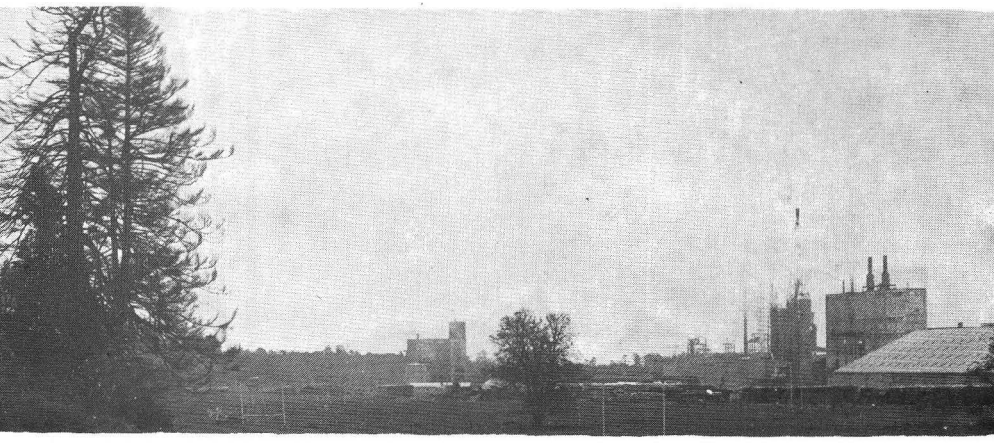
The Nitrogen Factory

MARGARET CURRAN

In the Garden of Ireland
They built a nitrogen factory.
The engineers looked at the soft folds
Of silky river between the trees
And said, "It's a pity to build it here."
"Build it." said authority.
So they built it.
Giant aluminium cans and metal domes and chimneys
Whose black and yellow breath fouls the sky.
And authority blessed it.

Now the trees are dying.
The river is surly, soiled and sour,
Swollen with oil
In which poisoned salmon
Sicken, gasping die
While fishermen mourn bitterly.
But money talks loud-mouthed
And a man's heart is in his pocket
As beauty leaves the Garden of Ireland.



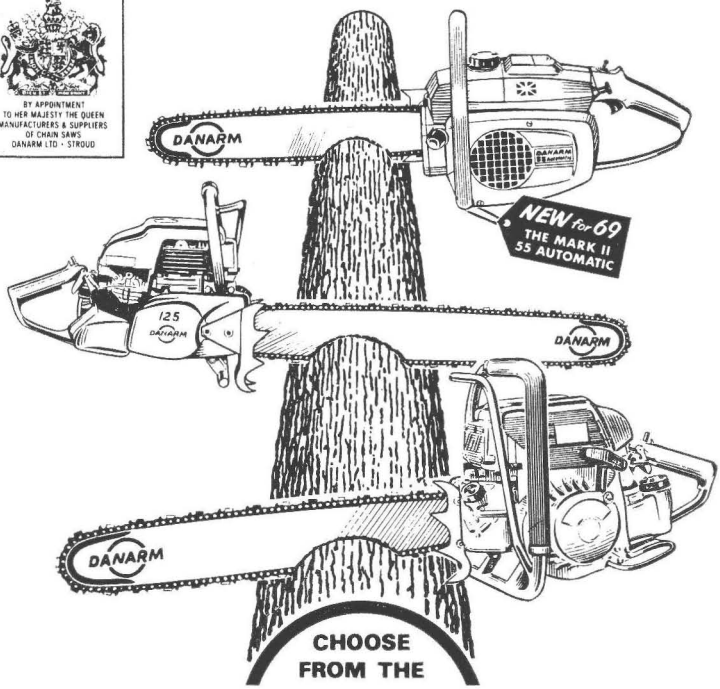
IRISH FORESTRY

Journal of the Society of Irish Foresters

Published Twice Yearly

Volume 27 No. 2 1970 10/- (50p)

BY APPOINTMENT
TO HER MAJESTY THE QUEEN
MANUFACTURERS & SUPPLIERS
OF CHAIN SAWS
DANARM LTD · STROUD



CHOOSE
FROM THE

DANARM

RANGE
OF

CHAIN SAWS

for the *QUICKEST* cut

At the Great Yorkshire Show 9 of the 26 finalists in the National Chain Saw Competition used DANARM SAWS and the 1st Prize in the SPEED OF CUTTING SECTION was won with a DANARM 55 AUTOMATIC.

- **BRITISH ENGINEERED, MANUFACTURED & GUARANTEED**
- **MEETS ALL SAFETY REGULATIONS**
- **EASY MAINTENANCE**
- **CHEAPEST SPARE PARTS SERVICE – NATIONWIDE**

DANARM LTD. SLAD RD. STROUD, GLOUCESTERSHIRE, Tel STROUD 2451

A UNOCHROME INTERNATIONAL COMPANY

GET DOWN TO IT WITH DANARM

The wide range of Danarm Chain Saws covers all requirements for efficient and economical timber cutting.

KEEP THIS PRICE LIST FOR HANDY REFERENCE

DDA. 110 MANUAL

16″	...	£69 0 0
20″	...	£73 0 0
24″	...	£75 0 0

55 AUTOMATIC

12″	...	£75 0 0
16″	...	£76 0 0
21″	...	£78 0 0
25″	...	£80 0 0

110 AUTOMATIC

16″	...	£77 0 0
20″	...	£78 0 0
24″	...	£80 0 0

125 AUTOMATIC

20″	...	£86 0 0
24″	...	£88 0 0
28″	...	£90 0 0
32″	...	£92 0 0

DD8F MANUAL

18″	...	£86 0 0
23″	...	£88 0 0
28″	...	£90 0 0

OREGON CUTTER BARS AND CHAINS

OREGON FACTORY FITTED CHAIN

Danarm cuts right down to ground level giving more timber and leaving no unsightly stumps. Precision engineering and perfect mechanical balance gives all-angle cutting. Danarm Saws are robust rugged and adaptable, backed by over 25 years experience. All models are fitted with Oregon cutter bars and chains. Danarm gives better service and cheaper maintenance.

Call, write or phone for detailed information from experienced technicians.

BUY DANARM SAWS GET DANARM SERVICE

Importers and Distributors

Lenehans

CAPEL STREET, DUBLIN 1

Tel. 45841

make your waste land pay!

Landowners . . big and small
. . . can profit from the Government's
Private Planting Grant Scheme.

- **£20 per acre State Grant**
- **Free technical advice**
- **Special grants for Poplar**

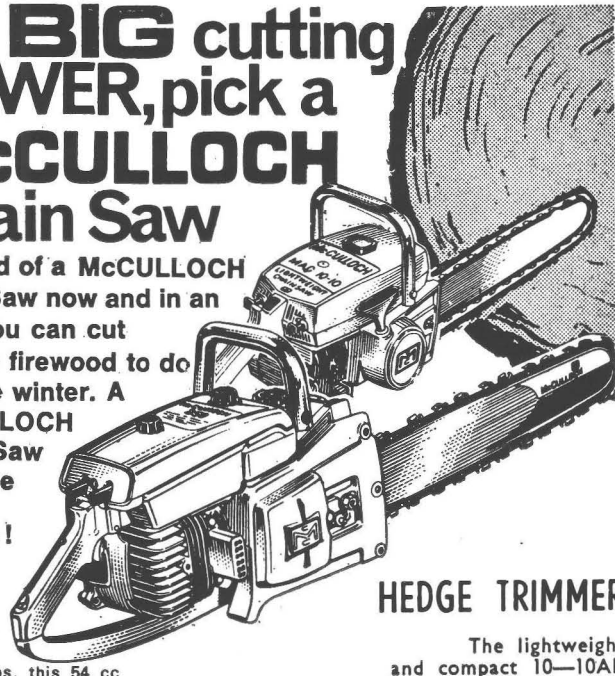
Full particulars from:

The Secretary,
DEPARTMENT OF LANDS,
(Forestry Division),
22 Upper Merrion Street,
Dublin, 2.

Brindley Adv.

for BIG cutting POWER, pick a McCULLOCH Chain Saw

Get hold of a McCULLOCH Chain Saw now and in an hour you can cut enough firewood to do a whole winter. A McCULLOCH Chain Saw will save you pounds!



MAC 10-10AL

Weighing only 10¼ lbs. this 54 cc engined saw is a fist full of power to crosscut and trim all types of trees. Start the MAC 10-10AL and see the firewood pile up!

£77.18.0 (incl. 16" bar and chain)

MAC 250 With a power-packed 80 cc engine with direct drive, the MAC 250 takes bars up to 24" and many attachments. It has a reborable cylinder for long engine life.

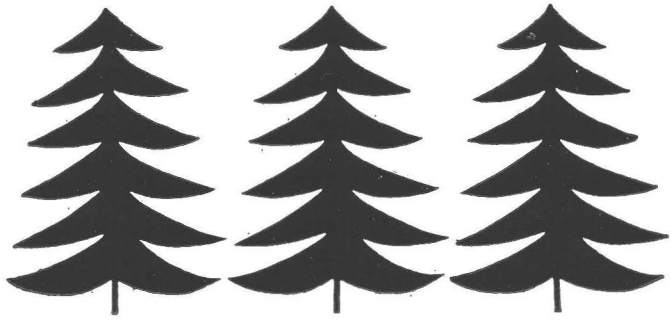
£88.2.0
(incl. 19" bar and chain)

HEDGE TRIMMER

The lightweight and compact 10—10AL is now widely recognised as an all-purpose farm implement. Because of its handy size the MAC 10—10AL can save you hours of labour on a multitude of chores including hedgetrimming, land reclamation and land clearing — and no extra fittings are required for these tasks! The 10—10AL means economy in modern farming.

Distributor
KEVIN BRODERICK LIMITED
74 Clareville Road, Dublin 6
Telephone 976758/9

Brindley Adv.



Control weeds in forestry plantations

. . . . . **with 'Gramoxone'. 'Gramoxone' contains paraquat which is potentially the most useful weedkiller for forestry. It kills all green growth and is particularly effective against grasses.**

'Gramoxone' can be used for: Cleaning seed beds and transplant lines. Chemical screefing of land prior to planting. Ring weeding of young trees after planting. Dessication of firebreaks for controlled burning. Total weed control in uncropped areas.

ICI **'GRAMOXONE'**

A PLANT PROTECTION PRODUCT FROM
I.C.I. (Ireland) Ltd., 35 Sth. Frederick St., Dublin 2.

IRISH FORESTRY

CONTENTS

(Authors alone are responsible for views expressed)

SOCIETY OF IRISH FORESTERS

President:

H. M. FITZPATRICK, Nuns Cross House, Ashford, Co. Wicklow.

Vice-President:

M. MCNAMARA, "Dairin", Little Island, Co. Cork.

Secretary:

M. E. CASSIDY, c/o Royal Dublin Society, Ball's Bridge, Dublin 4.

Treasurer:

T. MOLONEY, 1 Rosehall, Templeogue Road, Dublin, 6.

Editor:

N. O'CARROLL, 12 Mapas Road, Dalkey, Co. Dublin.

Business Editor:

J. F. DURAND, "Sequoia", 121 Arnold Park, Glenageary. Co. Dublin.

Hon. Auditor:

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

Grade I Councillors:

F. MULLOY, Site 14, Rochestown Avenue, Dun Laoire.

D. S. O'SULLIVAN, Ballydowling, Glenealy, Co. Wicklow.

P. M. JOYCE, Site 19, Carysfort Estate, Blackrock, Co. Dublin

R. O'CINNEIDE, 117 An t-Ard, Cnoch Mhuirfean, Co. Baile Atha Cliath

Grade II Councillors :

W. B. LUDDY, Rathnew, Co. Wicklow.

J. J. PRIOR, "Greenville", Portarlington, Co. Laois

Associate Councillors :

J. R. F. HILLIARD, Cahernane Garden, Killarney, Co. Kerry.

MISS E. FURLONG, "Silvern", 150 Clontarf Road, Dublin 3.

Regional Delegate :

J. E. MACKIN, Killeter Forest, Castlederg, Co. Tyrone.

IRISH FORESTRY

Volume 27 1970 Number 2

Editorial

The Pendulum

The pendulum swings always in new directions—if a pendulum may be said to swing in more than two. In the nineteen fifties it was genetics. All mysteries were ascribed to the obscure workings of the genes. In the early nineteen sixties physiology was the vogue; and that name, if not always the science, was used to get over many a knowledge gap. Later it was multiple land use, a useful cudgel with which to beat importunate economists.

This year it is Conservation.*

Many definitions of the word have been given, most of them designed to cover the definer's own particular interest, few of them simple, none straight from the dictionary.

How many projects have got under way as a result? This in itself distinguishes Conservation from the previous fashions, which tended mainly to cloak ignorance. Conservation has generally been used to justify action. It is quite certain that not every Conservation Year project will be useful, but it is unlikely that many will be harmful.

For this reason in itself we must welcome this particular swing, and hope that future oscillations will bring at least equal benefits.

* Written in 1970. Publication of this issue has been delayed by circumstances outside our control.—Ed.

Forestry and Irish Economic and Social Development.

Frank Convery[1]

INTRODUCTION

An attempt is made to indicate the role that the present and potential outputs of Ireland's[2] state[3] forests can play in the achievement of the country's long-term social and economic objectives. This is an essential first step in the evaluation of forestry investment[4] in the context of an overall macro-planning framework. This is not a highly quantified analysis, and no effort is made to justify (or otherwise) a particular level of expenditure on forestry.

