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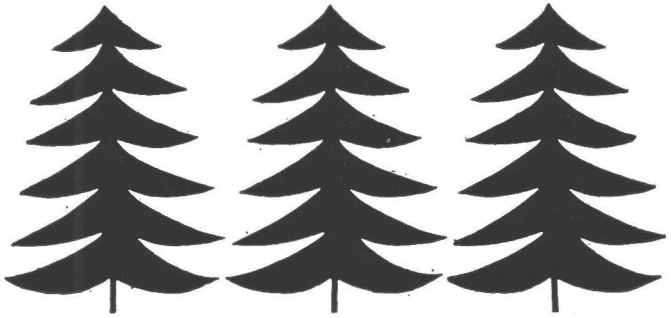

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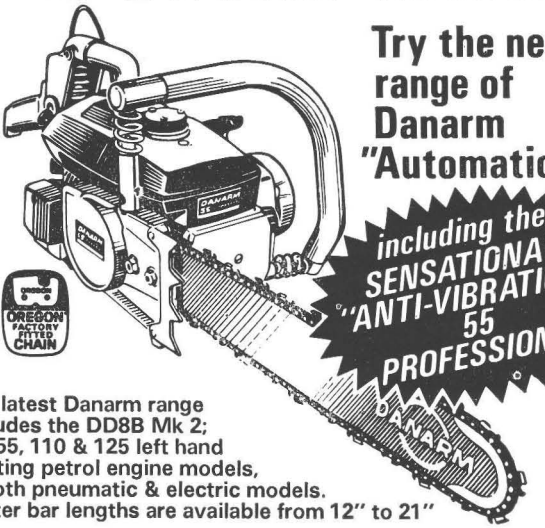

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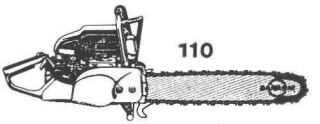

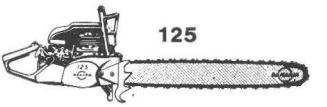

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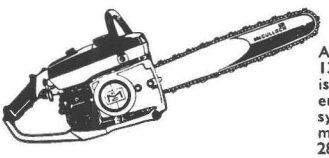

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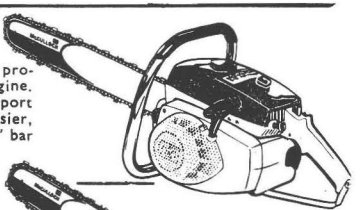

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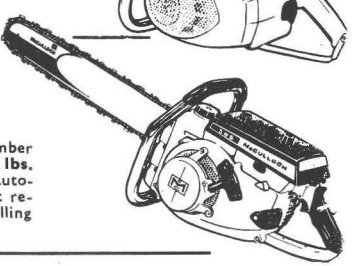

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IRISH FORESTRY

Volume 28 1971 Number 1

Editorial

The Society

One of the few pleasures of this office is the opportunity which the Editor has to express his personal opinions on this page (although under present circumstances there are fields in which he must be very circumspect indeed, and certain paths which he treads at his peril).

In former days when editorials were written it was common to centre them on the subject of the Society. The present editor hereby undertakes not (if he can avoid it) to raise the subject here again, but there are some feelings which must be expressed at least once.

As many members will know, the Society is in sight of financial trouble. Some of the reasons for this are specific but the situation is symptomatic of a general illness, which seems to take the form of apathy.

It is clear that most members are in the Society for what they can get from it, and quite rightly so: this is its purpose. But there are too many of the other class: those who have much to give, and choose not to, either by non-membership or non-participation. These people are generally too short-sighted to see their own ultimate gain from an active and successful Society.

We are all seekers, but we have too few prepared to give as well. (A Kennedy once made an interesting comment on this contrast of attitudes.)

And, of course, the main fault lies with those who have attained preferment, and who, for a variety of reasons, are content to enjoy the spoils without any thought for the less educated, the less successful, the less spiteful, the less selfish and the less aged.

Forest Economics: Evaluation for Rural Development [1]

W. E. S. Mutch[2]

The allocations of land resources presents one of the outstandingly interesting theoretical and important practical problems of the present time. Man's use of the land impinges on almost every aspect of his existence. Directly it involves the space we occupy for work and recreation, the quality, quantity and price of our food and most of our raw materials, and the level of employment in the primary industries. Indirectly, and not least in respect of forestry, land use decisions influence the provisions of material for further manufacture, the opportunity for employment in processing industries and even the promotion or curtailment of international trade.

The planning of land use can evoke strong emotions, since it implies a possible interference in the relationship between man and the land which may have long family associations. Even beyond this stumbling block, however. any attempt to generalise on land allocation is made difficult by the great range of crop productions that may be technically possible, and among food products alone, by the contrasts that exist between the extremes of excess supply and insufficiency, both internationally and within a single state.

In view of the range of conditions, it is difficult to generalise on land allocation problems, and, as in any display of wide diversity, it is difficult to ensure that the criteria and the methods of analysis are appropriate.

Within forestry the theory of resource allocation, including land development, has been dominated for more than a century by the work of Martin Faustmann (3). The contribution of Faustmann and his contemporary, von Gehren, was remarkable in that not only did it provide the land expectation value concept which served forest economics for a century and more, but it foreshadowed the discounted cash flow principle, rediscovered in the nineteen-fifties (6), that is now advocated for project assessment in industry.

In a form hardly distinguishable from Faustmann's original, the net discounted revenue or net present worth calcul-

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[1] Paper delivered at the Annual General Meeting of the Society of Irish Foresters on 13th March 1971.

[2] Department of Forestry & Natural Resources, University of Edinburgh

ation has been adopted as the criterion for project assessment by many forestry authors (4, 5, 10). The method allows for the differences in the times at which costs and receipts occur by discounting them to the moment of decision which, in the literature, is usually the present and the begining of the rotation. The essential feature is the adoption of a fixed discount rate, so that the projects under consideration as management options either are accepted when the time-streams of receipts and costs have positive net present values or are ranked in descending positive (or minimal negative) net present value per acre.

As an alternative to the procedure based on an accepted fixed discount rate, the formula may be re-arranged and solved for that rate of interest, the internal rate of return, which equates the time-streams of costs and revenues. Management options that offer rates greater than some critical rate are deemed to be acceptable (the critical rate being perhaps the market lending rate which may be the opportunity costs of the investment, or the market borrowing rate which may be the actual cost, or 'an average long-term rate' which may give answers the analyst wants, or the social rate of time preference, etc.). When the amount of capital investment is limited by a budget ceiling, projects may be ranked and undertaken in descending order until the budget allocation is filled.

There are considerable difficulties associated with the use of net present worth and the internal rate of return as criteria for resource allocation and management in forestry. The discounting period in years features in Faustmann's formula and its derivatives as the power of the discount rate (sums payable or receivable in the future being multiplied by $\mathbf{1.0p^n}$, where **p** is the rate of discount and **n** is the discounting period in years). As the production periods of forests tends, to be long, the calculations of net present worth, and hence the allocation decisions themselves, are especially sensitive to relatively small changes in the discount rate; conversely, large variations in estimated future income may represent such small changes in the internal rate of return as to seem insignificant.

Net present worth calculations may be used reliably for such purposes as choosing between two methods of tending a forest, say by one thinning regime or the other, or choosing between two species that are equally acceptable silviculturally, although it is obvious that the further ahead the calculation looks the more uncertainty is introduced. It is essential for a proper use of the calculation, however, that the object of management should be clear and consistant

with the factor being maximised upon (which is generally true for all cost-benefit analysis), since if one does not know where one wants to go, no-one can select the best way to get there. There is also an important restriction arising from the viewpoint of the manager or investor, to which reference will be made later.

In its most commonly quoted form in forestry, net present worth is expressed per unit of area, variously called the soil expectation value (9), land expectation value (4), and net discounted revenue (5), but it can be expressed per unit of capital committed to the project up to the point in time when the project is financially self-supporting. In this form the net present worth calculation is not distinguishable from the net benifit: cost ratio of cost-benefit analysis. In essence, all the net present worth calculations derived from Faustmann's formula are merely special forms of cost-benefit anlysis, and they suffer from all the general limitations of that group of analyses, even though foresters fondly believe their arithmetic to be infallible, as many undoubtedly do.

The most common major use of cost-benefit analysis has been in the justification of water-resource projects in the United States of America, for which the evidence of a cost-benefit calculation is a statutory requirement if federal financial assistance is to be available (1, 8). It may properly be used to indicate the best option for the lay-out and timing the building of forest roads and similar constructions, and, on a grand scale, one may even make a case for using cost-benefit analysis to choose the site for a third London airport from among five candidates, if one has sufficient information and courage.

Cost-benefit criteria are useful in selecting between management options which will employ a similar set of inputs, but when the choice is between options that do not use the same factor inputs, or do not even achieve the same objective, a cost-benefit calculation may be inappropriate or simply unworkable.

A full cost-benefit analysis will include all the costs and benefits associated with the project, no matter on whom they fall and to whom they accrue. For instance, the benefits of a dam project include not only the power generated, the value of which goes to the hydro-electricity board, but the loch fishing to those who enjoy that, and the protection from flood damage that benefits the farmers downstream. When the project options are simple, it is legitimate to make a partial analysis, since many of the costs and many of the benefits are common to all the schemes under consideration;

alternative forest road lay-outs probably vary only in the direct cost of construction and in the direct benefits of efficiency of extraction and transport, so that it would be superfluous to go beyond these in order to select the best scheme. As projects become more complex, however, the need for more complete analysis becomes unavoidable, since the secondary effects are not common to the options and even the factor inputs which are the primary costs may not be the same.

This last point must be regarded as a serious shortcoming in such work as the report of the Land Use Study Group in Britain (2), since neither the input factors, nor the outputs, nor the management objectives of the forestry and hill farming options were common. The report itself drew attention to the anomaly of the reversed ranking of the options when the criterion of net discounted revenue per acre was used in place of net discounted revenue per unit of capital invested. Although purporting to regard the options from the national point of view, the calculations did not succeed in accounting for the secondary effects of the investments.

In considering a major afforestation scheme, it is not easy to compile estimates even of those direct costs and direct benefits that can be expected, and it becomes very difficult to evaluate the secondary effects of the planting, say on the economy of the hotel industry through reduced woodcock shooting, on the retail and transport businesses and on the processing industries that will eventually depend on the successful timber growing enterprise. The careful critic may find many such project evaluations unconvincing because of their dependence on the evaluation of non-market costs and non-market benefits. In the recent airport enquiries in England, for instance, each project could be made acceptable or unacceptable on the evaluation of noise and the value placed on the time taken for the passengers to travel between the city and the airport.

In rural development schemes in many parts of the world attempts have been made to evaluate forestry and alternative land use by means of cost-benefit analysis or, more restrictedly, by net present worth or net discounted revenue calculations. Many of these are misleading because of a basic misapplication of the methods. Within each study, the common element may be only the occupation of a particular tract of land; the other inputs and even the investment objective may be so different as to frustrate the comparison.

Before making an assessment of profitability, prospective or retrospective, it is essential that the forester should ensure

that the criteria and the techniques he uses are appropriate. Above all this requires that he declare the viewpoint for the analysis and the objective of the management. The viewpoint may be a personal one, say the proprietor of private woodlands, or that of a commercial company, or it may be a regional or a national viewpoint. At the extremes, a net discounted revenue or an internal rate of return calculation is entirely consistant with the personal viewpoint, since the deployment of resources for money profit maximization is meaningful and realistic, and the private individual can identify the point at which his interest in the timber product ceases. For the region or the nation these conditions are not likely to be met, and even the differentiation between costs and benefits may be far from clear; in these instances this type of analysis is unhelpful, although frequently it is used.

How is 'profit' measured for a region or a nation, when its affluence is the sum of the profits and losses of all its citizens? The authorities must be concerned about the size of the regional income and of the gross national product, and more especially about the income per head of the population. (It may be misguided to assume that increased income does mean more welfare and more happiness, but it seems more sensible than other measures). For the region and the nation, the interest of forestry lies in the opportunity that its production of woody material provides for processing industries, not in what has passed as 'forest economics' for most foresters and state forest services, the financial arithmetic of growing trees up to stumpage or forest gate.

It is only since the work of Liontief (7) and especially in the last ten years that a form of anlysis appropriate to the regional and national viewpoints has been available, input-output anlysis. It is still a clumsy tool because of the large amount of data required, but it is with ideas and with the refinement of technique that foresters should now be concerned in forest economics. The analysis requires that the flow of funds through the economy be followed from the initial payment. The expenditure of funds for afforestation means that wages are spent in local shops, and then re-spent by the shopkeepers, perhaps more than once; that a tractor is bought diverting payments to another part of the country; that deisel fuel and superphosphates are bought from overseas, incurringforeign currency debts; that income taxes are paid to the government, and so on. Some of these shares of the initial expenditure are lost to the economic unit almost immediately, especially the taxes which may be leaked from the system by deduction at source, before they are even paid,

while other payments may be used several times, say from the forester to a retail tradesman, and thence to a farmer and to a local garage before finally leaving the region. Input-output studies show the true value of forestry in the economy of a rural area or of the nation, in terms of the contribution to the gross national product.

