IRISH FORESTRY

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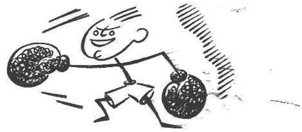

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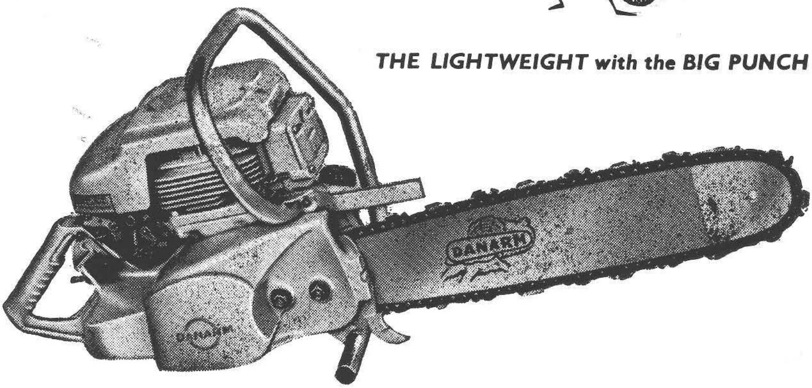

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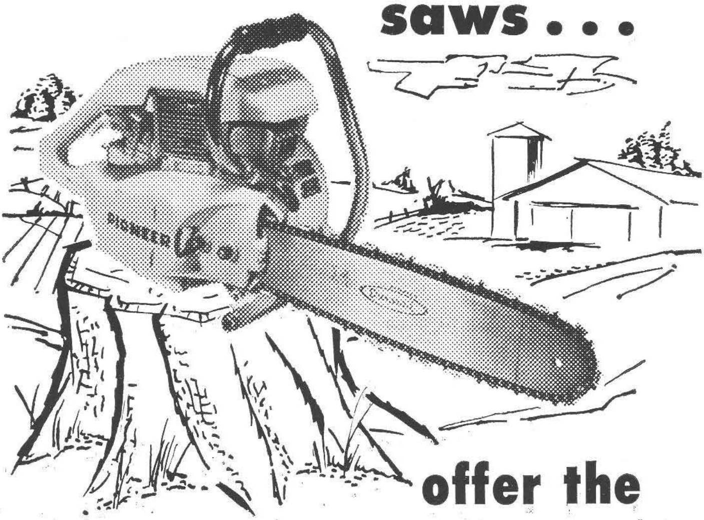

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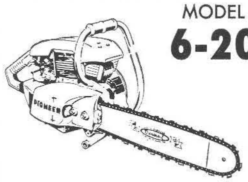

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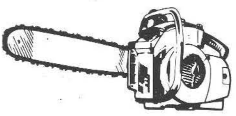

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IRISH FORESTRY

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"Bolander's Pine?"

A. M. S. HANAN

DURING recent years increased attention has been focused on a number of trees believed to be *Pinus contorta*, growing singly and in groups in the grounds of Ashford Castle, Cong, Co. Galway.

Before the 1961 gales there were 16 of these trees noted, but the "big winds" of September 1961 decimated the Cong amenity grounds and left only 9 of the known *Pinus contorta* standing undamaged. Fortunately, a measurement of the individual trees had been carried out in March 1961, and this showed that at least 8 of the specimens were over 80 ft. in height, a further 4 being between 70 and 80 ft. The largest tree measured was 97 ft. high by 10 ft. 8 ins. B.H.G., in November 1961, this being one of the trees that survived the gales. One of the blown trees measured, however, 102 ft. by 9 ft. 3 ins. and contained 167.6 cu. ft. (Hoppus) of timber.

Apart from the fact that these are the largest known specimens of *Pinus contorta* in Ireland (and possibly in Britain also), they are of obvious taxonomic interest. Their appearance, which resembles neither the well-known coastal type nor the less-favoured inland, led us to delve further into their history and background. No local records were available but ring-counts on the stumps of blown trees suggested a planting date of somewhere in the early 1880's. An extract from a 1928 "Gardener's Chronicle" added weight to this idea with this statement:—"On limestone soil at Cong, Co. Galway specimens planted in 1884 had reached a height of 70 ft. in 1923 with straight stems and well-furnished crowns. These were planted as *Pinus bolanderi*." It will be shown later that *Pinus bolanderi* is in fact a regional variation of *Pinus contorta*. Elwes and Henry recognise the introduction of this tree with the following note which appears under the paragraph dealing with *Pinus contorta*:—"A tree of typical *Pinus contorta* planted in 1886 at Grayswood, Haslemere as *Pinus bolanderi* measured, in 1906, 28 ft. by 3 ft. 1 in."

It will be seen from the above two extracts that a form of *Pinus contorta* has been recognised as a distinct taxon by some authorities and called *Pinus bolanderi* (Parl.), but Critchfield inclines to the view that it is a regional form meriting recognition as a subspecies: *Pinus contorta* ssp. *bolanderi* (Parl.). The other forms suggested by Critchfield are:—

Coastal Region:
Pinus contorta. Douglas ex Loudon. ssp. *contorta.*

Rocky Mountains:
Pinus contorta ssp. *latifolia* (Engelm: ex Watts).

Sierra Nevada:
Pinus contorta ssp. *murrayana* (Balf.).

The subspecies *bolanderi* appears to have a very limited range—Lat. 39 and 40 N., and Long. 123 and 124 W.—on the Mendocino white plains of California half-way between Cape Mendocino and San Francisco. This location is a Pacific coastal one about 20 miles long by a few miles wide, rising to only 200 ft. above sea level, and, though small in area, covers a wide series of site-types from heavily leached iron-pan soils to peat bogs further inland. Rainfall is generally high and the tree population extends on to the prairie-like coastal bluffs.

The Mendocino white plains *Pinus contorta* differs from the other three forms in one characteristic, namely, the absence of resin-canals in the leaf transection. This feature is all the more remarkable, when one considers that resin-canals are almost invariably present in the leaves of *Pinus* and are considered a characteristic of this Genus. They are occasionally absent in coastal contorta, particularly in those growing immediately adjacent to the Mendocino plains population. It is possible that the function of resin canals is that of protection against diseases and insects and thus this particular strain may be more prone to attacks of, say, the larvae of needle-miners.

Other differentiating features are not so striking, though it has been found that the Mendocino population have leaves of about 1.3 mm. width which is narrower than in any of the other areas sampled by Critchfield. The leaves were also found to be shorter than other forms, measuring from 3.1 to 4.6 cms. (mean) whereas in the coastal, intermediate and mountain types leaves range from 4.1 to 7.1 cms. in length. However, it is likely that the shortness of the Mendocino plains needles is largely a result of dwarfing due to exposure and it is possible that under good conditions they would be considerably longer.

Seed-cone orientation on the branch with consequent symmetry or asymmetry of the base of the cone is also used as a likely feature for separating *Pinus contorta* forms, but it is by no means conclusive. It suffices to say that the Mendocino type falls into a group with heavily reflexed cones, which are, thereby, oblique at the base. Two further seed-cone characteristics are noted. Firstly, the apophyses on the cone-scale of the Mendocino form are more quadrangular in face-view and pyramidal in outline than the coastal form which has an almost conical or rounded scale. In this feature the Mendocino and mountain groups are more alike than the Mendocino and coastal groups. Secondly, the serotinous habit has been more widely used as a taxonomic character in differentiating forms of *Pinus contorta.* A cone is considered serotinous if it remains closed on the tree for a period of 10-12 months after it matures, and this is very characteristic of the Mendocino white plains population. It has also been found that the Cong specimen cones are harder to open under room-temperature conditions than other home-collected contorta cones.

How well then do our Cong specimens fit into this picture? Firstly a note about the site might be appropriate. The trees in question are growing as park-land specimens scattered throughout the amenity grounds surrounding the Castle. The soil would appear to be a rich brown-earth overlying limestone which outcrops in several places in the immediate vicinity, in the form of the typical deeply-fissured limestone-crag. Shelter is adequate from the estate woodlands, groves and shelter-belts. The main Galway-Mayo mountain ranges lie to the South and West and afford considerable protection from the direct force of the Atlantic gales. The one exception to this is the shore of Lough Corrib, which bounds the South of part of the Gardens, and along which exposure is fairly severe. There are no actual meteorological records for Cong, which lies at around 40 ft. above sea-level, but the following records refer to a recording station at Claremorris, 18 miles to the N.E., at 225 ft. a.s.l. The yearly mean temperature over the years 1943-50, was 50° F. which is almost the same as that for Dublin, Tralee, Foynes, Mountmellick and other centres, but late spring frosts appear frequently in the Claremorris records. Screen temperatures down to 27° F. in April 1950 and 29° F. in May 1945 might be expected to preclude any but the hardiest exotic trees. During the 1943-50 period the extreme minimum screen temperature of 4° F. was recorded in January 1943, being the second lowest recording for Ireland during those years. Yearly annual rainfall, fairly evenly distributed throughout the year, is about 50 inches.