Since Ireland adopted a formalized planning approach to economic growth and development in 1958, attention has been focused on the composition of public expenditure and on its role in the growth process. This concern has been cogently presented in the most recent plan (27) p. 184:

> Particular attention will be paid to the composition of investment in the public capital programme, no less than to its actual level, since this is important in attaining the over-all investment target of about twenty three per cent of G.N.P. by 1972—a comprehensive appraisal of the public capital programme is at present in progress and the results may well indicate a need for changes in the pattern of expenditures.

The above appraisal aims at developing techniques of programming and analysing public expenditure, both capital and current, by reference to objectives and output, using a systematic method of quantifying future costs and benefits. In the spirit of this attempt to order expenditure in terms of priorities, the principal socio-economic benefits deriving from the forestry sector are examined.

Investment in plantation forestry is a long-term undertaking, with typically twenty years elapsing before the first returns accrue. In this situation, with a planning horizon that far exceeds the four to six years common in government medium term programmes, forestry

---

[1] Doctoral Candidate, Dept. of Forestry Economics, College of Forestry, State University of New York at Syracuse University.

[2] Although the data used in this discussion pertain only to the Republic of Ireland, many of the general remarks and conclusions have equal validity on both sides of the Border.

[3] The main thrust in Irish forestry development comes from the government service. About 90% of the total forest area is owned by the state.

[4] The words investment, spending and expenditures are used interchangeably throughout the discussion, except where otherwise indicated.

expenditure must be examined in a more extended perspective. For this reason, the long-term objectives, requirements and constraints of Irish economic and social policy outlined in the National Industrial Economic Council's (NIEC) **Report on Full Employment** (20) are used here as a frame of reference. These can be summarised as follows:[1]

Objectives

(a) Development of the national economy measured in growth in **per capita** standards of living.

(b) Full Employment: " . . . the creation of sufficient new jobs on average each year to ensure that no one who is actively seeking work in Ireland and prepared to accept it at the terms currently being offered is unable to find it within a reasonable period."

Requirements

(a) An equitable distribution of income and wealth, and an appropriate balance between the development of different regions and between private and community needs.

(b) Efficient use of all productive resources.

Constraints

(a) Price stability.

(b) Reasonable long-term equilibrium in the balance of payments.

It is common practise when evaluating alternative investment projects to compute their discounted net worth, using an interest rate which reflects the marginal efficiency of capital in the economy. The difficulties of determining the appropriate interest rate continue to generate much discussion (12), and are not considered here. Low interest rates favour long-term projects like forestry, higher rates favour those with quicker payoffs. Most afforestation in Ireland takes place on land that is marginal for agricultural purposes. Johnston (14) reports that on such land, forestry can expect to earn an annual return of about 3%. Recent Irish experience indicates that an average return of approximately 5% can be expected, estimated using currrent prices (17).

The financial rate of return is not the crucial measure in evaluating the effectiveness of public enterprise. Indeed, if this return were sufficiently large there would probably be no need for government intervention. The gap between what expenditure on forestry

[1] For the remainder of this discussion all of these factors are referred to collectively and interchangeably as the nation's goals, objectives, aspirations, etc.

actually earns and this money's highest alternative rate of return is the real cost of providing the net non-financial benefits that result from this investment.

Some measure of the relative importance of forestry expenditures in the national economy can be judged from Tables 1 and 2.

TABLE 1 — TOTAL FORESTRY EXPENDITURES AS % OF G.N.P., 1963-66

Year	G.N.P. (current prices) (£ Million)	Total Forestry Expenditures (£ Million)	Forestry expenditure as % of G.N.P.
1963	836.6	3.3	0.39
1964	946.5	3.6	0.38
1965	1,010.4	3.9	0.38
1966	1,061.0	3.9	0.36

Source: Tables 91 and 237. Reference 26.

TABLE 2 — ESTIMATE OF TOTAL PUBLIC CAPITAL PROGRAMME, AND ITS FORESTRY COMPONENT, 1963-70 (in 1963 prices)

Year	Total Public Capital Programme (£ Million)	Forestry (£ Million)	Forestry as % of Total
1963-64 (Actual)	78.5	1.81	2.30
1964-65	96.11	1.75	1.82
1965-66	95.57	1.89	1.97
1966-67	94.23	1.95	2.06
1967-68	93.2	1.99	2.13
1968-69	92.82	2.00	2.15
1969-70	97.32	2.02	2.07

Source: Table 4, **Second Programme, Part II,** Government Publications, Dublin, 1963.

State-owned forests make up about 90% of the country's total, and over half a million acres, or just less than 3% of the total land area. Because of a very poor endownment of indigenous forest and the difficulties of natural regeneration, most of this area is in the form of even-aged plantations. A little over half of this forestry estate is less than 10 years old, and 95% of it is covered by coniferous species, with Sitka Spruce (40%) and *Pinus Contorta* (30%) predominating (19). The mild, humid climate, with its well distributed

rainfall and lack of temperature extremes favours rapid tree growth which for conifers averages between 100 and 120 hoppus feet per acre per annum (11). Government has been involved in direct forest establishment in Ireland since 1903, but an explicit statement of the bentfits that should flow from this estate have not been formulated. Physical goals have been stated, such as the planting of one million acres, or the establishment of a forestry estate that could fulfil domestic needs (25). However, the benefits (and costs) of an Irish afforestation programme have been discussed in a number of quasi-official statements, such as the **Report of the Departmental Committee on Irish Forestry** (24), and various articles in **Irish Forestry.**[1] Some of these arguments are re-examined here in the context of national economic planning.

DEVELOPMENT OF THE NATIONAL ECONOMY

Economic growth is defined as the increase in real **per capita** income; economic development refers to the progressive refinement of the economic infrastructure, both physical and institutional. Attention in this section is focused on real **per capita** income growth. In all of the theories concerning economic growth, investment is regarded as a main propulsive parameter. Investment in Ireland for the period 1958-64 can be broken down as follows (20): Economic investments, which include almost all investments in agriculture and industry, and in services which perform a directly economic function make up about 50% of the total. The infrastructural category (electricity, gas, water, transportation, etc.) comprises about 32% of the total, while social investment (dwellings, hospitals, churches, social services, etc.) account for the remaining 18%. Expenditure on forestry falls into the economic category, but it has infrastructural and social overtones.

Direct Effect

As noted earlier, forestry investment within the constraints (mainly land quality and small operating units) under which it operates in Ireland is likely to earn an annual return of approximately 5%. This return is the direct income generating effect. In this respect the state forestry investment can be regarded as savings bonds held by the Irish people which have not yet matured. Present incomes per annum yields are low, averaging between 0.6-0.7 million pounds, or approximately £0.23 **per capita** per annum, from 1946-68 (26). The future time path of these (increasing) dividends is not

[1] Examples include: M. L. Anderson, "The Importance of Forestry in National Planning," *Irish Forestry*, 2, 1945; E. A. Attwood, "Problems of Forestry Development in Ireland, *Irish Forestry*, 21, 1964, and Johnston (14).

known, but should be facilitated by the new census of state plantations at present in progress, which will provide the basis for the first full long term production forecast for state forests (27).

Investment in forestry can be regarded as capital deepening or capital widening. Capital deepening increases the capital intensity of the productive process, and in forestry the annual growth accumulation is the most important component of this type. In 1963, 104,000 acres, or 28% of the total forest estate at that time was more than 20 years old (6). Assuming a net average annual growth rate of 100 hoppus feet per acre per annum, and an average per hoppus foot value (standing) of £0.05, this immediately exploitable part of the forest increases in value by over half a million pounds in one year. It is worth noting in passing that theoretically this increase in the forestry capital stock should be included as a contribution to the Gross National Product. Its exclusion, probably because of empirical difficulties, involves an underestimation of the forestry sector's contribution to current aggregate production. Other capital deepening forces include fertilization, thinning, pruning, drainage, etc. Expenditure on research can also be classified in this category. Capital widening extends existing capital or creates new capital. In the Irish case it includes most importantly the purchase of land and the consequent extension of the forestry estate.

Induced Effects

These include the inter-industry demand that is generated directly by the forestry sector, and its multiplier effect on the entire economy. Attention is focused in this discussion on the inter-industry linkages. Westoby (28) reports that (p. 193):

> Forest industries can be considered a propulsive sector, that is, a sector the expansion of which is liable to induce spontaneous investment in the other branches of production. This is due to the fact that forest industries have a very strong forward linkage with other sectors. A high degree of linkage makes a sector a good starting point for industrial growth; investment then, by inducing demand and providing supplies for other sectors, widens investment opportunities in the economy as a whole, and has a multiplier effect—not in the traditional sense of the word, which is based on final demand and on the consumption of income by the newly employed, but in the sense of increasing inter-industry demand.

These conclusions are based on inter-industry coefficients derived from input-output tables for a variety of countries. Unfortunately, probably because of their small relative size, forestry and the forest industries have not been included as separate sectors in the most recent Irish input-output table, although O'Connor and Breslin (22) have done some very useful work on its agricultural component.

About 50% of total forestry expenditures go to wages, and many

imputs such as fencing posts, gravel, seeds, trees for planting, etc., are produced internally, so that backward linkage is not strong. Machinery (saws, tractors, ploughs) must be imported. O'Neill (23) finds (p. 61) that on farm households with less than 30 acres and with a weekly expenditure (1964-65) of £10.88, value of food consumed made up 57% of this total. Forestry workers' weekly expenditures would be of this dimension, so that over a quarter of total annual forestry expenditure flows back into the agricultural sector. Forward linkage is strong. Table 3 gives some idea of forestry's potential as a propulsive sector. It would neither be possible nor probably desirable to meet all the fibre needs of these industries from domestic sources. However, the performance of the industries using domestic wood is encouraging. Annual gross output of the native wood-using pulp and panel industries is now valued at between 2 and 3 million pounds, and they are expanding as quickly as the raw material supply will allow, with pulpwood consumption increasing from 20,000 tons in 1951 to 138,600 tons in 1966 (5). The lumber industry is at present very small, with production in 1964 reaching 1½ million sawn cubic feet (6) with a gross value of about 1 million pounds. This industry absorbs all sawable material coming on the market from the Forest Service. These industries themselves have linkage effects. One chipboard plant makes furniture, the pulpmill manufactures newsprint from its groundwood plant, while hardboard, chipboard and lumber are used in construction. Their backward linkage in Ireland is poor, since the non-wood physical inputs, consisting chiefly of machinery and chemicals, must be imported.

All of these income generating effects presuppose a market for the outputs of the forest. For marketing purposes forests have important advantages[1] over more seasonal crops. The production function in forestry is flexible, so that output can be geared to the needs of industry. Thus the harvest can be delayed, storing the crop as it stands, or cutting can be accelerated temporarily, borrowing from capital. In addition, the output is very versatile, e.g., saw-log material can be used for pulpwood, and fuelwood can be used as raw material for chipboard. For Irish pulp, paper and panel products, future output increases must be sold on foreign markets. Already, with these industries at a very early stage of development, the home market for panel products is virtually fully supplied from domestic sources, and about half of their total output is exported, mainly to the U.K. In the U.K., from 1956-61, annual growth in consumption for panel products averaged 8.3% and the projected annual growth rate to 1975 is 8.2%.[2] Apparent income elasticity for panel products

---

[1] These advantages are listed by Westoby (28).

[2] Except where otherwise specified, the figures in this section are derived from *Unasylva*. Vol. 20, 80-81, 1966.

TABLE 3 —— INPUTS AND OUTPUTS OF POTENTIALLY [1] WOOD BASED INDUSTRIES, 1965

	Gross Output £000	Cost of Materials £000	Net Output (i.e., value added to materials) Total £000	Salaries and Wages £000	Remainder of Net Output £000	Average No. of Persons Engaged
Manufactures of Wood and Cork except Furniture	8,700	4,950	3,750	1,979	1,771	3,618
Manufacture of Furniture	7,210	3,634	3,567	2,287	1,288	4,300
Manufacture of Paper and Paper Products	16,657	9,950	6,707	3,382	3,325	5,167
Total (Wood based)	32,567	18,534	14,024	7,648	6,379	13,085
Total for all Manufacturing Industry	659,004	445,871	213,134	106,322	106,812	172,803
Industries that are potentially wood based as % of total	4.94	4.15	6.57	7.19	5.97	7.57

Source: Table 106. Reference 26.

[1] At present much of the pulp industry uses waste-paster as raw material, while some furniture manufacturers probably use very little wood. All chemical pulp requirements must still be imported.

for the U.K. calculated from 1951 to 1961 was 4.8%. Pulp, paper and paperboard, with a somewhat lower income elasticity of demand, still managed an annual consumption growth rate of 5.1% from 1956-61, and the projected growth rate to 1975 for these products is 4.6%. It seems then as if the aggregate export market situation for Irish pulp, paper and panel products is satisfacory. However, Irish producers share free access to the U.K. market with all Commonwealth countries (including South Africa), the EFTA nations, and Sweden. Irish panel products, accounting for much less than 10% of total British consumption, have consistently been the most highly priced of the imported boards (1). The ability of the Irish wood processing industries to compete successfully on the British market is an essential prerequisite for further expansion of the entire forestry enterprise. So far, the principal factor limiting production has not been demand, but wood supplies, so that the future in this regard looks promising. If the reactivated Irish and British membership applications to the E.E.C. are accepted, this will have the dual result of broadening the competition while at the same time increasing opportunities for expansion, since the E.E.C. as it is presently constituted is a net importer of pulp, paper and panel products.

For lumber, the domestic market should offer the main stimulus to expansion. Imports of sawn-wood amounted to about 6 million pounds in 1966 (26). Although not all of this material can be replaced by the domestic product, this import figure does give some idea of the scope of the opportunity involved. Thus it seems that for all Irish wood-based industries the potential markets exist, if production costs can be kept competitive.