It is only relatively recently that there has been significant vertical integration of the forest industry from plantation timber growing to the sale of manufactured timber and pulp products. Where this has occured the technical and financial interdependence of the parts is obvious, and the economic principle of the unity of the firm requires that the integrated enterprise should maximise the return from its whole activity. In this there is a clear lesson for those concerned with rural development and resource allocation at regional or national level. If return on capital is the required criterion, the analysis must maximise the return on the whole capital, mill and forest together; a partial analysis may actualy divert management from the desired course.

When the timber of Kaingaroa Forest in New Zealand became saleable in the 1950s, a contract was entered between the Forest Service representing the owners of the forest and the Tasman Pulp and Paper Co. Ltd., giving the company a large volume of timber each year for twenty-five years at the price of 3d per cubic foot. The low price reflected the fact that there was then a large supply and little demand for the wood, that this was a speculative and pioneering venture. The New Zealand government also acquired a large share in the equity of the firm and the appointment of one of the directors, so that the government could have a voice in policy direction, and receive financial return through company dividends as well as from sale of stumpage and taxes on income arising from the development.

Since the start of felling at Kaingaroa there has been intense economic analysis and replanning in order to improve the financial position of the forest grower, particularly aimed at making the next rotation's crop as financially attractive as possible. The pulpwood contract still runs, substantially unchanged, and the stumpage price of 3.75 cents per cubic foot (the decimal version of the original) is used in forward net discounted revenue calculations, together with rather high prices for saw-log assortments. The management guidance is clearly directed towards a low input system with very wide-spaced trees and little thinning; pulpwood would be produced form the sawmill residues and, mainly, from the knotty tops of the trees which provide butt-length saw-logs. The pulpmill engineers believe this type of material, especially the knotty

top lengths will be technically inferior to pulpwood grown for that purpose in a relatively high input system; although low-priced, the knotty pulpwood may be a high cost material in terms of mill-processing, particularly in 'down-time' of machines from paper tears which are serious in a fast, continuous production process, and in the quality of their final product which has to compete on the world market.

The true merits of the types of pulpwood and the effect on the mill production are somewhat speculative, but it may be fairly said that insufficient is known about the relationship between production functions in processing industries and the quality of the wood that is their raw material. This lack of understanding may be put down partly to the difference in the time horizons of foresters and mill managers and industrial financiers. The latter have relatively short views, and they are interested in the material that is available now; they accept its quality because it is beyond alteration. The technical possibilities of changes in forestry production in the medium to long term in a resource that does not belong to them tend to be unheeded.

The economics of scale in the pulp and panel industries, and in saw-milling also, are such that it seems inevitable there will be continuing increase in the size of processing plants. This implies that the mills will be increasingly vulnerable in respect of interuptions in the supply of raw material, and the managers of the mills must inevitably react by seeking vertical integration with the wood suppliers. Proprietorship implies the control of the management decisions and, in forestry, this means control of the rate of exploitation and determination of the technical quality of the wood produced.

It is therefore pertinent to question the future position of state forests where the state does not own the processing mills. The 'classical' European situation of a communal or state forest supplying processors or consumers who were all small in relation to the wood producing unit has now all-but vanished. The foresters' persistence in planning with net discounted revenue calculations based on stumpage or forest gate sales has masked the fact that forest proprietorship (at least in terms of effective control of management and realization decisions) is rapidly passing to the mill manager. Indeed, the proprietorship of the forests may be much less important than that they contribute most effectively to the whole forestry sector, even if this means state forest proprietorship passing to mills. The situation might require safeguards against spoliation of the forest by a ruthless miller, including inadequate regeneration, since the forest conveys

benefits to society other than wood supply, but reversion of proprietary rights to the state and sanctions could be written into an agreement. It seems probable that something like the British Columbian tree farm licence system, but applied to plantation forestry, would meet the requirements of management and would safeguard society's needs.

There appear to be only two possibilities: that the forestry proprietors, whether public or private, enter the processing industries: or that the large processors become the **effective** forestry proprietors. In several countries the first option is being taken, mainly through co-operatives or associations of private forest owners, as in Norway, but this generally leaves state forestry where it is, certainly so where the government denies the forest service the right to invest in private commercial enterprises.

In the long-run supply of wood for processing, and this is where the techniques of resource appraisal and the effects of viewpoint and proprietorship come together, one of the most important decisions is the location of the forests relative to the supplying mills. From society's viewpoint the effectiveness of wood-supplying forests varies greatly according to their proximity to the mill which they serve. When it is remembered that 65 to 85 per cent of the mill gate price of timber is incurred in the 24 hours before delivery, in felling and transport costs, minimization of transport costs usually provides the most effective way of reducing the cost of the raw material. The important thing, however, is the acceptance of the principle that the whole operation of growing, transporting and processing wood is one exercise in forest economics, certainly when viewed from the regional and national viewpoints.

This is the principle lesson that is emerging from forest economics in relation to land development. The interest in the micro-economics of forestry is diminishing as wood growing is seen as part of a larger industry. The future requires investigation of the inter-industry relations of forestry so that the forest planner may see the contribution that major management decisions make to the welfare of society or to some representation of that welfare, such as the income per head of the population. For purely internal management requirements, the net discounted revenue calculation still remains the most powerful tool, but the emergence of input-output analysis for development planning, it will have a restricted role.

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The Influence of Tree Spacing on Sitka Spruce Growth

W. H. Jack[1]

INTRODUCTION

In spite of a long history of forestry practice there is surprisingly little known about many of the fundamental relationships between tree growth and the growing space per tree. In Northern Ireland Sitka spruce is the most important single species, but it is often planted on sites where ground conditions make thinning extraction, without causing damage, a very costly operation. There is accordingly very considerable interest in growth development without thinning for this species with particular regard for the effects on individual tree size and gross increment.

As experiments starting from date of planting and attempting to determine these relationships would take a long time to produce results, it was felt that the process could be speeded up by starting with an existing plantation. The experiment was, therefore, started in 1960 on a stand of Sitka spruce planted in 1949. At 12 years of age the crop was approximately 4 m mean height and the side branches of the lower whorls were almost but not generally touching. The ground was virtually 100% covered with Polytrichum moss. It was hoped that the plants were sufficiently widely spaced (approximately 1.83 m or 6 ft.) that there had been no competition between individual trees at the commencement of the experiment. It was decided to use this area which was reasonably fast growing and appeared to be fairly uniform to get quick results and to follow up with a series of trials planted on deep peat at various spacings. The latter is in progress.

An area of approximately 4 ha was divided into 25 plots each 0.148 ha in a 5 x 5 arrangement. Five different spacing treatments were then allocated in a Latin Square design. As the area was already planted the spacings could not be arranged in a neat experimental sequence and it was necessary to use 3,000, 1,500, 750, 500 and 330 stems per hectare approximately as the treatments. The closest was the existing planting taken in its entirety, the next was obtained by cutting out every alternate tree in each row and leaving approximately square distribution of about 2.6 m, the next

[1] Formerly Research Officer, Forestry Division, Minstry of Agriculture, Belfast.

took out alternate rows and then alternate trees in the remaining rows to give approximately 3.66 m x 3.66 m distribution, etc, etc. It will be noted that the removals were completely mechanical and great care was taken with this aspect to make sure that the wider spacing did not contain a higher proportion of genetically better trees as would have been the case with a thining.

The stand is on an area of thin peaty humus over heavy blue clay and is the second rotation of Sitka spruce on this site, the first one having been planted about 1921.

At the centre of each plot a sub plot of 49 trees was selected for individual tree measurement. All these trees were measured every 3 years and the following records taken:—

a. Height to nearest foot (approx. 0.3 m).

b. Height to 10 inches girth over bark (approx. 8 cm diameter o.b.) to nearest foot—timber height.

c. Girth over bark at breast height (1.3 m) to nearest 0.1 inch (approx. 1 mm diameter).

d. Girth over bark at half the timber height with precision as at c. above.

From these records all subsequent measures were derived, tree volumes for the purpose of this report being taken to be the volume of a cylinder with height as at b. above and diameter as at d.

In addition to the 3 yearly measurements, records were taken every year on the two treatments where it appeared diameter at breast height differences may have been starting. In December 1969 special measurements were taken on 5 trees in each plot, randomly selected by strata of breast height diameters, to indicate the number of branches in whorls 2 m above ground and at stem diameters of 24 cm and also the size of the two largest in cm diameter.

Although the records were in Imperial units they have been transformed into metric for this report and all future measurements will be in metric units. If possible future tree volume records will be taken from a greater number of points than up to 1969.

TREE HEIGHT

The height of the dominant 4% of the trees in each spacing varied at December 1969 from 12.2m in the closest spacing down to 11.45m in the widest spacing. There is just a suggestion that the wider spacing has depressed this domin-

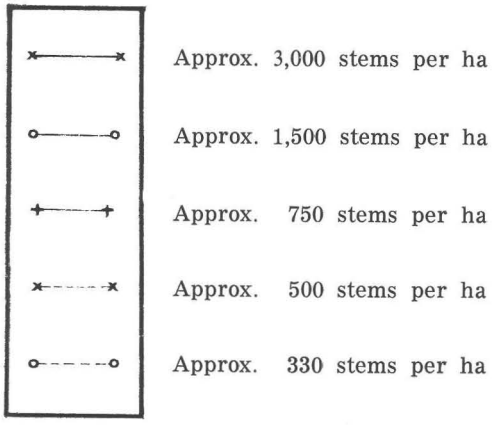
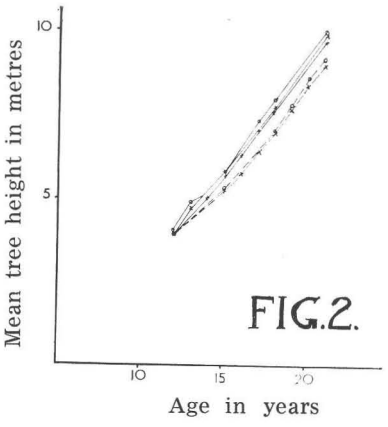
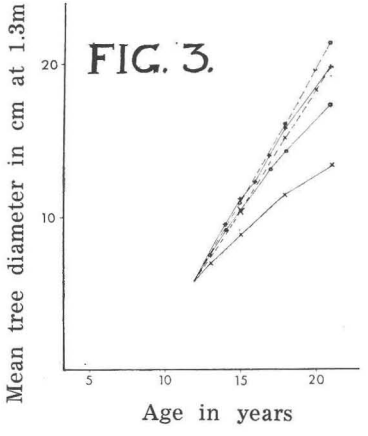
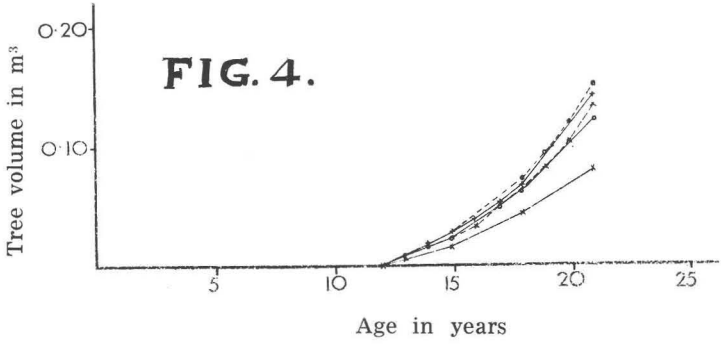


Fig. 1 Legend for all figures where relationships for different spacings are shown separately.







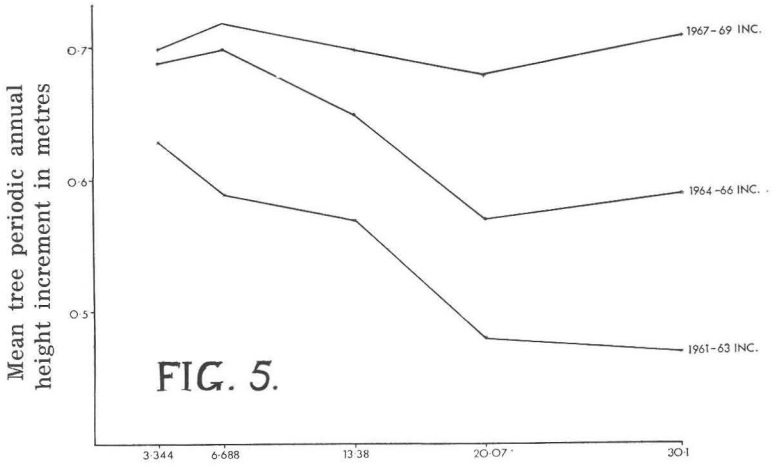


FIG. 5.