A description of the character and appearance of the trees themselves is difficult as they range between many-stemmed rough-branched types to tall trees with excellent stem-form and dimensions already mentioned. However, one could say that they mostly look like elderly *Pinus radiata* stems with *Pinus sylvestris* foliar-habit! It is this lighter-coloured foliage which first singled them out from the *Pinus radiata* with which they are intermingled. One notable feature of the better specimens is their uniform habit of branching. In other words, the branch spread is not remarkably wide at the base, tapering away rapidly in the typical cone-shape of coniferous trees, but the lower branches are not much wider than those further up the tree, the taper only occurring at the very top. This lends the trees a graceful columnar appearance.

The leaves average 6.7 cm. in length, which is disturbing, as it makes them longer than the average for any of the subspecies in their native habitat, whereas the Mendocino Plain population are reputed to have the shortest leaves! However, as already stated, the true "*bolanderi*" site is a barren exposed gravelly bluff, and the trees only windblown shrubs. It is possible, therefore, that when transferred to such a relatively favourable site as Cong, marked morphological changes may take place. The width of the leaves, 1.4 mm., is consistent with Critchfield's findings, and perhaps most important of all, no resin canals were observed in any leaf transections.

The seed-cones are remarkably long for *Pinus contorta,* 5.9 cm. × 2.2 cm. wide. In spite of being heavily reflexed they are not bulbously asymmetric, but they have a curious long, almost cylindrical appearance, curving towards the twig. The seeds so far extracted from cones of the Cong trees were noted to have unusually long narrow wings and also a particularly sharp hook-like projection on the seed itself.

Of the timber little can be said, unfortunately, as we have not yet had the opportunity of putting it through a full test schedule. However, some of the trees were sawn up in the Forestry Division's Cong saw-mill where it received favourable comment. The pith-flecking so prominent in *Pinus contorta* was very evident in this material which sawed well and planed cleanly with little or no lifting of the grain. Seasoning, along with *Pinus radiata,* proved no worry and the finished boards have an unusually attractive appearance. The intermediate relationship between spring and summer wood allows this timber an attractive "grain" without affecting the planing and working properties.

Seeds collected from these remarkable trees have been sown and it remains to be seen how their progeny behave in a variety of site-trials.

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Forest Haulage Roads in British Columbia

By Jack Durand *

THE building of roads for timber haulage is a comparative innovation by the B.C. Forest Service. This body administers the Crown forest lands of Canada's most westerly province and its 118 million acres of commercial forest stands. A postwar boom in timber had led the industry and the Forest Service to consider utilization of the less accessible of these stands. The Government then began to implement a blueprint presented to it in 1945 for the gearing of felling to growth in State owned forests and to reject older and less enlightened exploitation methods which gave no thought to the future of an area.

Certain forest areas were designated sustained yield units and management plans were completed for them. The province has continued to elaborate these units and to-day there are 78 covering over 46 million acres of productive forest. These are set an allowable cut which is, incidentally, set deliberately low, averaging 10 cu. ft. hoppus per acre per year. These areas are intended for the operation of sales to several smaller loggers, with a pre-set duration of sale which varies from 3 to 10 years. Larger operators generally arrange "tree farm" licences on long terms and are expected to provide their own development investment capital.

In the public sustained yield units, or working circles, the State is the manager through the agency of the local forest ranger and district management staff, there being five such districts in the province. Accessability being a primary requisite for the introduction of management, a special engineering section was organised in 1950 to provide for this. As the most rational system of haulage was by road the section evolved, as far as roading was concerned, into a highly specialised unit covering planning, design and construction. Its budget to-day exceeds £1 million which can be compared with the total forest industry production of more than £250 million (or roughly 40% of total provincial income) and the total allowable cut per year on State lands of over 650 million cu. ft. hoppus.

Planning.

The area of the unit is chosen from considerations of management, silviculture and access. Thus a large watershed or other naturally bounded area is frequently the unit. As the amount and type of roading is related to the amount and type of traffic, volume of timber, and constructional costs, a knowledge of the volume of timber and direction of haul is advantageously provided in the designed unit for a certain

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* (The author worked some years ago as a project engineer in British Columbia on forest road construction. For information on present day operations he is greatly indebted to Mr. P. J. J. Hemphill, Chief Engineer, Engineering Services Division, B.C. Forest Service.)

Naver-Ahbau Forest Development Road, Class 2 Road. Stand of over 100 year old Douglas fir and Western spruce in foreground. Waelti (1960).

Naver-Ahbau Forest Development Road, Class 2 Road. Waelti (1960).

sustained yield, moving towards a particular point or points. These facts, though helpful to the planner, leave him yet to decide a network of roads which ideally will have the least mean transporation cost and redemption costs. This latter concept stems from consideration of the roading as an industrial investment and a redemption or amortization period set usually at 20 years. For purposes of calculation this is regarded as an oncost to be recovered from sales of timber in the unit and the short period is comparable with private enterprise. This relatively short period has advantages in making an earlier return towards a faster rate of overall forest development and is helped by the fact that the most valuable stands in a unit are first exploited.

The calculation of the most efficient road network involves a summation of various combinations of elemental costs. Experienced judgement is necessary to ensure rapid elimination of the less likely methods in what is essentially a trial and error approach. It is found that networks will depend mainly on topography and layout of the block and generally will consist of main and tributary roads. The road classes, of which six are recognised, will on the other hand depend mainly on the tributary yield, which of course is known.

Road Classes — Minimum Dimensions in Feet

Class	Surface width	Subgrade width	Width of clearing
1	24–28	34	90
2	20–24	30	80
3	18–20	24	70
4	14	20	60
5	12	16	50
6	10	12	40

Classes 1 to 3 are double lane, Class 4 is $1\frac{1}{2}$ lane and Classes 5 and 6 are single lane. Classes 4 to 6 have passing bays built. Cut banks are sloped at $\frac{3}{4}$ to 1 or 1 to 1 and fill embankments are sloped at 1 to $1\frac{1}{2}$. Width of clearing is increased where necessary to provide 10 feet of cleared width above cut banks.

Of the roads constructed to date the ratio of length to area is 1 mile to 3,500 acres approximately and is intended frankly as primary access only, it being left to the operators themselves to lay out their own final haulage routes in keeping with their individual equipment. This allows adjustments in keeping with changing trends in logging practice, but it seems safe to assume that the density of construction of roading by the State will increase in the future.

The costs which must be recovered from the volume of timber transported can be divided into:

(1) yearly redemption costs for the road system,

(2) costs of haulage,

(3) yearly maintenance of the road system.

This total cost is usually expressed as dollars per hundred cubic feet of annual cut per mile of road. The general formula is stated as

$$y = ax + \frac{b}{x} + c \qquad \text{(i)}$$

where ax = redemption costs

$\frac{b}{x}$ = haul costs

c = road maintenance costs.

Figure 1 shows this concept graphically.

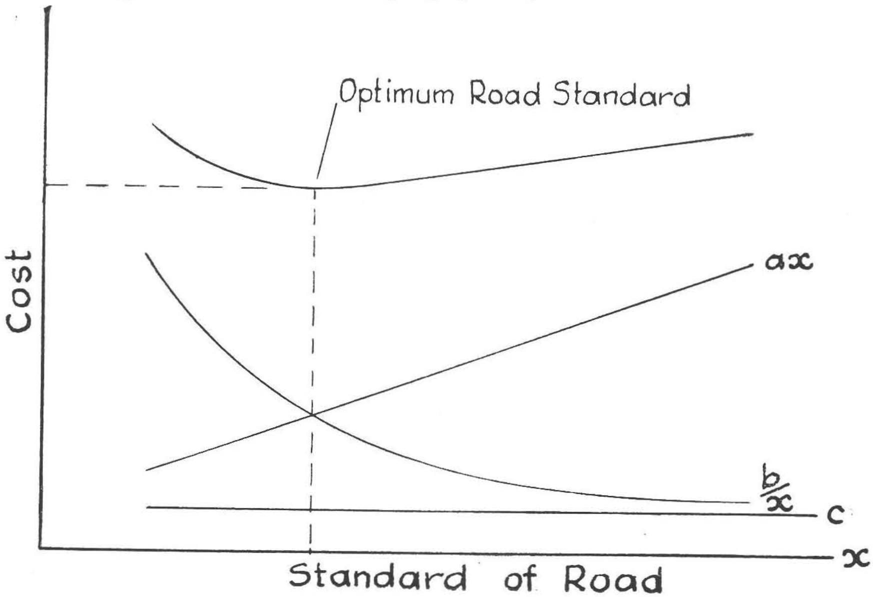


Figure 1

To find the optimal road class the formula is differentiated and then solved for x.