McGilvray (18), commenting on the Second Programme, suggests that (p. 34):

> Perhaps greater emphasis might have been placed on priority planning for certain key sectors which could be regarded as potential long-term growth industries in the context of international free trade, rather than on the formulation of detailed targets for all sectors of the economy. Thus the major objectives of the Programme would have been the structural changes required to sustain long-term growth, and maximising the rate of growth of output (principally exports) of these key sectors.

Forestry seems to fit the bill as a " long-term growth industry in the context of international trade." The success of forestry's role as a growh point in the economy depends on its ability to deliver wood to the mills at a competitive price. Labour costs are a major consideration in this regard. Aggregate employment and its efficiency are now considered.

EMPLOYMENT

The total number of persons directly employed by the Forestry Division was 4,750 at March 1968 (27). In the Third Programme

(27) it is pointed out that despite the continuing increase in the workload for maintenance of plantations, the total number employed has been falling in recent years as a result of the introduction of mechanisation, incentive payments, and methods of operations research. It might reasonably be asked whether the fall in employment is not partly attributable to the 20% reduction in the most labour intensive of all forest operations, the planting programme. It does seem nevertheless as if labour productivity in the forest is being increased as rapidly as possible. Clear (4) estimated in 1966 that in addition to those employed directly, there were 2,500 men employed in the felling, transporting, and processing of home-grown timber. Kennedy and Dowling (15) show that output per man-hour in the "Manufactures of Wood (Except Furniture)" group of industries averaged an annual increase of 4.56 % from 1953-66. The "Furniture, Brushes and Brooms" and "Paper" groups show annual increases in output per man-hour of 2.92% and 4.47%, respectively, over the same period. These figures compare with an all industry average of 2.87%. It seems then as if the wood-using industries have kept pace at least with domestic rates of productivity increase.

No published estimates of the likely final long-term work force induced by the forestry sector are available. Assuming an annual planting rate of 25,000 acres, the provisional goal of one million acres of forest should be reached by 1990. If one man is employed per 100 acres (14), direct employment would amount to 10,000 men, or about 5% of the total anticipated labour force on the land at that time.[1] Since two men working in the forest now generate work for one man outside, when much less than half of the forest area is producing saleable material, it seems reasonable to assume that as full production is approached at least a one-to-one ratio will obtain, i.e., 10,000 men employed in the forest will generate 10,000 more jobs through direct linkages. The location and quality of these jobs is important, and this aspect of the labour situation is considered next.

DISTRIBUTION OF INCOME — WEALTH

The low value per unit volume of raw wood means that wood using industries are usually resource oriented, i.e., they tend to locate near the forest. The Irish experience reflects these locational forces. Most sawmills are located outside of the large urban centres. The other wood processing industries are located as follows: A chipboard plant at Scarriff, Co. Clare (Pop. 673), a hardboard plant at Athy, Co. Kildare (Pop. 4,069), a chipboard plant at Waterford (Pop.

---

[1] Using an extrapolation from the 1980 estimate of 236,000 made by NIEC *Report on Full Employment*, Table 9, (20).

29,842), and a groundwood pulp plant in Dublin (Pop. 650,153). The Dublin plant is integrated with a long established paper mill.

Despite a vigorous industrialization programme, total employment in Ireland fell from 775,981 in 1961 to 765,212 in 1966,[1] with an 8.7% increase in industrial employment not quite compensating for an 11.94% decline in agricultural employment. The reasons why fairly rapid economic growth in Ireland has not resulted in an increase in the labour force are quite complex. They stem from the fact that Irish industry must become increasingly capital intensive both to compete on the export market and to satisfy the sophisticated tastes of the Irish consumer. In addition, many of the production units recently established in Ireland have weak linkages with other Irish producers. The numbers employed in the four largest urban centres (Dublin, Cork, Limerick, Waterford) have increased substantially, while counties farthest from the large growth centres have sustained the greatest reduction in the labour force. Some contrasting examples are given in Table 4. There are conflicting ideas as to which is the best way to handle the very large disparities in development rates which are reflected in these employment figures. Two views predominate: The first claims that concentration of industrial development in a limited number of large centres is essential to achieve a fast rate of economic growth. The Buchanan Report (3) represents this point of view, claiming that large scale, highly technological industry is necessary for rapid expansion, and that these are best concentrated in a limited number of major growth centres. The other opinion, supported by sociologists and humanists such as Newman (21) and Healy (13) favours a more dispersed form of industrial development. They argue essentially that the rapid decay in much

Table 4.—CHANGES IN THE LABOUR FORCE, 1961-66
(Percentage Increase)

County	Agriculture	Non-Agriculture	Total
Dublin	-7.63	9.12	8.76
Kildare	-10.59	13.35	5.80
Wicklow	-8.73	10.45	4.29
Limerick	-13.46	14.63	4.18
Leitrim	-16.24	-3.27	-12.54
Mayo	-13.82	6.13	-7.37
Cavan	-13.55	5.01	-6.83
Roscommon	-12.30	5.82	-6.75
Longford	-12.70	2.64	-6.52

[1] The population and employment figures given in this section are taken from tables in a publication by Michael Ross, *Personal Incomes by County*, 1965, ESRI Paper No. 49, Dublin, Nov., 1969.

of the countryside which results from a policy of very large growth centres would be too high a price to pay for whatever increases in aggregate output this centralization would achieve. The Minister for Lands (8) has recently added his voice to this "rural renewal" school, indicating that he would prefer to move away from the idea of trying to provide "economic" units of land for full-time farmers. Instead, the effort should go into creating off-farm jobs which would enable the house-holder to remain a part-time farmer. Increased labour productivity in farming commonly results in a fall in the numbers engaged in it, because most agricultural products face markets which are both price and income inelastic. This fact heightens the pressure to provide off-farm work. Baker and Ross (2) show that while some formerly very poor counties (notably Clare and Kerry) have in recent years had very high rates of economic growth, others, such as Leitrim, Roscommon and Longford have consistently lagged behind. These counties are poorly endowed with natural resources and are badly located to participate fully in national growth. It is in such poor areas that forestry can be especially useful. At the time of forest establishment, people who can no longer earn a "satisfactory" living at full-time farming can work in the forest, either full or part-time. Thus forestry can be used as a mechanism for slowing the rate of population drift from the land, while at the same time creating a wood supply that will induce locally oriented industry. Government sponsored forestry work is one of the most ideologically acceptable ways of using tax revenue to support a rural economy. It seems to give rise to less urban taxpayer resistance than product subsidies, rates remission, or direct payments. For the poorest counties it could provide an important stimulus on the way to sustained economic growth. Lucey and Kaldor (16) document the direct effects of a chipboard plant in Co. Clare on the local economy. They found (1966) that the plant (using 36,000 tons of pulpwood per annum) gave direct employment in the area to 134 people, all of whom would have left the area otherwise, with an associated increase in total population of 318. They also found that of the 17 employees who were also farm operators, eight said that the value of their farm output had been increased as a result of their plant employment; a further six said that it had been unchanged, while only three said that the value of their farm output had fallen. These effects could be duplicated many times in the poorest areas if the wood supply were available. It seems then as if forestry can provide what these areas so badly need—a mechanism for slowing the rate of emigration from the area until such time as off-farm opportunities can be increased, and at the same time providing the raw material (investment opportunities) for wood-using industries. Forestry's contribution will be most useful if it is

coordinated with other programmes involved with area development,[1] i.e., infrastructural, agricultural, industrial and tourist development plans.

Labour receives over half of total State expenditures on forestry, while it also receives a high proportion of the income generated in the wood-using sector. The labour employed does not represent a cross-section of the national labour force. It consists of a disproportionately large number of low skilled workers with limited opportunities for alternative employment. Geary and Hughes (10) point out that it is among this class of workers that the problem of unemployment is most critical, and that the problem is most severe in the poorest areas. Thus forestry has the effect of helping chiefly the most disadvantaged members of the labour force.

EFFICIENT USE OF ALL PRODUCTIVE RESOURCES

This requirement indicates that resources should be combined in a manner that maximizes the net return to society. This paper has been undertaken with the intention of identifying the part that forestry can play in the achievement of this objective, so that the idea of efficiency underlies the entire discussion. In this section, only the land resource is considered.

As was noted in the introductory remarks, investment in forestry can expect to earn an annual rate of return of 5% on the type of land presently being planted. Furness and Whatmough (9) use a case study approach to provide the most complete study to date on comparative net returns to agriculture and forestry on land that is marginal for agricultural use in Ireland, using a range of interest rates. As the quality[2] of the land improves, returns to both agriculture and forestry increase. Conceptually land should be devoted to those uses that contribute most to society's goals. As the discussion so far has indicated, this contribution can be extremely difficult to assess. National goals may be contradictory, e.g., the easiest way to increase **per capita** income in a region may be to reduce its population. Many goals are also unquantifiable;—to what extent should the rights of ownership (e.g., an absentee owner) be compromised for the good of society?—how can conservationist, wildlife, ecological and recreational benefits be measured? The rate at which society discounts future benefits (rate of time preference) vitally affects what is regarded as the "most efficient" way of using land. The greater the

---

[1] For government departments with regional offices, T. J. Barrington outlines a plan to facilitate interdepartmental coordination, in an Addendum to the *Report of Public Services Organisation Review Group*, 1966-69 (The "Devlin" Report), Government Publications, Dublin, 1969.

[2] "Quality" incorporates considerations of nutrient status, drainage, topography and exposure.

concern for long-term future welfare, the more will forestry and other long-term projects tend to be favoured. Because of these difficulties, attention has been focused on the quantifiable financial costs and returns of different uses. The State Forest Service has introduced (1969) a land pricing system based on the potential capacity of the area to produce timber, and on the assessed costs of developing it for this purpose (27). Previously the Forest Service was permitted only in exceptional cases to pay more than £10 per acre for land. The internal rate of return earned by forestry varies directly with the quality of the land planted. The increased flexibility in land purchase could dramatically alter the net return on the forestry investment, both by increasing physical rates of growth (increased revenue) and by allowing forest consolidation, which would achieve economies of scale (decreased costs). However, this valuation system does imply that all acres of land that have the same production and cost functions have the same social utility if devoted to this use. As has been pointed out already, this frequently will not be the case. This is intuitively recognised in the political sphere, being reflected in the remarks of the Minister for Lands (S. Flanagan) (8) to **An Dail** (p. 1425).

> I have plans for certain areas which I regard as being particularly suitable for forestry. I refer in particular to County Leitrim, and I should like to inform the House that I have directed the Forestry Division to make an all-out drive to acquire land in County Leitrim, to plant it and thereby give employment to as many people as possible in that area. This perhaps involves acceptance of the fact that most of the land in Leitrim is not suitable for development in agriculture. It is as well to face realities in regard to matters like this and to abandon the effort to make a living where a living is not to be got.

Within the forestry sector, land-use problems also arise. It could be argued, for example, that it would be in the best national interest to manage all of the forest lands near Dublin exclusively for recreational purposes, and that many of the western peatland plantations should be grown on a pulpwood rotation. There are no definitive answers to these questions. The land use pattern that best serves the needs of the country cannot be a static phenomenon, and will change as markets, technology and consumers' utility functions change. Defining forestry's role in this ever-altering matrix is particularly difficult because of the need to predict the distant future. The trend in Ireland is towards more refined regional planning. More data are becoming available on the production functions associated with different types of land uses. Intensified planning and better information should help direct the land of Ireland to those uses that are most consistent with its needs.

PRICE STABILITY

Theoretically, forestry expenditure should be detrimental to short-run price stability. Over half of these expenditures are paid out as

wages (i.e., to consumers) but this outlay does not result in any immediate corresponding increase in marketable output. However, as was noted earlier (23) about half of the wages paid to forestry workers are spent on food. Farm produce in Ireland should have a high price elasticity of supply because of existing unused capacity and the competitive structure of the farming industry. This factor should mitigate forestry's short-run inflationary effect. In the long-run, if it can provide goods (and services) which are cheaper than substitutes and imports, forestry will contribute to price stability.

BALANCE OF PAYMENTS EQUILIBRIUM

From the remarks made earlier concerning the markets for wood products, it is clear that the net foreign exchange earning potential of Irish wood using products is considerable. The importance of this import-saving export-earning potential is emphasized by the following points:

(a) The country has few economically exploitable natural resources. Substitutes for wood must be imported.

(b) Economic growth cannot be sustained unless there is a continuous process of increasing net investment. Most of this essential plant and equipment must be imported, financed in large part by the foreign exchange earnings of the exporting industries.

The contribution of forestry to the maintenance of balance of payments equilibrium is not considered further. In the summary and conclusions which follow, an effort is made to integrate the threads of the discussion into a cohesive pattern.

SUMMARY AND CONCLUSIONS

The reasons for looking at State expenditure on forestry as it relates to the over-all investment picture and stated national goals were first explored. The impacts of forestry on these goals were then described, with the emphasis on the benefit side of the cost benefit equation. Costs directly related to the forestry effort, such as the very poor conditions under which much forestry work must be undertaken, and the pollution induced by wood-using industries, have not been included. Estimation of the opportunity cost of the investment in forestry in Ireland is beyond the scope of this paper. However, it should always be borne in mind that the "goods" flowing from the forestry sector are being created at the expense of either current consumption or increased spending on industrial and agricultural productive capacity, tourism, housing, roads, etc. Many other effects of forestry investment have not been considered. These include water conservation, the prevention of erosion, shelterbelt effects, and the influences on climate and wildlife. Recently concern has centred on

the continuing deterioration of the environment and the role of forestry in maintaining ecological balance. The continuing growth of the Irish urban population and the increasing number of pollution-inducing industries being established indicate that these factors are becoming increasingly important.