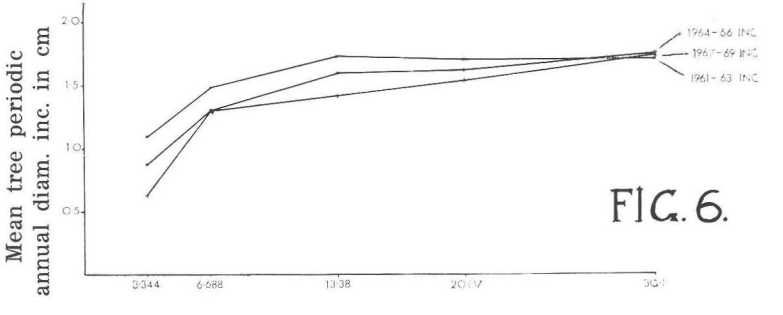


FIG. 6.

ant tree height. If dominant tree height is expressed as the mean height of the 100 largest per hectare as in the FC Management Tables then quite considerable differences are found from 12.4 m in closest spacing to 10.6 m in the widest. These are based on approximately 3% of the crop for the closest spacing and 30% for the widest spacing.

Based on the closest spacing the crop would appear to be approximately Forestry Commission Metric Yield Class 20 and Production Class A.

The mean tree height has progressed at a very even rate throughout the 9 years of measurement and has generally increased from 4 m to 10 m for the 3 closest spacings, but is only approximately 9 m for the two widest spacings. (Fig. 2) This differentation took place very soon after the cutting out at 12 years of age and continued until 18 years

of age. During the past three years all treatments have put on height growth at a similar rate. Taking the mean annual height growth by three-yearly periods one finds that in 1961-63 inclusive there was a fairly steady drop in annual height growth of some 0.075 m for every 10 m^2 extra space per tree until 20 m^2 is reached when there is no further effect. The trees at the start of this period were approximately 4 m high. From 1964-66 inclusive the drop in height growth relative to an extra 10 m^2 space had fallen to 0.065 m over much the same range with no effect over 20 m^2 per tree. Between 1967 and 1969 inclusive the mean leader growth was the same for all spacings. (Fig. 5).

MEAN TREE DIAMETER, BREAST HEIGHT

The following analysis is based on the mean diameters and not on the diameter of the tree of mean basal area.

At 12 years of age when the cutting out was done the trees were on average 4 m high and had a mean diameter of just under 6 cm. Right from the first year the closest spacing of 3.34 m^2 approximately per tree showed that competition was reducing diameter growth relative to 6.69 m^2 and wider spacings. By age 16 when the mean height was about 6.5 m there appeared to be the beginning of competition influence in the 6.69 m^2 spacing relative to wider spacings and a similar pattern developed by age 19 when the mean height was 8 m for the 13 m^2 spacing. The large effect of this can be noted from the differences at December 1969 between almost 20 cm mean diameter for the three wider spacings relative to just over 17 cm for the 6.69 m^2/tree and just over 13 cm for the 3.34 m^2/tree spacing. (Fig. 3).

It may therefore be inferred that if one wishes to avoid competition influencing mean tree diameters it will be necessary to reduce stocking to give more than 3.5 m^2 per tree at average height of 4 m, 7 m^2 at 6.5 m average height and 13 m^2 at 8 average height. It will be noted that the latter is equivalent to a stocking of under 750 stems per hectare before a normal first thinning would be attempted.

Except for the 30 m^2 spacing there has been a general slowing down of diameter increment in consecutive 3-yearly periods since 1960, but this has been more marked with the closest spacings. (Fig. 6). In the last 3 years 1967-69 the closest spacing put on only just over 0.6 cm diameter per year while the widest spacing grew at nearly three times this rate. Throughout the measurement period all spacings except the 3.34 m^2/tree and the 6.9 m^2/tree for 1964-69 inclusive put on more than 1.3 cm per annum, and this is equivalent to very approximately 4 rings per inch which is

one of the limits used in timber grading. It must be assumed that if one wishes to grow to this timber quality and wishes to get it in the centre 15 cm of the average tree at 1.3 m above ground level then the stocking must not be less than 5 m^2/tree (2,000 stems per hectare) when the crop mean height is below 6 m, and not less than 1,500 stems per hectare when the crop mean height is 10 m.

MEAN VOLUME PER TREE

When the cutting out was done the average tree had a volume to 8 cm top diameter ob of only 0.004 m^3, but right from this date the closest spacing (3,000 stems per ha) appeared to be effecting volume growth, i.e., when mean height was only 4 m. (Fig. 4)). The results suggest that competition effects were influencing volume growth of the next closest spacing of 6.69 m^2 per tree relative to wider spacings at 20 years of age or just over a mean height of 9 m. There is, therefore, a much longer time required for competition to influence tree volume than to influence breast height diameter growth. Nevertheless the magnitude of the effect can be judged by comparing mean tree volume at age 21 and mean height approximately 10 m of 0.08 m^3 for 3,000 stems per hectare and 0.14 m^3 for wider spacings. Similarly the periodic annual increment of the mean tree between 18 and 21 years of age was 0.012 m^3 for the 3,000 stems per ha, 0.020 m^3 for 1,500 stems per ha and approximately 0.024 m^3 for the wider spacings. (Fig. 7).

BASAL AREA PER SUB PLOT (49 trees)

Before the spacing cleaning was carried out the basal area sub-plot varied from 0.15 to 0.165 m^2. Six years later the closest spacing of approximately 3,000 stems per hectare was significantly less at 0.565 m^2 than the next three spacings which varied from 0.85 m^2 to 0.98 m^2. A similar difference had been noted 3 years earlier at 15 years of age. However, by 18 years of age the widest spacing of 330 stems per hectare had significantly greater basal area than any other and the basal area of the 1,500 stems per hectare was visibly less than wider spacings. By 21 years of age the widest spacing at 1.88 m^2 was significantly greater than all others and the next two were significantly greater than the 1,500 stems per hectare at 1.26 m^2 which in turn was significantly greater than the closest at 0.77 m^2. As the total number of trees per plot was very similar the above indicates the type of effect on the tree of mean basal area and is similar to the findings for mean diameter given above as would be expected.

Basal area increment per plot showed a similar pattern to that described for total basal area above.

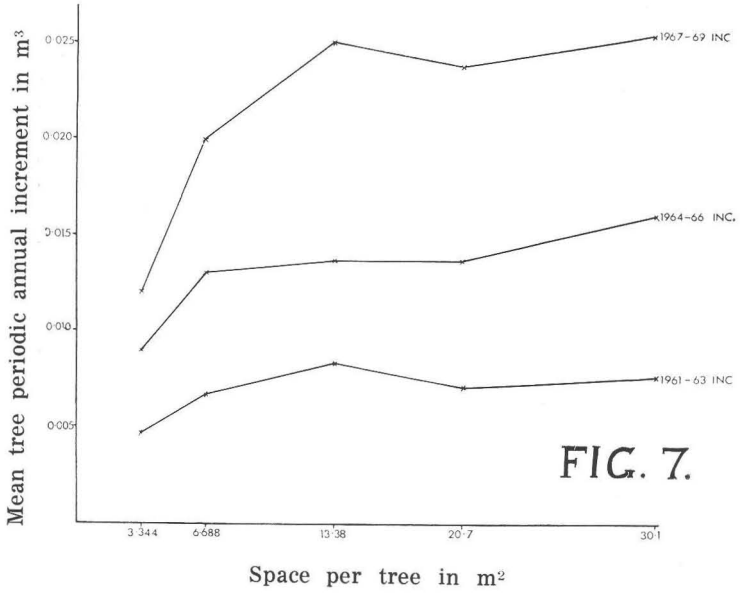


FIG. 7.

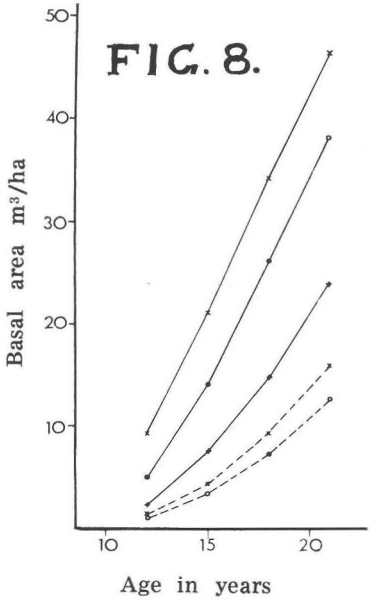


FIG. 8.

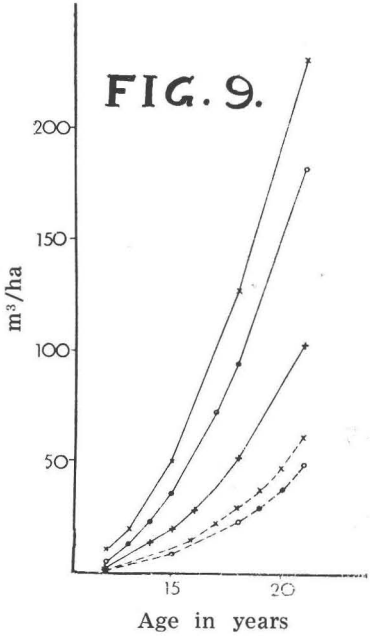


FIG. 9.

BASAL AREA PER HECTARE

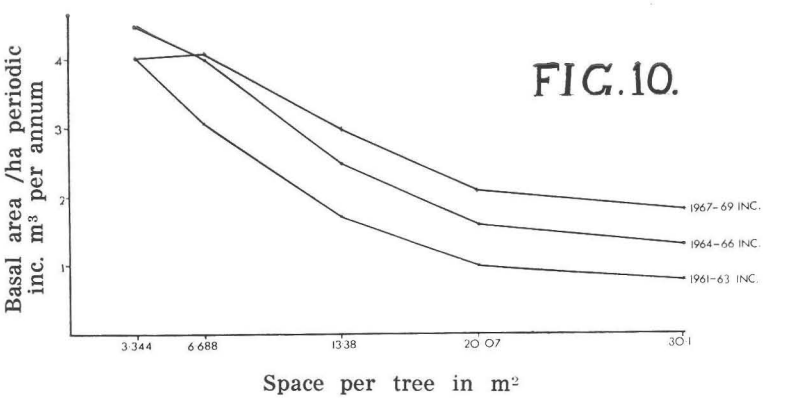
Rather more interest centres on the effect of spacing on basal area per unit area and here there is a very clear cut effect due to spacing. Thus the total basal area per hectare of the 330 stems per hectare is at 21 years of age (12.7 m^2/ha) similar to the basal area of the 3,000 stems per hectare at 13 years of age, and is only about 28% of the present 3,000 stems per hectare basal area (46.8 m^2/ha). (Fig. 8).

Between 12 and 15 years of age the basal area increment per hectare in the 4 widest spacings was similar to what one would expect in a condition of no competition effects but the curtailment of diameter in the close spacing of 3,000 stems was having a very noticeable effect. (Fig. 10) This pattern was repeated in the following 3 years, but with some evidence of the 1,500 stems per hectare falling behind as well. By 18-21 years of age the basal area per hectare increment was less for 3,000 stems per hectare than for the 1,500 stems per hectare. Over the latter 6 years there was also less difference in basal area per hectare growth between the two widest spacings than one would get from number of trees only.

It can, therefore, be taken that spacing has had a very marked effect on total basal area growth although there are indications that 1,500 stems per hectare may now be growing reasonably similarly to 3,000 stems per hectare. Wider spacings have considerable way to go to even approach current growth per hectare in the closest spaced crop.

