third approach, and it is with this that we are primarily concerned in Great Britain, is to take as the starting point the silvicultural potential; that is to estimate the volumes that will be felled under a specific silvicultural treatment. The essential difference between this approach and the felling plan is that in this case the silvicultural treatment is prescribed and the yields that result from it are estimated, while in the felling plan, the volumes to be felled are prescribed and the silvicultural treatment may have to be adjusted accordingly.

In order to determine the silvicultural potential of a forest or a whole country it is necessary to have information on:—

1. Area, volume and increment; this implies a survey of the growing stock.
2. The silvicultural treatment.
3. Statistics of past yields.

The collection and assembly of this information is perhaps the most difficult and laborious part of preparing forecasts and must therefore be considered in some detail.

The first of these requirements presents no particular difficulty in either State or private forests provided that permission can be obtained to enter private property to collect the necessary data. Information on future silvicultural treatment and statistics on past yields, on the other hand, is often only available for the State forests. But if the information on the growing stock is collected in the same way in all forests, irrespective of ownership, forecasts for the private woodlands may be made by using the State forests as a standard of comparison and as a guide. For this reason, our national forest survey covers both State and private forests.

Although there were some previous surveys, we may take as our starting point in the present context the complete census of all woodlands over 5 acres in extent which was carried out between 1947 and 1949 (Forestry Commission 1952). The first stage of the work was to visit all woods over 5 acres and to classify each stand in them according to crop type, age class, tree form, stocking and species. In order to provide adequate estimates of the total areas in each species and age category for the purpose of forecasting yields, a complete census of all woods was not necessary; a survey of a suitably selected 5 to 10 per cent. sample of the total area would have sufficed. The complete census was, however, carried out in order to enable us to implement the general policy of encouraging efficient forest management on private estates.

The second stage of the work was to provide estimates of volume. No attempt was made to estimate the standing volume of individual stands or even forests, but for each major region estimates based on sample enumerations were obtained, giving average volume per acre and total volumes by species and age classes. The sampling units were circular plots of 0.1 acre and there was one plot for every 200 acres giving a sampling fraction of 1 in 2,000. The sample was stratified by county, species and age class, but within each stratum the selection of the stands to be sampled and the allocation of plots within the stands was at random. The method of sampling was designed to give an unbiased estimate of adequate precision at minimum cost and an approximate estimate of that precision. A total of about 7,000 plots was measured.

The third stage was to arrive at an estimate of the current increment. No very precise estimate was considered necessary at the time, as the level of fellings and thinnings for many years to come would not be greatly influenced by the current increment. This is partially due to the very abnormal age class distribution of our forests and partially to the need, immediately after the war, of replenishing our sadly depleted stocks of standing timber by restricting fellings to a minimum irrespective of increment. The estimate of increment was based, not on measurements taken as part of the National Forest Survey, but on the data derived from our long term studies of growth and yield in the permanent sample plots of the Forestry Commission. In important species, for which insufficient permanent sample plot data were available, subsidiary information on the rate of growth was obtained by means of stem analyses on several hundred trees.

Long term studies of growth and yield are a field of work in which co-operation between neighbouring countries is likely to prove particularly useful. Co-operation leads to economy of effort and it may save time. For example, the results of our studies in Great Britain of species such as Sitka spruce should serve as a useful preliminary indication of the growth potential of the young stands of this species in Ireland and as a starting point for more detailed local studies in that country; conversely we in Great Britain should be able to benefit greatly from Irish experience with lodgepole pine.

The census of 1947-1949, the cost of which worked out at slightly less than one shilling per acre, was followed in 1951 by a sampling survey of the small woods, hedgerow and park trees which, in Great Britain, account for over 20 per cent. of our total standing timber and form such a characteristic and pleasing feature of our landscape, particularly in the southern half of the country. A detailed report on the survey and the methods used has been published (Forestry Commission 1953).

The information on the area and volume of our woods is now being kept up to date by a system of continuous census revision whereby a few countries are re-surveyed each year. This revision started in 1953; it embraces hedgerow and park trees as well as the larger woods, State forests as well as privately owned woods. In the State forests, most of the information is available from management records, but we record the information in exactly the same way as for private woods because this facilitates forecasts of production in the private woods. The methods used in the census revision are very similar to those used in the original census except for some minor refinements and only one of these need be mentioned here.

In each plot in which the volume is measured the portion of that volume which could be removed in thinnings at the time of measuring is recorded; this is intended to assist in determining the thinning potential. The method has not been in use long enough to prove its worth in Great Britain but it has been found useful elsewhere, for example in Finland, Sweden and Cyprus, and little additional work is involved. The surveyors' judgement of how many and which trees could be removed is necessarily subjective, but some uniformity of standards is maintained by the fact that the surveyors all have experience in the measurement and thinning of the permanent research sample plots of the Forestry Commission.

We must now consider how, with a given growing stock, yields will be affected by silvicultural treatment. Taking a long term view, the yield of a forest will equal the increment; experience has shown that the silvicultural treatment has only a limited effect on total increment, although it greatly influences the type and size of produce, the time when it comes on the market and the relative proportion of yield from thinnings and final fellings. It follows that a more accurate knowledge of the proposed silvicultural treatment is needed if forecasts are to relate to thinnings alone instead of to total production and if the forecasts are short term rather than long term. Thinning yields are primarily affected by the grade and frequency of thinnings; and to a lesser extent by the length of rotation.

In areas with large scale afforestation such as Great Britain, total yields from thinnings and fellings may also be greatly affected for a period by measures intended to improve the very abnormal age class distributions that may occur when a whole forest is planted in only a fraction of the intended rotation. The problem of how abnormal age class distributions may be improved with a view to securing a sustained yield has been discussed in two recent papers (Hummel 1956, Hummel and Grayson 1957).

There are five methods by which a transition towards sustained yield may be achieved :—Grouping, either temporarily or permanently, forests in the same neighbourhood to form a single felling series; underplanting or replacing plantations that are unsatisfactory or have failed; taking advantage of the fact that some species grow faster than others and that the rate of growth of any one species will vary according to the site; felling stands before or after they would normally be considered mature; and finally by varying the thinning treatment.

It was found that conversion to sustained yield presents no particular technical difficulties and little or no sacrifice in increment, provided it is planned in good time and an ample period of conversion is allowed. The main result of the investigation as far as forecasts of production are concerned, is that conversion usually entails some heavy thinnings and pre-rotation fellings; this means that a considerable volume of produce may be available for marketing earlier than without conversion.

While it is possible to prepare forecasts solely from a knowledge of the growing stock and future treatment, the reliability of any forecast is greatly increased if statistics of actual past yields are available as a guide. Early attention to the collection of felling statistics is therefore desirable in any large scale afforestation scheme, where the yields from the new plantations may be expected to differ considerably from old established forests. In collecting statistics on yield three points require particular attention.

First, the statistics must be as simple as possible. There is a great temptation, in an endeavour to achieve perfection, to devise too complicated a system of records which it is impracticable to maintain accurately; and inaccurate records may be worse than useless because they mislead. Secondly, the records must be consistent. Forestry is bedevilled by a multiplicity of units of measurement and conventions of measuring. Timber may be sold by volume or by weight, over bark or under bark; volumes may refer to "gross" volumes of a tree or to "net" volumes of what is regarded as merchantable under particular conditions. In Great Britain we have adopted stemwood over bark, measured to a top diameter of 3 inches, as the basis for our felling records and the volumes are expressed in "hoppus" feet, one hoppus foot being equal to 1.27 true cubic feet or 0.036 cubic metres. The archaic convention of hoppus measure can hardly be justified on rational grounds, but it is so widely used in practice that it was the obvious choice as the standard unit. Thirdly, as has already been mentioned, it is desirable that the statistics for private woodlands should be comparable with those for the State forests. In Great Britain all major thinnings and fellings on private estates are licensed by the State so that adequate records present no difficulty.

When the available information on the growing stock, future treatment and past yields has been been assembled, the actual work of forecasting can begin.

In Great Britain, we have found it useful, in both State and private forests, to distinguish between long term forecasts covering periods of about 5 to 30 years, medium term forecasts for periods of 2 to 5 years and short term forecasts for the year immediately ahead.

When preparing long term forecasts for the State forests, the first step is to determine the gross area which is in the thinning stage at the time of the estimate and to calculate what this gross area will be after 5, 10, 15, 20 years and so forth. Within each forest, separate areas are calculated for the major species groups and site types, but it has been our experience that if this differentiation is carried too far, much work may be caused without any corresponding gain in the accuracy of the forecast. In order to arrive at the gross area it is necessary to know the average age at which thinnings commence: under our conditions this is usually between an age of 15 and 20 years. From the gross areas deductions must be made for areas in 'check' (i.e. where abnormally slow growth leads to a delay in the first thinning), as well as for possible losses, e.g. from wind and fire and, where old age classes are present, for final fellings according to the felling plan.

Having determined the net area for each species-site category, the next step is to determine the average annual thinning yield for it. Under our conditions this usually works out at somewhere between 45 and 80 hoppus feet per acre per year in the case of conifers and rather less than half that amount for broad-leaved species. This figure is usually estimated from past records in the forest concerned but, in recently planted forests where no such records are available, the estimate is based either on records from other forests which are comparable, or on an estimate of increment from yield tables. Although thinning yields differ somewhat with the age of a crop, we have found that to work out separate thinning yields for each age class does not appreciably improve the forecasts of total thinning volume although it facilitates a breakdown of this total into size or produce classes. Every five years the long term forecasts are extended by five years and the forecasts for the intervening period are revised.

The long term forecasts in private forests are prepared in a similar manner but in less detail. The 'gross areas' in the thinnings stage are determined from the census of woodlands but are computed for whole regions and not for individual forests. The necessary deductions for arriving at the 'net' areas are estimated from our experience in the State forests. The forecast of average annual thinning yield per acre is based partially on our experience in the State forests which indicate the silvicultural potential and partially on records of thinning volumes on private estates which are available because, apart from some minor exceptions, whenever a private owner wishes to thin a plantation he must apply for a licence stating the volume to be thinned.

The medium term forecasts which cover a 2 to 5 year period are in some respects more difficult to prepare than the long term forecasts because yields may temporarily be either reduced or increased by relatively minor changes in silvicultural fashions or in economic climate. While the long term production is largely determined by the physical growth potential of a site, the amount that is felled during any short period of years can be varied greatly. Forecasting human behaviour thus plays an important part in medium and short term forecasts.

Reliable medium term forecasts are only possible where there are definite thinning plans such as we have in all State forests and some of the private estates. These thinning plans are based on a thinning cycle which is usually 3 to 4 years for young plantations and 6 to 8 years for older ones; they prescribe the area to be thinned each year and in some instances also the actual compartments in which these thinnings are to take place. It is particularly important to make provision for the areas which reach the stage of first thinning during the period. The area to be thinned is multiplied by the expected volume yield per acre which lies normally between 200 and 400 hoppus feet. This expected yield per acre is estimated either from past records or from an assessment of each individual stand. Except in special circumstances, estimates based on average past records for the forest as a whole have proved as reliable as the more detailed estimates compartment by compartment. For private woodlands, where thinning plans are either non-existent or unknown to the State forest authority, the medium term forecasts are prepared by taking the known yields of the previous year and the first year of the long term forecast, i.e. five years ahead, and interpolating for the years between, making any allowances that may appear desirable for expected changes in markets, e.g. the establishment of new wood-using industries, and other relevant factors. Each year the medium term forecasts are extended by one year and the forecasts for the intervening years are revised.

The short term forecasts for the year immediately ahead are prepared in great detail. For the State forests they are linked with the programme of work compartment by compartment and with the financial estimates for the year. In the private forests, where this is not possible, the results of the preceding year are taken as the starting point and adjusted to allow for expected changes in markets, etc.

Responsibility for preparing thinning forecasts in Great Britain rested originally with the Mensuration Section of the Research Branch; but gradually an increasing amount of this work has been passed to the territorial Conservators of Forests. This trend is likely to continue because the accuracy of locally made forecasts should steadily increase as more information becomes available from local records of management in both State forests and on private estates.

The actual methods of forecasting which are in use in Great Britain are unlikely to be applicable elsewhere where conditions are different, but it may be useful to conclude this paper by mentioning a few general lessons we have learnt which may prove of interest to others. Most of these points have either been discussed or at least implied previously in this paper.

1. The best guide to all forecasts is past experience; for this to be available proper records are indispensable. Records of out-turn from forests are usually only reliable if they are simple and if the units of measurement (e.g. over bark or under bark) are uniform and clearly defined.

2. It is desirable to keep the broad framework of statistics for State forests and private woodlands on the same basis so that valid comparisons are possible and the maximum use can be made of the more detailed statistics available in the State forests for predicting yields in the private forests.

3. In long term forecasts it is usually best to adopt the analytical approach, i.e. to take whole forests or regions and total volumes as the basic units of estimate and to derive estimates for smaller areas or the volumes in particular species groups or produce classes by a breakdown of the totals. The same applies to medium term and short term forecasts where no detailed data or definite thinning plans are available. To oversimplify: if guesswork is necessary, one big guess is likely to be more accurate than the sum total of many little ones—and it is far less work.

The opposite approach of synthesis, i.e. of building up the total estimate compartment by compartment, species by species, and volume category by volume category causes much more work and will only give more reliable forecasts if all the relevant facts and records are available and there is a detailed programme of work such as is only practicable for a limited period. Management planning and proper record keeping necessarily precede accurate forecasting.

REFERENCES

Forestry Commission (1952) ... *Report on the Census of Woodlands 1947-49,* H.M.S.O.

Forestry Commission (1953) ... *Census Report No. 2 Hedgerow and Park Timber and Woods under five acres, 1951.* H.M.S.O.

Hummel, F. C. (1956) ... ... *A Note on the Improvement of Abnormal Age Class Distributions,* I.U.F.R.O. 56/25/15.

Hummel, F. C. and Grayson, A. J. (1957) The Achievement of Sustained Yield by Varying Thinning Treatment and Rotation. *Forestry, XXX, No. 2.*

A Plea for the More Extensive Planting of Ash.