With regard to the present and potential contribution of forestry as considered under the NIEC headings, it seems to me that it is in the domain of regional development that forestry can make its most distinctive contribution. Aggregate employment, income, and foreign exchange earnings could in all likelihood be equally increased by using the money now spent on forestry to intensify the industrialization of the larger urban centres. Forestry seems to be one of the best ways of increasing investment opportunities in the poorest areas. There is adequate government funding available for investment in these areas. The problem is to find or to create self-sustaining income and employment-generating investment possibilities. Forestry helps create these opportunities, while it is also a politically and socially acceptable means of maintaining a watershed of labour in the area. This permits a "breathing space" while other efforts such as tourism, fishing, and the small industries programme are developed. Although its other contributions to the national well-being are not as distinctive, the entire forestry effort does seem to result in a "positive sum" outcome, to use the current jargon. In an increasingly competitive environment for public funds, the explicit identification of the role that forestry can play in the achievement of national goals becomes important.

References

1. *Annual Statements of the trade of the U.K.* Vol. 2, 1959-64.
2. Baker, T. G. and Ross, M. 1970. The changing regional patterns in Ireland. *The Economic and Social Review* I.
3. Buchanan, Colin, and Partners, in Association with Economic Consultants Ltd. 1968. *Regional Studies in Ireland.* An Foras Forbartha, Dublin.
4. Clear, T. 1966. *The development of a Forest industry in Ireland.* Society of Chemical Engineers A.G.M., Dublin.
5. Convery, F. 1967. *An economic analysis of the wood-using industries* in Ireland. Unpub. M.Agr.Sc Thesis. University College, Dublin.
6. F. A. O. 1965. *Year book of forest products statistics.* Rome.
7. Fitzpatrick, H. M. (ed.) 1965. *The Forests of Ireland.* Society of Irish Foresters, Dublin.
8. Flanagan, S. 1969. *Dail Eireann. Parliamentary debates* 242, 9, 20th Nov.
9. Furness, G. W. and Whatmough, R. 1969. *Economic features of Agriculture and Forestry on marginal land in Northern Ireland.* Paper read to Irish Agricultural Economics Society, Belfast.
10. Geary, R. C. and Hughes, J. G. 1970. *Certain aspects of non-agricultural unemployment in Ireland.* Paper No. 52. Economic and Social Research Institute, Dublin.
11. Grayson, A. G. 1967. *Forestry in Britain.* Agricultural Adjustment Unit, The University of Newcastle-on-Tyne.

12. Harberger, A. C. 1967. Techniques of project eppraisal, in *National Economic planning* (Max Millikan, ed.) NBER Columbia University Press, New York.
13. Healy, John. 1968. *The death of an Irish town.* Mercier Press, Cork.
14. Johnston, D. R. 1964. Potential and Economic aspects of Forestry in marginal and submarginal land. *Irish Forestry*, 21.
15. Kennedy, K. A. and Dowling, B. R. 1970. Productivity earnings and the composition of labour: Irish manufacturing industries, 1953-66. *The Economic and Social Review*, 1.
16. Lucey, D. I. F. and Kaldor, D. R. 1969. *Rural Industrialisation*, Geoffry Chapman, London.
17. McEvoy, T. (August 1970). Personal communication, Inspector General Forest Service, Dublin.
18. McGilvray, G. 1968. Economic planning in *Economic policy in Ireland* (G. A. Bristow and A. A. Tait ed.). Institute of Public Administration, Dublin.
19. Mooney, O. V. 1966. *A review of Forestry in Ireland.* Timber Seminar, Dublin.
20. N.I.E.C. 1967. *Report on Full Employment.* Government Publications, Dublin.
21. Newman, G. 1967. *New Dimensions in regional planning: a case study in Ireland.* An Foras Forbartha, Dublin.
22. O'Connor, R. and Breslin, M. 1968. *An input-output analysis of the agricultural sector of the Irish economy in 1964.* Paper no. 45, Economic and Social Research Institute, Dublin.
23. O'Neill, Sile, 1969. Farm Family Expenditures. *Irish Journal of Agricultural Economics and Rural Sociology*, 2.
24. *Report of the Departmental Committee on Irish Forestry, 1908.* H.M.S.O., Dublin.
25. *Report of the Minister for Lands on Foresty for year ended March 1943.* Government Publications, Dublin.
26. *Statistical Abstract of Ireland*, 1967, Government Publications, Dublin.
27. *Third Programme: Economic and Social Development 1969-72.* Government Publications, Dublin.
28. Westoby, G. C. 1962. Forest Industries in the attack on under-development. *Unasylva* 16.

Erratum

Vol. 27 No. 1

page 13, line 31. *For* ss *read* s_s

page 16, line 12. *For* $\underline{x}$ *read* $\bar{x}$

page 19. Last four lines should read:

Since the standard deviation of a distribution of values of w is σ_w the standard deviation of values of R is $\sigma_R = \sigma_w \sigma$, σ_R may be estimated from a sample as s_R and, similarly, σ as s. Then $s_R = \sigma_w s = \sigma_w \bar{R}/d$, since $s = \bar{R}/d$. Control limits for range can be set at

Fertilization of Conifer Plantations[1]

C. P. Van Goor[2]

INTRODUCTION

Tree growth in old plantations on various soil types can often be increased by a temporary improvement of the nutrient economy of the soil (4, 7, 13, 14, 15, 20, 26, 28), but fertilization of young plantations is much more important. Appropriate fertilization can temporarily or permanently stimulate growth, resulting in earlier closure of canopy, reduced susceptibility to various influences and a decrease in the risks to which young trees are exposed (22, 26). Research in this field is not complete, but some general recommendations for practical use of fertilizers can nevertheless be made.

THE NUTRIENT REQUIREMENTS OF THE VARIOUS CONIFERS

Not alone do confers and broadleaf trees differ basically in their nutrient requirements, but conifers also vary among themselves. The most important nutrients are phosphorus, nitrogen and potassium. Phosphorus is of fundamental importance for root development (19, 25); nitrogen and potassium are important in photosynthesis (2, 9, 24). Nitrogen is the basis of all the protein compounds in the plant, and one of the functions of potassium is to regulate assimilation, respiration and transpiration.

The differences in nutrient requirements between coniferous species cannot be simply expressed in terms of the quantity present in the soil, but can be expressed in terms of the quantity that a certain species can extract from the soil. Pines and larches on nitrogen deficient soils —for example reclaimed heathland—can extract far more nitrogen from this type of soil than can Norway spruce or Douglas fir.

On the basis of our present knowledge we can divide the most important tree species, according to their nutrient requirements, as follows:

Species	Requirements of		
	N	P	K
Pinus spp.	low	low	high
Picea, spp.	high	high	low
Pseudotsuga	high	high	high
Larix spp.	low	high	low

[1] Translation of *Bemestingsvoorschrift voor Naaldhoutcultwren.* Korte Meded. Bosbouwproefstation, nr. 56, 2e herziene druk, 1967.

[2] Stichting Bosbouwproefstation "De Dorschkamp" Wageningen. Netherlands.

DETERMINATION OF FERTILIZER REQUIREMENTS

Investigation of nutrient requirements by means of soil analysis gives rise to difficulties in relation to sampling, extraction method and interpretation of results. In taking soil samples there are questions of location of sample, number of sub-samples of which each sample is composed, and depth of sampling. Answers to these questions were found through research carried out in co-operation with the Soil Survey Institute and the State Laboratory for Soil and Plant Research, and these findings serve as a basis for soil sampling recommendations. Each soil type should be sampled separately. The sample should be taken from the 0-25 cm layer and should consist of at least 25 sub-samples.

The extraction method depends on the amount of nutrients available for trees. It appears that trees can extract nitrogen, potassium and phosphorus from relatively insoluble compounds, and therefore total analysis is carried out where possible (1, 23, 29). But this also gives rise to difficulties which will not be discussed here. At present only phosphate determination appears to be useful in indicating which fertilizers are required. There is a relationship between tree growth and soil phosphate level, within certain soil types. No workable system of soil analysis has yet been developed for potassium or nitrogen.

Needle analysis is more promising for potassium and nitrogen. There is often a close correlation between growth and nitrogen content or the nitrogen/phosphorus ratio. It should therefore be possible to evolve a method for establishing the fertilizer requirement by means of soil and needle analysis. Needle analysis is only possible in the case of existing plantations (9, 17, 27, 29, 30), but this is not a great disadvantage since nitrogen and potassium should always be applied after and not before planting.

PRACTICAL USEFULNESS OF THE RESULTS OF SOIL AND FOLIAGE ANALYSIS

A large number of fertilizer experiments have been carried out to determine whether the use of combined results of soil and needle analysis to determine fertilizer requirements is of practical value.

The following is a summary of the results of these investigations:

1. Even with similar results from soil and foliage analysis the reaction of a tree crop to fertilization may vary greatly on similar soil types. A combination of the results of foliage analysis carried out before and after fertilization gives a better indication of the fertilizer requirement of a particular plantation, but at this stage the crop has already been fertilized.

2. Soil type is very important in interpreting the results of phosphate

analysis. It has been shown for example that for trees the availability of phosphate is higher on **holt**-podsols (humus iron podsols) than on **haar**-podsols (dry humus podsols) or **veld**-podsols (moist humus podsols). There will usually be no response to phosphate fertilization on a **holt**-podsol with a P content of 20 mg/100g, but there will be a response with the same P content on **haar**-podsols or on **veld-**podsols. An extraction method is now being developed which will give a better reflection of the inorganic soil phosphorus. Phosphate in inorganic form can be easily taken up by coniferous trees.

3. The nitrogen content of the needles gives a clear indication of the nitrogen supply. The optimum level lies between 1.7 and 2.0% of the dry matter. Fertilization with nitrogen increases the N content. The growth response, however, is determined not only by the increase in the level of nitrogen but also by the effect of the nitrogen fertilizer on the levels of other nutrients. In some cases, for instance, potassium deficiency occurs; in other similar cases the potassium level does not change. This is unpredictable.

4. The supply of potassium to the trees depends, among other things, on the potassium content and acidity of the soil. An increase in nitrogen supply usually causes a decrease in foliar potassium content, but the converse does not hold. In certain conditions the nitrogen content of Douglas fir and Scots pine needles can be increased by the application of potassium (9). Even if the potassium content of the needles is normal, this does not mean that potassium deficiency will not occur when nitrogen is added to the soil.

From the results summarised in the preceding four paragraphs we can conclude that soil and crop analyses by themselves do not give a complete picture of the fertilizer requirements of conifer plantations. Many other factors, such as soil type, history, etc., influence the response to fertilization to a degree which cannot yet be accurately estimated. This means that, as in agriculture and horticulture, forest fertilization practice must be based on soil and crop analyses combined with the results of fertilizer experiments on similar sites.

A large number of forest fertilizer experiments will need to be established on all soil types so that the influence of locality factors, so far unanalysed, on the response to fertilization can be determined. This research will take many years.

WORKING METHOD FOR FOREST PRACTICE

In order to be able to make use of fertilizers in practice it was necessary to devise a method by which the fertilizer requirements of a plantation could be roughly estimated. It should be remembered

that the results obtained by this method may not always come up to expectations. The method that was developed is based on:

1. The tree species.
2. The average fertility of the soil type.
3. The result of soil analysis.
4. The symptoms observed in the needles and shoots.

Soil analysis and soil type will indicate whether phosphate content and acidity are satisfactory, the needle symptoms show whether there is a deficiency of certain nutrients or not. Fertilization based on these considerations will allow for possible interactions or antagonisms of nutrients in different tree species, and will avoid as far as possible any unexpected induced deficiencies (18).

DEFICIENCY SYMPTOMS

Deficiency symptoms for the most important nutrients are more or less similar in the different species of conifers.

1. Nitrogen Deficiency

Light-green to yellow-green discoloration of conifer needles indicates that the nitrogen supply is below optimum. The greater the deficiency the lighter and more yellow-green the colour, and the smaller the needles. The discoloration is uniform over the needles and over the whole tree. Nitrogen content of needles at the end of the growing season varies from about 1.0% (deficiency) to about 2.0% (optimum) of dry mater (6).

In all species of trees nitrogen deficiency is always accompanied by a decrease in growth.

2. Phosphorus Deficiency

A phosphorus deficiency severe enough to produce symptoms is rare. The needles have a typically dark greenish colour and are often covered with black algae. In severe cases the colour varies from a bronze-green to a brown purple and necrosis of the older needles occurs. In addition the needles are small. In spruces and in Douglas fir the foliage appears sparse. Growth is always poor. Deficiency symptoms appear when the phosphorus content drops below 0.10% of dry matter (6, 8).

3. Potassium Deficiency

Conifers suffering from a deficiency of potassium show a partial yellow discoloration of the needles, or a complete discoloration of the needles at the ends of the shoots. The latter only occurs in spruces, Douglas fir and larches, not in pines. In the needle discoloration the base of the needle remains green and the top is yellow. There is a

gradual transition from the yellow to the green zone. A combination of the two above-mentioned symptoms occurs in spruces. Potassium deficiency symptoms become most pronounced towards the end of winter, particularly in pines. In larch the discoloration is mainly confined to the needles of the short shoots.

Deficiency symptoms occur when the K content at the end of the growing season drops below the following content of dry matter: pines 0.35%, larches 0.50%, spruces 0.40% and Douglas fir 0.45%.