VOLUME PER HECTARE

Spacing has a very important bearing on total volume production at least up to 21 years of age and the range is



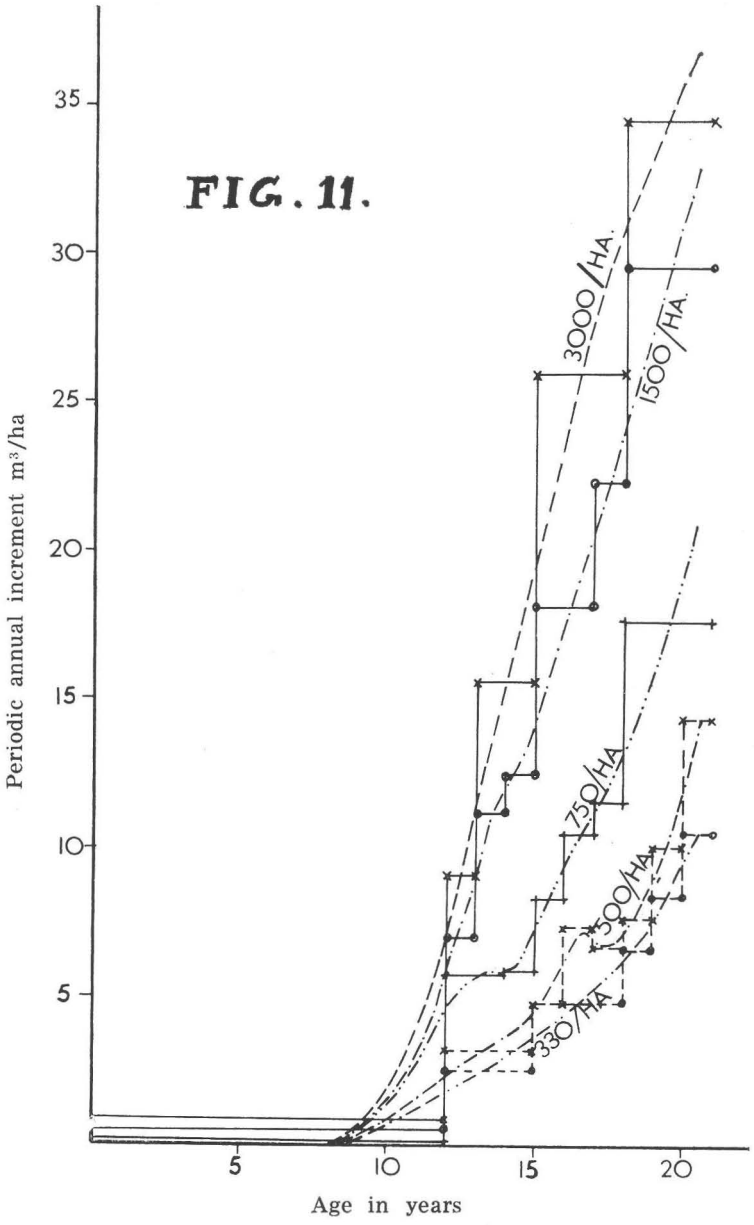


FIG. 11.
Periodic annual increment m³/ha
35
30
25
20
15
10
5
3000/HA.
1500/HA.
750/HA.
500/HA.
330/HA.
5
10
15
20
Age in years

from 233m³/ha for 3,000 stems per hectare down to 49m³/ha for 330 stems per hectare at that age. (Fig. 9)

It would, however, appear, (Fig. 11), that the volume increments per hectare for the 6.69 m² space per tree was in recent years fairly close to that for the 3.34m² per tree spacing and may have been increasing faster annually than the closer spacing which has tended to have a falling rate of increase over the past few years. Similarly the results suggest that the 13m² per tree spacing and 20m² per tree spacing may be starting to put on volume increment similar to what the 3.34m² spacing was doing some 4 and 7 years earlier respectively. The widest spacing of roughly 30m² per tree is still in recent years increasing its CAI at a slower rate than the closest spacing ever did.

A very crude approximation based on the above (and which may not stand the test of time) is that for every extra 10m² spacing given to the trees initially over and above 3.34m² (3,000 per hectare) total volume production is put back by 4 years. If this suggestion is valid and the pattern continues it means that a crop planted at 13.34m² spacing (750 stems per hectare) would at age 30 have only the same volume as the same species planted on the same site at 3.34m² spacing would have given at age 26.

BRANCHINESS AT 24 CM DIAMETER

Only 4% of the trees in the 3,000 stems/ha spacing, 28% of the 1,500, 48% of the 750, 56% of the 500 and 52% of the 330 stems/ha spacing sampled for branchiness had diameters over 24 cm. Where the trees had grown to this dimension it appeared that the 500 and fewer stems per ha had approximately 8 branches per whorl as distinct from approximately 7 branches in the closer spacing at the whorl nearest 24 cm diameter . The greater light had apparently encouraged the growth of more branches. There was no significant effect due to the tree diameter at breast height.

The diameter of the two largest branches in the whorl nearest to 24 cm diameter also appeared to be in general 0.5 cm greater with the two widest spacings than with the 750 or 1,500 stems per hectare where the trees had reached this diameter limit at any point on the stem. Again there were no significant regression differences with diameter at breast height although some spacings suggested an increase of 1 cm diameter for each 0.1 cm diameter breast height increase.

BRANCHINESS AT 2 M ABOVE GROUND

The number of branches in the whorl and diameter of the two largest branches in this whorl at 2 m above ground

level - ie, the first whorl just above where normal brashing would stop were also measured in December 1969.

The mean number of branches per whorl appears to be just over 5 for 3,000 stems/ha spacing and just under 6 for 1,500 spacing with 750 and fewer stems per ha having somewhat more than 7 branches per whorl. There is a hint of increasing numbers of branches as the tree diameter at breast height increases but the trend is not significant. This suggests that the opening up (when the mean tree height was about 4 m) has permitted more small branches at 2 m to develop in the wider spacings than would otherwise have persisted.

The diameter of the two largest branches in the whorl at 2m exhibit statistically significant differences due to tree diameter at breast height and although the slopes are similar there are significant differences in the constants for the different tree spacings. Thus although there is a general increase of 0.7 cm diameter for every 10 cm diameter breast height increase, (Fig. 16) there is a general difference of 0.3 cm between all of the spacings in the experiment except for the two widest.

Although the wider tree spacings appear visually to have much bigger branches than the closer spacings it is noted that this can be partly accounted for by the bigger tree diameters. Care must, therefore, be taken when interpreting visual effects. The differences are, however, of considerable practical importance and indicate a substantial deterioration in quality with wider spacing. This, combined with the greater number of branches per whorl, may be sufficient to influence pulp yields.

FREQUENCY DISTRIBUTION OF TREE VOLUMES AT DECEMBER 1969

For many purposes the size of the mean tree is not particularly useful by itself and a knowledge of the distribution by size class is more valuable. Such frequency diagrams are difficult to interpret when prepared from the actual data where there are few observations and they were, therefore, fitted to an incomplete Beta distribution function of the form - $f(x) = x^{\alpha}(1-x)^{\gamma}$ for each of the five spacings. The resulting relative frequency distributions are shown in Fig. 12 and all represented a satisfactory fit of the observations using a Chi-squared test.

It is evident that spacing has had a considerable effect on the skew of these distributions and it can be inferred that competition has not only reduced the size of the mean tree, but has also reduced the frequency with which large

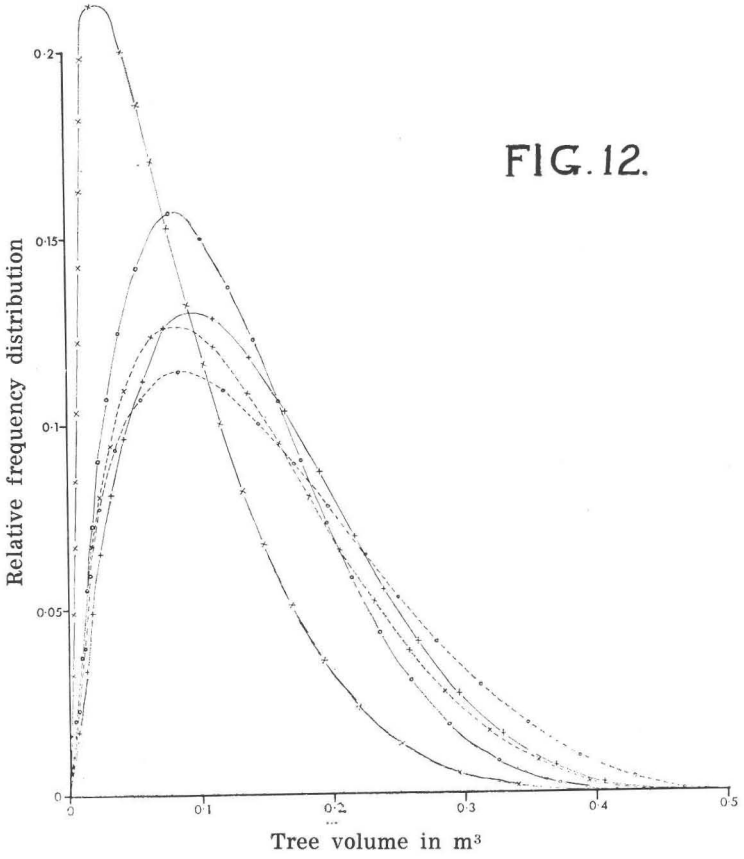
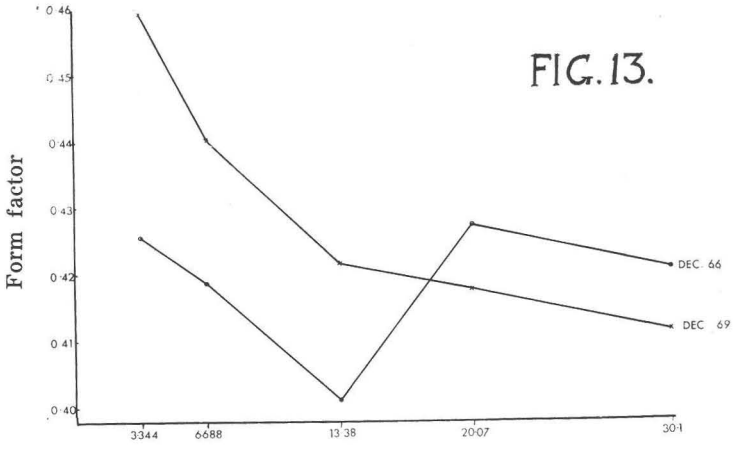
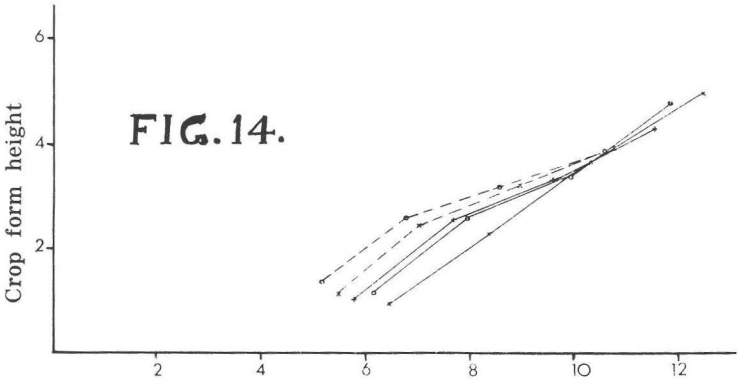


FIG. 12.

trees are found. This rather contradicts the evidence of thinning experiments in older Sitka spruce where large dominant trees tended to keep large and dominant and growing at a fairly uniform rate irrespective of the weight of the thinning. It suggests that the growth of all trees can be influenced by spacing and this result may be of very considerable importance when included with the relationship between felling costs and tree size.

The Alpha and Gamma coefficients of the Beta distribution were plotted against space per tree and for the four widest spacings gave fairly good linear fits dropping by approximately 0.25 and 1.2 respectively for each increase of $10m^2$ in tree space. The coefficients for the closest spacing of $3.34m^2$ per tree (3,000 stems per hectare) did not fit this linear trend.





The Alpha coefficients for the relative volume frequency distributions at December 1966 were at a similar level to December 1969, but showed a rather different pattern with a peak at approximately 13m² per tree. The Gamma coefficients at that time were not quite so clearly on a straight line, but did fall at approximately 1.4 for each increase of 10m² in tree space. They started however from Gamma = 15 for 3,000 stems/ha in December 1966 whereas the December 1969 equivalent was Gamma = 6.5. Unfortunately these results are too varied to suggest a prediction which would be used to describe the likely frequency distribution in the future.

FORM FACTOR

The form factor of individual trees which were over 8 cm diameter at 1.3m above ground were calculated for December 66 and December 69. At December 66 or approximately 8m height there were no significant differences due to spacing, and the mean was very nearly 0.42. By December 69 there were highly significant differences betweet the 3,000 stems/ha at 0.44 and 750 stems at 0.42 with the wider spacings just slightly under this, (Fig 13). Differences of this magniude would have important implications for the use of volume tables in different spacing regimes and one can expect the differences to increase in future.

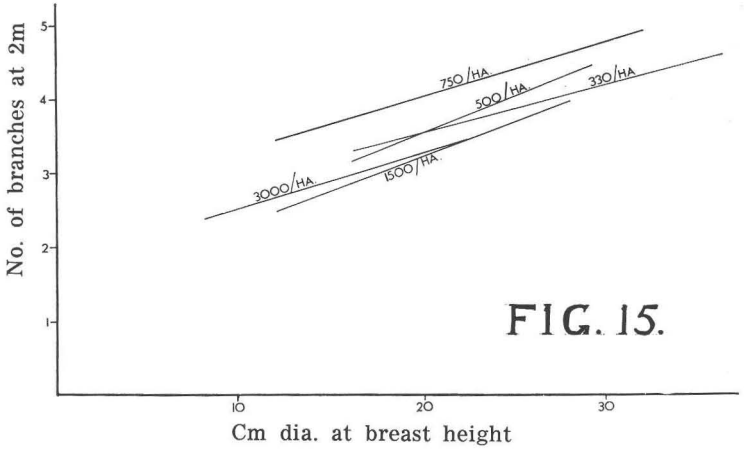


FIG. 15.

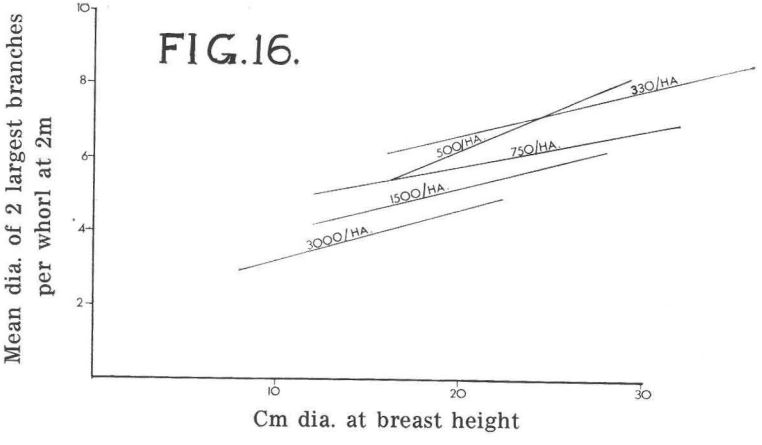


FIG. 16.