By HUGH GAVIGAN

ASH is one of the best woods in the world for sports goods, tool handles, oars, light wheels, furniture or any purpose in which wood is subjected to shock or strain.

It is the opinion of many, particularly of the organisers of our national game—hurling—that there is likely to be an increasing scarcity of ash suitable for hurley-stick making in the country.

The writer would like to put forward some proposals which might help to solve the problem and which may be of interest to foresters.

When required in its largest possible sizes, ash requires reasonably good, calcareous soils but there is evidence that ash suitable for the manufacture of hurley-sticks can be grown satisfactorily on some peaty soils in the west of Ireland.

Ash on Peat.

Apropos of ash on peat, some observations on a 40 year old plantation in Co. Clare, less than 4 miles from the Atlantic Ocean may be of interest .

On sloping ground of varied aspect, with peaty soils six inches in depth, ash and silver fir were planted in 50/50 mixture, while lower down on damp, deeper peat Sitka spruce was planted pure. Although frost, insects, disease and birds caused set-backs and several severe Atlantic gales took their toll, present-day average dimensions are as follows :

Sitka spruce :	10-15 ins. Q.G.B.H.,	50-70 ft. high
Ash and silver fir :	6-10 ins. Q.G.B.H.,	30-45 ft. high

Forking, due possibly to lack of pruning in its early stages, or to insect attack or damage of other kinds, has resulted in the failure of a considerable number of the ash to produce clean, straight stems of reasonable length.

Where undamaged the Sitka spruce trees stand approximately 12 feet apart—open enough to permit undergrowth development.

The ash being a prolific seeder started effective natural regeneration about eight years ago, and seedlings of the species can now be found well beyond the boundary of the original ash area. It has invaded the Sitka spruce ground where a thick layer of spruce needles overlying 2 feet of dampish peat has failed to halt its progress. The better conditions in the spruce ground have produced vigorous saplings : some up to 12 feet in height.

The proper treatment of these clumps of natural regeneration is now a problem. Gradual thinning to one stem per sq. foot, side pruning of promising saplings and cutting back of malformed stems are under trial. Coppice shoots may never produce first-class hurley sticks, but saplings having suitable low-level bends are encouraged with the hurley-stick market in view. By such operations it should be possible to establish productive ash groves by natural seeding relatively cheaply.

The Manufacturer's Angle.

As it is important that the grower be conversant with some of the

Composite picture showing different stages in the manufacture of a hurley-stick.
(1) Ash butt 9 ins. top diameter.
(2) Approximately a quarter of the same butt containing material for 3 "Senior" hurleys.
(3) "Plank" $1\frac{1}{8}$ ins. thick.
(4) Finished product—Senior hurley.

technical problems which confront the manufacturer who utilizes the timber, the writer recently paid a visit to a small "spare-time" hurley-stick factory, and learned that for the purpose of hurley manufacture the most desirable material is a butt with a top diameter of 8 to 12 ins. having four large, well spaced roots. The trees must therefore be uprooted, not felled in the normal way.

The butts are first broken down on a rack bench. With the narrow end of the log facing the saw in the usual way it is cut straight through the centre, halving two of the roots. A further cut through each half gives 4 pieces roughly equal in size and as near as possible to "quarter-sawn" sections. By means of a push-bench saw these quarters are further broken down to $1\frac{1}{8}$ inch "planks" which are immediately stacked for air seasoning. The accompanying composite picture shows the different stages in the manufacture of a hurley-stick.

Hurleys are usually produced in three sizes:—"senior", "minor" and "juvenile" which are $37\frac{1}{2}$, 36 and 35 inches long respectively. The largest size usually weighs about 20 ozs. The manufacturer likes to get 4 foot long butts to allow for the cutting off of the end which usually splits in seasoning. To overcome warping, which may also take place, he cuts the planks to a thickness greater than may seem necessary.

A good quality stick should have straight grain from the top to the "bas" curve from which point the grain should curve evenly to the end. The wood should, preferably, be white in colour, free from knots and blemishes and possess a good "spring". Quite clearly only good quality fast-grown, young ash trees could be expected to yield such products. Defective hurleys including discoloured or ripple-grained ones usually have to be sold at much reduced prices.

The writer saw some hurleys made from medium sized ash trees of approximately middle age grown on a good limestone soil which were of the unpopular, reddish, ripple-grained, brittle type while ash grown on peaty soil had yielded sticks having few of these defects. It would seem that peat induces a shallow rooting system—three or four main roots running close to the surface. Better quality, heavier soils favour deeper roots with—from the hurley manufacturer's point of view—objectionable tap roots which make the tree more difficult and costly to uproot and play havoc with the grain. For various reasons a butt 8 inches in diameter which should produce ten first-class hurleys may yield 2 or 3 only, or possibly none at all.

The Importance of Sports Goods.

In the writer's opinion the value of sports goods, especially hurley-sticks, in the everyday life of the Irish people is incalculable. At the moment we are catering for a relatively small "hurling public," something approaching rock-bottom populations in 20 counties out of 32, plus a very small export market. The trend in demand for ash for hurleys is upward, and it is imperative that this demand be satisfied.

The following suggestions are offered, therefore:

(1) To meet short-term needs in hurley ash, natural underwood regeneration of ash should be encouraged by relieving suppressed saplings and the greater use of secateurs and pruning knife.

(2) To meet long-term needs, apart from the good mineral soils on which it normally thrives, ash should be considered as a possible choice on some of the more alkaline peats. In addition it should be planted on knoll tops and along marginal rows so that besides providing a source of supply in themselves these plantings take maximum advantage of the wind to spread its abundant seed crops.

Afforestation of Peat-lands in Northern Ireland. *

By K. F. Parkin

A target of 150,000 acres of forest by the end of the present century has been set by the Government of Northern Ireland, and up to the present, the progress of afforestation towards this target is most encouraging, there being 43,000 acres under forest, about 30,000 acres of government owned land awaiting planting and the annual planting programme has now been geared to 3,000 acres. In addition to the government programme, approximately 600 acres are planted each year by other public bodies, farmers and private landowners.

It is an important government policy that afforestation should proceed in harmony with agriculture and not in competition with it, so that much of the afforestation is confined to marginal and sub-marginal agricultural land. The peat covered moorlands, which often lie derelict, or at the best carry a very small sheep population, form a high proportion of the sub-marginal agricultural land and it is here that much of the future afforestation may be carried out. In the past only a relatively small proportion of the planting has taken place on those areas of deep peat, mainly because of the difficulties and expense of providing adequate drainage, but the areas that were planted have produced very promising stands of timber, so that with the advent of mechanical draining in recent years, large-scale afforestation of peat covered land has been stimulated.

This paper summarizes the present policies and techniques of afforestation of peat covered areas in Northern Ireland, mentions the lines along which research is proceeding and briefly assesses the future management problems which may be anticipated in the developing forests.

---

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

Classification of Peatlands.

It is estimated that approximately 600,000 acres,—(one-fifth of the total land area) of Northern Ireland is covered with a discontinuous peat layer of varying depth. Of this total over 500,000 acres may be classed as blanket bog and the remaining 100,000 acres is predominantly basin bog.

A good deal of the basin bog occurs at low altitudes, and where this has proved economically drainable it has been reclaimed for agricultural purposes or has been cut-over for fuel. It, therefore, does not often become available for afforestation purposes. When drainable basin bog has been planted with trees, vigorous growth has normally occurred, probably due to the accumulation of nutrients in this type of peat and to the more favourable climatic conditions associated with the low altitudes.

The blanket bog of the hill land must therefore remain the main planting medium for the forester. At first sight this blanket bog appears remarkably uniform both in depth and in the type of vegetation it supports. Closer analysis, however, reveals a complex variation in the peat type associated with moisture content, nutrient status, degree of decomposition, etc. An understanding of this variation is vital to the success of afforestation on the blanket bog for it is well known that within this range lie peat conditions which will support excellent tree growth and others upon which afforestation is doomed to failure from the start. While a study of the local tpography and climatic influences provides valuable indications of the suitability of a moorland site for tree planting, a knowledge of the peat fertility is essential if afforestation is to be anything more than an expensive gamble.

The accepted method of assessing the fertility of peatlands for afforestation purposes is to use the existing vegetation cover as a classification factor, on the assumption that peats of a particular fertility will support similar plant communities. This is the current practice in Northern Ireland, plant communities dominated by *Molinia, Eriophorum, Trichophorum, Calluna* or *Sphagnum* being accepted as indicators of sites of differing forest potential.

When dealing with considerable areas of peatlands which are approaching the limits for economic afforestation, as in Northern Ireland, it is becoming increasingly obvious that these accepted plant community classifications have important limitations. Accordingly an intensive programme of investigation into the possibilities of providing more reliable indicators of peat fertility is being undertaken largely by botany and soil experts from Queen's University.

Drainage.

The first consideration when undertaking afforestation of peatlands is to provide adequate drainage. The water table of most peat covered areas is at, or very close to, the surface and it is essential for the establishment and ultimate development of a tree crop that the tree roots should remain in a well-aerated medium above the water table. The task of lowering the water table in normal peat is both difficult and expensive and until recent years this was a serious obstacle to economic afforestation. Recent development of large drainage ploughs and machines capable of pulling these over soft peat has now made intensive mechanical drainage an economical proposition, so that this barrier to afforestation of peatlands has been virtually removed.

The Northern Ireland Forestry Division has a fleet of tractors and ploughs of various kinds designed to drain and provide planting turves in an efficient and inexepnsive manner on most types of peatland to be encountered in this country.

Drainage techniques have been developed to meet a variety of topographic conditions. The moorland blanket bog areas in Northern Ireland are characterised by gentle slopes and a regular surface broken only by occasional flushes or streams and on such areas the standard practice is to provide a deep cut-off drain along the top edge of the proposed planting area and then to cross the slope with wide-spaced, main run-off drains into which are ploughed the planting or turfing drains at 5 or 10 feet intervals. The cut-off and run-off drains are normally at least 3 feet deep and are usually the maximum depth plough drains deepened by hand. Normally, the main drains are put in during the same year in which planting will take place, but on very wet peat areas a system of "pre-draining" is carried out up to 5 years ahead of planting in order to promote surface consolidation of the peat.

Other Pre-planting Treatments.

Some of the peat moors which are being afforested have lain practically derelict for many years and on the drier slopes there is sometimes a vegetation of high woody heather. This interferes with the turf-ploughing of the area to such an extent that the general policy is to remove it by burning one or two years ahead of planting. Other peat vegetation is not normally burnt prior to ploughing.

It is standard practice to fence all planting areas against stock and harmful vermin. A wire and netting fence is normally employed.

Many of the moorland areas now being afforested are quite remote from existing roads, so that a new road system has often to be built into and through the planting sites in order to get men, machines and materials into the area. Such roads form part of a more complex network which will eventually be used to remove the forest produce. Many of these roads pass across areas of deep peat and special techniques of construction and bridging have been developed to ensure that they will carry the heavy loads of the future.

Layout of Plantations.

To facilitate future management of the plantations the stands are divided up into units or compartments of approximately 25 acres. The compartments are separated by unplanted strips (rides) about 35 feet wide which will form future extraction routes and roadways. Through the compartments are left unplanted strips (racks) 15 feet wide, which will allow the passage of future extraction machinery. These racks are laid out so that the maximum distance of drag of a pole during extraction to a rack will never exceed 100 yards.

The laying-out of these roads, rides and racks is one of the first operations undertaken on a proposed planting site. It is considered very important that the peat surface of these future extraction routes should not be disturbed by the intensive drain and turfing ploughing which is employed on the actual area to be planted. The future risks of windblow also make it important that the racks should be left unplanted now to avoid having to cut the extraction routes through the stands during thinning operations—a frequent cause of the start of windblow.

Wherever possible the layout of the main drains corresponds with the roads, racks and ride system, as this can appreciably reduce the number of bridges or culverts, and maintenance and inspection of the drains throughout the life of the forest is facilitated.

Planting.

The turfing ploughs provide ribbons of peat about 9 inches thick and five feet apart across the planting area. The young trees are planted on these at 5 foot intervals using a semi-circular spade. With this tool a peat plug 4 inches in diameter and 9 inches long is removed from the peat ribbon and the young tree is inserted into the resulting hole so that the tips of the roots reach the bottom of the hole and hence the layer of vegetation which was formerly growing on the ribbon of turf before inverting. The peat from the broken-up plug is then used to pack the tree roots. When planting on ribbons from main drains, which may be up to two feet thick, a piece of the ribbon is removed to leave a 'step' 9 inches thick through which the tree is planted.

On the less fertile peat it is the standard practice to give each plant a dressing of 2 oz. of Basic Slag. This is deposited in the hole left after the removal of the plug and before the tree is inserted. Several experimental trials have indicated that high grade Basic Slag is more beneficial than other forms of phosphate when applied in this way at the time of planting.

The actual organisation of the planting is as follows: A number of men start on the removing of peat plugs with semi-circular spades, these are followed by men who drop a handful (2 oz.) of slag into each hole. Behind them other men (or usually boys) drop a plant into each hole which has had slag and these are followed immediately by men who do the actual planting. A well organised squad plant at the rate of 800 trees per man per day.

Planting of the high moorlands is normally undertaken as late as practical in the season—usually the end of March—since exposure of the newly-planted trees to winter conditions before the roots are established leads to many failures. Well rooted 2 + 1 year plants are preferred.

Choice of Species.

Certain of the lowland peats which have a high nutrient status and a relatively high pH will support a wide variety of tree species, but on the acid, infertile blanket bog areas the choice of species is very limited.

In flush areas on the peat moors, Norway spruce is sometimes planted if the peat is not very deep but Sitka spruce and contorta pine are undoubtedly the most successful species on a wide range of peat types.