This gives $x = \frac{b}{a}$ showing that the optimal road class is that for which redemption costs and transportation costs are equal. The following table shows the general trend of these figures for the six classes of roads.

(i) Sundberg, U. Studier i Skogsbrukets Transporter Svenska Skogsvordsforeningens Tidskrift No. 4 1952 and No. 1 1953.

Road Class	Average Tributary Annual Cut in cubic feet hoppus.
1	8 million
2	4 — 8 ,,
3	2 — 6 ,,
4	1 — 2½ ,,
5	½ — 1½ ,,
6	less than ½ ,,

As can be seen, a deal of flexibility and assumption exists and experience is relied upon to choose between alternative evaluations provided by examination of all known factors.

Finally, the development estimates are tabulated and a decision on a programme of gradual construction is made. This allows for immediate access to over-mature stands and also for priorities between different units depending on availability of fiscal funds and management requirements. The Canadian Federal Government contributes a small proportion of the cost to the Government of B.C.

Procedure in Development Planning.

The first stage is office work, comprising a study of forest statistics —annual cut, age distribution etc., provided by forest surveys—and of maps and data giving existing means of access to the area. Aerial photographs are used extensively at all stages of the work.

The second stage is undertaken in the field in summertime. There is first an aerial reconnaissance, by helicopter where practicable, to mark critical points on the photos and to record on tape descriptions of terrain and generally to get the feel of the area. Secondly there comes the ground inspection on foot. This can be an arduous pursuit as the engineer packs supplies and equipment to cover a trip of some days' duration.

Points from the photographs are picked up on the ground and notes made on all points of interest in determining final route layout, gradients, bridge sites, costs and so on. A reliable and experienced observer can progress at 2-3 miles per day on this type of work and furnish information on which rather accurate estimates can be based. This, the third stage, is a tedious operation, involving estimation of earth quantities and construction costs, bridging and culverting costs and transport times on any proposed route. The correlation of these various factors yields the road class and so the system. Should the answer lie between two road classes the higher order one is chosen as it is to be expected that annual increment will increase with management.

Road Design.

The road classes having been defined, the detailed survey and design of the route is next undertaken. In keeping with general American standards, field costs of survey are of the order of 5% of construction cost, with an additional 2% covering draughting and estimating, so that the standard of survey is matched to the road class. Just as distinction is made in road classes, there are also design classes. Class 1 is a specific design with the highest standards of accuracy and is not stated in general terms. Class 2 is a formal design requiring the plotting of plans, profiles, cross sections and a tentative grade line. Contours at 5 foot intervals for up to 100 feet wide must be established along the accurately laid out centre line to allow of calculation of earth movements. Class 3 design employs generalised graphs for the computation of quantities. It is used in road classes 4, 5 and 6 and requires only plans, profile and a tentative grade line. Class 4 design is used in development planning described above and is again a graph design.

For the various road classes there are specified design speeds and gradients which are set as standard for each project. The following table is observed.

Design Speed (M.P.H.)	Minimum Radius feet	Road Class
50	900	1 & 2
40	600	2 to 4
30	340	3 to 5
25	240	4 to 6
20	140	5 & 6

In specifying grades, allowance is made for the fact that laden trucks will generally be travelling in one direction so that a distinction can be made between favourable and adverse grades. Allowance is likewise made for the capability of a laden truck to develop top speed on grades of up to 1 in 25 or 4%, and grades for the higher order roads are kept within this limit.

Table of Maximum Grades allowable

Road Class	*Favourable*		*Adverse*	
	Less than 600 ft. long	More than 600 ft. long	Less than 600 ft. long	More than 600 ft. long
1	8% or 1 in 12½	6%	4%	4%
2	8	6	4	4
3	10	8	6	4
4	10	8	6	5
5	12	8	8	6
6	14	10	8	6

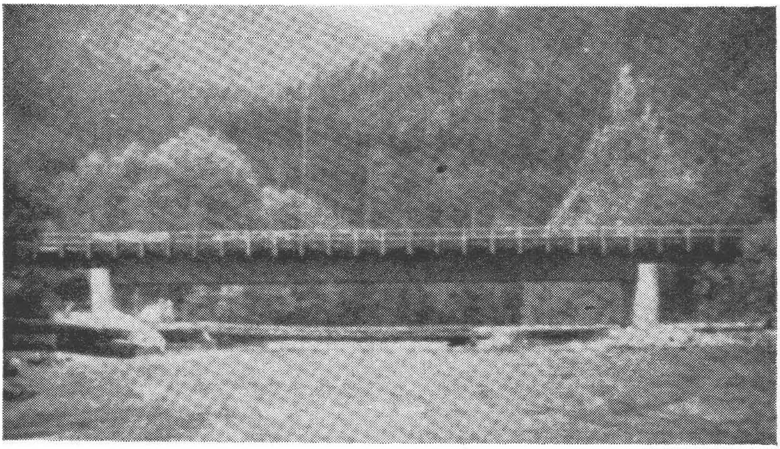
The necessity of ensuring an adequate sight distance to give a driver time to stop when noticing an obstacle on the road ahead must also be considered. For a single lane road this distance will be twice that calculated for the double lane type. In the same context, minimum radii for vertical curves are observed. All of these factors must be considered in design and location and all brought to the same order of consistency to avoid anomaly.

Field Survey and Location.

The field survey is undertaken in the summer months by a party of 6 to 8 men. The party chief may be a university student in his final year of civil or forest engineering and his crew may be composed largely of high school students earning holiday money. The isolation of the camps provide difficulties of supply but trail motorcycles developed for use in the forest are proving of advantage in this type of work.

Perhaps 20 miles of road may be located in the 4 or 5 month season. Use is again made of aerial photographs to first establish the tentative line recommended by the development report. The usual survey instruments are staff compass, steel band and Abney level and they give lines and levels of sufficient accuracy.

The survey results are draughted as the survey proceeds, on the scale of 1″=200 feet horizontal, and 1″=20 feet vertical, and the proposed horizontal alignment draughted and marked on the ground. Cross sections, earth and stand samples are then recorded. The computation of clearance costs and earthworks in balancing cut and fill, where applicable, are done later in the office. This eventually yields the final grade line to be used in construction. In these computations greater use of the ubiquitous computer and punched card machine is being introduced.



Crossing the Chilliwack river at Mile 12.2, this Forest Development Road Bridge spans 102 feet, and has four main glulam girders, each 12½″ wide × 65″ deep. The total length of the bridge is 158 feet, having approach spans also on glulam girders. Built in 1959 for heavy log-truck loads, the deck measures 22′ 5″ between curbs. Note the old temporary log bridge in the background. Scarisbrick (1959).

Road Construction.

The removal of the timber from the line of the road is the first and one of the most costly operations, absorbing as much as 1/3 of the total cost. It will be noted from a table earlier that widths of up to 100 feet are cleared. It is generally difficult to sell the timber and controlled burning or burying is adopted to reduce the serious fire risk from slash. The heaviest of machines are employed at this stage of clearing and de-stumping.

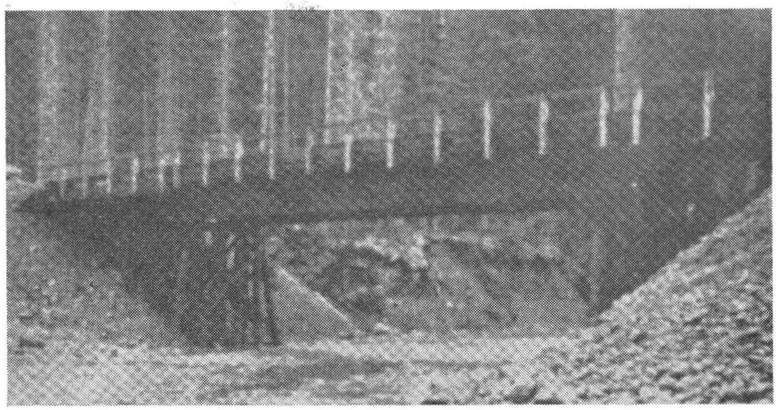
Road construction proper then begins with the large scale movement of earth to its designed and compacted position. Culverts are placed at this stage of the work. Construction is made easier by the presence of easily workable gravels in the main valleys which are glaciated. On higher ground, however, alternative methods of construction and soil stabilization are being employed to an increasing degree. As axle loadings 50% in excess of Public Highway limits are allowed, subgrade compaction is most necessary. These loads in the coastal forest area reach 100 tons on five axle units and in the interior area a load of 50 tons is assumed in design.