4. **Magnesium Deficiency**

Although magnesium deficiency is less important in conifers, since no accompanying decrease in growth has so far been established, it is discussed here in order to prevent confusion with K deficiency symptoms. In pines, magnesium deficiency is indicated by a strong yellow discoloration of the needle ends (5). The transition from the yellow top to the green base is rather sharp. In spruces and in Douglas fir there is likewise a discoloration of the needle ends, but only in needles older than one year. Magnesium deficiency symptoms in larch are so far unknown in this country.

5. **Copper Deficiency**

Copper deficiency may cause serious growth disorders. In Douglas fir it shows in a contorted growth of the leader and side shoots (12, 21). Necrosis of the shoot tips occurs early in winter. Sometimes the needles at the lower ends of the shoots are yellow or even necrotic. In spruces the tips of the leaders and side shoots die back during autumn and winter resulting in a bushy form of growth (12). In larch also the deficiency symptoms consist of a dying back of the shoot tips and subsequent bushy growth. So far no deficiency symptoms have been found in pines. Deficiency symptoms occur when the copper content drops below 2.5 to 3 ppm of dry matter (12, 21).

GENERAL RECOMMENDATIONS FOR FERTILIZATION

The following general observations should be kept in mind:

1. The young trees must be in a suitable condition to respond to the nutrients supplied. This is possible only when the root system is fully intact and the above-ground parts have not been damaged in any way. Fertilization can only be effective in a viable plantation. Plantations of genetically inferior trees should not be fertilized.

2. Ground vegetation, particularly grasses, checks tree root development. Under these conditions the trees often show nitrogen

deficiency symptoms, due not so much to a poor soil nitrogen economy as to inadequate uptake by the underdeveloped root system. In such cases weed control is necessary before fertilizers are applied. If the ground vegetation consists of a not too heavy growth of heath, weed control is less important and fertilization can proceed without it.

3. When using individual fertilizers alone, phosphate and copper fertilizers can be applied at any time. They act slowly and therefore a winter application is preferable. Nitrogen fertilizers are more soluble, are not retained in the soil and are leached out relatively quickly. These fertilizers should therefore be applied in Spring so that the trees can benefit immediately.

   Potash fertilizers should preferably be applied in February/March. When mixed fertilizers are used the time of application is determined by the most soluble component. This means that all fertilizers containing nitrogen must be applied in April/May.

4. Phosphate, potassium and copper fertilizers are always broadcast. The method of application of nitrogen fertilizer depends on the age of the plantation. If canopy closure can be expected within two or three years the nitrogen may be broadcast. If the trees are smaller, nitrogen should be given to each plant separately over an area of about 1 sq. metre around the tree. An even distribution around the tree can be obtained by dropping the fertilizer from above the tree and then shaking it lightly with the foot, but for this the trees must be dry.

5. Phosphate should be applied before planting, or as soon as possible after, since it stimulates root development. Potassium and nitrogen are given after planting, nitrogen preferably not in the year of planting but rather in the following year.

   The fertilizers mainly used in forestry are: for phosphate, basic slag and ground rock phosphate; for potassium, sulphate of potash magnesia, muriate of potash and sulphate of potash; for nitrogen, calcium ammonium nitrate and sulphate of ammonia; and for copper, copper slag flour and copper sulphate. Mixed fertilizers should as far as possible be free of chloride and in granulated form.

6. If mixed fertilizers are used the phosphate and potassium dressings need not be repeated. These nutrients are retained in the soil to a greater or lesser degree and have long lasting residual effects. If nitrogen is required, the application must be repeated every year or every second year until the time of canopy closure.

RECOMMENDATIONS FOR FERTILIZING THE DIFFERENT CONIFERS

Pines

Species of **Pinus** do not make heavy demands on soil nutrients. Under certain circumstances, however, fertilization may be advisable:

1. In the afforestation of uncultivated ground where the vegetation consists of heath and grass, without Scots pine or other conifers, phosphate fertilizer may be necessary. Quantity: 300-500 kg of basic slag per ha (2.4-4.0 cwts per acre). No phosphate fertilization is necessary when replanting.

2. If potassium and/or magnesium deficiency symptoms appear in a plantation it is advisable to apply 150 to 300 kg of sulphate of potash magnesia per ha (1.2-2.4 cwt. per acre).

3. Nitrogen fertilization is not normally required for pines (10), except in serious cases of potassium deficiency when the base of the needle, in addition to the top, is discoloured. In such cases a light dressing of nitrogen, 200 kg (1.6 cwt per acre) of calcium amonium nitrate, is recommended in addition to the potassium. When only nitrogen deficiency symptoms are present it is better not to apply nitrogen.
   It should be noted that potassium deficiency symptoms in Scots pine can also be due to genetic factors (11). Continental provenances, particularly those from northern regions, always show potassium deficiency symptoms in winter. In such cases potassium fertilization may have disappointing results. If, however, a pine plantation of doubtful provenance growing on **veld**-podzol (moist humus podsol) or on **haar**-podsol (dry humus podsol) or on a sand dune soil shows signs of potassium deficiency, fertilization with potassium may be worth while.

Spruces

The nitrogen and phosphorus requirements of **Picea** species are generally high.

1. Soils with insufficient phosphate should be treated before or at the time of planting with 500 kg of basic slag per ha (4.0 cwt per acre). Such soils are **veld**-podsols or **haar**-podsols and **goor** earth soils (moist old arable land on sandy soils) with a total phosphate content of less than 40 mg $P_2 O_5$ (18 mg P) per 100g of soil. If the content is higher, or if the planting is on **holt**-podsol (humus iron podsol) or **enk** earth ground (dry old arable land on sandy soils) or old farmland, then no phosphate fertilizer is required even if total phosphate content is below 40 mg $P_2 O_5$ (18 mg P) per 100g of soil.

2. If nitrogen deficiency symptoms—small light-green to yellow-green needles—develop during the year after planting, or later, a dressing of calcium ammonium nitrate should be given. 50g ($1\frac{3}{4}$ oz) per plant or 400 kg per ha (3.2 cwt per acre) broadcast. If the dominant ground vegetation is grass, or anything other than heath, it must be controlled first.

   If nitrogen deficiency symptoms develop in a plantation on a soil which is low in phosphate, and where phosphate was not applied before or at the time of planting, the first nitrogen dressing can be given as phosphate ammonium nitrate rather than calcium ammonium nitrate. In this case the phosphate ammonium nitrate should be applied broadcast. If the plants are too small for broadcast fertilization it is more effective to treat each individual plant with calcium ammonium nitrate, and to broadcast phosphate instead of phosphate ammonium nitrate. Calcium ammonium nitrate can be given again later.

   On **veld**-podsols (moist humus podsols) and on poor moorland soils there is a danger of copper deficiency when nitrogen and phosphate are applied as fertilisers. On these soil types therefore it is advisable to use copper fertilizer in the form of 50 kg per ha (45 lb per acre) copper sulphate in addition to the other fertilizers.

3. Symptoms of potassium deficiency are either a yellow discoloration of the ends of the young needles or a discoloration of the needles at the ends of the shoots. When these appear the plantation should be treated with 150—300 kg of sulphate of potash-magnesia per ha (1.2-2.4 cwt per acre) combined if necessary with 50 gm ($1\frac{3}{4}$ oz) of calcium ammonium nitrate per plant or 400 kg per ha (3.2 cwt per acre) broadcast. The symptoms indicate whether the combination is required. If the trees are strongly discoloured and if the needle bases are also yellow-green then nitrogen is necessary. If the needle bases are green to dark green and discoloration limited to the very young needles at the end of the shoots then nitrogen need not be given. Potassium deficiency symptoms can be due not only to potassium deficiency in the soil, but also to excessively high pH (greater than 5.5 in water or 5.0 in KCl), for example in plantations on former arable land. If the pH is not much above this critical limit, and if the humus content is less than about 5%, fertilization with 400 Kg per ha (3.2 cwt per acre) of sulphate of ammonia and 200 kg per ha (1.6 cwt per acre) of sulphate of potash will give good results. If the pH and/or humus content are much higher than these limits then the dressing must be combined with 250 kg of flowers of sulphur per ha (2.0 cwt per acre). The latter can be given at the time of planting.

4. With phosphate deficiency symptoms—small green to blue-green needles pressed closely against the twig—500 kg of basic slag per ha (4.0 cwt per acre) should be given. In the following year this can be supplemented by nitrogen and potassium if foliar symptoms indicate that these are required. If phosphate deficiency symptoms are combined with those of nitrogen deficiency—in which case the ground vegetation is usually heathy and the needles are a dull greenish yellow—the nitrogen and phosphate can both be applied in the same year.

   For this phosphate ammonium nitrate (400 kg per ha, 3.2 cwt per acre) can be used.

Douglas fir

Douglas fir makes the highest demands on soil nutrients. The nitrogen, phosphorus and potassium requirements are all high.

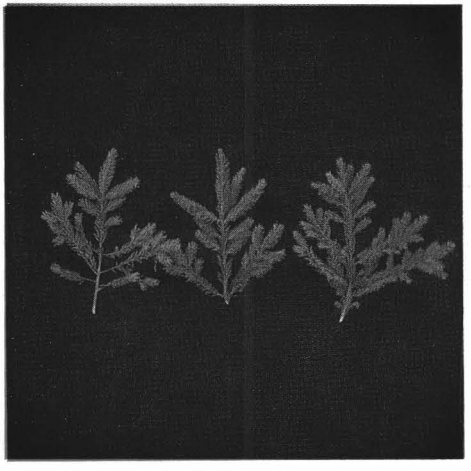
1. Phosphate is applied in the same way and under the same circumstances as for spruces (No. 1).

2. When symptoms of nitrogen deficiency develop—light green to yellow-green needles—calcium ammonium nitrate should be applied at the rate of 50g ($1\frac{3}{4}$ oz) per plant or 400 kg per ha 3.2 cwt per acre) broadcast. This should always be combined with 150-300 kg of sulphate of potash magnesia per ha (1.2-2.4 cwt per acre). Even in the absence of potassium deficiency symptoms it is possible that, because of the high potassium requirement of this species, the nitrogen dressing will result in a shortage of potassium. The nitrogen dressing would then be inefficient. In subsequent years the nitrogen should be repeated if necessary but without the potassium. If phosphate has not been given at the time of planting on soils where phosphate is necessary, phosphate ammonium nitrate is used instead of calcium ammonium nitrate. Alternatively in such cases an initial application of compound NPK fertilizer can be given. Once the phosphate ammonium nitrate or compound NPK fertilizers have been broadcast, calcium ammonium nitrate will suffice for later applications. The quantity of fertilizer to be applied to each plant is determined by the nitrogen content. A minimum of at least 10g (0.35 oz) of elemental N per plant should always be supplied.
   Douglas fir makes high demands on the supply of copper, and in all podsols, with the exception of **holt**-podsols (humus iron podsols) there is a danger of copper deficiency following the application of nitrogen and phosphate.

   It is advisable therefore to treat all Douglas fir plantations on such soils with copper sulphate at the rate of 50 kg/ha (45 lb/acre).

1. Nitrogen deficiency douglas fir

2. Phosphate deficiency douglas fir



3. Nitrogen deficiency Norway spruce

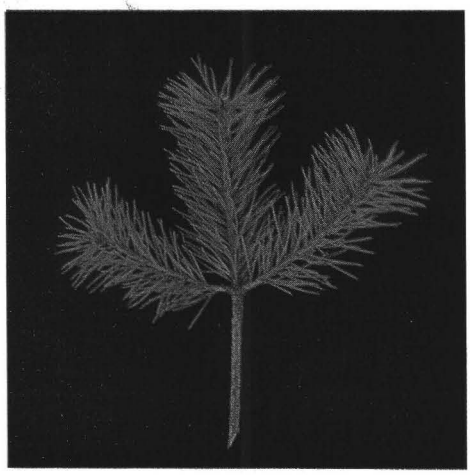
4. Phosphate deficiency Norway spruce

5. Potassium deficiency douglas fir at low nitrogen level

6. Potassium deficiency douglas fir at high nitrogen level

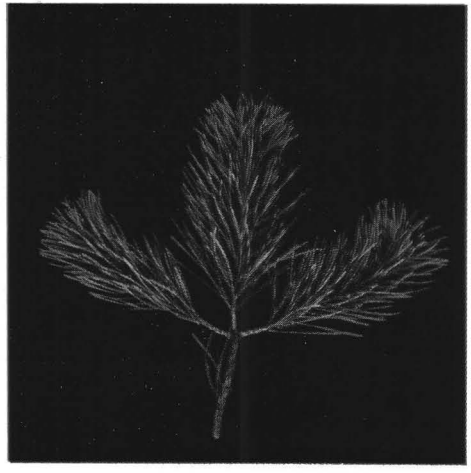
7. Potassium deficiency Norway spruce at low nitrogen level

8. Potassium deficiency Norway spruce at high nitrogen level



9. Nitrogen deficiency Scots pine

10. Phosphate deficiency Scots pine



11. Potassium deficiency Scots pine

12. Magnesium deficiency Scots pine

13. Copper deficiency douglas fir

3. Potassium deficiency symptoms are similar to those in spruce. When they appear a dressing of 150-300 kg of sulphate of potash magnesia should be given, combined with a normal nitrogen fertilization if necessary. The need for nitrogen is determined by the intensity of the deficiency symptoms. (See notes on **spruces**) Douglas fir is less sensitive than spruce to high pH values, so that potassium deficiency due to calcium antagonism is rare.

4. If symptoms of phosphate deficiency appear — small blueish green to brownish green needles — a dressing of 500 kg of basic slag per ha (4.0 cwt per acre) should be given. In the year following this application a supplementary dressing of nitrogen and/or potassium may be given as indicated by deficiency symptoms.