For many years it was the practice in Northern Ireland to plant contorta pine either pure or in mixture with Sitka spruce on the peats considered to be of very low fertility, but recent studies of the older stands containing contorta pine suggest that it is not a species for planting on deep peat at all. While it undoubtedly gets off to a good start in mixture with Sitka spruce it appears very doubtful whether it has any beneficial effect as a nurse whereas it frequently delays the closing of the tree canopy and consequent suppression of the ground vegetation. A pure crop of contorta pine appears to start off well on deep peat but after a first thinning the shade cast by pine never appears to be sufficiently intense to prevent the invasion of Sphagnum moss which may well lead to the stagnation of the pine stand. Consequently the current choice of species policy on the areas of blanket bog is to plant pure Sitka spruce wherever there is a possibility of any tree growing and to concentrate on helping them through the period of check which often follows a few years after planting. Contorta pine is planted only on the shallow, dry, infertile peat areas characterised by a plant community dominated by *Calluna* and lichens.

Heather Competition.

The considerable drying out of the surface peat layer which results from the intensive drainage associated with mechanical turfing prior to planting, causes remarkable changes in the surface vegetation. On the less fertile blanket bog areas a vigorous re-growth of *Calluna* within three years of planting is characteristic. Apparently associated with this *Calluna* development is a yellowing and slowing down of the growth rate of the young Sitka spruce planted on this peat—which for the first two years after planting normally grow extremely well. This checking of the spruce is a very serious matter and if no treatment is provided the trees often cease growing and eventually die. It has been discovered, however, that there are a number of ways of overcoming this "check" and stimulating the trees into renewed growth. Top dressing the checked spruce with a phosphatic fertiliser often has the effect of turning the trees green again and starting growth the following season. This phosphate stimulus is often only temporary, however, and the trees may go into check again after a year or two. A more permanent improvement has been brought about in many checked areas in Northern Ireland by spreading peat—dug during drain deepening operations—around the base of the checked trees. The exact reasons why this spreading of peat around the base of the plant causes re-vitalization is obscure—it may be merely that it causes temporary suppression of the *Calluna* or it may provide a supply of nutrient which has become limiting in quantity. However there is no doubt that this treatment is highly effective in its stimulation of the trees to such a size that their own developing lower branches cause sufficient shade to kill off the *Calluna* after which stage the stand growth continues unchecked. The disadvantage of this treatment is its expense—the cost of providing sufficient peat and spreading it around each plant may approach £10 per acre. Accordingly, experiments are being carried out to try to discover an economic means of overcoming this *Calluna* check in young spruce plantations. Three main approaches are being tried experimentally. They are:—

(i) The addition of fertiliser to the plants after "check" has occurred, to stimulate them to a size when they can suppress the *Calluna* by shade.

(ii) The addition of fertiliser at the time of planting to provide sufficient vigour to permit the tree to reach the heather-suppressing size before the *Calluna* can cause it to check.

(iii) Treatment of the site before planting in such a way as to reduce the vigorous return of *Calluna* after planting.

Results to date are limited but they suggest that top dressing with organic fertilisers containing slowly available nitrogen will bring spruce out of check and will stimulate rapid growth.

Development of Plantations.

Only a few of the plantations on deep peat in Northern Ireland have reached exploitable size and, since no detailed records of the original sites were kept, the application of development information from these old plantations to the ultimate growth of those being established at present is very limited. However certain parallels may be expected and these will influence management policies to some degree. For instance, the susceptibility to windblow of trees growing on deep peat has often been revealed in the past and this knowledge should stimulate foresters to avoid underthinning and to provide wind-firm edges to all plantations. The fact that the developing stands cause considerable shrinkage of the peat is obvious from a study of the older plantations and this demands that frequent attention to drains will be a future management policy since some of the drains provided at planting time will lose their effectiveness as the peat shrinks beneath the developing trees. The invasion of stands by *Sphagnum* moss after thinning has been observed on areas of deep peat and it is probable that special thinning regimes may be necessary to avoid this invasion and the apparent stagnation which follows it.

These and many more problems will beset the forester faced with the task of growing and harvesting timber on these difficult peat lands, but new and often encouraging information is coming to light constantly as the older peatland plantations develop and new techniques and treatments yield results.

Conclusions.

It may appear from this paper that the Northern Ireland Forestry Division is rushing ahead with the wholesale afforestation of vast areas of infertile peat lands which have long been accepted as unplantable. This impression would, however, be erroneous, for up to the present, large-scale planting is confined to sites which past experience has indicated beyond reasonable doubts will produce a crop of timber. The planting of the doubtful peat areas is being undertaken on an experimental scale only, but all aspects of this are being tackled with enthusiasm under the stimulus of the knowledge that each advance opens up for afforestation considerable expanses of land at present lying barren in a country which is so short of raw materials.

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

By R. E. PARKER,
Department of Botany, The Queen's University, Belfast.

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.

Corcashel Plantation, Co. Cavan.

By J. E. Johnston

AMONG the areas of woodland owned by Public Bodies in Ireland is a Plantation of about 30 acres in West Cavan belonging to the County Council and situted in Corcashel Townland.

The countryside around it consists of bare drumlin ridges divided into fields by a network of whitish drystone walls and as the wood occupies a north-western brow at between 330 ft. and 470 ft. elevation it is a conspicuous feature in the scenery; particularly as it is backed by mountain ridges rising about a mile away to the South East.

About 45 years ago the holding fell derelict on the hands of the County Council, who had it planted with a mixture of conifers, which were interplanted with hardwoods in the margin next to the public road. 70,000 young trees were stated to have been used—European and Japanese Larches, Scots pine and smaller amounts of Norway spruce were selected; together with Silver fir, Douglas fir, Beech, Oak, Sweet Chestnut, Ash and Alder in the roadside strip.

Scots pine occupies a little over half the area and the other species the remainder.

From evidence on the ground the trees appear to have been planted on mounds, made of sods obtained from an extensive network of shallow drains, and both pure blocks and intimate mixtures of the species are to be found.

The selections and techniques would have been in agreement with the up-to-date afforestation practices of the time.

At present the roadside margin gives a somewhat misleading impression of the general prosperity of the stand as it is stocked with Scots pine of 20 to 30 ft. in height mingled with individual specimens of the minor species of the crop, some of which are considerably taller than the pines. Silver fir, Douglas fir and Oak are particularly noticeable, but are wind blasted on the exposed sides of the crowns.

Within the Plantation and on the higher slopes development improves until the best of the Norway spruce and Japanese Larch are met with. These consist of beautifully straight and cleanly developed stems of 48 to 54 ft. in height and 8 inches Q.G.b.h.

The form of the Larch is remarkably good, and would suggest that it may be of hybrid origin. A few Scots surviving among the Larch are also of good stem form, and over 40 ft. in height, but the crowns are sparse and exhibit a good deal of pine shoot beetle damage. Lightly furnished crowns, bearing two years' needles are typical of all the Scots pine in the Plantation.

In general the dominant trees of the Scots pine portions of the stand have attained a height of about 35 ft. with slender stems of 5 inches Q.G.b.h. and in a few patches of wet ground bearing strong tufted *Molinia* they have scarcely closed canopy, and exhibit butt rot, which does not appear elsewhere in the crop.

The site on which the wood is growing consists of inert, gleyed boulder clay of carboniferous sandstone origin.

The soil has a gritty texture, poor seepage characteristics, and fresh profiles show a typical mottled colouring at shallow depths. The water table has always been close to the surface, even on the steepest portions of the slope, and slight peat formations are present on the flatter parts.

The vegetation on similar land around the Plantation consists of a sward of short jointed rush, sedges and heath grasses such as *Agrostis stolonifera* and *Molinia,* with devil's bit and a colouring of weak heather.

Under the tree canopy this has modified to *Deschampsia, Molinia,* brambles and creeping soft grass, with traces of weak rush (*J. communis*). Holly and wood sorrel are making headway over much of the area. Woodland mosses are well developed.

Pure *Molinia* covers the few wet flattish areas where the pines are weakest.

From an examination of soil profiles it would appear that the roots of all species have been confined to the surface foot of depth, with the exception of Alder, which penetrated the gleyed sub-soil for two feet or more.

This suggests that Alder may have a special significance in forest soil development and conservation on poorly aerated sites.

On the wetter portions of the land the main tree roots either rest on the actual ground surface or penetrate only an inch or two, which accounts for the stunted growth of Scots pine and European Larch on these sites.

Remarkably little damage was done to the wood by the gales of January 1957. Less than a dozen individual blown trees were observed. The stand is relatively exposed to the prevailing winds which sweep up from Lough Allen, which lies to the South-west, and impinge fairly directly on to the "bulge" of the hill on which it is.

At the time the Plantation was laid down it must have been a pioneering effort by the Council as there is very little evidence of tree growth on similar sites in the locality, and the present state of development of a considerable proportion of the wood, stocked with Japanese larch and Norway spruce is a good advertisement for forestry enterprise. In this connection a number of small shelterbelts, of under 20 years old, around farmhouses in the locality are encouraging. They are stocked with hybrid Larch, Sitka spruce; and *Pinus contorta.* Direct comparisons between small shelter strips and plantations are hardly satisfactory, but all three species show promise of equivalent or better productivity (particularly Sitka spruce) compared with the best portions of the older stand.

In conclusion I wish to acknowledge the ready consent and helpful information given by the Cavan County Council when I expressed a desire to examine their Plantation and prepare this note on it.

"Roads for Economic Timber Extraction."

By E. R. HUGGARD,

Lecturer in Surveying and Forest Engineering, University College of North Wales, Bangor.

(*Paper read at meeting of the British Association for the Advancement of Science at Dublin in September, 1957.*)

OVER £500,000,000 will be spent on the extraction of timber in the United Kingdom during the course of the next 40 years. The amount of profit, or loss, to the owner will depend largely on the existence and efficiency of a road system within the forest.

There is little doubt that roads are an answer to economic timber extraction.

In a questionnaire, recently sent to various authorities in twenty-eight different countries, and which asked for information and opinions, some of the questions were aimed at determining the importance of roads to timber extraction. Of the many replies received to date, it is almost unanimously agreed that roads are what are required—more roads and cheaper roads. In countries like Switzerland, with its mountains and aerial ropeways, and Norway, with its snow and skidding tracks, it was, nevertheless, advocated that money spent on roads and road construction research would be more remunerative than research on off-the-road haul methods.

Until quite recently, roads, like the notorious Working Plan, were either not required or not desired. Happily, now, roads are both required and desired. A surge of enthusiasm is apparent and the bulldozer is hard at work. As for the Working Plan, that is the "pigeon" of the Forest Officers, some of whom predict that the bird will, one day, escape from its pigeon hole and come home to roost. As an engineer, I humbly ask forest planners-at-large to remember that civil engineering construction and timber extraction cannot be carried out economically unless they are pre-planned and the programme adhered to.

Planning any forest road network starts with calculating the density of roads required, i.e. the most economic density. The cost of extraction is equal to the sum of the cost of roads plus the cost of off-the-road extraction. The ideal density, therefore, is when the sum of these two costs is a minimum.

A recent contributor to one of the British Forestry journals produced useful tables showing how much money could be spent on a road construction programme, based on the saving in cost on off-the-road haul. He assumed that the ideal road density in the United Kingdom to be 7 miles per sq. mile. The amount of money which could be spent on constructing the seven miles was equal to the sum saved by virtue of the shorter off-the-road haul. I do not, altogether, agree with the approach to the problem. For not only is the ideal road density not always 7 miles per sq. mile but also it would be very difficult to apply the figures taken from the tables. For instance, if it were found that, due to the reduction in short haul cost the money available to construct up to the advocated seven miles was, say, £400 per mile, what would be the answer if the estimated cost of road construction was, say, £2,000 per mile? I hold that the ideal density, based on short haul and road construction costs, must be first calculated and then applied.

I wish to present three graphs :—

(1) An ideal density graph for forest roads, which incorporates
(2) A unit short haul cost graph and
(3) A short term investment graph, which will be of more interest to those who are concerned with the practical rather than the ideal.

The ideal road density depends on three main factors, namely :—

(a) Off-the-road or short haul costs.
(b) Road construction costs.
(c) Yield.

As each of these vary from place to place it is necessary to devise a graph covering a wide range of conditions. In the United Kingdom an off-the-road haul cost will vary considerably, according to topographical and other conditions. The cost of road construction will vary from as little as £300 to as much as £7,000 per mile. Smaller and greater figures have been known but the former should not be believed and the latter never divulged! The following are some examples of average cost in the United Kingdom, though they may not necessarily apply to any district in particular.

Cost of road per mile	*Notes on type of construction*
£300—£600	A machine made earth road over easily drained soil and with no major constructional difficulties.
£1,000	A reasonably well drained sub-soil requiring a thin base coat of stone and with no major constructional difficulties.
£1,500	Same conditions as for a £1,000 road, except that some or all of the constructional work necessitates greater expense, e.g. weaker sub-soil calling for thicker base, greater excavation work or increased drainage difficulties.
£2,000	The average cost of the normal forest road. A base coat of stone on a machine excavated sub-soil with side drains and culverts.
£3,000—£5,000	A road constructed with one or more major difficulties such as a bridge (£12 per foot), very weak sub-soil necessitating a thick stone base, rafting or rock excavation (20/- per cu. yd.), etc.

A figure for yield can only be a long term estimate, as road planning policy will have to be decided and acted upon prior to the first thinning.

For the purposes of this calculation the figure of a total crop of 6,000 cu. ft. per acre, over a 60 year rotation, is selected. It is sufficiently accurate and represents an average for a new conifer plantation, which now forms a large proportion of our forest area.