The final road surface is intended to be an "all weather" road and may consist of naturally occurring gravel or of crushed stone. As areas come into regular management and consequent heavy traffic, the means of surface binding is receiving attention. Chemical additives are being tested as a first stabilizer in this connection.

Bridges and Culverts.

In designing culvert sizes, maximum periodic run off is expected in order to avoid costly washouts. In areas of heavy snowfall special attention is given to spring thaw conditions.

A particular design section deals with bridges. These are designed as permanent structures on the basis of minimum annual costs, including redemption, as in road calculations. Spans of up to 100 feet are not



Lightning Creek, of historic interest from gold-mining days, is spanned by this 60-foot glulam girder at mile 0.3 on the Swift Forest Development Road near Quesnel, B.C. The one-lane bridge, built in 1957, is on a 17-degree skew. Pressure creosoted pile bents support the main girders. Scarisbrick (1959).

infrequently encountered and superstructure technique has gone some way towards standardization. Creosoted timber is preferred to either concrete or steel on grounds of lower initial cost and less dependence on good maintenance practice than in the case of the latter.

For longer spans transverse decking is laid on glued laminated timber girders. For short spans longitudinal laminated decking may be employed directly or sawn stringers used to carry transverse laminated decking. All timber used is treated under pressure with up to 10 lbs. of creosote per cubic foot and all work possible is done in the shop to aid accuracy and treatment.

Wherever possible, bridges are carried on treated timber piles. These are economical as they eliminate costly underwater construction and abutments and can be driven using conventional road making plant. Freedom from corrosion and security from scouring are also advantages. Protection of the pile bents against ice floes and log jams is necessary in some cases and they may thus be sheeted with planks or steel and pile dolphins driven upstream of the bents.

The erection of bridges is undertaken by the normal road construction crew. The main girder may be walked out by power shovels or other machines or pulled across the river by overhead cable. The experience so far with timber bridges has been very satisfactory and it is natural that this type is encouraged. Although timber is not selected merely because it is timber, design in some cases goes to considerable length to plan timber structures that are competitive in the particular conditions. Close attention is paid to cost records of bridges during construction and information regarding maintenance is being accumulated.

Conclusion.

To date 670 miles of roadway have been constructed in 21 managed units and 24 major bridges have been built. The increasing rate of construction leaves little doubt that these development roads are providing the best solution to present day access problems of B.C's forest industries. Each year great areas of forest are moved from the column headed "inaccessible" to that headed "potentially usable" in forest statistics, and the forest development road is expected to continue to play a vital role in that desirable transformation.

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The Estimation of Heart Rot in Standing Crops: a Note

N. O Carroll and N. Ó Muirgheasa

THE presence of heart rot in a standing crop is often a major consideration in deciding when the crop should be clear-felled. The great problem here is to estimate the proportion of trees affected and the degree to which they are affected. Two of the criteria sometimes used as aids to the solution of this problem are the amount of abnormal swelling in the butts of the standing trees and the proportion of affected trees found in recent thinnings. In the course of a current investigation into the estimation of timber loss through heart rot some data were obtained which are of interest in relation to these criteria.

About an acre and a half of 56 year old Sitka spruce in Avondale forest, Co. Wicklow, carrying 168 trees and believed to be heavily affected by *Fomes annosus* heart rot was scheduled for clear felling. Thirty-six of these trees, forming a random sample of the whole, were investigated in detail.

Buttswell.

This was defined as the ratio of the sectional area at 2 feet above ground level to the basal area, and this ratio was determined for each tree. On felling it was found that eighteen of the thirty-six trees were rotten to some degree, and among the measurements taken for each of the trees with rot were the area of the rot (all stages discernible by eye) at 2 feet above ground level, the total volume of the rot (estimated by Huber's formula in 4 ft. lengths), and total volume of timber containing rot (estimated as for rot volume). This last was termed waste volume. Linear and quadratic regressions of buttswell on each of these three variables, and on the ratio rot area at 2 feet/sectional area at 2 feet, were investigated but no significant relationship was detected. The mean buttswell values for trees with and without rot were then compared and were found not to differ significantly.

Thinnings.

The volume of each tree to 3 inches top diameter was estimated by Huber's formula. The mean volume of the trees without rot was 62.0 Hoppus feet while that of the trees with rot was 39.8 H.ft. (Standard errors were 5.61 and 6.53 H. ft. giving "t" value with probability less than 2%). Since thinnings invariably consist mainly of the smaller trees an estimate of the proportion of affected trees in the crop based on the proportion of thinnings affected would almost certainly be biassed upwards.

Summary.

A limited investigation in 56 year old Sitka spruce suggests that the presence of markedly swollen butts is not related to the presence of heart rot, and that estimates of the proportion of affected trees in a standing crop based on observations from recent thinnings are apt to be exaggerated.

A Note on Damage caused to Apples by Storage in Thuja plicata Boxes

By J. B. Loughnane and L. U. Gallagher

IT was brought to our notice by Mr. F. V. Grennan, Horticultural Inspector, County Limerick, that Bramley Seedling apples stored in "red" wood boxes suffered damage not readily associated with fungal attack, while those stored in "white" wood boxes were not so affected. Also it was reported that where any "red" wood was used mixed with "white" wood in the same box similar damage occurred in apples in contact with the "red" wood and not in those touching "white" wood.

On microscopic examination the "red" wood was identified as being *Thuja* spp., presumably *Thuja plicata* Donn and the "white" wood was of *Abies* spp. An experiment was set up to test the hypothesis that the damage occurred as a direct result of using *Thuja* timber. Newton Wonder apples were stored in boxes of *Thuja plicata* Donn and in boxes of *Picea sitchensis* (Bong.) Carr. Further, apples were immersed in aqueous extracts of Thuja, Sitka spruce and in distilled water.

On termination of the experiment, while some apples stored in both types of boxes showed rot caused by a *Penicillium* fungus, the damage typical of that reported was not evident in Sitka spruce boxes, occurred in 39.3% of apples in mixed spruce and Thuja boxes, and was found in 54.9% of apples in *Thuja plicata* boxes. All apples immersed in Thuja extract were damaged while no damage was found in apples either in spruce extract or in water.

In appearance the damage first showed as an orange to light-brown blemish. After a while the skin shrivelled slightly, the affected area was depressed and developed a mid-brown colour. The damaged area remained quite firm and it was only after secondary infection by *Penicillium* and other fungi that a soft rot developed.

These findings are in agreement with those of Calhoun *et al.* (1961) who studied this problem independently at Queen's University. Trees of the genus *Thuja* are well known for their durability which is associated with natural preservatives contained in the heartwood.

Gardner and Barton (1958) made a study of these, and apart from finding many phenols, isolated three isomers of thujaplicin. Thujaplicin is extremely toxic and Calhoun and Parks (1963) showed that it produced damage to apples similar to that indicated above. Thus it would appear that the highly toxic Thuja extractives are very damaging to apples in storage. Calhoun *et al.* (1961) found this damage also associated with redwood boxes (*Sequoia sempervirens* (D. Don) Endl.), but only to a lesser degree in partly seasoned, and not at all in one year old boxes of Thuja. It is evident that *Thuja plicata,* when fresh, is most unsuited for apple boxes and should not be used in their manufacture.

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Society Activities

Illustrated Lecture in Dublin

AN illustrated lecture was held in the Shelbourne Hotel, Dublin, on Saturday, 15th December, 1962.

The President, Professor Clear introduced the first speaker, Mr. D. McGlynn. He expressed the appreciation of the Society to Mr. McGlynn for volunteering to speak, at very short notice, instead of Mr. Joyce who was unable to be present due to illness.

Mr. McGlynn prefaced his illustrations with a short *resumé* of the visit to Holland in which he and Mr. Joyce participated. They had gone as representatives of the Department of Lands, on a tour of that country. The tour was held under the auspices of F.A.O., and organised by the Dutch forestry service. He briefly described the country, emphasising its more unusual features. Holland, he said, was a flat land, being the basin of three great rivers. Its highest point did not exceed 1,060 ft., and were it not for the sand dunes and man's endless battle against the sea, some 40% of its area would be under water.

Holland's average temperature, he told us, was 50° F. to 75° F. Its annual rainfall was, 30 ins. and was well distributed throughout the year. The soil was sandy and rather poor, with most of the forests situated on those areas often subject to water shortage.