Larch

The only high nutritional demand of **Larix** species is on the soil phosphate supply. Their nitrogen and potassium requirements are low.

1. Phosphate is given in the same way and under the same circumstances as for spruces (No. 1).

2. Symptoms of nitrogen deficiency are rarely seen in larch unless the plantation is seriously infested with weeds. Here the first requirement is weed control. If nitrogen deficiency symptoms occur on soils without a strong growth of weeds, or with a heathy vegetation, calcium ammonium nitrate should be given at the rate of 20 gm ($\frac{3}{4}$ oz) to each plant, or 200 kg per ha (1.6 cwt per acre) broadcast. Nitrogen should be given cautiously since it is easy to give an overdose which will result in distorted growth.

3. When potassium deficiency symptoms occur—yellow-tip disease of the needles on the short shoots, and yellow needles at the ends of the long shoots—150-300 Kg of sulphate of potash magnesia per ha (1.2-2.4 cwt per acre) should be applied.
Potash deficiency symptoms in larch are often due to moisture deficiency or high pH. In both cases the larch is on an unsuitable site and it is better not to fertilize but to replace the plantation.

4. Symptoms of phosphate deficiency occur sometimes in larch. The needles are blueish green, sometimes changing to yellow-brown, mauve-brown or violet. The plantation should be treated with basic slag at the rate of 500 kg per ha (4.0 cwt per acre), supplemented in the following year, if necessary, with nitrogen and potassium.

Other Conifers

Little is known about the other coniferous species, but remarks on Douglas fir apply also to **Abies grandis** and **Tsuga heterophylla.**

SUMMARY.

From the results obtained from fertilization research carried out so far it can be concluded that the need of nutrients and the effect of a fertilization cannot be forecast from the data of soil and needle analysis only. The data of complete fertilizer trials under comparable conditions must necessarily be combined with it. This means that a great many fertilizer trials have to be laid out, which take much time. In the meantime a directive for fertilization of young plantations for practical use has been drafted. This directive is based on the results of research concerning fertilization carried out until now, and further on tree species, soil type and soil analysis, and symptoms of needles. In this way it will be possible to obtain an appropriate improvement of growth in many plantations with insufficient growth although the effect cannot be forecast quantitatively. The present directive has been worked out for *Pinus, Picea, Pseudotsuga* and *Larix.*

1. Anonymous — Overzicht van de Werkzaamheden in 1957. Korte Meded. Bosbouwproefstation, nr. 34, 1958.

2. Anonymous — Overzicht van de werkzaamheden in 1959. Korte Meded. Bosbouwproefstation, nr. 43, 1960.

3. Anonymous — Overzicht van de werkzaamheden in 1961. Korte Meded. Bosbouwproefstation, nr. 52, 1962.

4. Brockwell, J., and W. V. Ludbrook — The response to phosphates of Pinus grown on infertile soils in New South Wales. Div. rep. Commonwealth Sci. and Ind. Res. Org. Div. of Plant Ind., nr 22, 1962.

5. Bruning, D. — Forstdungung, 1959.

6. Fricker, C. — La fumure et sylviculture. Circ. d'inform et de doc. Serv. agron. Soc. Commerc. des Potasses d'Alsace, 1959.

7. Gessel, S. P., and R. B. Walker — Height growth response of douglas-fir to nitrogen fertilization. Proc. Soil Sci. Soc. Amer, 20, 1956 (97-100).

8. Goor, C. P. van — Bemesting van fijnspar in heidebebossingen. Stikstof (14), 1957 (62-68).

9. Goor, C. P. van — Iets over de kalivoorziening van de jonge douglasaanplantingen. Kali (40), 1959 (377-382).

10. Goor, C. P. van — Is naast kali- ook stikstofbemesting in Pinus-culturen met gelepuntziekte noodzakelijk? Ned. Bosb. Tijdschr. 34 (10), 1962 (304-391); Berichten Bosbouwproefstation, nr. 30, 1962.

11. Goor, C. P. van — Kaligebrekssymptomen bij groveden. Kali (50), 1961 (317-321).

12. Goor, C. P. van, en Ch. H. Henkens — Groeimisvormingen bij douglas en fijnspar en sporenelementen. Ned. Bosb. Tijdscher. 38 (3), 1966 (108-120); Korte Meded. Bosbouwproefstation, nr. 76, 1966.

13. Hausser, K. — Dungungsversuche zu Kiefern mit unerwarteten Auswirkungen. Allg. Forstzeitschr. 34 (1), 1960 (1-5).

14. Hausser, K. — Ergebnisse von Dungungsversuchen zu 50- bis 70- jahrigen Fichtenbestanden auf oberen Buntsandstein des Wurttembergischen Schwarzwaldes. Allg. Forst- u. Jagdztg. 132 (11), 1961 (269-291).

15. Hesselman, H. — Om humustackets beroende av bestandes alder och sammansattning i den nordiske granskogen av blabarsrik Vaccinium-typ och dess inverkan pa skogens foryngring och tillvaxt. Medd. Statens Skogsfors, anst. 30, 1937 (529-715).

16. Laurie, M. V. — The place of fertilizers in forestry. J. Sci. Food and Agric. 11 (1), 1960 (1-8).

17. Leyton, L. — The mineral requirements of forest plants. Encyclopoedia of Plant Phys. 4, 1958 (1026-1039).

18. Meiden H. A. van der — Kopergebrek bij populier. Ned. bosb. Tijdschr, 34 (1), 1962 (29-33); Berichten Bosbouwproefstation, nr. 20, 1962.

19. Meiden, H. A. van der — Reactie van populierenstek op fosfaat Ned. Bosb. Tijdschr. 29 (10), 1957 (220-242); Korte Meded. Bosbouwproefstation, nr. nr. 31, 1957.

20. Mitscherlich, G., und W. Wittich — Dungungsversuche in altern Bestanden Badens. Allg. Forst- u. Jagdztg. 129 (8/9), 1958 (169-190).

21. Oldenkamp, L. and K. W. Smilde — Kopergebrek bij douglas. Ned. Bosb. Tijdschr 38 (5/6), 1966 (203-214); Korte Meded. Bosbouwproefstation, nr. 77, 1966.

22. Oldiges, H. — Der Einfluss der Waldbodendungung auf das Augtreten von Schadinsekten. Zeitschr. angew. Entomolgie 45 (1), 1959 (49-59).

23. Reinken, G. — Untersuchungen uber die Aufnahme verschiedener Phosphatverbindungen und die Phosphorverteilung bei Apfelbaumen. Gartenbauwissenschaft 3 (21), 1956 (3-58).

24. Scheck, H. — Uber den Einfluss des Kaliums auf den Kohlhydratstoffwechsel und die Carbohydraten bei Kulturpflanzen. Zeitchr. Pflanzenern. Dungung. Bodenk. 60 (3), 1953 (217-227).

25. Schonnamsgruber, H. — Die Aufnahme der Phosphorsaure aus Thomasphosphat durch junge Holzpflanzen. Phosphorsaure 18 (1), 1958 (24-41).

26. Stoeckeller, J. H. and H. F. Arneman — Fertilizers in forestry. Adv. in agron. 12, 1960 (127-195).

27. Tamm, C. O. — Studier over skogens naringsforhallanden, 3. Medd. Skogsforskn. inst. Stockholm, 46 (3). 1956 (1-84).

28. Tamm, C. O. and C. Carbonnier — Vaxtnaringen som skoglig produktionsfaktor. Kungl. Skogs- och Landbruksakad. Tidskr. 1/2 1961 (95-124).

29. Wittich, W. H. J. Fiedler and H. H. Krauss — Moglichkeiten der Produktionssteigerung in der Forstwirtschaft durch Dungung und die sich daraus ergebenden Forschungsprobleme. Sitzungsber. Deutsche Akademie der Landwirtschaftswissenschaften. Berlin, 9 (6), 1960 (4-72).

30. Wright, T. W. — Forest soils in Scotland. Empire forestry rev. 38 (1), 1959 (45-53).

The Augustine Henry Memorial Grove—A Record

O. V. Mooney[1]

On the 29th September, 1951, the Society of Irish Foresters with the co-operation of the Department of Lands, Forestry Division, dedicated a grove of trees and shrubs to the memory of Professor Augustine Henry, at Avondale, and, as the report of the event in the Journal (1) of that time runs, "the Dedication Stone was unveiled by the Minister for Lands in the presence of a large and distinguished gathering of members of our Society, friends and colleagues of Dr. Henry and members of the public." Alice Henry, his widow, who had been Professor Henry's close and gifted collaborator in his work, was present, and was the most honoured guest on the occasion.

Mr. T. McEvoy, the President of the Society at that time, Mr. H. M. FitzPatrick, a friend and a one-time student of Professor Henry, and Dr. T. Walsh, Curator of the Botanic Gardens, Dublin, paid tributes and recounted many incidences of his career and were fully reported in Irish Forestory (1). However, for those who have come to the Society in more recent times a brief resumé of Professor Henry's career and his achievements may not be out of place at this time.

Augustine Henry was born in 1857 into an ancient Irish clan, the O'Innerighs of Derry, and spent most of his boyhood near Draperstown, in that county. In 1877 he took his B.A. degree at Galway, with first-class honours and a gold medal, and his M.A. at Queen's, Belfast, in the following year. In 1879 he passed his final medical examination at Queen's and, subsequently went to Edinburgh for post graduate medical studies. In 1881 he went to China to take up a medical post in the British Chinese Customs Service. Dr. Henry did not find fulfilment in his medical work, or satisfaction in the social life of the white man in China posts at that time. He turned to the study of plants and botany and became a plant collector, a line which eventually completely absorbed him and led him on his main life's work.

During his time in China he sent back great numbers of plants to Kew, and it has been stated that he introduced five hundred new species to Europe and twenty-five new genera. The total number of specimens received at Kew amounted to 158,000.

Dr. Henry left China in 1900 and soon after he went to

---

[1]Senior Inspector, Forest and Wildlife Service, Department of Lands, Dublin.

Nancy to study Forestry for two years. Returning, he worked at Kew and started in 1903 with Elwes his great work. "The Trees of Great Britain and Ireland," which was published in 1913 and still stands as a classic of its sort. In 1907 Dr. Henry took up a post as Reader in Forestry at Cambridge University, where he spent six years. It was during these times that he became the pioneer worker in tree genetics producing amongst other things two hybrid poplars and became world famous for his work in this field.

Finally in 1913 he came back to Ireland as Professor of Forestry at the Royal College of Science for Ireland, later part of University College, Dublin, where he worked until his death in 1930.

There is no doubt about Henry's world standing in his own fields of work; forestry, tree breeding, and botany. Of him, Dr. Ernest Schreiner, now one of the world's first tree breeders, said: "Augustine Henry was the first forester to realise the possibilities of creating better forest trees by scientific breeding and he was the first forester to do something about it." In 1929 a new wing in the Fan Memorial Institute of Botany and Biology in Peking was dedicated to "Augustine Henry, through whose assiduous botanical exploration of Central and South Western China, the knowledge of our flora has been greatly extended."

Professor Henry's contribution to forestry in his own country was great if not so well recorded. It was he who in 1907 emphasised western N. American conifers as the basis of a future forest industry in Ireland and his influence through Mr. A. C. Forbes was great in the formation of the early forest plantations such as Avondale and elsewhere.

Henry was, to quote Sheila Pim (2) "Irish through and through." He turned away from greater laurels and greater fame to come back and work and live his life in, and for Ireland.

THE MEMORIAL GROVE

In the early stages of planning the Henry Memorial Grove it was the intention to fill the plot with trees and shrubs which had some association with Henry or which were specific to his name. Due to the non-availability of appropriate plants and the length of time it would have taken to come by them it became evident that the original ideal would have to be abandoned or at least watered down considerably. At this juncture it was Mrs. Henry herself who happily commended a compromise to some "Henry trees" and a representation of trees from other parts of the world as Henry was a much travelled man and was associated with the growing of exotic trees in forestry practice in Ireland.

Thus the apparently random *mixum-gatherum* of trees in the

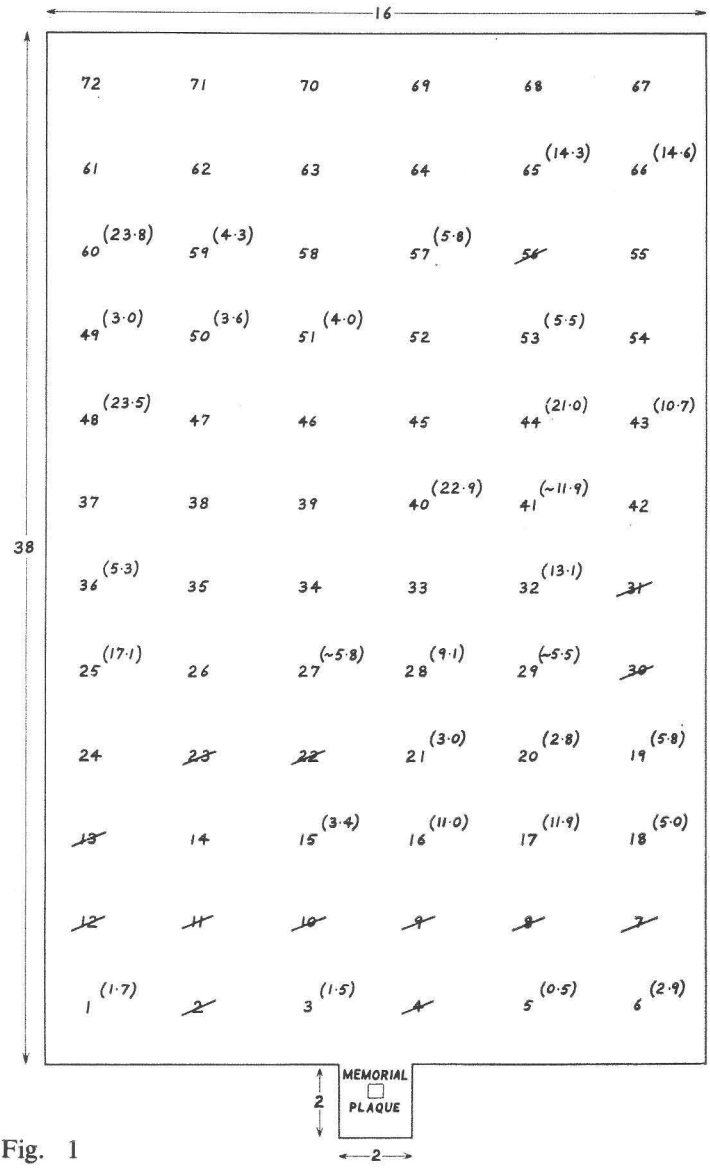


Fig. 1

Plan of Memorial grove. Not to scale. Numbers 1 to 72 are original planting positions. For plant names see Table 1. Numbers with oblique strokes indicate failures. Numbers in brackets beside tree numbers indicate tree heights. All measurements are in metres.