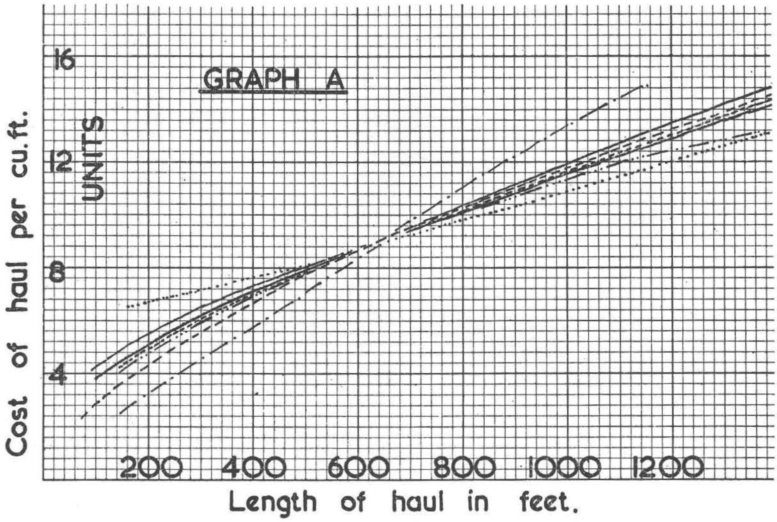
Assuming this yield, it can be determined what charge has to be carried by each cu. ft. of timber to be extracted throughout the rotation of the crop. This is done simply by dividing the total expenditure on roads, after accounting for compound interest, redemption of capital and maintenance etc. by the estimated total yield. Column 3 of the following table shows that figure in an example where the road construction cost is £2,000 per mile.

Road Density Mls./Sq. mile	Maximum Haul Feet	Cost of Road per cu. ft.	Cost of Short Haul per cu. ft.	Total Cost per cu. ft.
2	1,320	0.41d.	8.6d.	9.01d.
4	660	0.82d.	5.8d.	6.62d.
6	440	1.22d.	4.5d.	5.72d.
8	330	1.63d.	4.0d.	5.63d.
10	264	2.04d.	3.6d.	5.64d.
12	220	2.45d.	3.33d.	5.75d.
14	188	2.86d.	3.0d.	5.86d.
16	175	3.26d.	2.7d.	5.96d.

Some people may doubt the smallness of the figure to be borne by the timber due to road construction cost. They are the people who like to slap on 5 or 6% compound interest on to the capital for road construction and leave it there to accumulate until the final felling. Compound interest will strangle you if you will allow it. If one correctly starts to redeem the loan immediately after the first thinnings, similarly as a house owner gradually redeems a mortgage, then one obtains a much lower and realistic figure.

To revert to the main interest, it follows that the greater the cost of road construction and the larger the road density, the greater will be the amount which will have to be borne by each cu. ft. subsequently extracted.

It is next necessary to know how the cost of off-the-road haul varies according to the change in the length of haul. Graph A shows this relationship. The length of haul in feet is costed against the cost of haul in UNITS. This is a very useful graph and one which could form the basis for off-the-road economics. It has the big advantage of providing a figure for all off-the-road hauls, i.e. the cost per length of haul, without pegging a definite cost to any particular length haul. For

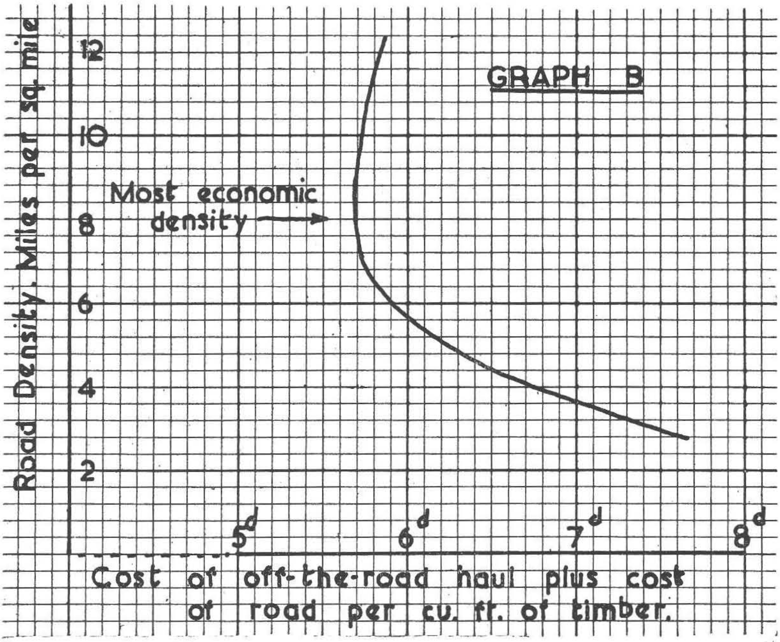


example, if the cost of, say, a 165 feet haul was known for a particular set of conditions, then the cost of other length hauls are readily obtained by reference to the graph and using simple proportion. In this way all length haul costs may be determined from one haul cost figure. As it is in the saving in cost, due to shorter haul, that we are at the moment interested, the graph will provide us with the data which we require.

Whence the graph? Does the cost actually rise to follow this fixed curve? I maintain that it does. On the graph are shown a number of lines, each of which is the result of figures gained from different authentic sources. These include the U.S. Dept. of Agriculture, Technical Bulletin No. 700 on logging Southern Pine, Matthew's "Cost Control in the Logging Industry" and other sources including many replies to the questionnaire already referred to. Indeed, not all of the replies agreed, but many did, and most of those which did not either were straight line graphs, indicating simple multiplication or else were incorrect in that they were acutely convex, instead of being concave. To reduce the scatter all figures were converted to represent 9 units of cost for a haul of 600 feet. Although the graph is presented here as a factor towards the solution of the ideal road density, I feel that it is a graph of importance in its own right.

To proceed with the density calculation, it is remembered that the ideal density is when the total cost of road construction per cu. ft. plus the cost of short haul is at a minimum.

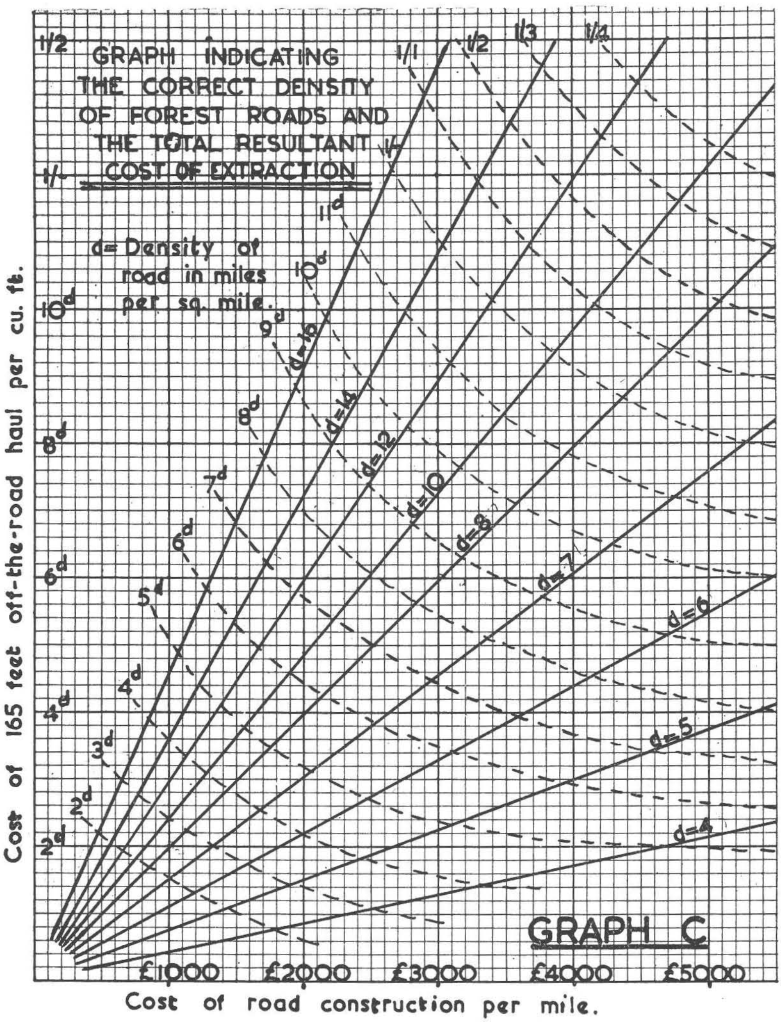
To take one particular example, if the cost of road construction was £2,000 per mile and the cost of a 165 feet haul was, say, 4d., then



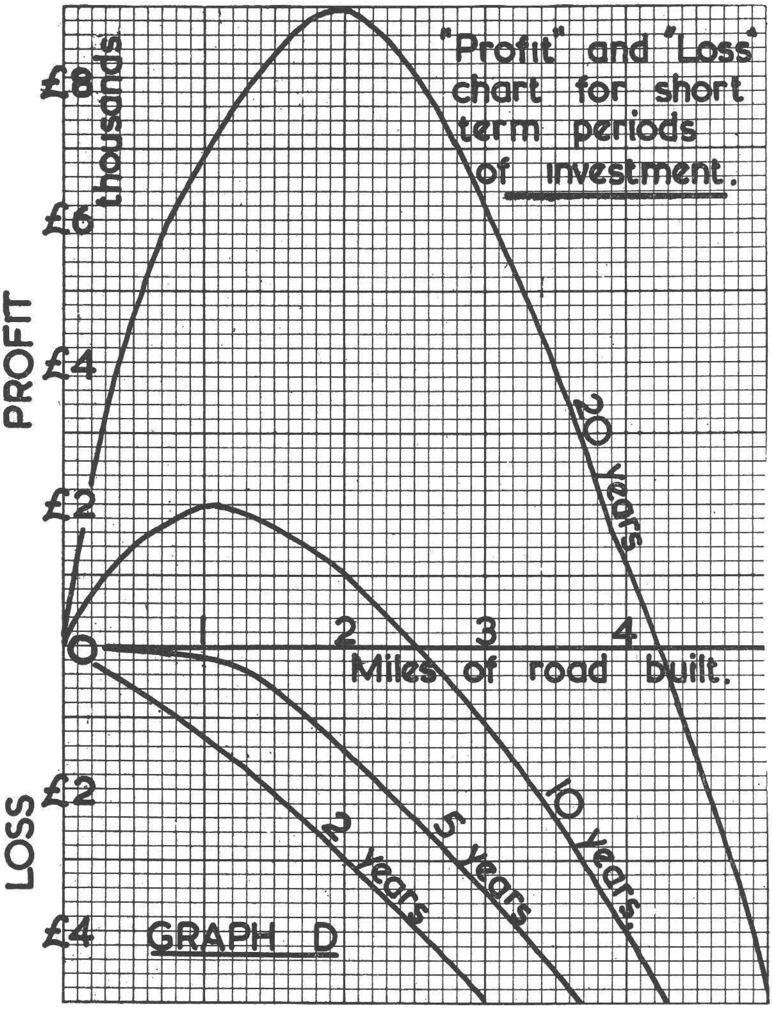
Graph B can be drawn. For those conditions, which are quite possible for the United Kingdom, it is seen that the most economic density is 8 miles per sq. mile, with a resultant total cost of extraction to be 5.7d. per cu. ft.

In this manner Graph C was compiled to cover all the possibilities between a road cost of £250 and £5,000 and a 165 feet off-the-road haul cost of between 2d. and 1s. 2d.

The ideal road density, depending, as it does, on short haul and road construction costs, cannot be a constant. If the cost of one rises in relation to the other the balance is upset with a change necessary in the road density. Prior to this century off-the-road timber haulage was extremely cheap relative to the cost of construction of either railroads or timber wagon roads and so the older plantations were covered with horse racks and narrow extraction rides. Now the trend is the other way and cheaper roads and more efficient transport justify higher densities. Graph B shows that to under-road a forest means expensive extraction. To over-road a forest does not account for a great loss but one would not, in this case, construct beyond a density of 8 miles per sq. mile as the availability of plant, labour and capital to construct roads is a major item to be considered.



It is generally only in the State forests that one is able and satisfied to invest over a long period in order to construct a large mileage of road. In the case of private forests it is more probable that the landowner will wish to see a return of profit within a short period. I believe that many owners are under the impression that to invest in forest roads at all is merely to create a nest egg to be collected (if not poached) by the Chancellor of the Exchequer in years to come. That pessimistic view is not necessarily true, as the following example graph will show.



Taking as an example an area of one sq. mile, already covered by one mile of road and giving a sustained yield of 100 cu. ft. of timber and where roading costs £2,000 per mile to construct and a 165 feet short haul cost is equal to 4d. per cu. ft., graphs are drawn showing the profit and loss for various short term periods of investment, i.e. the cost of the road construction is written off within these periods. The profit or loss represents the amount of money gained or lost over and above the cost of the total extraction, should no roads be constructed.

The graph shows that, for investment over 2 or 5 years it would not pay to construct any roads beyond the one mile already assumed to exist. If the owner is willing to spread his investment over a period of 10 years, then he should construct one mile of road, in which case his extra profit would be £2,000. Over a 20 year period of investment he should build 2 miles of road and his gain would be equal to £9,000. Should he, like the State, be willing to invest over 60 or 70 years, then the ideal density figure of 8 miles, for these conditions, would apply and would produce a very substantial profit.

I apologize that this paper is mainly a mixture of compound interest, graphs and simple arithmetic but its purpose is to stress that the construction of roads is economically correct and that, for all forest areas, the effect of roads on the economics of the forest should be closely studied.

Handling of Irish Timber.

By Wm. A. P. Crowe.*

THE purpose of this article is to acquaint foresters with what happens to the portion of a tree which is suitable for constructional timber, after it has been felled and delivered to the sawmill. It is possible, that his interest in live-wood, its care and cultivation, may obscure his interest in dead-wood, and the various factors which influence its conversion into a form of timber which is suitable for use in the building trade. In considering this, no attempt will be made to investigate the various other processes to which the timber is subjected, such as pulping, chipping, roasting, etc., to produce various forms of manufactured commodities.