Forest land was of course necessarily restricted due to the high population density. At present there were, however, some 390,000 acres of coniferous, and 91,000 acres of broadleaved high forest. Coniferous species were planted in the following proportion :—

Scots pine ...	75%	Japanese larch	11%
Douglas fir ...	8%	Norway spruce	7%

With some Corsican pine, Sitka spruce and contorta pine.

We were told that the State owned 19.5% of the forest, though it controlled 35%. Private owners had 58%, co-operatives 15%, and 7% was owned by public companies. An interesting facet of Dutch forestry was the very large area, amounting to 99,000 acres, of single row trees.

Very little timber was exported and that which was, was primarily pulpwood. Timber consumption was, however, high and some 233m. cubic feet were imported annually. Forest policy had three main objectives.

i. The production of timber. ii. Nature conservation.
iii. Recreation.

In Holland working conditions were good and the forestry workers well trained.

Among the many interesting photographs shown by Mr. McGlynn, were illustrations of poplar and larch plantations, Corsican and Scots pine seed stands, and Douglas fir stands at different espacements. Here it was noted that, though there was a material increase in diameter due to wider espacement, total volume and height growth did not substantially differ. Many slides of up-to-date forest machinery were seen, including barking and snagging implements, extraction trolleys, forest tools and equipment.

The President thanked Mr. McGlynn for his instructive and informative talk and introduced the next speaker, Mr. L. Gallagher. We were informed that Mr. Gallagher had returned to this country a short time previously, from the United States, where he had spent a year at the University of Washington, Seattle, as a Kellogg Foundation Fellow.

Mr. Gallagher commenced his talk by briefly reviewing, with the aid of a map, the principal forest regions in the United States. These regions, broadly classified were :—

1. The Pacific Coast conifer belt.
2. The Rocky Mountain or inland conifer belt.
3. The Lake States mixed forest.
4. The north-eastern mixed forest.
5. The south and south-eastern "pine" forests.

Of these, Mr. Gallagher had visited the Pacific Coast, Rocky Mountain, Lake States and north-east areas. He pointed out on the map, routes taken through these forest regions, and he proceeded to illustrate with photographs, the main guiding factors governing forest management, especially in the west and north-west. Silvicultural, technical, and industrial aspects were illustrated; and also many of the greatly impressive scenic vistas which abound along the western seaboard of the United States.

Rather than following the route of any particular journey made in that part of the U.S., the speaker demonstrated with his illustrations, the pattern of vegetation types from the west coast, inland.

(*a*) *Californian*

First the "Chaperral" was seen, which consisted mainly of scrub forest vegetation. Species present were—*Ceanothus, Eucalyptus,* evergreen oak, etc. This, he said, was essentially protective forest, against soil erosion, and for water conservation. It had little timber productive value.

The redwood forests, where active forestry of a specialised nature took place and which in size and grandeur were the most striking of the forestry world, were then shown. These were pure stands of *Sequoia sempervirens* and understandably, they posed special problems for management and lumbering, due to the enormous height of the individual stems and consequently, the difficulty of felling safely. Another unusual aspect seen, was their capability to reproduce vegetatively from the stump.

Moving inland to the middle and southern Californian region, the rapid transition to desert was seen. Here sage brush growing on a very primitive soil type dominated the sparse vegetation.

Inland from the coastal region, in northern California, Douglas fir occurred immediately east of the coastal fog belt; this gave way to an oak wood prairie association, typified by large expanses of prairie grass and scattered clumps of evergreen oak. This area occurred in the valley between the coastal range and the Sierra Nevada.

Rising up through the Sierra Nevada, the first species met was the "Digger" pine (*Pinus sabiniana*) at elevations up to 3,000 ft. Further up, at 3,000 ft. to 5,000 ft. there were associations of ponderosa pine (*Pinus ponderosa*), the white fir (*Abies concolor*) and the incense cedar (*Libocedrus decurrens*). At 5,000 ft. to 8,000 ft. one of the most spectacular species found was the *Sequoia gigantea,* and also the sugar pine, (*Pinus lambertiana*), the Californian red fir (*Abies magnifica*) and the Jeffrey pine (*Pinus jeffreyii*). From 8,000 ft. to the timber line, grew lodgepole pine (*Pinus contorta* var. *latifolia*), western white pine (*Pinus monticola*), and the mountain hemlock (*Tsuga mertensiana*). Samples of the vegetation types were illustrated by photographs taken in the Yosemite National Park; there also some striking examples of *Sequoia gigantea* were to be found, and the various pioneering species growing at the higher elevations.

Over the ridge of the Sierra Nevadas and descending in elevation, a rapid transition occurred from pine associations to the typical sage brush desert with a rather narrow intervening belt of grassland.

(*b*) *Pacific north-west region.*

In the coastal region, Douglas fir, rising from sea-level to some 2,500 ft., was the typical forest form. In the Cascade range, the main species was Douglas fir, and, associated with this, were many stands of red alder (*Alnus rubra*). This species was encroaching on the many clear-cut and burned areas, posing problems for regeneration.

In the crest of the Cascade range, particularly in the Oregon region, very fine stands of *Pinus contorta* were illustrated; further north this gave way to *Abies amabilis*. Associated with the *Abies amabilis* was *Thuya plicata* and *Tsuga heterophylla* at about 3,000 ft. At timber line, *Abies lasiocarpa* (the Alpine fir) grew and also some very stunted *Pinus contorta* sometimes in pure stands, but mainly in mixture.

(*c*) *Rocky mountain region and eastwards.*

East of the Cascades was the dry land farming region of cereal crop production, the hills and mountains here, bearing species of *Larix occidentalis* (Western larch) "Bull pine" and some Douglas fir.

Rising into the Rocky mountains in the Idaho-Montana area the major forest species was ponderosa pine. Although Douglas fir occurred here, its growth was very poor owing to insufficient precipitation, and frequently stagnation occurred at an early age.

There were illustrations of silvicultural practices in the cultivation of ponderosa pine, such as the methods of obtaining pure stands, frequently incurring the use of controlled fire. In this region also, overall vigour was noted to be less than in the coastal areas.

Finally, some slides of the typical prairie in central Montana demonstrated the situation prevalent throughout the northern midland states where forestry as such did not exist.

The President thanked the speaker, and commented on the value and interest to the audience of the graphic illustration of two different forest regions given by both contributors.

G.J.G.

Pinus contorta in Ireland

A Symposium on *Pinus contorta* in Ireland was held in Hearn's Hotel, Clonmel on Saturday, 16th February. Papers were read by: Mr. O. V. Mooney, on the Origin, History and Provenance of the Species; Mr. J. O'Driscoll, on Improvement by Selection and Breeding; Mr. P. M. Joyce, on Growth and Yield and Mr. A. M. S. Hanan, on Timber Tests.

The President, Mr. McNamara, opened the meeting and introduced the first speaker, Mr. Mooney, to the members.

Mr. Mooney told us that it was the first time, as far as he knew, the Society had devoted a full session to a symposium on one tree species. It underlined the importance we attached to *Pinus contorta* in this country. To further illustrate this we were told that the Department's planting of contorta in the 1934-43 period was 14.2% of all species planted, whereas by 1952 the figure had risen to 40%.

On its history it was learnt that *Pinus contorta* or lodge-pole pine, as it is loosely called in Britain, was discovered in 1805, and was introduced into that country, from Oregon, in 1852, by Jeffrey. The first introduction to Ireland was not known, but what might be the earliest plantings had been recorded at Ashford Castle, Cong. These were trees planted in 1884 of which some fine specimens are still standing up to 97 ft. high.

The first serious planting of contorta was in 1918 in Ballyhoura, Co. Cork. Later, A. C. Forbes planted trees of *Pinus contorta* of the inland and coastal varieties at Avondale, and was so impressed with the growth of the coastal that he ordered further seed for expansion into State Plantations. From 1920 onwards, the seed was imported from many places, but notably from British Columbia, Washington Coast and more towards recent times, from a region known as Lulu Island in south-west British Columbia.

It was realized early on that here at last was a substitute for the scrub-like mountain pine (*Pinus mugo*). Many people did not, however, expect very much more from the contorta than they had from the mountain pine, and it was looked on as a pioneer species or ground improver. This outlook was to change when the superiority of its growth form over mountain pine became apparent, and it was realized that here was pulp and timber potential as well.