CROP FORM HEIGHT

This was calculated on the basis of the volume of all trees over 8 cm diameter breast height as a ratio of the height of the 100 largest stems per hectare times the basal area at breast height for each plot and details are given in Fig. 14. Apart from quite considerable differences in the early years of the experiment which can be attributed to the use of the 100 largest per hectare for height determination which, therefore, requires the acceptance of a much higher % of the available stems for the wider spacings, it is remarkable how similar has been the relationship of crop form height to 100 largest height once the crop was over 10m high and how uniform has been the convergence. It will be interesting to watch the future development of this relationship relative to the changes in individual tree form pattern noted above.

MORTALITY

A number of trees were windthrown in the very severe gales of September 1961 when the crop was just 12 years of age. This storm largely affected the 500 stems per hectare spacing where almost 8% of the trees were blown over. In all other spacings of 1,500 and fewer stems per acre mortality including theft, etc., has been under 4% to date. With the closest spacing of 3,000 stems per hectare there are now some deaths occuring and at 12m top height there has been a $6\frac{1}{2}$% mortality to date.

VOLUME/BASAL AREA RELATIONSHIPS

The relationship of volume to 8 cm top diameter ob per hectare to basal area at breast height indicates that for a given basal area volume production is greater with the wider spacings. It must be remembered that the closer spacings reached these basal areas at an earlier age and, therefore, height was much less and also that the wider spacings have still very small basal areas relative to the close spacings. (Fig. 8).

The periodic annual increment (calculated from consecutive 3-year periods) relative to the basal area of the crop at the beginning of the period is now showing a very similar relationship for both the 3,000 and 1,500 stems per hectare treatments. (Fig. 17). The wider tree spacings have a smaller volume increment but again the basal areas are still quite small at this stage of the experiment and it will be some time before a pattern can be traced from the data.

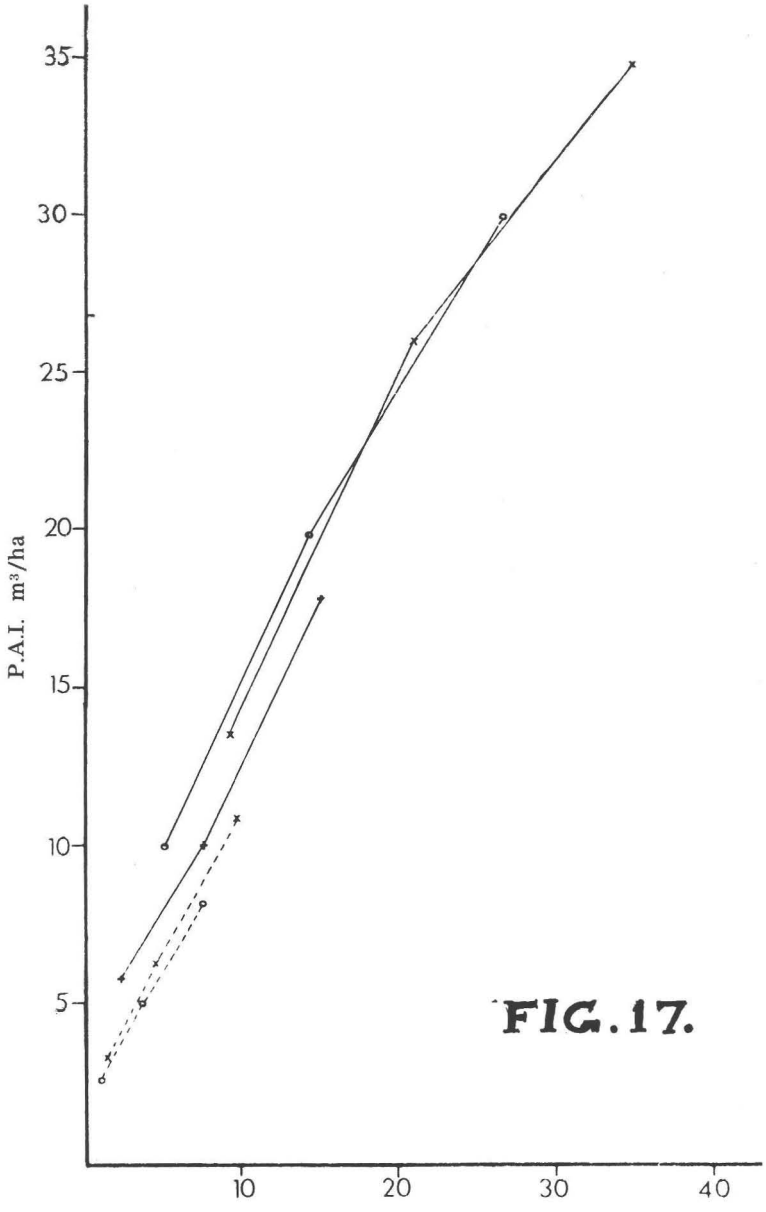

35
30
25
20
15
10
5
P.A.I. m³/ha
10
20
30
40
Total basal area m²/ha at begining of 3 year period

FIG. 17.

DISCUSSION

Although the spacings were made when the crop averaged 4 m high and it is true that the results suggest that there could well have been some diameter competition effects before this time it is unlikely that these or any influence on other crop characteristics were of great magnitude. The results of this experiment may therefore be used to draw inferences on the likely effects of differing initial planting distances without much probability of error. Comments in the results discussed above can be assumed to apply to crops planted at equivalent initial spacings.

It would appear from an inspection of smooth lines taken from the figures that the results given in table 1 could be expected from spacings of approximately 2,200 per hectare (7' x 7') and 1,685 per hectare (8' x 8').

Table 1

Factor	2,200 per hectare	1,685 per hectare
Mean tree height	10.0 m	10.0 m
Height of 100 largest per hectare	12.1 m	11.9 m
Mean tree diameter	16.0 cm	17.5 cm
Mean tree volume	0.101 m^3	0.114 m^3
Volume per hectare	218 m^3	188 m^3
Basal area per hectare	43.4 m^2	40.1 m^2

Notes

The mean tree height would be the same as that obtained with the crop planted initially at 3,000 stems per hectare on a similar site. The height of the 100 largest per hectare as above would have been 12.4 metre when initial planting distance was 3,000 per hectare. Although all replicates of the experiment were on a similar site it could be taken as fairly certain that the above results could be obtained when crops planted at these spacings had reached top heights as shown.

The experimental results can also be used to make projections of future growth although these must be subject to some uncertainty. Details of individual tree volume increment by 3-year periods plotted against age appeared to offer the most reliable forecasting curves and these multiplied by numbers of stems but with some allowance for mortality suggest that the total crop yield in the next few years would be as in table 2.

Table 2

Date	3,000 per hectare	1,500 per hectare	750 per hectare
December 1972	360 (356)	300 (288)	200
December 1975	500 (486)	440 (415)	310

It was considered too problematical to project the curves any further. Because of the peakiness which was appearing in the curves of the basal area increment and the uncertainty of whether crop form height would in future show a single relationship to top height, irrespective of spacing, projections of volume per hectare using these characters appeared to be too uncertain. Estimates using the periodic volume per hectare increment over age curves were difficult to make but did suggest that the above table would be overestimating the increment of the 2 closest spacings by about 10 per cent to give the figure shown in brackets in table 2. The height of the 100 largest per hectare is likely to be about 16.2 metres by December 1975 on the closest spacing and by this time there will be a loss of 60 - 70 m^3 per hectare by planting at 1,500 rather than 3,000 stems per hectare.

Projections for the next 3 years for likely volume growth of the 2,220 per hectare and 1,685 per hectare spacings considered above can be made with a fair degree of certainty from basal area increment curves and the relationship of periodic annual increment to basal area at the start of the 3-year period (Fig. 17) and these suggest that the volumes per hectare at December 1972 will be 335 m^3 and 300 m^3 respectively. Thus planting at about 2,000 stems per hectare will result in some 30 to 35 m^3 per hectare loss of production

at 12 m top height (about 40 feet) but this could be acceptable where first thinning was normally uneconomic and the increased branchiness was not likely to seriously influence final crop prices.

The characteristic of distribution of tree stems by volume classes together with the initial effect of different spacings can have a major influence on costs and some calculations are given below to indicate how an economic appraisal of the complete system from planting through to produce loaded on customer's lorry can alter decisions from these suggested by looking only at the tree growth statistics. Unfortunately the calculated parameters of the Beta distribution did not exhibit sufficient stability to enable forecasts to be made of the likely distribution in the future and so the calculations are based on clear felling a crop of 12.4m dominant tree height at 3,000 stems per hectare planting spacing because this is the oldest stand for which information is available from the experiment. They should not be taken as an indication that clear felling at this height is suggested as a good management practice for such stands as the determination of rotation lengths etc. must be based on the owner's overall objectives and decision making criteria.

There is a strong suggestion from Table 2 above that much better financial returns would be obtained by having much longer rotations under the usual conditions which apply. Site factors would alter the ranking, etc, for poorer or better sites than used in the calculations.

Calculations of net discounted revenue were made for clear felling at 21 years of age of 3,000, 2,200 and 1,500 stems per hectare using the data inferred above where necessary, and are summarised in Table 4. It will be noted that under the assumed conditions the best financial return would be made by an initial spacing of 2,200 plants per hectare. This is partially made up, relative to the 3,000 stems per hectare, of a saving in gross felling costs of some 10% while volume production only fell by 7% and a saving of some 10% on expenditure in the year of formation of the plantation. Wider spacings would have given greater losses.

It is hoped that this paper will stimulate interest in the factors influenced by initial plant spacing whether they are of a silvicultural or an operational nature.

Table 3

Costs, etc. assumed

Type	Operation	Unit Costs	Remarks
Fixed Costs	Clearing lop and top, draining, etc, pre-planting.	£25 per ha	Constant
	Weeding.	£75 per ha	"
	Maintenance, including roads, drains, etc.	£2.5 per ha per year.	"
Variable Costs	Young trees.	£10 per 1,000 trees.	Costs proportional to numbers.
	Planting.	£10 per 1,000 trees.	do.
	Extraction and conversion and loading.	£2.44 per m^3	Total costs proportional to volume removed.
	Felling and snedding	£0.076 per tree of 0.036 m^3	Total costs depend on gross volume to be felled and the distribution of this by tree size. Unit costs are based on a regression line of standard time against tree volume in h ft.
	do.	£0.127 per tree of 0.108 m^3	
	do.	£0.167 per tree of 0.180 m^3	
	do.	£0.208 per tree of 0.252 m^3	
	do.	£0.250 per tree of 0.324 m^3	
	do.	£0.292 per tree of 0.397 m^3	
Revenue		£5.55 per m^3 loaded	Clear felling at age 21. Total revenue proportional to volume to be felled. No bonus for larger logs.
Interest Rate		5%	

Continued on page 33

Table 3 (continued)

NOTES a. Costs are taken to include all labour, machinery, supervision general overheads, etc.

b. It will be obvious the above data are oversimplified.

c. A further simplification which affects the magnitude of differences but not their ranking was to treat ground preparation and weeding as being done in the year of planting.

d. No provision is included for risk or for conversion loss.

Table 4

Summary of calculations on a hectare basis

Type	Date	Operation	3,000 stems /ha	2,200 stems /ha	1,500 stems /ha
Actual Expdt	Year 0	Draining and weeding.	100	100	100
	" "	Planting and young trees	60	44	30
	Year 0-20	Maintenance	52	52	52
	Year 21	Felling, etc.	263	229	178
	" "	Extractions, etc	565	530	450
Discounted Expdt to Year 0	Year 0	Draining and planting	160	144	130
	Year 0-20	Maintenance	32	32	32
	Year 21	Felling, extraction, etc.	297	272	225
			489	448	387
Actual Revenue	Year 21	Sale of produce traded at forest gate.	1,290	1,210	1,020
Discounted Revenue	" "	do.	463	435	366
Net discounted revenue to Year 0			- 26	- 13	- 21

ACKNOWLEDGMENTS

Thanks are due to Mr. R. W. Boyd who has borne the brunt of the measuring of this experiment to date, and to the staff of Biometrics Division of the Ministry of Agriculture who assisted with the statistical analyses.

Trees, Woods and Literature–5

Binsey Poplars

felled 1879

My aspens dear, whose airy cages quelled,
Quelled or quenched in leaves the leaping sun,
All felled, felled, are all felled;
Of a fresh and following folded rank
Not spared, not one
That dandled a sandalled
Shadow that swam or sank
On meadow and river and wind-wandering
weed-winding bank.