It is presumed that the reader realises that certain changes take place in timber after life has departed, and just as it is necessary for the forester to learn something of the histology of the growing tree, so it is necessary for the wise sawmill owner to follow the scientist in his search for knowledge among the dead fibres of timber, if he is to learn how best to process it. The first and most obvious change is that in the physical properties of the timber as it seasons. The following table will

* Mr. Crowe is a director of W. & L. Crowe Ltd.

indicate roughly how these changes favour or disfavour the material as used for constructional purposes :—

		Increase	Decrease
A.	Weight.		×
B.	Bending Strength.	×	
C.	Modulus of Elasticity.	×	
D.	Impact Resistance.		×
E.	Compressive Strength.	×	
F.	Hardness.	×	
G.	Shearing Strength.	×	
H.	Cleavage Resistance	×	

The degree of change varies according to species, as does the rate of change. Also it is clear that the loss of weight is due directly to the loss of moisture from the log, which in turn is responsible mainly for the other changes which occur. But perhaps the most important change, and certainly one which affects both the manufacturer and the builder who uses wood as a medium in his work, is that of dimensional change. In the case of D above, the botanical cellular structure of softwoods—which is in the form of tracheids—is probably the reason why most softwoods react less favourably in this respect than most hardwoods. Unfortunately, a study of the botanical structure of wood, does not at present help the mill owner greatly in judging the suitability of the various species for any specific requirement. For example, it is not possible for the scientist to determine what exactly causes one species to be durable and another to be easily infected by fungi or inscts. Nor can the scientist say why the gum which is found in *Lignum vitae* (*Guaicum* Spp) is suitable for the dry lubrication of ships' bearings. Again it is not possible from a study of Jarrah under the microscope to say why it is, that it will not readily burn. Many of the so-called minor components found in different species offer the scientist no explanation for their presence, despite the fact that in many cases they are of prime commercial importance. It is still largely true to say that, despite the great advances in timber technology—the scientific study of dead-wood—the sawmill owner still depends to a great extent on experience, as being the best source of his knowledge.

It may be thought from the foregoing that there is no need for the sawmill owner to interest himself at all in timber technology until it has reached a much more advanced stage, but that would be quite erroneous. An example of how the scientist can help springs to mind if we investigate the confusion which exists regarding the identification of species. It is not perhaps generally realised that there is vast confusion in commerce over the identifaction of many commercial timbers. This has arisen and been aggravated greatly by the introduction of new timbers from Africa, South America and Austral-Asia, as the knowledge of forestry and the care of forests has spread to these continents. Many of these timbers, until recently unknown in commerce, have been introduced as substitutes for the better known and well tried species, supplies of which, however, have become exhausted due to their popularity. A striking instance of this is the huge variety of timbers marketed under the name "Mahogany". Similarly the species known as African walnut is much closer to the Mahogany family than well-known European walnut. Similar confusion exists between the commercial terms pine and fir and cedar in softwoods. The scientist has greatly helped by introducing botanical classifications, and where a doubt exists, the sawmill owner often quotes the botanical name.

Much more, however, has been achieved in the identification of hardwoods and softwoods, by the use of, in the former case a lens, and in the latter case a microscope. Under the trained eye of the timber technologist such magnification reveals the fact that there are present slight differences in almost seventy features in hardwoods and about forty in softwoods. Thus to identify a species, a small sample of the wood in question is all that is necessary. First, it is studied with the naked eye and its various characteristics or the absence of certain features is noticed and recorded; then, under the lens or microscope, as the case may be, its structure is studied in transverse, longitudinal and tangential section. Again positive features, negative features, their presence or absence are noted. From these notes, in their numerical order, the correct species can be selected by process of elimination, on a simple punched card index. If further doubt exists, comparison can be made with photomicrographs available in album form. While the system is almost fool-proof particularly for hardwoods, a greater degree of magnification is necessary with softwoods, and indeed it is almost impossible to identify softwoods without the aid of a high power microscope, and facilities for making microscopic slides. Even then, owing to the similarity of softwood structure, it is not always possible to separate closely related woods of the same species, such as spruces.

Returning to the matter of the changes which occur as wood seasons, the one which needs the most attention is obviously that which concerns the loss of moisture through evaporation. One of the first visible signs that a change is taking place is the emergence of checks and splits in the surfaces of the wood. These are faults which cannot be subsequently eliminated by any process available to the sawmill owner. A close study is therefore necessary of the causes which bring about this phenomenon. Briefly it can be said that in the early stages of seasoning most species will loose their moisture content rapidly. This moisture derives from the sap of the tree and the conducting rays etc., which convey moisture. Free Moisture is given off readily even in the dampest conditions, much of it in the forest, where initially it may be as high as 170% moisture content or more. The moisture content measurement is simply the weight of a sample when wet expressed as a percentage of the weight of the same sample after all moisture has been evaporated from it. When all the free moisture is dried out, the timber is said to be at "Fibre Saturation Point", but it is still far from being in equilibrium with the surrounding atmosphere; yet no great distortion has occurred nor any dimensional changes, and the moisture content stands at about 28%. At any time during this period the timber may be processed in the sawmill and of course the fact of dividing the log into smaller sections helps to accelerate the drying process. It must be emphasised that further drying must take place before the timber can be said to be fully seasoned. The correct m.c. figure, may only be assessed when the eventual use for the timber is known. For example a moisture content of 18% is quite satisfactory for rafters, floor joists, studding, etc., but for joinery articles, such as external doors, windows, etc., which are subjected to both outside and inside atmosphere, an average must be struck of 15%, and a protective coating of paint must be applied to cushion the effects of seasonal changes. For furniture and hardwood floors, the moisture content is usually reduced to 12% on the understanding that the internal portions of a building are normally heated. The effect of steam or hot water radiators is to lower the humidity in the surrounding atmosphere below normal, with effects which are aften unpredictable.

It must be realised that after Fibre Saturation Point has been reached in the drying process of timber, further moisture can only be evaporated from the cell walls, such moisture being called Bound Moisture. Also if either Free Moisture or Bound Moisture, is extracted too rapidly from the cells, their walls will rupture or collapse, causing serious defects. It should also be realised that the degree of shrinkage in a radial direction is only half that in a tangential direction to the circumference of the log. This phenomenon is known as Differential Shrinkage and explains why a tangentially sawn board warps so that the side nearest the heart becomes convex, technically known as "Cupping". Unequal or too rapid drying will aggravate this tendency bringing about various splits and checks which often spoil the timber for commercial purposes.

There are two main methods of seasoning timber, firstly Air Seasoning, and secondly, Kiln Drying. The first and oldest method is still widely practised and many architects and sawmill owners refuse to believe that good can come from kiln drying, but if the above figures are to be attained without down-grade, kiln drying is almost indispensable, particularly in Ireland, where air drying is bound to be slow. It is impossible for timber to fall below 18% by air drying, and in modern heated buildings, a much lower figure must be aimed at (10% is not unusual in a centrally heated building). Apart from the advantage in a kiln, of being able to control all the factors which affect drying, it offers the economic factor of time saving; nevertheless, if the limitations of air seasoning are realised and careful supervision ensures that a good flow of air through the stack is available, good results can be obtained from air drying. The choice between air and kiln drying boils down to consideration of economy and space. Thus, if the mill is a static permanent affair, located in a city, kilns are the obvious choice. Conversely, if the mill is a mobile, portable plant, working in or close to a forest area, air seasoning is usually relied upon. Of the two the latter is more common in Ireland, but not, in the opinion of the author, the more desirable. It should be pointed out here that the tendency in the timber producing countries is to locate a static mill some distance from the forest, but close to a densely populated centre. The disadvantages in obtaining supplies of raw material can be more than offset by:—

(a) Improved transport facilities.
(b) Heavier Plant and Handling Equipment.
(c) Improved methods of waste disposal in the form of manufactured products.
(d) Proximity to a large market for the end products.

In such circumstances, the installation of kilns is almost essential, if native softwoods are to be presented to the builder in competition with well-easoned imported timber.

To appreciate what this means it is necessary to understand the conditions which obtain in a kiln. The factors which affect drying and over which the kiln operator has complete control, are:—

(1) Temperature.
(2) Humidity.
(3) Air Flow.

Firstly the temperature requires to be raised to speed up the vaporization of the moisture. Certain timbers will withstand and indeed require higher temperatures than others. This is achieved by the installation, usually in the roof of the kiln, of a number of steam coils, each with its own control valve. The second factor, humidity, allowing the kiln operator to control the rate of drying, is usually achieved by the installation also in the roof, of a further coil, which is perforated at intervals along its length. The effect is a steam spray, the volume of steam being regulated by an ordinary valve. To enable the above two conditions to be equally distributed, the air in the kiln, the third factor, is forced over the surfaces of the planks, by means of electric fans. To ensure even distribution, as much as possible, these fans are reversible, the intervals of clockwise and anti-clockwise working being kept equal.

In order that the process may run continuosusly and smoothly, it is essential that the sawmill take into account the following factors, before presenting the timber to be dried:—

(a) Species.
(b) Thickness.
(c) Length.
(d) Initial Moisture Content.

In the case of (a) it must be realised that the species determine the type of treatment which the load will undergo. In this connection the forester should be interested to learn that some species of Irish softwoods are extremely stubborn in yielding up their moisture content. Experience shows that the spruces, Douglas fir and Scots pine can usually be mixed in a load, provided the requirement in (d) is met. It has proved impossible to mix silver fir (*Abies alba*) with the other species. It proves to be a very stubborn drier, so much so that it is uneconomical for kiln handling, except in complete kiln loads of thickness not greater than $1\frac{1}{2}''$. It is one of the species which require a high temperature before it will give up moisture. The same temperature applied to the other species causes a serious degrade. In the case of (b) it should be obvious that the thinner the section of the plank the quicker it will dry. Thus a load must contain planks of only one thickness.

The case for length (c) is not quite so obvious until it is realised that kilns have to be manufactured to certain static dimensions. The length of the planks, therefore, must be multiples, which will fit snugly into the kiln length. It is important in this connection that no air gaps occur in the pile since this would interfere with the flow of air through the load, causing pockets of inertia and back eddies.

In the case of (d) the initial moisture content is important, in that it should be the same throughout the whole load, otherwise those planks which begin drier than their fellows, will end up overdried. If attempts are made by the operator to hold the planks of lower content in equilibrium then the drying of those which are wetter is very much retarded, and the result is that the time factor increases to an extent which is uneconomical in working.

Experience has shown, that it is possible to produce sawn Irish softwood in the usual standard sizes and widths, for constructional purposes, at 18% moisture content, in from four to five days drying time (including loading and unloading) in competition with the imported equivalent. Unfortunately the quality and the mixture of species, act as a superficial deterrent, but with good sawing and a ready method of using the part of the log which is unsuitable for planks, builders and architects can be persuaded to substitute Irish timber for the imported article to a growing extent.

It is hoped that the foregoing information will serve to emphasise the importance of growing the right species in Irish forests, and in determining this, the drying characteristcs must be taken into account, if we are to compete successfully with seasoned timber from abroad. At the same time it is fully appreciated that the selection of species depends on many other factors such as soil, altitude, etc. Nevertheless, if we are ever to achieve a balanced budget, it is essential that Irish softwoods be made readily available to builders and architects at competitive prices, condition, and quality with Scandinavian and Canadian softwood. No amount of processing by the sawmill owner will convert material which is only fit for pulping into sound constructional timbers.

The VIth International Poplar Congress.

Report by NIALL MORRIS

THE IXth Meeting of the International Poplar Commission and the coincident Congress, held in Paris in April 1957, together with the Associated Study Tours in France, marked the culmination of a decade of endeavour and of steady progress by this subsidiary organisation of the F.A.O.

It was but fitting that France should have been the meeting place on that particular occasion because it was in France that the idea of having such a Commission first originated and it was following a meeting held in Paris in 1947 and at which the representatives of nine nations attended, that the International Commission was established. For a time the headquarters of the Organisation was in Paris but later it was transferred to the F.A.O. headquarters in Rome.

The Congress.

The IXth meeting of the International Commission and the VIth International Congress were in effect the same meeting which differed from the normal annual meetings of the Commission through the presence there of representatives of non-member nations.

Held at the Palais d'Orsay, Paris the Congress took place over the course of four days. Some one hundred and thirty delegates, representative of twenty-eight countries, including Ireland, were present.

Apart from organisational matters which were dealt with the greater part of the time was occupied with the reports of the activities of the National Commissions, and of the specialised working parties established by the Commission. These reports presented a wealth of information on almost every aspect of the poplar industry. Though not always conclusive in their findings, they evinced a high degree of determination to grapple with difficulties and from the accounts of the advances achieved to date it seems evident that outstanding progress can confidently be expected in the future.

From the reports the following items have been selected.

National Poplar Commissions.

The nature and composition of the National Poplar Commissions generally may be gauged from the example of the Belgian Commission. It is composed of fifteen members including representative of the Ministry of Agriculture, the Poplar growers, the Poplar timber users, the Nurserymen, the Research Institutes and the Government, Water and Forest Services.

† Clone Study.

In Belgium the officially approved and most widely planted poplars are the Euramerican hybrids "robusta," "serotina," "serotina erecta," "gelrica" and "marilandica." The study of a large number of other potentially interesting and useful clones is also being carried out. As an aid to this study selected growers in various parts of the country are given free supplies of cuttings belonging to the clones being studied. The only condition attaching to acceptance of the cuttings is that free access to the resulting trees is thereby granted to members of the National Commission. Thus the Commission has the advantage of being able to carry out its investigations at a minimum of cost.

The Poplar Industry in the Netherlands.

In Holland the annual consumption of poplar timber totals 3,300,000 cu. ft. (Hoppus), as follows:—Clog-making, 59%; matches, 19%; plywood and veneers, 10%; packing timber, 9% and paper and pulp, 3%. Because of the premium prices paid for match and veneer quality timber the prices for poplar in general tend to render clog-making less profitable than formerly and as an industry it tends to decline. In the match making industry all the commonly grown poplars are used, but there is a preference for "marilandica". In the box-making industry poplar is considered preferable to spruce—especially where food or fruit containers are concerned.

Poplars Versus Grass Production.

The great majority of Dutch poplars are grown along roads, streams and in boundary plantations. The effects of such trees on the grass production of adjoining lands is a matter of considerable importance. With a view to ascertaining the facts involved the National Poplar Commission conducted an investigation. A series of 43 trials were made and it was found that pasture within twenty metres of the trees showed a reduction in both the quality and the quantity of the grass produced by comparison with corresponding areas outside the deleterious influence of the trees. In ordinary circumstances the production of the 20 metre belts showed a grass output reduction of 23%. When additional artificials were applied this was improved to a 15% reduction. Where drains were cut, separating the poplar from the fields the difference in grass output was reduced to 9% when normal artificial dressings were applied; when in addition to the drains, extra artificials were also applied to the 20 metre strips their grass production was not reduced at all.