Turning to its natural habitat, it was seen, with the aid of a map, that *Pinus contorta* had a wide range; stretching from the Yukon in Alaska, 2,400 miles south, to California. Inland, it reached 1,000 miles to Wyoming, and further north, 800 miles, to Alberta. It was found from sea level to 11,000 ft. The extremes of climate varied from 11 inches, mean annual rainfall, in North British Columbia to 160 inches at Baranof Island, Alaska, and from regions where snow was rare, in California, to the opposite extreme at high altitudes. Resulting from this range of climate and geographic differences, there were many variants of the tree; to such an extent that, in former days, these variants were known as different species. These were variously called *Pinus murrayana, Pinus latifolia, Pinus banksiana, Pinus bolanderi, Pinus virginiana* and *Pinus contorta*. Now it was regarded as being one species, of which Critchfield had listed four sub-species, *Pinus murrayana, Pinus latifolia, Pinus bolanderi* and *Pinus contorta*, and had designated certain geographical ranges to fit their botanical variations.

Botanical differences could most clearly be seen between the coastal and inland provenances. These differences were in needles: coastal—short, 1″ to 3″, narrow, dark green and inland—longish, 2½″ to 4½″, wide, yellowish green colour and branching: coastal—heavily furnished, large crown spread, dark rough bark, and numerous branches, 6 to 9 at each whorl and inland—foliage sparse, few branches, 5 to 7 at each whorl, and lighter smoother bark in its earlier years.

From observation of the various provenances growing in this country, the following became apparent. All provenances attributable to British Columbia were lacking in vigour and showed poor performance, particularly, on poor soil types and exposed conditions. They were, further, prone to severe attacks by pine sawfly, *Diprion pini*. The inland species from Utah, Sierra Nevada and Alberta did not show much better promise.

On the other hand, practically all good crops were traced to contorta from the Washington Coast and the Olympic Peninsula. These types showed consistently greater vigour and health and were particularly noteworthy for their ability to form crops on poor peat site types and even in very exposed positions. Of importance too was the fact that some of the older crops were showing promise of producing good stands of forest timber.

A comparison between the inland and coastal forms was then illustrated by figures. A thirty year old stand of inland contorta growing at 800 ft. above sea level under reasonably exposed conditions was measured in 1961.

Stems per acre	1,086
Average Top Height	36 ft.
Average Height of Crop	31 ft.
Average B.H.G.	14″ (3½″)
Volume per acre	1,182 cu. ft. (Hoppus)

On the same site type, the following could be confidently expected from a good coastal form.

	Quality Class I (29 years)	Quality Class II (31 years)
Stems per acre	540	720
Average Top Height	52½ ft.	44 ft.
Average Height	48 ft.	40 ft.
Average B.H.G.	23″ (5¾″)	20″ (5″)
Volume per acre	2,680 cu. ft. (Hoppus)	2,130 cu. ft. (H.)

As an extreme case of coastal contorta (Washington Long Beach) doing well at high elevation, severe exposure and on thin mineral soil, we had the well known stand at Ballintombay, near Rathdrum, where the elevation was 1,350 ft. Here at the age of 31 years we had the following figures.

Stems per acre	970
Average Top Height	39 ft.
Average Crop Height	34 ft.
Average B.H.G.	19″ (4¾″)
Volume per acre	1,975 cu. ft. (Hoppus)

Inland *Pinus contorta* nearby on better ground and less exposed conditions had as yet failed to close crop and hardly exceeded 15 ft. in height.

Mr. J. O'Driscoll in his paper said that from the last speaker we learnt that there was a wide variation of performance with *Pinus contorta* in this country. This could be traced to the imported seed which had been collected over a wide geographical range. In his talk, he intended to tell us about the methods they were adopting to find the provenance best suited to growing conditions in Ireland and then to perpetuate and improve the strain from that source.

There were two methods by which a good source could be perpetuated. The first, seed orchards, was slow to build up; it was, however, the most exact method as it gave the true characteristics of the chosen trees; the second, seed stands, was an "on the site" method and was really an in between phase until seed orchards could be got into production. Seed stands could only give a supply of genetically superior seed of which the mother characteristics were certain, as there was no control over the pollen dispersal in a forest stand.

For the establishment of a seed stand we learnt that, from the provenances chosen, the most superior stand was selected and after that the better trees in this stand were located. Such characteristics were studied as, place in crop, vigour, stem form and crown. The chosen trees were then helped in every way by removing all competing neighbours and, particularly, inferior trees between seed trees.

For the establishment of a seed orchard, the initial selection of the plus trees was the same as that for seed trees, only, in this case the trees were subjected to a much more detailed scrutiny. After the plus trees had been located, the seed orchard itself could be considered. The scions, which were collected from the plus trees, by means of shooting, were grafted to vigorous stock previously laid out in the seed orchard. Once the graft became effective and the clones were established, the final stage was progeny testing and the eventual production of classified genetically superior seed.

Mr. Joyce said that growth was a general term meaning the gradual increase of a living thing by natural process, but that yield had a totally different meaning. This was the total amount capable of being harvested at a given time.

He said the estimation of growth was essential in forest management and that, while past growth could accurately be measured, future growth could only be predicted with uncertainty.

Yield tables, he said, were a tabular presentation of statistics of growth and yield, which could be obtained from three sources :

(1) *Permanent sample plots;* plots covering a whole rotation from first thinning on.

(2) *Period sample plots;* plots differing in age by a number of years and measured at intervals to give a series of measurements at different ages.

(3) *Temporary sample plots;* plots covering a large series of age classes.

Though the latter method was the least accurate, it was used in most countries and was the method employed recently in constructing yield tables for *Pinus contorta* in Ireland. It had the advantage that years of preliminary plot treatment and measurement could be avoided.

Planting records, Mr. Joyce said, indicated some 84,000 acres of *Pinus contorta* in Ireland and it was felt that data on growth and yield of this species was desirable.

Three basic steps formed the method of yield table construction :

(*a*) The construction of height-age curves (Fig. 1).

(*b*) The classification of plot data by site classes in accordance with the curves.

(*c*) Final yield table construction by plotting the various measures on top height.

We were informed that height-age curves of 97 samples, each representing 3 stems of *Pinus contorta* were constructed. These were selected objectively from census data representing 2,900 acres of coastal *Pinus contorta.* On the basis that top height was not affected by stocking within the range of plantations, understocked and fully stocked stands were sampled.

Height at 25 years was taken as the quality indicator, and quality class I ranged from 40 ft. to 50 ft., quality class II from 30 ft. to 40 ft. and quality class III from 20 ft. to 30 ft. at this age. This corresponded to site indices of 55, 43, and 31 respectively. The graph which also showed the mean curve for each quality class and the interpolated limiting curves was illustrated photographically by Mr. Joyce. We were told that of the 97 sample curves