O if we but knew what we do
When we delve or hew—
Hack and rack the growing green!
Since country is so tender
To touch, her being só slender,
That, like this sleek and seeing ball
But a prick will make no eye at all,
Where we, even where we mean
To mend her we end her,
When we hew or delve:
After-comers cannot guess the beauty been.
Ten or twelve, only ten or twelve
Strokes of havoc únselve
The sweet especial scene,
Rural scene, a rural scene,
Sweet especial rural scene.

From *Poems of Gerard Manley Hopkins* (Edited by Robert Bridges) reprinted by permission of the Oxford University Press.

Gerard Manley Hopkins was born in Essex in 1844. He changed his religion in 1866 and was ordained a Jesuit priest in 1877. In 1884 he was appointed Professor of Classics in University College, Dublin, but was unhappy there, being out of sympathy with Irish nationalist aspirations. He died

in Dublin, of typhoid fever, in 1889, and is buried in Glasnevin.

This poem is more apposite now than when it was written nearly a century ago: the environment is so vulnerable that "even where we mean to mend her we end her." The poet leans towards the popular fallacy that the felling of a tree is an act of finality, whereas we know that trees can be re-created without any distinguishable differences from previous generations, while buildings can not.

The last three lines of the poem give an onomatopoeic representation of the sound of a cross-cut saw, now (unfortunately but necessarily) replaced by the apoplectic roar of the chain saw.

Notes and News

"A ROSE BY ANY OTHER NAME . . . ."

Because of the centralization of all wildlife services within the Forestry Division of the Department of Lands, the name of that division has been changed to the Forest and Wildlife Service, or in the Irish language, *An tSeirbhis Foraoise agus Fia-Dhulra.*

HISTORY OF BAUNREAGH

The many foresters who have had associations with Baunreagh, Mountrath Forest, will be interested in the following extract from *The Realities of Irish Life* (1868) by W. Steuart Trench, supplied by Mr. H. M. FitzPatrick, showing that the land which has grown such fine Sitka spruce was ploughed, limed, manured with guano and planted with potatoes in 1845.

"I went to reside at Cardtown, my place in the Queen's county, in 1845. It adjoins an extensive tract of mountain land which I had purchased (3,000 acres for £10,000) and which I was reclaiming. This was done chiefly through the means of the potato, as the only green crop which grows luxuriantly in rough ground with previously imperfect tilth and I planted each year larger and larger quantities of that root. Guano having been recently brought into use as a manure was found to be particularly suited to the production of the potato and I applied a liberal quantity to the crop.

"The land consisted generally of rough mountain pasture covered with heather. There were no stones, or few of sufficient size to impede the plough. The land was first

limed with 80 barrels of lime to the Irish acre, spread broadcast upon the surface and was then ploughed into 'lazy beds', narrow ridges about five feet in width, with a furrow between each ridge. Into these ridges the seed was put by dropping it at the back of the spade. Guano, six hundredweight to the acre, was then scattered over the ridges and this being done, the furrows were dug and the clay shovelled over the ridges. The potatoes grew to perfection in this rude description of tillage. The guano stimulated an enormous growth of the potatoes and when they were being dug out, the act of digging mixed the lime, manure and the several soils together leaving the land previously worth one shilling per acre permanently worth at least one pound per acre.

"I planted in the year 1846 about one hundred Irish acres of mountain land under potatoes, counting, as surely as any farmer can count on reaping any crop, upon a produce worth at least £30 per acre. My reclamation had succeeded beyond my most sanguine expectations, and in the month of July 1846 my potato crop, for its extent and luxuriance, was the wonder of everyone who saw it; and at the very moderate price of threepence per stone, I felt certain of realizing at least £3,000.

"For some years I had not less than two hundred labourers, employed constantly draining, levelling, liming and the heavy work of digging out enormous quantities of potatoes and a more cheerful sight it was scarcely possible to conceive than these numerous labourers employed at good wages. But all this passed away like a dream on the sudden failure of the potato, and the "happy valley" as the sloping sides of my mountain property of Baureigh, with a clear trout stream running in the hollow, was frequently called, turned into a valley of woe.

"On August 1st I was startled to hear that all the potato fields in the district were blighted and I immediately rode up to visit my crop and found it as luxuriant as ever. On August 6th—I shall not readily forget the day—I rode up as usual to my mountain property and before I saw the crop, I smelt the fearful stench, now recognised as the death-sign of each field of potatoes. And as I wound down the newly engineered avenue* running through the heart of the farm to the steward's house I could scarcely bear the fearful smell which came from the crop growing all round. The stalks soon withered, the leaves decayed, the disease extended to the tubers. My plans, my labour, my £3,000 were gone!"

*The avenue from Moore's farm (H.M.F.).

FORESTRY ATTACKED . . .

In an article in the *New Statesman* of 5 March 1971, Gilbert Ellice seriously questions the present and future value of British forestry, which he claims should be more correctly, if less romantically, called the "British softwood production industry." He admits that there is something in the argument that home production of timber helps to improve the balance of payments situation, but in view of the uncertainties involved suggests that more thought should be given to whether or not the money spent on forestry could have been used to encourage other industries which might be more beneficial. He discusses the two great dangers to the forest industry : substitution and competition. On substitution he quotes a prediction by Mr. H. C. Dawkins of the Commonwealth Forestry Institute that in certain areas of the world "all non-aesthetic, large-scale, industrial uses of wood will be taken over by synthetic plastics and derivatives of the Al Fe Si Ca minerals within the next half century." On competition he refers to three-year pulpwood rotations in West Africa. He concludes that "a large-scale softwood production industry is not a viable commercial proposition" for Britain, but suggests instead that British forest policy should concentrate on the production of hardwoods for which there "is a permanent if small-scale market", with the additional amenity benefit.

. . . AND DEFENDED

In the *Irish Times* of 1 April, 1971, Christopher Moriarty, in a leader page article, defended Ireland's State conifer forests against the attacks, mostly on aesthetic grounds, which have been made against them. He suggested a common bond between foresters and architects, insofar as the results of their work are conspicuous and more or less permanent. Mistakes, while admitted, are difficult to conceal or obliterate.

AVONDALE HOUSE OPEN

The Forest and Wildlife Service of the Department of Lands announced that certain rooms of Avondale House would be open to the public between 11.00 and 18.00 hours on Fridays through Mondays from May 7th until September. The presence of a tourist adviser to assist visitors is being arranged by the Eastern Regional Tourism Organisation Ltd. The rooms which will be open are those which have been set aside as a repository for articles associated with Charles Stewart Parnell, whose home Avondale was.

FOREST FERTILIZATION (1)

The year 1967 saw the publication of the first text-book on forest fertilization. Entitled *Die Dungung von Waldbaumen* by Hubert Baule and Claude Fricker, it gave an excellent account of the basis of forest fertilization and collected all the important published information on the subject. Recently an English translation has been published (by B L V Verlagsgesellschaft mbH, Munich), under the title *The Fertilizer Treatment of Forest Trees,* complete with 157 illustrations, 45 of them in colour. The book can be strongly recommended, despite the fact that the translation, while accurate, is in a very awkward style and is not easy to read.

FOREST FERTILIZATION (2)

Reprints of the article *Fertilization of Conifer Plantations* (with 13 illustrations, 12 in colour) by C. P. van Goor, published in *Irish Forestry* Vo. 27, No. 2 (1970) are available from the Hon. Secretary at 25p each. There are also a few copies of the book *The Forests of Ireland* available at £1.50 each.

Abstract

Forest cover and the water table in peat

We in Ireland are deeply involved in peatland forestry, but so far our research efforts in this field have been concerned mostly with aspects of the establishment and early growth of forest crops. As the crops develop the nature of the problems will change and it would be prudent for us to look ahead a little and see what may concern us during the periods of later development and crop regeneration.

A good example of the kind of information which we will need appeared some years ago in a publication* by Leo Heikurainen from Finland, a country where peatland forestry research has reached an advanced stage of development.

Heikurainen studied the effects of clear cutting on the ground water table in peat. His method of investigation was to observe the water table levels for two years before stand treatment and for two years after. He found that clear-cutting led to a rise of 20-40 cm in the ground water table during the growing season. The effect was much less in

winter. He also found that thinning had a similar but much weaker effect.

Heikurainen concludes that "the results obtained mean that the influence of the forest cover makes up for that of drainage. Thus, the need for maintenance of the ditches might not be so great as has been generally assumed. On the other hand, it can be observed that the final cutting to be done will rise the ground water strongly. Thus, creation of another tree generation will require repeated drainage."

*Leo Heikurainen: Hakkuun vaikutus ojitettujen soiden vesitalouteen (Summary: On the influence of cutting on the water economy of drained peat lands) Acta Forestalia Fennica 82, 45pp, 1967.

N. O'Carroll

Meeting

IUFRO, Gainesville, Florida

About 680 delegates from 58 countries (including 7 from Ireland, two of whom were engaged in post-graduate studies in the U.S.A.), got together at the University of Gainesville, Florida, for the 15th Congress of the International Union of Forest Research Organisations, which took place from March 14th to 20th, 1971. Apart from the technical discussions, which are always the primary purpose behind any gathering of research workers, an important item of business was the adoption of an entirely new structure for the organisation. The old Sections will be replaced by a number of fairly clearcut Divisions, which will avoid the overlap between Sections which had developed during the years.

Within each Division there will be a number of Subject Groups and Project Groups. It is envisaged that the former will be relatively permanent while the latter will each have a specific goal, after the achievement of which the group can be dissolved. The basic division, as before, will be into Working Groups, which can overlap the Subject and Project Groups. This is the level of close personal contact at which the useful work gets done.

The arrangements for the Congress itself differed somewhat from those for previous meetings, concentrating more on plenary sessions at each of which an invited paper, summarizing the present state of a particular field of forest research was read. This arrangement, while well-intentioned, was not entirely a happy one. The plenary sessions were too large and formal for any discussion, and their number seriously depleted the time available for the Working Group meetings, which are, after all, the main business of the Congress.

N. O'Carroll

Reviews

The Irish Woods since Tudor Times

EILEEN MCCRACKEN
David and Charles. 184 pages. £2.25.

All Irish Foresters owe a debt of gratitude to Dr. McCracken for the publication of this most readable book which has been made possible by a grant from the Institute of Irish Studies of The Queen's University of Belfast.

It is difficult to imagine the number of hours of detailed research through old records and newspapers which preceded this work. Dr. Eileen McCracken has, of course, become the recognised authority on the history of Ireland's ancient woods and has contributed many articles in forestry and historical journals. In fact, some may be lulled into imagining that they have read it all before, or may consider this a dry subject which is of no interest to present-day foresters.

In this they would be quite wrong as this book has the freshness of completely new writing and holds one's attention throughout.

The distribution of our native woodlands through their last two centuries is traced and well illustrated by maps. It would be appropriate if more of our modern forests could adopt ancient forest names which have vanished from use as has been done in the case of "The Fews".

The utilisation of the timber in the various industrial processes of the day is covered in a most interesting way. What havoc must have been caused by tanners and brogue makers who stripped the bark from oak trees for miles around and then turned their attention to less suitable trees.

The explanation as to why so much timber from Ireland was used in making staves for casks, etc., is revealing.

In the interest of English cattle graziers the export of live Irish cattle was prohibited so that numbers fell from 60,000 in 1660 to 1.454 in 1669. Irish cattle thereafter had to be shipped as salted beef, much of it going to the colonies.

The timber trade is well covered in two chapters. The first deals with the seventeenth century when only native timber was in use, with the exception of masts and spars for ships, which had to be imported due to the complete lack of softwoods.

The other chapter brings out the effects on the population and trade of our dependence on imports. Timber frame houses ceased to be built, dug out boats could not be constructed, turf had to be used for fuel. Belfast could only

build small ships by 1660 and none at all 100 years later.

Costs, of course, rocketed so that an average standing Oak fetched 1/- in 1600, £3 17 0 by 1700 and £13 10 0 by 1780.

The Scandinavians were using wind and water driven sawmills while the pit saw was still in use here, yet the artisans fearing for their livelihood frustrated attempts to follow suit. As a result timber was imported in plank rather than in the round.

The era of private planting followed by state planting brings the book to our own period and introduces a more controversial note.

Our modern exotics are said to be forced like battery hens with a resulting loss in quality of timber. The statement is made that it is a long time since the fattest pig was considered the best bacon producer.

Far from being forced in hothouse conditions and spoiled with rich soil our poor trees have to make do with the poorest of food and the most exposed conditions. Fat pigs and battery hens indeed with a few ounces of phosphate to keep them going maybe for 40 years.

Doubts are expressed about the economics of forestry and yet with all a plea is made for the planting of more hardwoods which would hardly remedy the situation.

The only historical point which puzzles the reviewer was the statement that Ballykelly Forest, formerly Walworth Wood, was owned by the Lord Mayor of London, Sir William Walworth, who struck down Wat Tyler in 1381. To the best of my knowledge the English were virtually driven out of Ulster for 300 years following the Bruce invasion 1315-1318.

Foresters have for long begun their talks to the public with a mention of our great forests of the past. "The Irish Woods Since Tudor Times" should be well studied by all who wish to be well informed in the subject.

I recommend it to all Irish Foresters.