---

† A Clone is the term used to designate a group of plants, no matter how large, produced by the vegetative propagation of a single plant.

Underplanting of Poplar.

This question is the subject of study in many countries. In Germany especially it is considered important that underplanting should be carried out. The problem as to which are the best trees or shrubs with which to underplant is not readily solved however. In Britain, Holland and several other countries trials are in progress. In Holland it has been found that the presence of willow in the understory can have a serious effect in reducing the increment of the poplar crop.

Propaganda.

In most of the National Commission reports details of propaganda campaigns aimed at increasing the growing of more and better poplars were given. In Holland a series of radio broadcasts on the subject of poplars was given. In Spain and Germany special films were made and distributed widely. In Germany also, a "Poplar Calendar" was published in 1957 and ran to two editions. In most countries the more fundamental propaganda of ensuring the provision of good advice and of adequate supplies of good quality plants to poplar growers was not being overlooked. In many countries a steady flow of scientific, technical and popular publications relating to poplar is being maintained. In consequence of such encouragement poplar growing is on the increase. In Italy, for example, where Black Poplars and their hybrids are those most frequently grown, and on a rotation averaging about thirteen years, the area of land under poplars increased by more than 10%, or some 385,000 acres, in the two years from 1954 to 1956.

Poplar Research and Development in Great Britain.

In Britain this work is one of the responsibilities of the Forestry Commission which serves as Britain's National Poplar Commission. Poplar growing is encouraged by the Commission through grants made to those who plant a minimum of two acres with poplars, or who plant a minimum of two hundred such trees. The trees approved for planting are *Populus berolinensis, P. canescens, P. deltoides-missouriensis,* and the Euramerican hybrids "robusta," "serotina," "gelrica," and "eugenei."

The Forestry Commission Authorities consider that the Balsam Poplar hybrids would prove very useful in Britain were they not so generally susceptible to that most serious of poplar pathogems there, the Bacterial Canker. These trees are held to be better adapted to cool and humid conditions than are the Black poplars. Great hopes are therefore being reposed in two Balsam hybrids—*P. tacamachaca* × *trichocarpa* 32 and 37—which have in recent times been found to exhibit exceptional resistance to the disease.

In *Sweden* the breeding of new poplar hybrids—those of the Leuce section in particular—is being carried on. Specimens of an interesting hybrid—*Populus tremula* x *tremuloides* have grown thirty feet in height in eight years and have yielded a Mean Annual Increment of 86 cu. ft. (Hoppus) per acre over the same short term.

Amongst the Black Poplars a remarkable female tree, found in mixture with commercial "robusta" and now named "Clone No. 25" has surpassed all others under trial—including "robusta," "gelrica," "serotina," "regenerata," and several Italian hybrids. At Ekebo in southern Sweden it reached a height of 67 ft., after 17 years, when it had attained a breast height diameter of 20 inches and a stem volume of 55 cu. ft. (Hoppus).

From *Austria* it was reported that in the inner Alpine valleys Aspen and White poplar are extensively grown. They are often produced and propagated vegetatively in those regions, by means of root-suckers and vertically set root-cuttings.

In those mountainous regions also, a new hybrid produced through a back-cross of one of the Euramerican hybrids with *P. nigra* L., has been found of considerable value. In some places it has been found to grow satisfactorily at elevations up to 2,000 ft.

The Diseases of Poplar.

Though in Britain and Northern Europe generally Bacterial Canker appears to be the most serious disease affecting poplar, it is the onslaughts of the fungus *Dothichiza populea* which are causing the greatest concern to continental growers in general. From Germany, for example, it was reported that approximately 15% of the poplars in the nurseries were affected by the disease and the estimated losses in plantations ranged from 10 to 12%.

The International Commission has been paying special attention to this problem of *Dothichiza* and a great deal of information concerning it has been assembled. A special working party has been established to conduct a further enquiry and it is hoped that as a result of its efforts and those of the National Commissions already studying this disease, that effective control will be found possible.

Poplar Leaf Rusts.

The increasing incidence of these diseases was mentioned in some of the reports. Though seldom fatal the rusts can cause serious loss of increment in poplars. The fungi *Melampsora allii populina* (with a member of the onion family as secondary host) and *Melampsora larici populina* Kleb (with larch as the secondary host) are amongst the principal pathogens involved.

Among the *Insect Pests of Poplar* the most troublesome appear to be the wood borers *Saperda carcharias* and the larva of the goat moth—

Cossus cossus. Trees attacked by these pests are greatly reduced in value.

Poplar Identification and Nomenclature.

Of the primary tasks which the International Poplar Commission set itself at its inception was the resolution of the extremely complicated and closely allied problems of poplar identification and nomenclature. A good measure of progress has been achieved but a great deal of work still remains to be done. The Commission has decided to act as a Registration Agency for poplars, in accordance with the International Code of Nomenclature of Cultivated Plants. During the course of the congress a definite step forward was taken when the first batch of some thirteen †Cultivars was approved for registration.

Painstaking work in poplar identification is being carried on by several national commissions. In Britain, for example, following the careful measurement of large numbers of their leaves it was found possible to prepare alignment charts which enabled the separation of *P. serotina* and *P. gelrica* on one hand and *P. robusta* and *P. deltoides* ss. *missouriensis* on the other.

Statistical Methods in Poplar Experiments.

In order that the results of experiments with poplar, as carried out by the various member countries of the International Commission, will be directly comparable with each other, an attempt has been made to arrange a generally acceptable code of measurements and general procedure. Following the issue of a questionnaire to all members, and the receipt of replies a working party was formed for the purpose of preparing the code which, it is hoped, will find general acceptance and be applied in field practice by all of the National Commissions.

Willows.

Following the meeting of the VIIIth Session of the International Commission held in Latin America in 1956, and the study of the growth of willows in the Parana delta of the Argentine it was decided that willows should thenceforth be included within the scope of the Commissions' interests. At the Paris Congress the question of willows was discussed further. While some delegates felt that the propagation of willows might also mean the propagation of the great array of insect and fungous pests to which the genus is said to be host, there was general agreement that further study of willows might be rewarding. This, it was suggested, would be particularly true of regions where soil and climatic conditions are not altogether ideal for poplars.

---

† A "Cultivar" is a limited group of closely related Clones the individuals of which are similar in their appearance and reaction to environmental conditions.

The Study Tours.

The Study Tours which preceded and succeeded the Congress proved of very great interest from the point of view of the poplar industry. In addition they were otherwise enlightening and memorable experiences. Arranged with the utmost forethought by the French Poplar Commission they were carried through in a calmly efficient manner which did credit to all concerned. Planned to provide as comprehensive a survey of the many facets of the poplar industry in France as time would allow they proved highly successful. In addition they afforded delegates the opportunity of learning something, first-hand, of the natural beauty of rural France, of the relics of her glorious past, of the vigour of her modern industrial enterprise and above all of experiencing the kindly welcome and hospitality of her people.

The Itinerary.

The whole itinerary, including a day-long, yet interesting, train journey from Paris to Toulouse involved a total journey of some 1,800 to 2,000 miles. The principal centres of interest lay in the Middle and Lower Valleys of the Garonne, the Valley of the Seine and its tributaries, the Blois region of the Loire Valley and the Calvados region of Normandy.

The French Forests.

Before dealing with interesting matters which were studied in the course of the tours it might be useful to put things in proper perspective by giving some general data as to Forestry in France and the place of poplar in the French timber industry.

The total area of land classed as forest in France is 28,000,000 acres or 21% of the entire land surface. Of this, approximately 70% is under hardwoods such as oak and birch and 30% is under softwoods such as maritime pine, Scots pine and spruce. Of the total forest area poplar represents but 1.3%—a seemingly insignificant part. It is in its productivity however that the poplar displays its real importance. It represents no less than 21% of the total of national timber production, and of the hardwoods grown, it yields 57% of the industrial timber produced.

Poplar Growing means Black Poplar Growing.

In France as in Italy and indeed in most of those European countries where poplar culture is traditional, to speak of poplars is to mean Black Poplars. Aspen and White Poplars do occur but they are of relative inconsequence by comparison with the others.

As in other countries also poplar growing tends to concentrate in certain areas—by and large, in the alluvial valleys of the great rivers. In France some 50% of the poplars grown are to be found in the area known as the Paris Basin—the Valley of the Seine and its tributaries, 25% occur in the Valley of the Garonne and the balance is distributed in the valleys of the Loire, the Rhone and in other areas to the West and North.

Uses of Poplar Timber.

The wide use made of poplar timber is indicated by the following statistics supplied by the French National Poplar Commission. Some 55½ million hoppus feet of poplar are consumed annually by the French timber industry as follows:

Building and furnishing industries ...	46%
Laths and panelling	3%
Box wood	17%
Light packing wood	20%
Cheese boxes	5%
Plywood	7%
Matches	2%

Cross-cutting of Poplar logs into billets for peeling, at cheese-box factory in Calvados.

The Valley of the Garonne.

In the Departments of Tarn et Garonne and Lot et Garonne poplar growing originated along the river margins as a means of bank fixation and as a general protection from floods. In this highly fertile region which has a local rainfall of but 25 inches per annum the restless Garonne regularly overflows its banks following the rapid melting of snows around its Pyrenean head streams or the occurrence of torrential rains in its upper valley. On occasions it rises as much as thirty feet above its normal level. It has therefore been necessary to build twenty foot retaining embankments, or *Mattes* as they are locally known, to prevent wholesale devastation. Outside these a mixed agriculture is carried on, tobacco, maize, vegetables, and a variety of fruits being grown—often interspersed between poplar groves. Between the banks and the river, poplar growing is extensively carried on and stock are grazed on the fertile meadows.

While in the older plantations of the valley trees such as *P. deltoides cv.* "Carolinensis," *P. nigra cv.* Blanc de Garonne, *P. nigra cv.* "Verte de Garonne" and *P. deltoides cv.* "Virginiana" still occur, in the younger plantations "robusta" and "regenerata" more generally occur. In recent times the Italian Clone "I. 214" has been introduced.

From the city of Toulouse the first tour was routed through the Lower Valley via Auvillar, Agen, Marmande and Cousson. From a parapet overlooking the river at Auvillar an example of the general pattern of poplar growing in the region was seen. At a low lying place between the *Matte* and the river near Cousson, a number of stands averaging 16 to 17 years of age were seen and in these Mean Annual Increments were found to vary from as low as 86 cu. ft. (Hoppus) per acre in the case of "serotina" to 280 cu. ft. (Hoppus) in the case of "regenerata."

In this region experience shows the benefits to be derived from inter cultivation between poplars in their early years. In one case where one part of a "robusta" stand had been intercultivated and the other not, the Mean Qr. Girth B.Ht. of the trees on the cultivated area was 26% above that of the trees on the uncultivated area, after thirteen years of growth.

Middle Valley of the Garonne.

In this region the itinerary included the towns of Moissac, Malause, Montech and Bourret.

At the box-factory of the Societe des Emballages de Moissac, which was visited, some 10,000 tons of poplar are used annually in the manufacture of fruit and vegetable baskets and boxes. Of the total production some 80% is exported to North Africa. This factory was said to be representative of a large number of similar ones owing their existence to the poplar groves of the Garonne Valley.

The Regional Populetum.

Close to Bourret—the 12 acre Regional Populetum of the Garonne Valley was visited. It is on a site with an alluvial soil with a p.H. which ranges from 7.9 to 8.9 and a water table which varies from $3\frac{1}{2}$ to 10 ft. In this populetum some twelve clones are being grown for comparative purposes and the benefits of inter-cultivation are also being investigated. Though the populetum was established as recently as 1954 the Italian Clone "I. 214" already gives promise of being the most adaptable as to site, and the most vigorous of the trees planted. The benefits of inter-cultivation are also becoming apparent in the populetum.

The Lower Valley of the Rhone.

En route from Toulouse a stop was made at Nimes, a city of great antiquity which is often and rightly referred to as the 'Rome of France'. There in the bright and warm April sunshine, comparable to that of an Irish June, some time was spent viewing buildings and other great structures dating back to Roman times. Of these the excellently preserved 'Coliseum'—still occasionally used for bull-fighting displays—and the famous aqueduct known as the Pont du Gard, built by Agrippa about 19 B.C., will best be remembered.

By contrast the next stage of the route led close by the towering steeple of the atomic development centre at Marcoules. On reaching that great commercial artery, the River Rhône, the party crossed from Port L'Ardoise to the island of La Piboulette and examined some characteristic natural stands of White Poplar there. An explanation of the treatment of these dense stands was given and as an indication of the growth of this tree—*P. alba* L. *var. nivea*—a 22 year old stand stated to have a Mean Annual Increment of 166 cu. ft. (Hoppus) per acre was visited. Leaving La Piboulette the party travelled down-stream by boat to historic Avignon. There, in bright sunshine but with the local 'mistral' wind blowing freshly, after brief visits to the Chateauneuf-du-Pape—the one time home of the Papal exiles—and to the famous Pont d'Avignon the party boarded the 'mistral' express bound for Paris.

The Middle Valley of the Loire.

In the course of a day excursion from Paris the National Populetum of Vineuil situated south of the Loire near Blois and the Experimental Centre of the Pre-au-Chast in the Chambord demesne were visited.

The Populetum which was established in 1949 is on a soil of silty to clayey texture with a p.H. of 6.6—6.0 and a mean ground water level which ranges from 3-7 ft. over the area. The Populetum is sub-divided into (i) a $13\frac{1}{2}$ acre collection arboretum; (ii) a $10\frac{1}{2}$ acre forest arboretum; and (iii) a $2\frac{1}{2}$ acre nursery. The collection arboretum contains some 900 poplars sub-divided according to the various sections—

Airgeiros, Leuce etc. This collection is used in the study of all the various clones available in France or introduced as being of interest. It is also used as a centre from which material of newly introduced trees is distributed throughout the country.

The Forest Arboretum.