Grove. Nevertheless there are six species of trees and shrubs in the plot which have a direct association with Henry. Regretably there is no representative from the South American continent.

The trees and shrubs in the plot were planted at 3.2m. apart in 1950 and 1951. They were pit planted and there were no special cultural operations at establishment time except for the eucalypts which were moss-balled. The *Abies nobilis* were lifted from a plantation and were about 1m. high at the time. The lay-out and the location of the various plants at planting time is shown in Figure 1 and Table 1.

Plant numbers 1 to 36 were planted in March 1951, and the remaining numbers up to 72 with the exception of number 50

Tree No.	*Identity*
1, 3, 5	*Hypericum patulum henryi*
2, 4, 6	*Rhododendron henryi*
7, ...	*Tsuga diversifolia*
8, 9, 10, 11	*Ginkgo biloba*
12, ...	*Tsuga brunoniana (T. dumosa)*
13, 18	*Cedrus atlantica glauca*
14, 15, 16, 17	*Pinus armandi*
12, 24	*Cryptomeria japonica* var *elegans*
20, 22	*Abies lowiana* (*A. concolor* var *lowiana*)
21, 23	*Acer rubrum*
25, 30	*Pinus radiata*
26, 28	*Thuja plicata*
27, 29	*Quercus cerris*
31, 36	*Cedrus deodara*
32, 33, 34, 35	*Pseudotsuga taxifoloia (P. menziesii)*
37, 39, 41, 43, 45, 47	*X Populus vernirubens*
38, 40, 42, 46, 48, 52, 54, 56, 58, 60	*Eucalyptus muelleri (E. Johnstoni)*
44	*Spiraea henryi*
49, 51, 53, 55, 57, 59	*X Populus generosa*
50	*Metasequoia glyptostroboides*
61, 66, 67, 72	*Abies procera*
62, 63, 64, 65, 68, 69, 70, 71	*Abies grandis*

Table I. Henry Memorial Grove. Key to Fig. 1.

This table shows the identity of the trees as recorded at the time of planting. Modern synonyms are shown where necessary in brackets.

were planted in 1950. No. 50 *Metasequoia glyptostroboides*, The Fossil Tree or Dawn redwood was planted a few years later having been obtained from the Botanic Gardens as a plant from the original world distribution of seed of this tree which was only discovered in Central China in 1945.

A number of trees failed and these failures are indicated by oblique lines through the appropriate tree numbers. The reasons

for the failures are unrecorded and can only be guessed at and accordingly will not be discussed.

A number of selected trees were measured for height and these measurements are indicated above and to the right of the tree numbers.

Some simple points of interest emerge from the comparative performances of the various species at this present time. *Populus generosa* and *Populus vernirubens* both hybrids produced by Henry have shown the abhorrence this genus has for competition from vegetation and lateral or overhead shade and low pH and are mostly weak malformed trees. The identity of the eucalypts in the plot calls for critical examination. As is already well established the eucalypts can in certain sets of circumstances outgrow any other tree we have here. We note that No. 60, *E. urnigera**, at 23.8 m. and No. 48, *E. Muelleri,* at 23.5 m. are fine trees. All the original plantings of eucalypts are recorded as *E. Muelleri* but it is evident that *E. urnigera* and *E. johnstoni* (from Glenealy) are present and the identities will require reconsideration. It will be remarked that No. 65, *Abies grandis,* probably our fastest growing conifer on this type of ground has only reached 14.3 m., and No. 66, *Abies procera,* beside it has reached 14.6 m. The two rows of conifers 61 to 71 have closed canopy between the rows and completely suppressed ground vegetation. Douglas fir and western red cedars are all good healthy specimens but unspectacular in height growth so far.

Pinus armandi. These trees have grown well and look healthy, one, No. 17, having reached 11.9 m., but No. 15 has had its top blown off at 3.3 m. It is of interest to note that seed of this tree, Armand's pine, was sent from China to Britain by Henry in 1897 and is regarded as the first introduction there though beaten a close head in Europe by seed which was received by Villmorin in France two years earlier. (3). Both specimens of *Cryptomeria japonica* var *elegans* are in excellent condition at about 5.8 m.

The *Hypericum patulum henryi* are variable but No. 1 is a fine bush and flowers profusely. No doubt all these bushes and the *Rhododendron henryi* (this should probably be *R. augustinii).* No. 6 would respond to cultivation and manuring.

Probably due to its being planted a few years after and possibly to its use as a source for cuttings the *Metasequoia* has not grown very vigorously being much overshaded, but it is still a healthy tree. Some trees have been lost but the only failures of importance are the four *Ginko biloba* which have completely

---

* Tree No. 60 is plainly *E. urnigera* and is accordingly referred to as such.

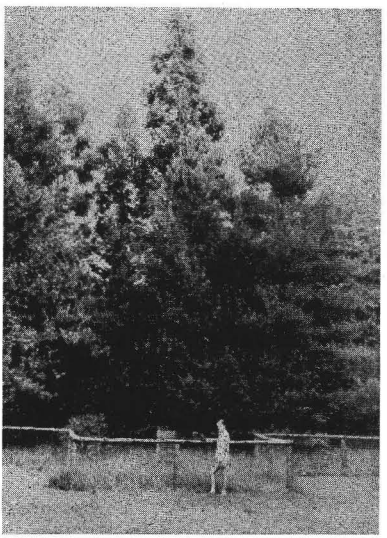
disappeared. Some trees which have been suppressed like *Abies lowiana* and others might be helped by discreet removal of overhead competition.

Finally, one name does not appear in the chronicle of events associated with the Henry Memorial Grove, the late Michael O'Beirne whose sylvicultural skills had contributed so much to Avondale. Having retired from the Forest Service he took a very active part in establishing the Memorial Grove.

In writing this note I have been helped by recollections and knowledge of events at the time of planting from Mr. J. J. Deasy and I am grateful to Mr. Chris Kelly for drawing the plan and to the Editor for suggesting that the present state of play should be put on record.

REFERENCES

1. Anon. 1951. Dedication of Memorial Grove to Augustine Henry. *Irish Forestry* 8, 78-80.
2. Pim, Sheila. 1966. *The wood and the trees. A biography of Augustine Henry.* MacDonald, London.
3. Dallimore, W., Jackson, A.B., and Harrison, S.G. 1966. *A handbook of coniferae and Ginkgoaceae.* Fourth Edn. Edwin Arnold. London.



General view of Memorial Grove

Trees, Woods and Literature–4

And it seemed to me all the more important to get out of this forest with all possible speed as I would very soon be powerless to get out of anything whatsoever, were it but a bower. It was winter, it must have been winter, and not only many trees had lost their leaves, but these lost leaves had gone all black and spongy and my crutches sank into them, in places right up to the fork. Strange to say I felt no colder than usual. Perhaps it was only autumn. But I was never very sensitive to changes of temperature. And the gloom, if it seemed less blue than before, was as thick as ever. Which made me say in the end, It is less blue because there is less green, but it is no less thick thanks to the leaden winter sky. Then something about the black dripping from the black boughs, something in that line. The black slush of leaves slowed me down even more. But leaves or no leaves I would have abandoned erect motion, that of man. And I still remember the day when, flat on my face by way of rest, in defiance of the rules, I suddenly cried, striking my brow, Christ, there's crawling, I never thought of that. But could I crawl, with my legs in such a state, and my trunk? And my head. But before I go on, a word about the forest murmurs. It was in vain I listened, I could hear nothing of the kind. But rather, with much goodwill and a little imagination, at long intervals a distant gong. A horn goes well with the forest, you expect it. It is the huntsman. But a gong! Even a tom-tom, at a pinch, would not have shocked me. But a gong! It was mortifying to have been looking forward to the celebrated murmurs if to nothing else, and to succeed only in hearing, at long intervals, in the far distance, a gong. For a moment I dared hope it was only my heart, still beating. But only for a moment. For it does not beat, not my heart, I'd have to refer you to hydraulics for the squelch that old pump makes. To the leaves too I listened, before their fall, attentively in vain. They made no sound, motionless and rigid, like brass, have I said that before? So much for the forest murmurs.

From *Molloy*, by Samuel Beckett.

Reprinted by kind permission of the author and publisher (Messrs. Calder and Boyars Ltd.).

Samuel Beckett was born in Dublin in 1906 and educated at Portora (Enniskillen) and Trinity College, Dublin, where he became lecturer in French. He has lived mostly in France since 1932.

Most of his later work has been written and first published in French, and subsequently translated by the author into English.

He became widely known in the early nineteen fifties for his play *En attendant Godot (Waiting for Godot)*, and was awarded the Nobel Prize for Literature in 1969.

Notes and News

Conservation Competition

A competition for post-primary schools has been devised jointly by Irish Shell and BP Limited and the Irish National Committee for European Conservation Year. Teams of not more than seven pupils are invited to select a piece of land in their neighbourhood, suggest ways of improving it and, if possible, carry out the improvement. The entries will take the form of illustrated reports. The competition will be administered by the Department of Lands and will run until June 1971. The Minister for Lands, Mr. Sean Flanagan, T.D., welcoming the announcement of the competition in Dublin on 16th September 1970 pointed out that in a competition such as this there could be no losers. "Even those who might not figure in the final list of awards surely derive intangible but lasting benefits from working in harmony with nature and in dedicated co-operation with their team-mates."

Rhododendrons

A Conservation Limerick has been kindly supplied by Mrs. Ann Quinn, of the Institute of Physical Planning and Research (An Foras Forbartha).

That Glorious Weed

How glorious a plant the Rhododendron,
Its spread you can surely depend on,
But we must save the west
From that greedy pest,
Or be devoured by a weedy dendron.

Eating Sawdust

An item in *Chemistry and Industry* (29th August, 1970) mentions an experiment on the analyses of flavours in La Trobe University, Melbourne, Australia, and quotes Professor J. B. Morrison, of that university, on the increasing importance of synthetic flavours, since it was "likely that everyone would be eating processed sawdust by the year 2000."

Abstract

An Aid to Management Decisions

A recent paper* is of special interest since it uses a set of Irish conditions as an example of how the capabilities of the electronic computer can be used to generate a whole spectrum of values, each the consequence of varying the assumptions which the forest manager must make about future prices and costs. Considering contorta pine at four yield classes, and interest rates of 4, 5, 6 and 7%, the authors calculated Net Discounted Revenues for all possible combinations of 3 different levels of establishment cost, 3 of roading cost, 3 of pulpwood price trend, and 2 of annual maintenance cost trend. In addition they had 3 alternative saw timber price trends in the first two quality classes and alternative rotation lengths varying from 10 different lengths in Quality Class I to 6 in Quality Class IV. The total number of NDR's calculated was 14,256.

These were displayed in 432 tables (not all printed in the published paper!) each showing the NDR's for varying interest rates and rotation lengths where the other factors were kept constant. For example, taking establishment cost at £60, roads at £30, constant protection and maintenance cost, and annual increases of 1% in the prices of pulp and timber, the following results were obtainable for Quality Class 1 sites.

At an interest rate of 4% the NDR varied from −£108.4 with a 16 year rotation, to +£118.9 at 49 years, with a maximum return of +£141.6 at 33 years. At an interest rate of 7% (the highest rate considered) NDR varied from −£84.7 at 16 years to −£22.9 at 49 years the maximum rate achieved being −£0.9 at 33 years showing that under all the conditions assumed in this case no net profit could be achieved.

This method could of course be used to consider the possibilities of any species for which yield tables are available, over any assumed range of costs, prices and interest rates.

N. O'CARROLL.

---

* R. J. McConnen and E. A. Amidon. A computer-based approach for evaluating plantation alternatives — a case study of **Pinus contorta** in Ireland. **Forestry** 43 (1) pp. 31.43. 1970. (The senior author spent the year up to October 1965 working in Ireland on a Fulbright grant).

Obituary

David Stuart, I.SO.

It was with deep regret we learned of the death, on 22nd August, 1970 of Mr. David Stewart, who was head of the Forestry Service in Northern Ireland for thirty years.