C. S. Kilpatrick

Trees and Shrubs Hardy in the British Isles. Volume 1, A - C.

W. J. Bean. Eighth Edition.
John Murray. £8.

This book was published for the first time in 1914. Since then its immense popularity has required the publication of a fully revised eighth edition.

The first part of this introductory volume is comprised of an extensive historical account of the collection and intro-

duction of exotic trees and shrubs to these islands. The first-named authority is a William Turner, a herbalist, who in 1548 published his *Names of Herbs,* recording about thirty foreign trees and shrubs. Among the most notable collectors mentioned are Parkinson, Fraser, Douglas, Hooker, Veitch, Jeffry, Henry, Wilson and Forrest.

The cultivation of trees and shrubs is also covered. In this section considerable attention is given to propagation, hybridisation, nursery practice, pruning and the care of old trees. The actual operation of hybridisation is so well described that even the most hesitant amateur is given sufficient information to carry out this delicate operation.

The development of the taxonomy and nomenclature of plants is given in great detail. The difficulties experienced in nomenclature are appreciated when one considers the Douglas Fir saga; "Carriere, who was first to place the Douglas Fir in a separate genus, adopted the specific epithet under which it was already well known in combination with a new generic name: *Pseudotsuga douglasii.* Applying the rule of priority, however, the name was changed to *Pseudotsuga Taxifolia,* the epithet *taxifolia* having been published earlier than *douglasii.* For many years there was thus a choice of names according to one's views on priority. Subsequently an objection to the epithet *taxifolia* was found and the name *Pseudotsuga mucronata* enjoyed a brief reign. Then grounds were found for restoring *taxifolia* again, to be discredited by another means only a few years later and yet another epithet found, *menziesii*! On the basis of available evidence, *Pseudotsuga menziesii* is certainly the correct name at the time of writing, but for how long?" (p.95).

The descriptive list of genera and species includes all trees and shrubs which alphabetically range between the genera *Abelia* and *Cytisus.* The botanical description is accompanied by information on "native country, history, distinctive characteristics and merits and individual requirements." The amount of information in the book is enormous. In the genus *Berberis* 91 species are fully described with at least twice as many more varieties and cultivars of the species included. The volume also contains 77 photographs and 84 line drawings.

At £8.00, this book may be beyond the reach of most readers, but it should be made available in all libraries.

J. Dillon

Other Publications Received

Recent publications from the British Forestry Commission: —

Fiftieth Annual Report and Accounts of the Forestry Commission for the year ended 31st March, 1970, *together with the Auditor General's Report on the Accounts.* 70p

Report on Forest Research for the year ended March, 1970. £1.50

Donald L. Shaw: *Gwydyr Forest in Snowdonia: a History.* Forestry Commission Booklet No. 28. 40p

J. E. Everard: *Metric Conversion Tables and Factors for Forestry.* Forestry Commission Booklet No. 30. 50p

R. T. Bradley: *Thinning Control in British Woodlands (Metric).* Forestry Commission Booklet No. 32. 70p

C. I. Carter: *Conifer Woolly Aphids* (Adelgidae) *in Britain.* Forestry Commission Bulletin No. 42. 75p

D. G. Pyatt: *Soil Groups of Upland Forests.* Forest Record No. 71. 40p

G. G. M. Taylor: *Ploughing Practice in the Forestry Commission.* Forest Record No. 73. 20p

R. B. Herbert: *Development of Glasshouse Techniques for Early Progeny Test Procedures in Forest Tree Breeding.* Forest Record No. 74. 20p

E. F. Granfield: *Design, Construction and Maintenance of Earth Dams and Excavated Ponds.* Forest Record No. 75. 17½p

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Society Activities

Minutes of 29th Annual General Meeting

Annual General Meeting of the Society of Irish Foresters held at Science Room, R.D.S., Dublin, on Saturday, 13th March, at 6 p.m.

The President, Mr. H. M. FitzPatrick, opened the meeting, welcoming those present. The Secretary read the minutes of 28th Annual General Meeting. These were adopted and signed by the President.

The Council report was then read by the Secretary. Arising from the report Dr. W. Jack pointed out that due to the Postal strike in Northern Ireland he had received examination papers for Foresters Certificate for correction on that day, 13/3/'71. As the examination took place in January '71, the Society agreed to notify candidates of the cause of the delay in examination results.

The Treasurer, Mr. Moloney, having circulated the statement of accounts to those present, explained that due to the Bank strike he was unable to receive a statement from the Bank and have accounts audited in time for incorporation into the Annual General Meeting notice. The Treasurer then stated that the balance was much lower than for former years, which was due to 50% unpaid membership fees amounting to £372.00 and to the fact that postage and printing costs had greatly increased. To help surmount the problem of unpaid membership fees the Treasurer requested members to pay by Bankers Order in future.

It was suggested that economies might be effected by reducing the number of reprints printed with the Journal. On the question of which rate of annual subscription would apply now that only one grade of technical membership remains, it is expected that the Council would decide on the higher rate.

On the proposal of Dr. W. Jack, seconded by Dr. P. M. Joyce, the Council's report and abstract of accounts were adopted.

The President then delivered his address covering the progress of Forestry in different countries.

The President paid tribute to the members of the 1970 Council for the work carried out and time spent in the interests of the Society. The members of the 1971 Council were congratulated on confirmation of their election.

The legality of the Annual General Meeting was queried by some members who had not received 14 days' notice of the meeting due to the Post Office strike in Great Britain and Northern Ireland. It was explained that mail for delivery to these deestinations was not accepted by Post Office personnel in the Republic of Ireland. It was agreed to hold an Extraordinary General Meeting at which the proceedings of the Annual General Meeting held on 13th March, '71, would be ratified.

The motion "that the revised Constitution and Rules of the Society be adopted" was proposed by the President on behalf of the Council of the Society. This was seconded by Mr. F. Mulloy and was adopted unanimously.

The meetings convenor gave details of the Annual Study Tour which would be held in Northern Ireland with the party based at Belleek, Co. Fermanagh. Indications were that many members were interested and would take part in the Study Tour.

A film show would be held at Shell/BP House, Hatch St., Dublin, in April '71. The films deal with Nature, Wildlife and Forestry and would include Mr. Patrick Carey's film "Oisin", which was commissioned for Conservation Year.

This concluded the business of the meeting and the President declared the meeting closed.

M. E. Cassidy

Council Report for 1970

The year under review proved an active and rewarding year for the members and Council of the Society of Irish Foresters. Nine Council meetings were held and attendances were as follows:—

Mr. FitzPatrick (9), Miss Furlong, Messrs. Moloney and Cassidy (8), Dr. Joyce and Messrs. Mulloy and O'Carroll (7), Messrs. Luddy, Macken and Prior (6), Dr. Durand and Mr. O Cinneide (5), Mr. O'Sullivan (4).

Conservation Year—In the Annals of the Society, 1970 will be remembered as Conservation Year due to its great influence on members' activities. The Society is justifiably proud of its contributions to Conservation Year, which varied from guided forest walks to indoor educational meetings open to the public. Thanks are due to the meetings sub-committee and the many participants for the success of these ventures.

Constitution—Another milestone in the Society's year was the redrafting of the Constitution and the drawing up of Rules for Regionalisation. For this the Society is much indebted to the President of the Society and Messrs. T. McEvoy and C. S. KilPatrick.

All members should by now have a copy of the Constitution and Rules of the Society.

Financial—The cost of running the Society is increasing yearly due to increasing overheads. Paid annual subscriptions for 1970 were much lower than for former years.

As the running of the Society is dependant on subscriptions, members are requested to forward annual subscriptions early each year and if convenient by bankers order.

Journals—During the year two Journals were published and the Autumn issue saw the innovation of colour illustrations. The extra technical processes involved resulted in a delay in publishing this issue.

Indexing of previous journals was carried out by Dr. Eileen McCracken and should be available in print shortly.

Meetings—The Annual General Meeting of the Society was held on 7th March, 1970, the Minutes of which were written up in the Autumn issue of the Journal. The much advertised Public Meeting at the Royal Dublin Society attracted a large attendance where Mr. W. Grant of Grizedale Forest Lake District, England, read a very interesting paper on "The Forester and Conservation in the 70's".

A full complement of indoor and outdoor educational meetings were held at approximately monthly intervals. Some of the lectures were repeated at different venues for the benefit of regional groups.

Study Tour—A very enjoyable study tour was held in the south-east of the country with headquarters at Wexford. Forty-six members participated and the subject matters were wide-ranging, varying from Conservation to Arboreta to Forest Management.

Examinations—Examinations continue to be held for Foresters and Woodmans Certificate. For the year 1969/'70 four candidates presented themselves for the Woodmans Certificate. All were successful.

For the year 1970/'71 there was one candidate for the National Diploma in Forestry. Four candidates presented themselves for the Foresters Certificate and two for the Woodmans Certificate.

Election—Elections to the Council for 1971 were confined for Northern members to elect a Northern Region Representative. All other members nominated for posts were returned unopposed. The post of Associate Councillor remains vacant as of those nominated none were prepared to accept the post. This suggests a lack of interest in members to serve on the Council. It is hoped that with the redrafting of the Constitution more members will contest elections in future years.

M. E. Cassidy,

Secretary.

22nd February, 1971.

Statement of Accounts for Year ended 31st December, 1970

1969	RECEIPTS	£ s. d.	£ s. d.
263 18 1	To **Balance from last account**		388 0 4
	„ **Subscription received:**		
	3 Technical Grade 1 1969	3 0 0	
	57 „ „ 1970	110 0 0	
	1 „ „ 1971	2 0 0	
	1 „ Grade 2 1967	1 0 0	
	2 „ „ 1968	1 10 0	
	15 „ „ 1969	19 0 0	
	74 „ „ 1970	107 10 0	
	1 „ „ 1971	1 0 0	
	6 Associate 1969	6 0 0	
	68 „ „ 1970	95 19 8	
	5 „ „ 1971	6 10 0	
635 6 4	7 Student 1970	7 0 0	
			360 9 8
6 10 0	„ **Interest on Investments**		6 10 0
	„ **Journal:**		
32 14 10	Sales	78 9 4	
158 2 0	Advertisements	130 16 6	
	U.C.D. Contribution	41 0 0	250 5 10
	„ **Examination Fees**		
1 10 0	Woodman's Certificate		
	Foresters „	10 0 0	
2 6	Examination Papers	17 6	10 17 6
	„ **Book "The Forests of Ireland"**		
42 18 0	Sales	29 4 5	
6 14 2	Map reprints	7 8 9	34 13 10
	„ **Glenealy Exhibition**		70 0 0
£1,147 15 11			£1,120 17 2

1969	EXPENDITURE	£ s. d.	£ s. d.
123 5 4	By **Stationery and Printing**		148 0 8
426 15 2	„ **Printing of Journal & Reprints**		649 13 8
107 0 6	„ **Postages**		99 12 5
41 12 11	„ **Expenses re Meetings**		52 14 4
4 7 6	„ **Bank Charges and Cheque Book**		3 17 6
	„ **Honoraria:**		
	Secretary	12 10 0	
	Treasurer	12 10 0	
	Editor	12 10 0	
50 0 0	Business Editor	12 10 0	50 0 0
	„ **Book "The Forests of Ireland"**		
6 14 2	Map reprints		7 8 9
	„ **Insurance - Public Liability**		5 0 0
	„ **Balance in Bank**	110 9 10	
388 0 4	**less, overpayments by members**	6 0 0	104 9 10
£1,147 15 11			£1,120 17 2

I have examined the above account have compared it with vouchers and certify it to be correct, the balance to credit being £104 9 10, which is on current account at the Ulster Bank Ltd. There is also a holding of £200, Dublin Corporation 5% Redeemable Stock 1968/73 and a holding of £200 Prize Bonds. Credit has not been taken for Subscriptions amounting to £372 0 0, which were outstanding at 31st December, 1970.

D. M. CRAIG,
Hon. Auditor,
85 Harcourt Street, Dublin 2.

24th February, 1971.

President's Address

PARTICULARS OF THE WORK OF THE IRISH FOREST SERVICES

supplied through the good offices of Mr. C. S. Kilpatrick, Northern Ireland Ministry of Agriculture and Mr. T. McEvoy, Department of Lands, Republic of Ireland.

Total Forest Land on Hands			
Republic	660,000	acres	
Northern Ireland	152,000	"	
Productive area			
R.	586,000	"	
N.I.	126,000	"	
Plantations			
R.	531,000	"	
N.I.	100·000	"	
1970/71 Operations			
Area acquired			
R.	34,000	"	
	(29,000)	"	productive land
N.I.	2,745	"	
Area planted			
R.	20,970	"	New planting
R.	1,413	"	Reforestation
N.I.	4,339	"	
	800	"	Private planting
Thinnings marked			
R.	7,857	"	
	15,758	"	Programme for season
	6 million cubic feet projected.		
Sales			
N.I.	11,000	tons	Round timber
	10,600	"	Fencing material & firewood
	800	"	Pulpwood & Pitwood
	10,800	"	Chipwood
Total	33,200	"	
Employment			
R.			
N.I. ...	109 Foresters		
	900 Workers		

In Northern Ireland a White Paper on Forestry is under consideration. It doubles the target for Forest to 300,000 acres to be reached by annual plantings 5,000 to 6,000 acres. A total production

of 30,000 tons of sawable timber and stakes is guaranteed. It is proposed to reorganise the Forest Service and to plan a series of 5-year Plans. A "Rural Improvement Campaign" with a staff of foresters to carry out exceptional work has been set up and already has 15 foresters and 350 men engaged. They are employed on work planned for the period 1970-75 which includes clearing scrub on private land free of charge to assist planting under the Planting and Maintenance of Woodlands Scheme.