This serves as the Regional Populetum of the Loire Valley. It contains 800 trees belonging to ten different clones. They are grown for comparative purposes and in the form of small stands. Though it is as yet rather early to come to final conclusions, the Italian tree, "I. 214", is already showing a noticeable superiority over the other clones.

The Nursery.

This includes a half acre stool-bed with some 2,000 stools set at 20 × 40 inch spacing. In the sixth year of its growth the bed yielded from 50-60,000 poplar cuttings which were distributed to the French Forest Service and to commercial nurseries throughout France.

The Experimental Plantation of Pre-au-Chast.

Intended as an extension to the National Populetum this $11\frac{1}{2}$ acre plantation was established in 1955 on acid soil which varies from a gleyed sand with a pH. of 4.9-5.4 to a moderately deep peat of a 6.3 (approx.) reaction. Though here again it is rather soon to draw conclusions the indications are that success will be very limited—especially on the peat.

Normandy.

At the Leroy factory of Saint Pierre-Sur-Dives in the Department of Calvados some further evidence of the industrial potential of poplar was seen displayed. There, where some half a million boxes for the famous Camembert cheese are produced daily, the annual consumption of poplar is 20,000 tons and the number of persons employed is 500 (approx.). In order to ensure continuity of supply of poplar the factory owners, some years ago, launched a campaign to encourage poplar growing. They did so by reclaiming and planting 100 acres of local marsh-lands. Later they were joined by other land-owners in a co-operative effort and to date some 600 acres have been planted. The trees used are "robusta" and "serotina du poitou". The Italian clones "I. 214", "I. 455", "I. 92/40" and "I. 154" are being tested as possible trees for future plantings. In this locality where the rainfall is 31 inches *per annum* (a high figure for most of France) the water table is relatively stable and in the areas where the poplars are being grown, it is generally high. It has become a practice, therefore, to plant all poplars as unrooted sets—the idea being that it is best to leave it to the

Part of a 10 year old crop of *P. x euramericana* cv. "robusta" growing near Argences, Normandy. The soil has a pH. of 7.9 and an organic content of 22%. In 1956 the Mean Qr. Girth (B. Ht.) of the crop was 6.8" and the Mean Breast Ht. increment for that year was $\frac{3}{4}$ inches Qr. Girth.

tree to select the optimum rooting level in such soil conditions. While some excellent stands of "robusta" were seen in this area the inadvisability of extending poplar planting to improperly drained, stagnant soils was also demonstrated.

The Paris Basin.

In the Valley of the Oise where the annual rainfall is 23 inches (approx.) some 300 acres of marsh and meadow lands have been rented for poplar growing by the national match and tobacco concern—the SEITA. The trees used are "robusta", "serotina du poitou", "serotina de champagne", "I. 214" and *P. deltoides cv.* "virginiana de Frignicourt". The planting spacing adopted is 23 $\times$ 23 ft. except in the case of "virginiana de Frignicourt" which is set at a 26 ft. spacing. In this area "serotina du poitou" has been found more tolerant of a high water table than the other trees.

The SEITA Match Factory.

This plant which is situated at Saintines consumes some 14,000 tons of poplar annually and gives employment to 350 people. It produces one-third of French match requirements and one-fifth of its match splint requirements.

In addition to growing poplars and making matches the SEITA organisation conducts research into several aspects of poplar, including identification, growth rhythm studies, *Dothichiza* investigation, etc.

Close to the town of Noyon in the Valley of the Verse the SEITA has established an experimental plantation of poplars where intensive study is being given to the problem of disease arising through *Dothichiza populea, Cytospora chrysosperma* and the *Fusarium* fungi.

The Valley of the Marne.

In this area one of the chief centres of interest was the poplar plantations owned by the Societe des Eaux Vannes, established since 1929 on a poor chalk soil which has been irrigated by the waste waters of Rheims. The trees grown are *"regenerata"* and *"robusta"*. Yields generally may be gauged from that of a 25 year old "robusta" stand which had a mean annual increment of 162 cu. ft. per acre. The price being paid for poplar in this area is approximately 4/- per cu. ft. (Hoppus) standing.

At the saw-mill of Vitry-le-Francois near Châlons-sur-Marne the breaking down of poplar to boards and planking for general use and also the manufacture of block-board from poplar were seen.

Valley of the Seine.

At the plantations of the Administration des Eaux et Forêts, near Troyes on an alluvial clay of 7.9-8.4 p.H. and with summer water table of two-and-a-half feet, crops of "serotina de champagne", "regenerata Ourcq", "regenerata Yonne" and "robusta", twenty-three years of age, showed mean breast height quarter girths of 9, 9.9, 10.6 and 10.7 inches respectively.

At these plantations a demonstration of high pruning of poplars was given. The saw was the light-weight "Erve" saw manufactured at Nancy and found to be the best of its type for this purpose. The ladder was one especially designed for the purpose by the technicians at the Ecole Forestière at Nancy. The combined use of the saw and ladder made the pruning of the tallest trees a rapid and apparently easy matter.

Following a visit to the recently established Populetum of Sainte Bênoist near the village of Courmononcle, where the effect of various planting distances are being tested, the party travelled to Romilly-sur-Seine where on a gleyed soil of 7.9-8.1 p.H. and with a mean water table at 3 to 3½ ft., interesting stands of "serotina de champagne" were visited. These crops which ranged from 17 to 19 years of age showed mean annual increments ranging from 112 cu. ft. to 146 cu. ft. (Hoppus) per acre. In this case the presence of roots of old coppice in the gleyed soil was said to have proved helpful to the poplar crop by opening an otherwise compact soil ensuring an adequate supply of needed oxygen to the tree roots.

Leaving these impressive "teen-age" stands of poplar, the party returned by road to Paris. There at the Palais d'Orsay the members took leave of the many friends with whom they had renewed acquaintance or whom they had come to know during the course of the Congress and tours. Each went his way with a feeling of gratitude to the members of the French National Poplar Commission through whose efforts the visit proved so memorable an occasion and so very fruitful as a source of new knowledge of poplars, their production, their cultivation and their use.

Fourteenth Annual Study Tour

THE Council's decision to go 'West' again for the Annual Study Tour proved popular, judging by the attendance, which was good. Limerick was headquarters for this tour of Clare, and South Galway, and as interest was keen, discussions lively, and the all-important weather on its best behaviour the outing was enjoyed by all present.

Tuesday, 4th June, 1957.

Cratloe State Forest.

The party travelled by two special buses to Cratloe Forest, where the President, Mr. Mooney, welcomed the members of the Society and expressed his appreciation of the facilities granted to the Society by the Minister for Lands, and the spirit in which he co-operated.

Mr. Haas, District Inspector, on behalf of the Minister for Lands, welcomed the Society to the District. He introduced the Forester-in-charge, Mr. Kelly, and promised that the local staff would do what they could to make the visit pleasant. The property, he said, was acquired in three parcels in 1936, was 1,100 acres in extent, 200 to 400 feet above sea level and the soil was from red sandstone. It had been old oak woodland, but unfortunately no good oak had been left standing at the time of acquisition. The area had since been planted with Scots pine, beech, Sitka spruce, Norway spruce, Douglas fir, Jap. larch, and Silver fir.

A discussion on the soil and its suitability for the growing of oak developed. It was not considred a good oak soil, as its fertility was low. One member stated that on somewhat similar sites in County Tipperary, only good *red* soil at the foot of the hills can grow good quality oak. The wisdom of re-planting most of the area with pure conifers was questioned, and arguments for and against this were put forward.

In compartment 9 a stand of Jap larch, planted in 1937, average height 43 feet, carrying 530 stems per acre with a volume of 2,019 Hoppus feet O.B. was considered too lightly thinned and a much heavier thinning to bring the material quickly to sawlog size was considered desirable.

A Norway spruce stand in compartment 7, planted in 1937, average height 38 feet, carried 950 stems per acre, with a volume 2,325 Hoppus feet. O.B. Some members were of the opinion that a mixture of deep-rooting hardwoods with Norway spruce would make better use of the available soil and keep up its fertility. Others thought that we could not afford to grow hardwoods like oak, and favoured the application of lime, and artificial manures to keep up fertility.

A discussion on the desirability of high pruning final crop trees arose in compartment 4 where Sitka spruce was planted in 1938, the crop now being 45 feet in height and carrying 560 stems per acre giving a volume of 2,268 Hoppus feet O.B. Members favoured high pruning as early as possible where the crop was to be left to mature, and likely to produce constructional timber. Although the crop looked healthy some considered the site rather dry for Sitka spruce, and feared that the rotation would be short.

Property of Major Stafford O'Brien.

By kind permission of Major Stafford O'Brien the party visited a 180 year old oak plantation near the forest. Before entering this plantation the Convenor, Mr. McNamara, gave an interesting history of the local clans including the O'Briens and the McNamaras who claimed to be direct descendants of Brian Boru.

Mr. McEvoy ably described some of the rarer plants to be found in the district. Major Stafford O'Brien's plantation was considered poor quality oak, timber height being about 16 feet and B.H.Q.G. only 13 inches. There were approximately 100 trees per acre, and the crop had not been treated for many years. Turkey Oak scattered throughout the area were at least 15 feet taller than the sessile oak.

Tulla State Forest.

Having lunched at Shannon Airport the party visited Tulla Forest, where at Maghera Property the damage caused to a 25 years old crop of Sitka spruce by the wind storm of February 4th of the same year was seen. This property is between 600 and 900 feet above sea level and the crop between 30 and 40 feet in height. Thinning had been carried out recently, and drainage was good. Of the 330 acre block about 22 acres were severely damaged, many stems being broken off six feet above the ground.

It was amazing to see how trees had been blown in different directions, and the crop completely levelled in pockets in comparatively sheltered areas. Other more exposed areas were intact.

Measuring, valuing, and marketing problems were discussed and the necessity for a local industry to use such material now available in quantity was readily appreciated.

Wednesday, 5th June, 1957.

The second day of our study tour was favoured with exceptionally good weather and our two buses left Limerick, via the Treaty Stone, passing the E.S.B. Generating Station at Ardnacrusha and round by Killaloe, where we glimpsed one of the launches which C.I.E. are using for touring the Shannon Lakes. Lough Derg looked particularly beautiful in the morning sunlight, but it was noticeable that there did not appear to be a sail or indeed a craft of any kind visible on the blue waters. Perhaps tourism has not yet become fully alive to the attractions of this area.

Tuamgraney State Forest.

On arrival at Tuamgraney Forest (350 acres), the party was welcomed by Mr. White, the Forester-in-Charge. Our first stop was in Compartment 1, Raheen Property. This was an area of approximately 14 acres of Sitka spruce, originally planted at 5 ft. × 5 ft. in 1926 and thinned in 1947, 1951 and 1954. The area was described as having been a grass-rush field at the time of planting. Some of the figures given were:

Number of trees per acre	320
Number of high pruned stems	150
Average quarter girth B.H.	8¼ ins.
Height to tip of average tree	74 ft.
Height to 3″ diameter	58 ft.
Mid. quarter girth (at 29 ft.)	7 ins.
Volume of average tree	19.73 H. ft.
Volume per acre	6,313 H. ft.

In addition, at the time of our visit some 160 trees per acre were marked for thinning. The average tree among these was 5½″ quarter girth B.H.:

Height to tip	68 ft.
Height to 3″ diameter	46 ft.
Mean quarter girth (at 23 ft.)	4½ ins.
Volume of average tree to be removed	6.47 H. ft.
Volume to be thinned per acre	1,035 H. ft.

The figure of 74 ft. for thirty-one years' growth would bring this stand almost into quality Class 1 and it would appear to have produced about 8,000 H. ft. per acre to date. Thinning had been delayed, due to shortage of labour around the 1947 period, the staff then consisting of three men. The high pruning cost about 7d. per tree. On examining the soil, it was observed that there was no profile like that seen, for example, at Cratloe. It was a rich alluvial soil in which the roots had penetrated deeply to give a wind-firm crop. Mr. Clear gave it as his opinion that it was probably the best stand for its age in the country. The rainfall was about 48 ins. Mr. White had felled a sample tree, showing that there was a taper of 1¼ ins. in 29 ft., the Form Factor of .56 being rather higher than normal for this species. Mr. Mooney and Mr. Clear both agreed with Mr. White's observations—that it would be dangerous to compute the total volume of a stand from a sample which might possibly not be typical.

Compartment 8 consisted of 15½ acres of Sitka, planted on peat in 1928 and which had survived very well, in spite of the fact that the River Shannon is liable to back up along the drainage system during times of flood. This stand had to be repeatedly beaten up, due to recurrent frost damage in the early years. The present volume ran at about 10.5 Hoppus feet per tree and there was about 5,686 Hoppus feet per acre. The stand was first thinned at twenty-two years of age and was immune from severe wind-throw during the recent storms. Thinnings realised 1/- per Hoppus foot and some of the timber was good enough for sending to the State Sawmill at Dundrum.

Another Sitka stand showed the effects of the back-flooding of the Shannon and the roots had a tendency to be over the general soil level, while a further stand was on peat (Mr. Mooney thought probably a fen peat) which varied from 3 ft. to 20 ft. deep. On a 1½ acre plot, planted with 50% Thuia, the average stem was 12½ ins., the height 79 ft. up to 3 ins. (94 ft. total height), the mid quarter girth being 8¾ ins. The estimated volume was 7,112 H. ft. per acre.

A promising discussion on the relative merits of "Hoppus" versus "True Volume" had to be abbreviated, due to the intervention of the "Man with the Watch," Mr. McNamara, but we had time to get some figures from Mr. Mooney regarding the analysis of the soil, from which it appeared that the extreme ranges of p.H. were 3.8 to 6.5 The site was very low in nitrogen, ammoniacal nitrogen, phosphate and potash and was medium high in calcium and manganese.

We were treated to a very thorough demonstration by Mr. Swan of the system of stem analysis, the subject being a felled Spruce tree, originally planted in 1914 and now set out for us on the ground in 10 ft. and 5 ft. sections. Great trouble had been taken, with the aid of the diagrams and graphs, to set out the life history of the tree in question and its potentialities as a timber producer. It would appear that the Current Annual Increment of the tree was greater than the Mean Annual Increment, so that the argument is that we should allow such a stand to continue growing as it is putting increment on the growing stock at about 5% per annum.

