

Pinus Contorta in Irish Forestry.

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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 techniques 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 interpretation 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		
		<i>Pinus contorta</i>	<i>Scots pine</i>	<i>Sitka spruce</i>
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 command 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. $\times$ 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, fastigate 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. $\times$ 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. $\times$ 5 ft. to 6 ft. $\times$ 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 fastigate 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. $\times$ 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. $\times$ 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 ($P_2 O_5$), 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.

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