Glenarriff Lodge with 1,400 acres of land beside Parkmore Forest in the Glen of Antrim was acquired in 1970 and 50 men are employed turning it into a Forest Park. The Prime Minister, Major Chichester Clarke, opened Drum Manor Forest Park in Co. Tyrone during June 1970. Seven areas were set up as Forest Nature Reserves in the following Forests : Breen, Slievenamorra, Rostrevor, Bohill, Killeter, Castle Archdale, Marble Arch and four Areas of Scientific Interest viz. Ballintempo, Fathom Wood. Ballypatrick and Glenarriff Glen.

In the Republic a Forest Inventory covering crops planted in 1957 and later was completed. It covers 246,514 acres and forecasts production to the year 2009 when it is expected that output will be 90 million H.ft. Sitka spruce is the principal species, 26.4% by area and 33% by volume. Data has already been given to industry and the Inventory will be published later. Field Work is proceeding on the Inventory of Private Woodlands by ground mapping and aerial photographs.

Experiments have been carried out in line thinning in Sitka spruce, removing one third of the volume in the first thinning by taking out every third line or a pair of lines in six, to ease extraction by tractor and to reduce cost of brashing and marking.

The application of phosphatic fertilisers is now the general practice on poor soils and recent years have shown the need for potash also on certain soils especially midland swamp peats. The experimental plantations at Clonsast where a variety of species have been planted on cut-away bog are very promising.

Over 700 acres of native woodlands have been designated "Nature Reserves". They are Glengarriff, Uragh (Kenmare), Derryclare (Co. Galway), Pontoon (Co. Mayo), Glendalough and Glen of the Downs (Co. Wicklow) and Lough Gill (Co. Sligo).

There has been a significant break-through in the impregnation of Sitka spruce for transmission poles. The method is to soak the poles in ponds for several months to permit biological activity to render the wood penetrable by preservatives under pressure.

The Wildlife Branch of the Department has been incorporated into the Forestry Division in a combined Forest and Wildlife Service.

A number of "Nature Trails" were laid out in State Forests and have proved highly popular with the public.

In Northern Ireland research work started included investigation into the effect of different ploughing depths on the survival and growth of Sitka spruce on heavy clay soils and further work on fertilising with N. P & K on slow growing crops on peat, peaty gleys and surface water gleys. Spacing and thinning trials were continued by the addition of further replicates.

Provenance trials were extended by the inclusion of Douglas Fir. A pilot study was started to investigate the effect on tree crops of allowing cattle into a plantation.

A preliminary assessment was made of the relationship between soils, species, crop heights, growth, site, wind damage etc.

The Work Study Section continued method and time studies on a wide range of operations including timber extraction, planting, ploughing, stake production, fencing and chain saw snedding.

Annual Study Tour 1971

The 1971 Study tour of the Society took place in Fermanagh and Tyrone on 25th-27th May. While the Belfast Forestry Division, our host, was fully represented at all levels, there was a notable and regrettable absence of senior officers from the Dublin Forest and Wildlife Service.

The tour was based at the Carlton Hotel, Belleek, charmingly located on the banks of the Erne, and the quartering and provisioning arrangements were up to the usual impeccable standard, under the direction of Miss Lily Furlong, in the unavoidable absence abroad of the Convenor, Mr. Fergal Mulloy. A tower of strength also in running the tour was Mr. Jim Mackin. A problem in logistics caused by the absence of the bus was efficiently overcome on the third day. Our leader and guide for most of the tour was Mr. J. C. L. Phillips, Regional Officer in charge of the West of Northern Ireland.

The first morning was spent in Ballentempo forest (Foresters: Messrs. J. Doran and P. McAlonen), where Dr. D. A. Dickson of the Chemical Research Division, Ministry of Agriculture, demonstrated a range of manuring experiments conducted jointly with the Forestry Division. The effects on Sitka spruce on blanket peat of nitrogen, phosphorus, potassium and ground limestone were shown, and deficiency symptoms relating to N, P and K were also seen. There was some suggestion that the problem of nitrogen nutrition of trees on peat may be more intractable than was hitherto believed.

In the afternoon we visited Castle Caldwell Forest (Forester: Mr. G. Cunningham). The main interest was in a series of thinning plots in *Abies grandis* and *Tsuga heterophylla,* demonstrated by Mr. C. N. Parker, District Officer, Fermanagh. The subsequent discussion centred on a possible management policy of no thinning. Following this a talk on the wildlife management of the estate was given by Messrs. S. White (R.S.P.B.) and McLean (Wildlife Officer).

An interesting item at the old Estate gate was a violin-shaped stone commemorating a certain "fidler", Denis McCabe, who, having drunk well but unwisely, was drowned off a barge in Lough Erne in August, 1770.

On Tuesday night the party was entertained to dinner by the Ministry of Agriculture. The Minister was represented by Mr. Malcolm, Assistant Secretary, who welcomed the Society on his behalf.

Wednesday was spent in Baronscourt forest (Foresters: S. Raphael, J. Milligan and D. Drew) and estate. The history of the forest was given by Mr. W. Wright, District Officer. The first stop was in a series of thinning plots in Sitka spruce, demonstrated by Mr. P. Savill, Research Officer, Forestry Division. This was followed by a visit to the respacing trial in Sitka spruce, which is the subject of Dr. W. Jack's paper elsewhere in this issue.

Lunch on this day was taken in the splendour of Baronscourt Castle (through the courtesy of the Duke of Abercorn and his staff) under the somewhat awesome gaze of the family portraits, including a magnificent Gainsborough. After a comprehensive and lucid description of the Estate's activities by the Land Agent, Mr. R. A. L. Waller, we visited the splendid *Azalea* garden. This was followed by a look at an area where dense laurel and rhododendron scrub had been cleared by bulldozer, and finally a visit to some plots of *Nothofagus,* which are a feature of the estate.

On Thursday morning we went to Lisnaskea forest (Foresters: Messrs. K. McDonald and C. Collins), where most of the available time

was spent looking at and discussing a "stem number reduction" trial, one of a series organized on an international basis by the International Union of Forest Research Organisations. Again the subject of no-thinning on fertile but shallow rooting soils was intensively discussed.

The whole of Thursday afternoon was spent on a visit to the extensive operations of Ballycassidy Sawmills Ltd., situated on a runway of the old Enniskillen Airfield. The softwood operations are geared specifically to deal with the small-dimension material now becoming available from wartime and post-war plantings. Its present input averages about 370 tons (about 11,500 Hoppus feet, 415 cu m). We were most hospitably received and shown around by the Managing Director, Mr. George Kidney, and Mr. R. F. Sheridan, who manages the buying and transport to the mill of round timber. The party was most impressed by the care taken at all stages to eliminate wastage.

The tour ended on Thursday evening with the Society's Annual Dinner, presided over by Mr. H. M. FitzPatrick, in the course of which a piece of sawn *Pinus contorta* timber, a rarity in those parts, supplied by Mr. Seamus Galvin, was solemnly presented to the representative of Ballycassidy Sawmills.

A welcome feature of the 1971 Study Tour was the comprehensive, informative, and well-produced 64-page tour handbook supplied to each participant.

N. O'Carroll

Lecture on Arboreta

As the final part of its contribution to European Conservation Year, 1970, the Society arranged a lecture entitled *Irish Arboreta—Past, Present and Future,* by Mr. A. M. S. Hanan, Director of the John F. Kennedy Memorial Park and Arboretum, Co. Wexford. The lecture attracted an audience of some 600 people to the Members' Hall, Royal Dublin Society, Ball's Bridge, Dublin, on 21st November, 1970, and was repeated in Omagh on 1st May, 1971.

In listing the best of the Irish arboreta, Mr. Hanan, with the aid of slides, described the particular features of places like Fota, Co. Cork; Powerscourt, Kilmacurragh and Mount Usher in Co. Wicklow, and Mount Stewart and Castlewellan, Co. Down. He also pointed out our unique opportunity in the gardens of Cork and Kerry where a wealth of "semi-tropical" plants, seen elsewhere in these Islands only in greenhouses, can be grown.

Mr. Hanan pointed out the dangers of neglect or destruction and called for a more lively interest on the part of the public so that this heritage would not be destroyed or forgotten.

Lecture in Mallow

On March 4th, 1971, Mr. G. de Brit (Research Branch, Forest and Wildlife Service) delivered a lecture on "Managing Insect and Disease Problems in Forests".

Lecture on air pollution

The effects of air pollution on growth was the subject of a lecture given by Mr. Donal T. Flood, formerly Director of the Timber Division, Institute for Industrial Research and Standards.

Mr. Flood began with a history of air pollution, beginning with the London observations of the diarist John Evelyn in 1661. In 1904 the main effects of pollution, namely, covering of leaves, obscuring the sun, and injury by acids, were distinguished by Boyd, who also noted differences in susceptibility between species, and in particular between conifers and broadleaved trees. Recent research in controlled environments has shown that chemical effects are more harmful than physical, while the era of petroleum has increased the range and intensity of atmospheric contaminants.

Study of the notorious Los Angeles smog has shown the importance of light other than in photosynthesis. There is a complex system of photochemistry centred around a certain number of pollutants. Sulphur dioxide and sulphuric acid are generally the most important pollutants in damaging plant life, but some derivatives of oxides of nitrogen, whose reactions are not well known, can damage plants in concentrations so low as to require measurement in parts per 1,000,000,000.

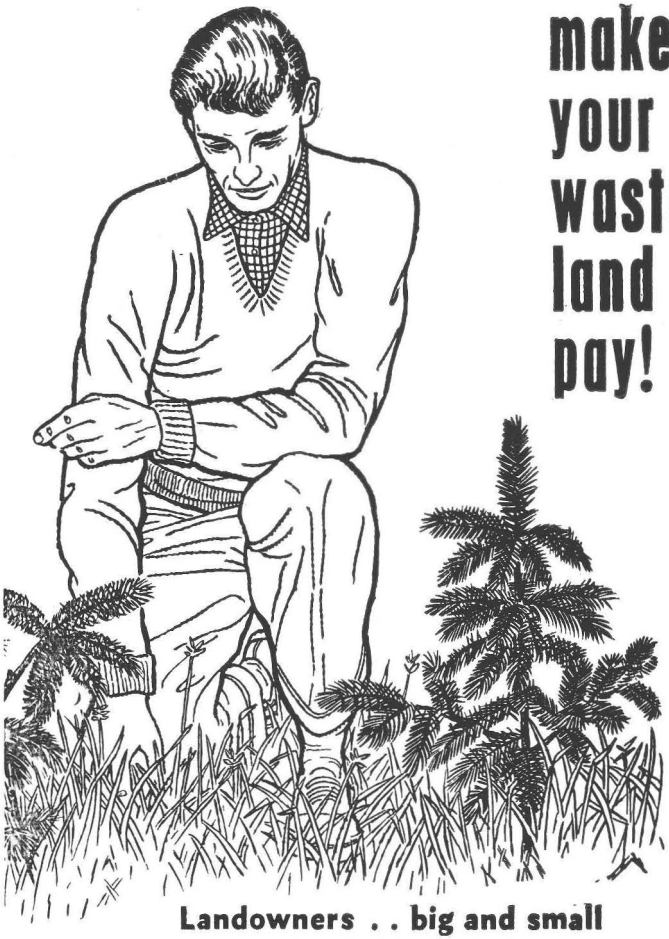
Mr. Flood went on to discuss some specific Irish problems, and the international situation, and concluded that a compromise must be found between man's demand for industrial employment and his need to preserve trees and forests.

In proposing a vote of thanks, Fr. J. J. Moore, S.J. (Botany Department, University College, Dublin) congratulated Mr. Flood on the thoroughness of his research and the range of his survey.

The vote of thanks was seconded by Mr. Leonard Gallagher (Institute for Industrial Research and Standards), who called attention to the need for increased research into the hidden effects of pollution, e.g. reduction in growth without any visible symptoms of damage.

Mr. Flood's lecture was repeated in Limerick on 26th March, 1971.

N. O'Carroll



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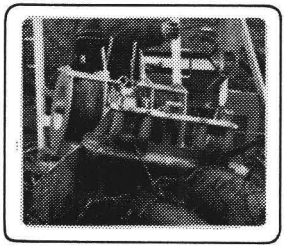

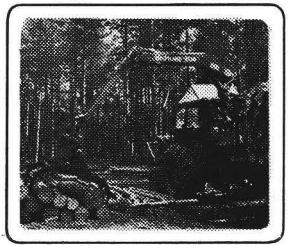

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