Property of Dr. McLysaght.

Our party was joined by Dr. McLysaght, the original owner of the property, who very kindly invited us to see his nursery on the adjoining ground and we were considerably impressed by his huge movable glasshouse, which was capable of being hauled on rails from one end of a large field to the other, when changing of the soil became necessary.

Following this, another interesting feature was the sight of an Oak tree which Dr. McLysaght said was reputed to be a thousand years old (inevitably referred to locally as "Brian Boru's Tree") and under the shade of whose spreading branches we were treated to a discourse on the history of the McLysaght clan.

Our break for an *al fresco* lunch in the woods was a tribute to the excellent arrangements of Mr. White and his able assistants. With smooth efficiency (no panic whatever, despite the length of time the party had been on its feet), we were all seated, cups of tea gravitated into hands as if by magic and sandwiches were circulating as though wafted on the winds of the forest.

Mount Shannon State Forest.

Tearing ourselves away from this delectable spot, we resumed our journey via the shores of Lough Derg to Mount Shannon Forest, where we were welcomed by Mr. Byrnes, the Forester-in-Charge. Our first stop here was in Compartment 9, Bohatch Property, where at an elevation of 700 ft., we saw a case of fairly severe wind-throw from a south-westerly storm. It appears that the wind reached a peak in a period of about one hour or so. This twenty-eight years old Sitka spruce plantation was carrying about 630 stems per acre, the average quarter girth B.H. being 6¼ ins. the total height 59 ft. and the timber height 44 ft. Mid quarter girth (at 22 ft.) was 5¼ ins. The volume of a sample tree taken was 8.03 H. ft. and the estimated volume per acre was 5,058 H. ft. Something around 1,400 H. ft. was due to come out in thinning, so that the volume per acre will shortly be 3,600 H. ft., approximately. The marketing of the produce was difficult, rendering thinning unattractive. Mr. Clear then initiated an interesting discussion as to the merits of a system of "thinning in reverse," by which the forester would thin the larger stems, likely to find a market in the sawmill and leave the smaller stems to put on increment, when a market is not available for the lighter thinnings. This could be described as a selection thinning.

Mr. Byrnes then brought us to a case of Group Die Back in a twenty-nine year old Sitka spruce stand. The disease was first noticed in 1955, when there were sixteen dead trees; there are now thirty-nine. Mr. Swan gave us the history of the Die Back, as known to date. This "group dying" was known in England since 1936, but the majority of cases have been reported since 1946. Trees tend to die in groups, but in all observed cases, the spread stops after some time. The roots are the parts affected and crown symptoms of thinning needles and shortened increments are consequent on the dying root system. At first no responsible organism could generally be associated with the disease, until in 1953, McKay & Clear, following up a report by Mr. Shorten, noted an association of *Rhizina inflata* with Die Back groups. *Rhizina inflata* so far has been noted only in association with dead roots or groups. In 1954, the British Forestry Commission began to associate Die Back groups with the sites of mealtime fires. Mr. Swan pointed out that they had found such a fire site in the case of the present attack and members of the party viewed with interest the pieces of charcoal concerned.

Our final stop was at a twenty-eight year old Sitka spruce stand in Compartment 13 of the Bohatch Property. A sample plot of one-tenth of an acre had been measured to give the following figures:

Number of stems approximately	680 per acre
Quarter G.B.H. of average stem	4¼ ins.
Height to tip of average stem	33 ft.
Height to 3 ins. diameter	22 ft.
Quarter girth of average stem at 11 ft. ...	3½ ins.
Volume of average stem	1.87 H. ft.
Approximate volume per acre	2,542 H. ft.

Thursday, 6th June, 1957.

On Thursday, 6th June, the excursion party visited Coole Property of Gort Forest. The weather was fine, and members were afforded an ample opportunity of visiting all the places of interest in the vicinity of Coole.

Coole, once the home of Lady Gregory, noted playwright, and founder member of Dublin's Abbey Theatre, was, during the latter part of the last century, and early twentieth century, a rendezvous for the well known literary personalities of the day. Indeed ample proof of this fact was afforded us, in the course of our walk around Coole, when we were shown the Autograph tree in Lady Gregory's garden. Side by side, were to be found etched in the bark of a stately old beech, the names of G. B. Shaw, Sean O'Casey, W. B. Yeats, K. Tynan, E. M. Martin, Wm. Rd. Gregory and others. To prevent lesser known "literary lights" of the modern era from defacing those autographs, a fence 10 ft. high now stands around this old beech.

Coole Property, was also to give us food for thought in another sphere: in the course of discussions, Mr. Maher pointed out, that it was a limestone area, and subterranean caves and channels abounded. It is not unusual to find large streams disappearing underground, only to re-appear again. Though seven miles as the crow flies from the sea, high tides affect the water supply in the locality. This is due to caves and channels, which connect with the sea.

Mr. T. Cox, Head Forester-in-Charge at Gort Forest, took the party on a tour of the woods. Main item of interest, was the natural regeneration of beech and ash. Our first stop was in a plot of naturally regenerated ash, beech and silver fir growing in mixture. A number of parent trees mainly beech were still standing. Suggestions from members, as to the future treatment of the area, were invited. Mr. Johnston suggested, as a first step, heavy side pruning of parent beech, to minimise damage during removal. Mr. Maher pointed out that in the past few years this crop had made very good progress. Mr. Mooney commented on the fact, that the ash saplings were well formed and would produce hurley material at an early age. The party then moved on towards the site of Coole House, now demolished, and viewed a crop of ash, beech and silver fir planted in 1943. The site, the lawn in front of Coole House, was low-lying, and in the early years we were told silver fir was affected by frost. The crop is now making excellent progress.

Next we visited the Autograph tree in Lady Gregory's garden, reference to which was made earlier.

Next a crop of naturally regenerated ash in mixture with European larch, which required a thinning, was visited. The question arose, what species should be retained. Mr. Maher pointed out that on limestone European larch is liable to suffer from butt rot. Mr. McEvoy considered that ash here had possibly reached its maximum height growth, and in the circumstances the crowns were rather small to permit of a drastic opening. As the party moved through the property, members had an opportunity of viewing the many rare species growing along the avenues. The "Mother Tree," a *Thuia plicata* with 13 lesser members coming from the same root, excited much attention.

A stand of beech, ash, and silver fir, which had received its first weeding, drew favourable comment from the party. The retention of silver fir as the final crop was favoured by Mr. McGlynn. Mr. Mooney considered the crop was open enough for its present stage. Material being taken out is being sold locally as firewood, where a ready market exists for accessible material.

A crop of Japanese larch and ash planted in 1937, which had received a low pruning and weeding, and which it was now proposed to treat was next visited. Members were invited to suggest a suitable treatment for the crop. As there were a number of deformed stems in each species it was suggested that a heavy thinning, leaving the elite stems, would be the most suitable. The introduction of silver fir could then be considered.

The Burren Country.

In the afternoon the party went on a scenic drive via the Burren Country, Lisdoonvarna, Cliffs of Moher and Lahinch back to Limerick. A halt was made at Corkscrew Hill where Mr. McEvoy described the geological features of Co. Clare, and especially of the Burren area—a typical "karst" country of bare carboniferous limestone which had probably never had much soil covering.

Mrs. King then gave a short account of the flora of the area, which is famous far outside Ireland. Its great interest lies in the large number of otherwise rare plants found growing together here though their usual habitats may be poles apart. So you see such late glacial species as *Dryas octopetala* (Mountain avens), *Arctostaphylus* (Bearberry), *Gentiana verna* (Spring Gentian), and several Saxifrages, all of which are normally inhabitants of mountains or sub-arctic regions, growing in Clare down almost to sea-level. In contrast to them there are the Mediterranean plants—*Neotinea intacta* (Close-flowered Orchis) and the Maiden-hair Fern, quite at home in the fissures of the limestone, and all around are masses of plants otherwise rare or uncommon in Ireland. The explanation of this varied abundance in such apparently unpromising conditions lies in several factors. The mountain plants have the same open situation and freedom from competition of larger plants which they would enjoy in the hills and so have been enabled to persist since post-glacial times. The southern group are probably relicts of a warm inter-glacial period which found complete shelter in the deep fissures of the limestone pavement where also enough moisture percolates to serve their needs. Both types enjoy the good drainage.

Besides the flora of the karst area you find patches of scrub occurring wherever enough soil covering exists to give them a rooting medium. In places the ground flora is even suggestive of woodland having at some time existed there. However, in Ireland woodland plants often grow with no more shade than that afforded by furze and bracken.

In conclusion there is one more problem deserving of attention. Plants that are calcicole or calcifuge in England or the Continent do not always show the same preferences in Ireland. This is just one more headache for the botanist.

After a very welcome tea in Lisdoonvarna the party viewed the Cliffs of Moher, and then proceeded to Limerick.

This concluded our Study Tour for 1957.

CORRECTION TO VOL. XIV, No. 1.

Summer, 1957.

Page 43, Lines 15 and 16.

for

"(b) Scots pine	20	2-4¾	3¼	14	26	925	760
(a) European larch	20	2¼-4¼	2¾	17	29	925	160"

read

"(b) Scots pine	20	2-4¾	3¼	14	26	925	760
(b) European larch	20	2¼-4¼	2¾	17	29		160"

Obituary

John O'Leary

1892—1957

News of the death, on November the 13th, of Mr. John O'Leary came as a great shock to his colleagues and friends both inside and outside the Forestry Service. Up to a day or so before this, few were aware that there was anything serious the matter and the fact that he had gone to hospital did not give any cause for concern. It seemed unbelievable then, to hear that he had passed away within the space of a very few hours and the news was received with stunned incredulity.

One might say that 'John O', as he was affectionately called, and forestry in the Midlands were synonymous, particularly in the Slieve Bloom country where his vast knowledge of local forestry conditions left an indelible mark on all forestry operations carried out there.

Prior to his transfer to the chargeship of the midland forest district, Mr. O'Leary served with distinction as Forester at Glenmalure, Clonmel, Clogheen and Cappoquin. It was not, however, until he arrived at Portlaoighise and worked the Midland area that his real worth became apparent. This District is regarded technically by most foresters as probably the most silviculturally difficult of all areas to handle and we cannot praise too highly the work carried out by Mr. O'Leary during his 19 years of office there. His exceptional energy, keeness of mind and devotion to duty enabled him to build up a deep and intimate knowledge not only of each Forest in his District but of each Compartment in each Forest and it was said of him without much exaggeration —he knew every tree in his sphere of activity.

'John O' was a quiet man both in private and public life and in company his voice would be rarely heard. It was his quiet confidence and sympathetic manner that impressed most and induced people to consult him on all possible occasions.

No tasks were too heavy for him and were always handled with speed, efficiency and, above all, utmost good humour, despite the heavy burden of work which rested on his shoulders at all times in this District.

His kindness to others, particularly to the "lame dog" was legendary and his death has left a void in many lives which will be difficult to fill.

Review

The Empire Forestry Review. Vol. 36, No. 3, September, 1957.

Published by The Empire Forestry Association. Price to non-members 7/6 net.

In this issue Professor E. P. Stebbing, University of Edinburgh, gives a further account of forestry research in various parts of the British Commonwealth including outstanding items of investigation into forestry problems in Canada, Australia, New Zealand and South Africa.

Dr. F. C. Hummel of the Forestry Commission gives the first instalment of a report on a visit to the Soviet Union.

This visit by six British foresters and an interpreter in September, 1956 was at the invitation of the Soviet Government.

The vastness of the forests of the U.S.S.R. can be gauged from the total woodland area which amounts to 2,640 million acres or about half the total land area of the Soviet Union. This is about 660 times the woodland area of Great Britain or about 50 times its total land area. It is about a quarter of the total woodland of the world. More than half the forest area is classed as mature or over-mature and the annual cut is less than half the estimated increment.

During the tour of inspection the spotlight was mainly on research, silviculture and shelter belts (as requested by the visitors).

It would seem the visitors found that the equipment and staffing of the research stations are much on the same lines as in Great Britain and Western Europe, and the fact that there are detailed sample plot records going back to 1876 showed that there has been continuity of work.

Planting of shelter belts as protection to agriculture against wind and snow is concentrated mainly in the arid regions of the south east, the Volga areas and semi-deserts of the central Asian republics. In this matter of shelter belts a good deal of attention seems to be paid to the balance between upper canopy and lower canopy species. The main tree species used are European larch, Norway spruce, lime, oak, birch, Norway maple and American ash while the shrubby species comprise dogwood, privet, red-berried elder, hazel, wild pear and currant as well as *Caragana* and *Euonymus* spp. The belts are considered to be effective for a distance equal to about 20 times their height. There is useful information concerning the lay-out of shelter-belts and the effects of shelter on the yields of crops.

The visitors found the Russian forest officers and foresters keen, competent and cheerful. In these islands where forestry is very much a man's job there can only be surprise at the information that quite a number of the forest officers in the Soviet Union are women.

There is an article by Mr. D. A. Francis on the use made of aerial photographs and aerial survey methods by foresters in Norway, Sweden and Finland with mention of the equipment and techniques used.

Mr. E. R. Huggard, lecturer in Surveying and Forest Engineering, University College of North Wales, Bangor, has an interesting contribution on the economics of extraction as affected by the date of road construction relative to the age of the plantation.

An article entitled "Differential Effects of Root-Infecting Mycelia on Young Trees in Different Environments" by Dr. Ida Levisohn of the Botany Department, Bedford College, London, tells how inoculation experiments have demonstrated that unequal effects produced by certain mycorrhiza-formers on young trees of birch and Norway spruce are associated with the soil condition under which the plants are growing and that ecological conditions are also responsible for the degree of virulence of a root disease fungus in parasitising Scots pine.

Mr. M. G. Yearsley, Assistant Conservator of Forests, Trinidad and Tobago has given a final report on trials, laid down in June 1939, of Copper Napthenates and Mercuric Napthenates as wood preservatives.

J.J.D.

The Earlsfort Press Ltd., 85 Harcourt Street, Dublin.