30% were Quality Class I
50% were Quality Class II
20% were Quality Class III

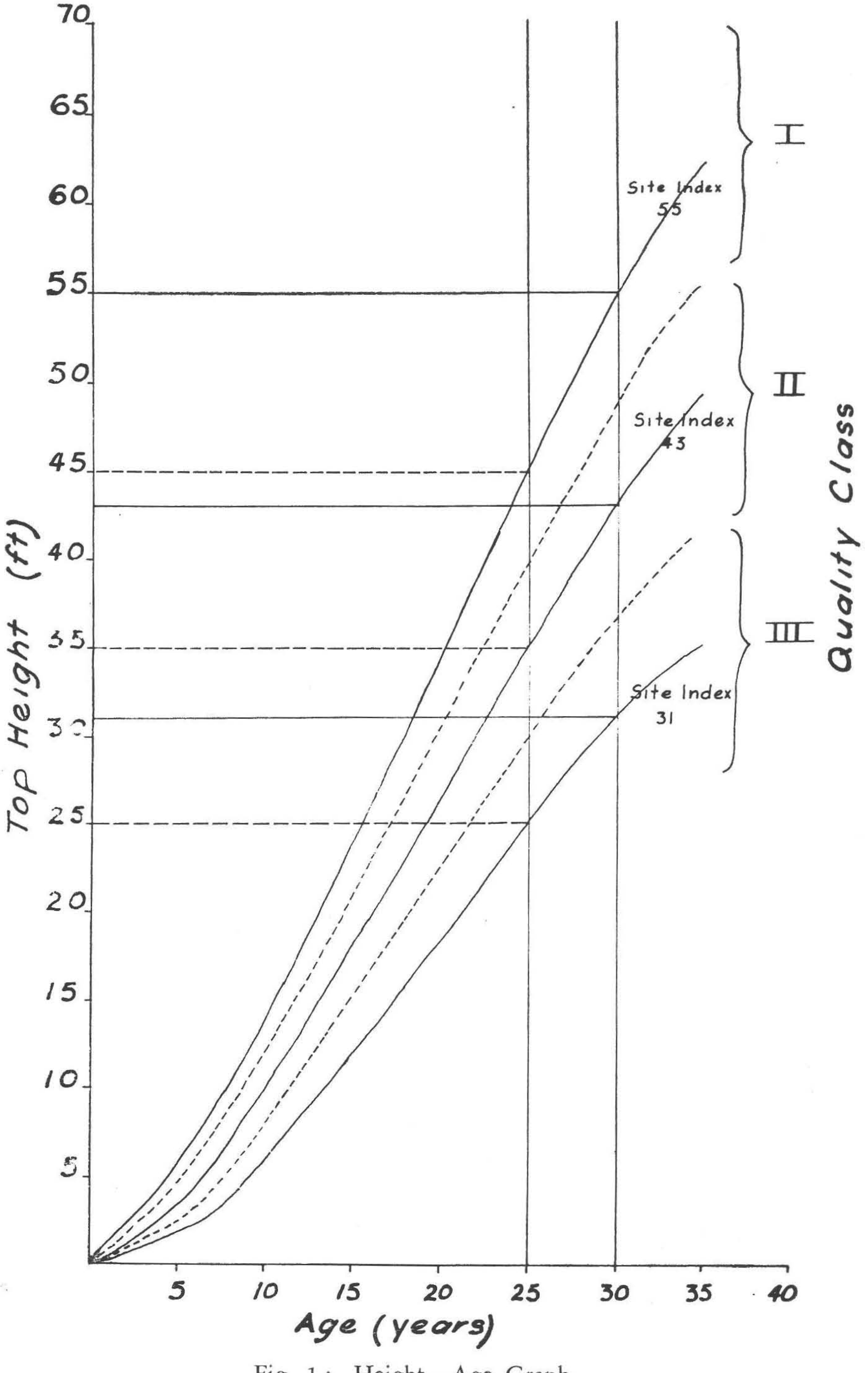


Fig. 1: Height—Age Graph.

Mr. Joyce went on to say that plot data was obtained from subjectively chosen sample plots in fully stocked *Pinus contorta* stands. A normalising moderate low thinning was marked in all plots in need of thinning to counteract the wide range of stocking which occurred.

Spacing in these plots was $4\frac{1}{2}$ ft. $\times$ $4\frac{1}{2}$ ft. and age varied from 14 years to 38 years. Most of the plots were on better sites. There was a scarcity of data from the poorer sites, due to the difficulty of getting uniform fully stocked stands on poor sites which did not reach the 'thinning' stage until about 25 years. Data was also scarce from plots over 30 years on all sites due to the fact that there existed very few such crops.

We were shown illustrations of graphs relating the various crop characteristics to top height, used in the construction of the actual table. These were main crop volume; mean quarter girth of standing crop; mean height; and number of stems per acre against quarter girth as a check. A good relationship was shown for all characters against top height, except basal area, from which no relationship could be determined. It was decided that the difference between quality classes was slight enough to warrant a single graph or equation for each character. In the absence of information on growth and yield, we were told that volume removed at each thinning had to be estimated indirectly.

Mr. Joyce finally showed graphs illustrating, by number of stems per acre on top height, the approximation of present thinning practice to the British Forestry Commission thinning grades. The stocking of plots prior to 'normalisation' showed that the average thinning in Ireland approached the British Forestry Commission 'C' grade.

Mr. Hanan told us that the evaluation of the timber quality of the coastal sub-species (*Pinus contorta*) was not easy, when so comparatively little is known about it. This lack of knowledge was attributed to the fact that, first, in America the coastal species was considered to be a scrub tree and, second, that up until recently, there had been very little research done on this side of the Atlantic and the timber quality was not known.

In America, use had been restricted to the inland variety. This variety had been put to many uses, among which pulp and transmission poles were high on the list.

The first research on coastal contorta timber was done in Prince's Risborough. This was carried out on a small consignment of 43 year old timber from an estate in Scotland; only five trees were to be had, giving a volume of 69 Hoppus feet. Four years later, however, a sample load of 50 coastal contorta was sent to the English research station from Ballyward Property of Blessington Forest. The trees were 28 years old and comprised 405 Hoppus feet, average B.H.Q.G., 33″, and height, 46 feet. In this load there was some visual evidence that two distinct provenances were involved; some trees having a finer branch and better stem form. Though these were kept separate during testing, the only variation between the lots showed up in density and proportion of heart wood to sap wood.

After a year a report was published and from it came the following result:—Proportion of heart wood was 50% to 60% as compared to 25% in Scots pine. There was a noted uniformity of growth—ring-structure as seen in the lack of contrast between the spring wood and the summer wood zone. This gave the wood a quite uniform texture which was reflected in its easy planing and working properties. The Blessington load had, for a pine, a low density, averaging 27 lbs. per cubic foot at 12% moisture content; this, however, could be mainly attributed to the fast ring growth, averaging 4½ rings to the inch. In contrast, the Scottish load had a density of 32 lbs. per cubic foot and 6¾ rings to the inch. This, in turn, was lower than Scots pine and Corsican pine. Strength tests were made for compression, static bending, impact bending, shear, cleavage and a wide variety of others, as well as tests for nailing, nail withdrawal, planing, sawing, etc. The strength tests showed the Blessington load to be slightly weaker than the Scottish load, or Scots pine and Sitka spruce of comparable age, or inland contorta tested in Canada. This was largely accounted for by the high proportion of wide ringed timber grown in the first five years which seemed to have a definite weakening effect. It was emphasized, though, that wide rings within reason, were not a sign of weakness. As far as sawing and general properties were concerned, the contorta was superior to Sitka spruce. Another good quality noted was the lack of inclined grain, which in Sitka spruce is so prevalent; this had particular significance where kiln drying was concerned. The timber in the Blessington load was considered to have seasoned well with remarkably little twist. Any checking was due mainly to large knots. Preservative tests classed contorta as resistant, as far as heartwood penetration was concerned; penetration being easier than Sitka spruce but more difficult than Scots pine. For pulp, contorta was favoured more than any other pine, but must be used soon after felling.

In conclusion, it was thought there was a definite future for contorta. But for all aspects of utilisation it was stressed that particular attention must be given to pruning.

The speaker closed with this comment: that with contorta, so long as it was grown straight, pruned well, and delay in handling avoided, there was little need to worry too much over wide rings.

After the papers were read, several interesting questions followed; but as the hour was late these had to be limited. Mr. McNamara closed the meeting after congratulating the speakers on their excellent papers. He said, he thought we had all learnt many things to-night that we were only half aware of up to this; and felt sure that those who had managed to come, did not regret their journey. He particularly referred to the two members who travelled from Belfast to attend.

Illustrated Lecture in Galway

A meeting of the Society held in Galway on Saturday, 2nd March, 1963, was addressed by Mr. Padraic Joyce on "Forestry in Holland". Mr. Joyce was one of the participants in the F.A.O. Study Tour on Thinning held in Holland in the summer of 1962. The Study Tour was the fourth held under the auspices of F.A.O. and the party travelled extensively throughout the country.

The talk which was illustrated by colour slides covered not only the main theme of forestry in Holland but also took us on a colourful tour of the country. Mr. Joyce succeeded through his extensive selection of slides and by comment in creating a most interesting picture of life in the Netherlands. In addition to forestry we saw the vivid colours of the bulb fields and the flower markets; the landscapes of windmills, canals and picturesque houses; the cities with their quaint versus modern buildings and the people at work and at play.

The meeting was organised by a local committee under Mr. McMenamin and was presided over by Mr. McNamara, our President.

M.S.

Omagh: Symposium on Pinus contorta

THE contributions by Messrs. O. V. Mooney, J. O'Driscoll, P. M. Joyce and A. M. S. Hanan on aspects of *Pinus contorta* in Ireland (reported elsewhere in this issue) were given to a meeting of the Royal Forestry Society of England, Wales and Northern Ireland in Omagh, on 9th March, 1963. The Duke of Abercorn, Chairman of the Northern Ireland Division, had extended through our President an invitation to all members of the Society of Irish Foresters to attend.

The meeting, with an attendance of about 60, was opened by his Grace at 2.30 p.m. and the formal contributions were followed by a period of lively and stimulating questions and comment. Mr. M. MacNamara, President, thanked the Chairman on behalf of the Society of Irish Foresters.

An informal evening followed, organised by Mr. W. G. Dallas, which began with a showing of forestry films and continued for some hours with pursuits of a social nature in which audience participation became more pronounced.

On the Sunday forenoon following, those who remained were conducted on a tour of Lislap Forest by Mr. K. F. Parkin, Chief Forest Officer, and others of the Northern Ireland Forest Service.

N.O'C.

Reviews

Measure for Measure

Conversion Tables by P. J. Rennie, Forest Research Branch, Canadian Department of Forestry, Petawawa Forest Experiment Station, Chalk River, Ontario.

THIS reference book by Mr. Rennie will not only serve the research worker in his daily round, but, indeed, will be of practical use to every forester who is faced with the varied problems of mensuration. Figures and questions that are not easily retained by memory can be referred to in this useful handbook.

Naturally, this publication has a slant towards Canadian problems in measurement. It is, however, equally applicable in this country, dealing with English systems of measurement—including both Imperial and United States units, the Metric system, conversion between English and Metric units, and giving, as part of its Canadian flavour, certain pre-metric French measures of interest in Quebec Province.

The general layout of the sections is arranged in increasing order of complexity. The simple, angular and linear measurements come first, then the square and cube of length, viz. area and volume with special timber measures. After this comes weight, followed by various multiple units falling under the general title of proportion. In this category are two sections depending upon whether the basis is area or volume. The first section embraces units expressing yield or rates of application; the second, units expressing density and concentration. The final sections deal with pressure and energy.

Within the sections, the English, Metric and, where they occur, the United States measures are set out, followed by conversions between them.

Accuracy in relationships is to one part in a million—unless a relationship is an exact conversion. In this way it is possible to select a degree of accuracy depending on the work being done: in some cases, as in quick or rough calculations, a degree of accuracy to one part in 100 or even 10 may be all that is required; elsewhere more exact figures can be taken.

It is clear that this reference book will be an accurate and easily readable guide to all who use it. It can be highly recommended.

M.J.S.

Rotations and Regeneration Problems in Coniferous Plantations in Great Britain

(Supplement to "Forestry"—The Journal of the Society of Foresters of Great Britain.)

Published by The Oxford University Press, 1962. Price: 7/6.

THE Supplement is a report on the Second Discussion Meeting arranged by the Society of Foresters of Great Britain, held in Edinburgh from the 4th to 6th January, 1962.

This publication contains a series of very informative articles on a range of very topical questions. In the first article, for example, a representative of the timber trade describes "the kind of timber the 'trade' would like the grower to produce" and "how the timber should be presented for sale and the felling coupes". Here we have an excellent piece of market analysis which should be a valuable guide to those concerned with marketing of standing timber and thinnings and also those responsible for silvicultural practice. "It often puzzles me," says the writer "why the requirements of silviculture should ever be so exacting as to make a sale obnoxious to the purchaser". Perhaps some of our own timber merchants have felt the same way.

In subsequent articles we get the economists' views and the silviculturists' views on problems affecting the thinning and regeneration of coniferous plantations.

There is a contribution by E. W. J. Phillips of the Forest Products Research Laboratory which considers the gross natural features which govern timber quality and also the effect of rate of growth on structure and quality.

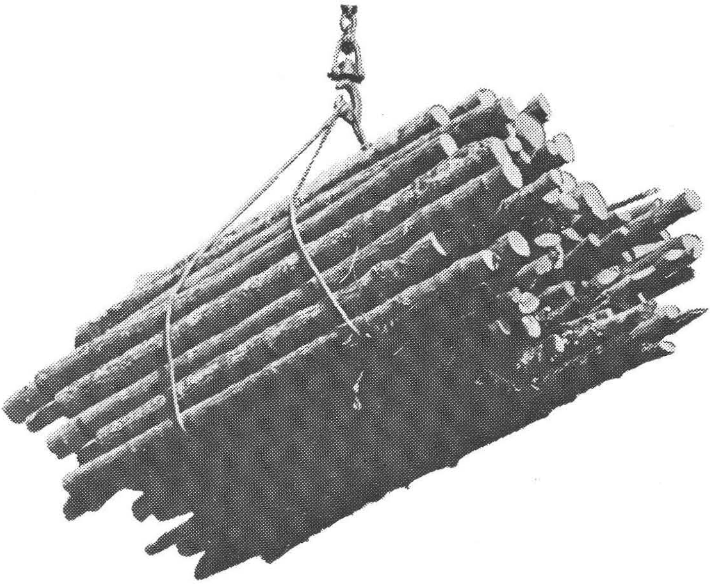
W. E. S. Mutch, in an article on the economics of timber growing, discusses the revision that may come about in economic thinking with the change in national policy that has come with the abandonment of the need to create a strategic timber reserve.

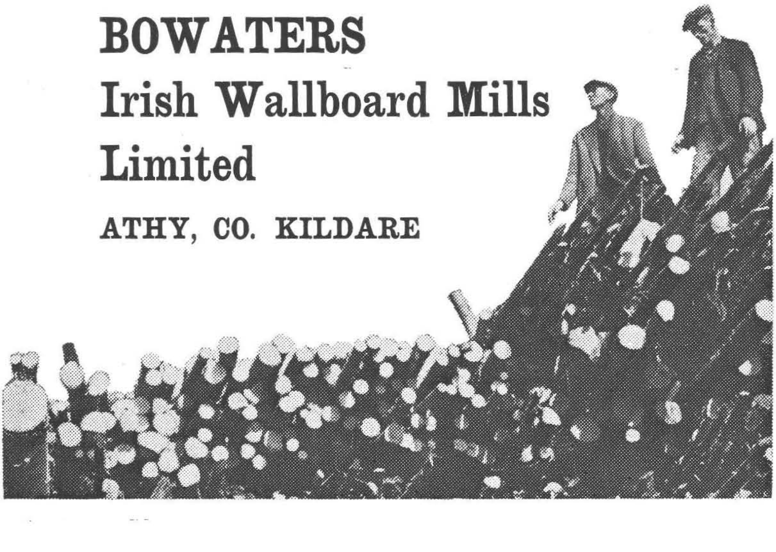
There are articles dealing with the management and silvicultural problems of the approaching second rotation which according to G. B. Ryle, Director, Forestry Commission, England "is going to give us more troubles than we shall later have to face with the third and subsequent generations". Mr. Ryle thinks that we shall have to create our second crop under conditions which may be even more troublesome than those which existed when the first crop was established on bare land.

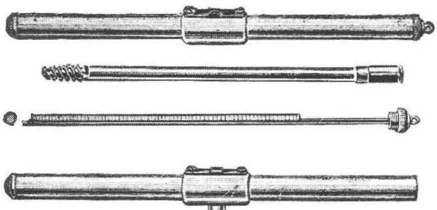
The use of working plans and the factors determining working plan areas are discussed, as well as such matters as rotation length and the pattern of future forests.

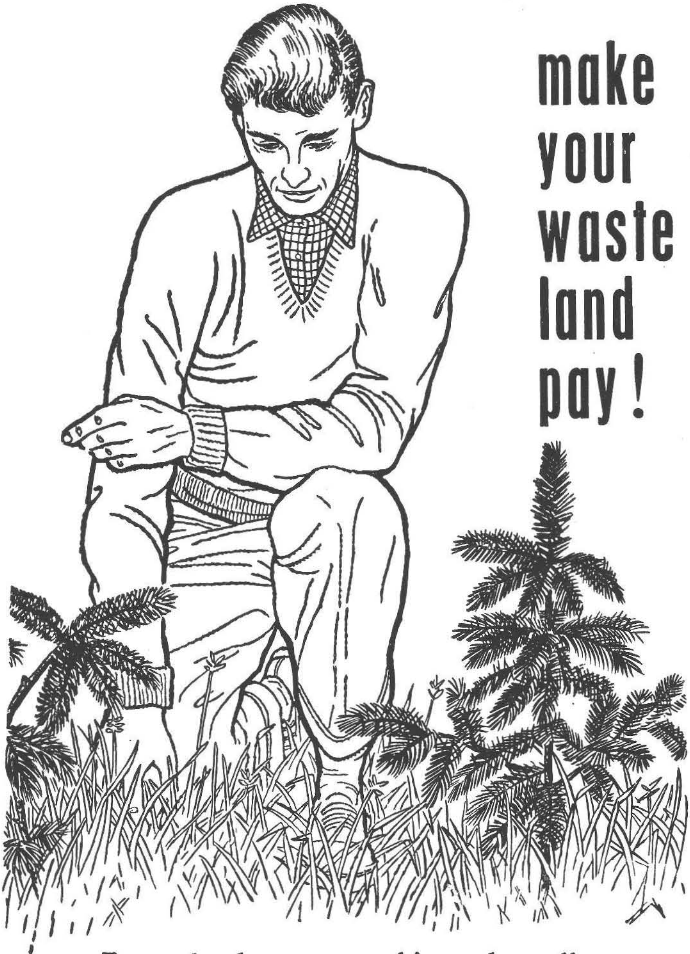
It is obvious to anyone reading the articles and discussions recorded in this supplement that the problems facing the future generation of foresters will be, if anything, more complex than those facing the present, and that it is not too early to be confronting these problems which were aptly characterised as those associated with the conversion of plantations into forests.

T.C.









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