David Stewart was born at Argyle in 1885, where his father was forester on the Stonefield Estate. He received his early training at Edinburgh Botanic Gardens and the East of Scotland Agricultural College. In 1908 he came to work at the Lisduff Estate in Ireland as Head Forester. He left in 1911 to join the Department of Agriculture and Technical Instruction at Baunreagh, now Mountrath Forest, as Forester-in-Charge. He remained there until 1920 and trained many foresters. In 1920 he was appointed District Officer by the British Forestry Commission at Baronscourt, and transferred as Inspector to the Ministry of Agriculture in Northern Ireland in 1922.

David Stewart, starting with a small squad of men, virtually built up the Northern Ireland Forestry Service as it exists today. In his early years at Baronscourt he used to cycle to Ballykelly, do a day's work in the nursery, and cycle back at the end of the day. During the war he was responsible for timber control by the British Board of Trade, a task he performed along with his normal forestry duties.

He was a tough task master and expected everyone under him to give his best. In fairness to him let it be said he never asked anyone to carry out a task he could not do himself, and although his tongue was harsh at times to people under him it was for their own good or the good of the Service. Truly it can be said he made a greater contribution to forestry in Northern Ireland than any man of his time. The older forests are a fitting memorial to "ould Davy," as he was called, the father of forestry in Northern Ireland.

After his retirement in 1950 he was honoured by the Royal Scottish Forestry Society by honorary membership. The Royal Forestry Society of England, Wales and Northern Ireland awarded him their Gold Medal in 1963 at a ceremony in Hillsborough Forest near his home. At a similar ceremony in Gortin Glen Forest he was made an honorary member of the Society of Irish Foresters in 1965.

Typical of the man, up to the day before he died he was hard at work tending the trees and shrubs in the large garden at his home, which he had designed and developed into a masterpiece. Few men can leave behind such a wealth of creative work for the benefit of their fellow men.

S. RAPHAEL

Reviews

Collins Guide to Tree Planting and Cultivation

Collins. £2.10 (42 shillings).

This book is the latest in Collins' excellent series of pocket guides and is stated to be for the gardener no less than the forester. It is in fact much more comprehensive than the title would indicate and covers virtually the same ground as "Forestry Practice." It includes, in addition to planting and cultivation, information on protection, pruning, tree surgery, thinning, felling, planning, nomenclature, arboriculture, trees and the law etc. From a forester's point of view it is a most satisfactory book as it is practical and concise and provides for the layman a wealth of forestry common sense. If only the general public could digest the advice given in this small volume the calls on the advisory services would be very greatly reduced.

Foresters will find it rewarding reading and will be surprised at the interesting asides which Edlin always manages to introduce into his articles and books. How many for example know that Bachelor in the academic sense comes from *baccalaurus* meaning the berried laurel of the green bay tree, or that dogwood comes from dog meaning a spike or skewer.

I liked the statement that no one would plant Monkey Puzzle outside a Botanic Garden except in some nightmare. There must have been a lot of sleepless nights in this part of the world !

One could find fault with a few statements where outdated views are expressed but the only actual error detected is the statement that there is no quarantine as far as trees are concerned between Great Britain and Ireland. In fact it is forbidden to import elm into either part of Ireland from Great Britain.

As it is Forestry Commission policy to use only the rifle in deer control it is regretted that he mentions the use of the shot gun for this purpose even though allowed by law.

Mr. Edlin keeps Ireland in mind throughout the book and mentions the Society of Irish Foresters and our publication "Irish Forestry" as well as the 2 Forestry Divisions. It is therefore surprising that in his list of "Leading Arboreta open to the Public" he only mentions under Ireland Glasnevin and Tollymore Park omitting the Kennedy Memorial National Arboretum at New Ross and Castlewellan Forest Park with its famous Annesley Arboretum.

This book is a potted version of Mr. Edlin's many other

publications on forestry and trees. It deserves to be widely read by the general gardening public to whom it presents in a readable form the relevant parts of our every day work among trees.

C. S. KILPATRICK.

Forestry Commission Report on Forest Research

for the year ended March 1969. H.M.S.O. £1.12½ (£1 2s. 6d.).

Until the formation of its own Research branch in 1957 the Irish Forest Service in Dublin relied heavily on the results of research carried out in Britain by the Forestry Commission. The great advances in the afforestation of blanket peats and difficult Old Red Sandstone soils in the early nineteen fifties were made possible because of fertilising technique and ploughing equipment developed in Britain. At that time the publication of the B.F.C. research report was (or should have been) as important an event here as in Britain.

Now that forest research is carried on independently in Ireland this situation has changed. The report is now regarded as an invaluable record of results of research which can confirm our own results, or contradict them (in which case a search for the reason may provide valuable new insights) — or as a source of possible new approaches towards the solution of similar problems.

In this present situation the form of the report, that of the "follier-upper," presents difficulty. The report covers the whole field of forest research (also Management Services and Marketing) and under each heading the advances made during the year under review are reported. Here lies the difficulty for those outside Britain, most of whom will be reading the review from the point of view of a specialist interested in one subject. Such a reader, in order to get the background, the design, and the results of a single experiment may have to consult three or four separate issues of the report. (This also leads to difficulties in reference citation, which the lazy might be tempted to solve by omission). For the outside reader the value of the report would be considerably increased if projects were written up when complete, or when an important stage of development had been reached, in the form of discrete and self-contained papers. The needs of the Forestry Commission's own staff for hot news around the board could then be met by internal communications of a more ephemeral nature.

The Commission's Research staff is to be envied on the speed with which its results are now published.

One unhappy feature of the report is the tendency in the

results of work carried out by the Commission's own research staff to give tables of mean values without any indication of degree of variation or of the statistical significance of the differences. Compare this with the tables of results at the end of the book in the reports of work carried out for the Commission in such institutes as Rothamsted, The Macaulay Institute for Soil Research, and the University of Oxford Department of Forestry, where such information is strictly provided.

N. O'CARROLL.

Guide to Site Types in Forests of North and Mid-Wales.

By D. G. Pyatt, D. Harrison and H. S. Ford.

Forestry Commission: Forest Record No. 69. H.M.S.O. 40p. (8s. 0d.) p.p. 35.

This Forest Record describes a site classification applicable to a region comprising slaty rocks of the Cambrian, Ordovician, Silurian and Devonian systems. The region includes 275,000 acres of Forestry Commission land and a good deal of land afforested by private owners.

The site classification is based on soil type and is derived principally from soil surveys carried out in a number of forests between 1964 and 1967. The classification is presented in the form of three tables listing the pedological, ecological and topographical properties of each site, an assessment of the windthrow hazard associated with each, and some silvicultural and management properties including cultivation, drainage, fertilization, weed control and thinning requirements in addition to guidance on species selection. The guide also includes sections on geology, topography, climate and the various kinds of soil parent material found in the region. Ten colour photographs are included showing a range of the site types described.

The development of modern silviculture requires a thorough understanding of the soil as a medium for tree growth. Data about the distribution of the various kinds of soils, their physical and chemical characteristics, their management requirements and suitability to various tree species are indispensable. For this reason and the many pedological similarities between parts of Ireland and Wales this Record is strongly recommended It is concise, to the point and easily read.

M. L. CAREY.

OTHER PUBLICATIONS RECEIVED

Forestry Commission publications:

See Your Forests. (Information on car parks, forest trails, forest walks, information centres and camping sites in Great Britain). Free.

Forty-ninth Annual Report and Accounts of the Forestry Commission for the period ended 31st March, 1969. 11s. (55p).

Imports and Consumption of Wood Products in the United Kingdom 1950-1967, with Forecasts to 1980. By A. J. Grayson. Forest Record No. 70 6s. (30p).

Experiments on Drying and Scaling Close-piled Pine Billets at Thetford. By J. R. Aaron and J. J. Pruden. Forest Record No. 72. 3s. 6d. (17½p).

Library Review. No. 14, September. 1969.

To be reviewed in next issue.

Trees and Shrubs Hardy in the British Isles, by W. J. Bean. Eighth Edition fully revised. Volume 1, A-C. £8.

Society Activities

Minutes of 28th Annual General Meeting

6th MARCH, 1970, AT THE ROYAL DUBLIN SOCIETY

The President, Mr. McNamara, opened the meeting, and welcomed those present. The minutes of the 27th A.G.M. had appeared in the Journal and were taken as read. The Council Report for 1969 was read and approved, proposed by Professor Clear, seconded by Dr. Joyce. Following the report, the facilities offered by the Royal Dublin Society were discussed briefly. The scheme appeared to have been a success to date, and services provided had been generally free. Mr. McEvoy congratulated the Society and Professor Clear on taking advantage of these facilities.

Abstract of Accounts: The Treasurer had circulated the statement and it was assumed that those present had studied it. The present position was more bouyant with a balance increase of £120 over 1969. There were 382 members of whom 93% were paid up for 1969. Profit from "The Forests of Ireland" amounted to: £482 15s. 0d., but deducting £202 in donations, the actual profit was: £280 15s. 0d. The Society was losing on the Journal. The selling price was 10s., but each number cost 12s. 3d.; average income over the past 7 years was £245 with £403 costs for the same period. Despite the promising balance, the Society could not afford to undertake any ambitious projects. The main source of income was members' subscriptions, and if the Society ever became involved in heavy expenditure, it would have to rely on 100% paid up membership. Mr. McEvoy proposed that the statement of accounts be adopted, and congratulated the Treasurer on his presentation of them. This was seconded by Mr. Hanan.

A discussion followed in which the possibility of producing a second edition of "The Forests of Ireland" was raised. It was felt that editions could be published at 5 year intervals; that these could concentrate on technical aspects of forestry, to be a source of information, and a guide to forests. Regarding financing, it was quite usual to obtain subscriptions prior to publishing.

The valedictory address was then delivered by the President.

The 1970 Council elections were confirmed as follows:—President: H. M. FitzPatrick; Vice-President: M. McNamara; Secretary: M. C. Cassidy; Treasurer: T. Moloney; Editor: N. O'Carroll; Bus. Editor: J. Durand; Hon. Auditor: D. M. Craig; Councillors: Grade I: P. M. Joyce and R. O Cinneide; Grade II: J. J. Prior; Associate: Miss E. Furlong.

Mr. H. M. FitzPatrick then took the Chair, having paid tribute to the outgoing President.

The motion: "That there be one grade of Technical Membership," was introduced by Mr. Macken, who felt that members united as one grade would benefit the Society. Mr. Prior, seconding the motion, felt that the financial concession was the main reason for having two grades, and if such was the case, then thought that grades should be abolished.

In the following discussion it was mentioned that the original idea might have been for technical members to work up to Grade I. However, technical members could become Grade I by payment of the additional 10s. and it was felt that there was now no need for the cheaper subscription rate, especially if the rule was causing a rift between grades. It was assumed that the motion meant that subscriptions should be brought up to the Grade I level. Before voting it was pointed out that

Statement of Accounts for Year ended 31st December, 1969

1968			RECEIPTS						£	s.	d.	£	s.	d.
186	4	0	To **Balance from last account**									263	18	1
			„ **Subscriptions received:**											
			8	Technical	Grade 1			1968	12	0	0			
			103	„	„			1969	199	3	1			
			5	„	„			1970	10	0	0			
			6	„	Grade 2			1967	5	10	0			
			15	„	„			1968	15	0	0			
			156	„	„			1969	230	0	0			
			13	„	„			1970	17	10	0			
			1	Associate				1967	1	0	0			
			1	„				1968	1	0	0			
			95	„				1969	135	3	3			
479	5	0	6	„				1970	9	0	0	635	6	4
6	10	0	„ **Interest on Investments**									6	10	0
			„ **Journal:**											
52	4	7	Sales						32	14	10			
154	5	0	Advertisements						158	2	0			
22	16	0	Reprints							—		190	16	10
			„ **Examination Fees**											
1	0	0	Woodman's Certificate						1	10	0			
7	10	0	Forester's „							—				
	—		Examination Papers							2	6	1	12	6
			„ **Book "The Forests of Ireland"**											
91	10	2	Sales						42	18	0			
			Map Reprints						6	14	2	49	12	2
£1001	4	9										£1147	15	11

1968			EXPENDITURE	£	s.	d.	£	s.	d.
143	4	5	By **Stationery and Printing**				123	5	4
374	7	4	„ **Printing of Journal & Reprints**				426	15	2
84	11	5	„ **Postages**				107	0	6
51	9	0	„ **Expenses re Meetings**				41	12	11
3	17	6	„ **Bank Charges and Cheque Book**				4	7	6
			„ **Honoraria:**						
			Secretary	12	10	0			
			Treasurer	12	10	0			
			Editor	12	10	0			
75	0	0	Business Editor	12	10	0	50	0	0
4	17	0	„ **Examination Expenses**					—	
	—		„ **Book "The Forests of Ireland"** Map reprints				6	14	2
263	18	1	„ **Balance in Bank**				388	0	4
£1001	4	9					£1147	15	11

I have examined the above account have compared it with vouchers and certify it to be correct, the balance to credit being £388 0s. 4d. 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 £60 10s. 0d. which were outstanding at 31st December, 1969.

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

27th January, 1970

the motion was a "motion of intent," and that wording to be included in the constitution, together with necessary alterations to it, would have to be decided by Council and members notified of the wording in writing before the actual change. A General Meeting would have to be called, and it was felt that this might take place during the Annual Study Tour.

The motion was put to the meeting and with 44 in favour, and 1 against, was declared carried.

The 1970 programme was briefly discussed. One meeting to be held in Armagh had been held over from 1969. The Annual Study Tour in Wexford would be held the third week in May, and members would stay at the Ferry Carrig Hotel, which had been booked, together with the bus. The itinerary and cost had not been worked out, but a circular would be issued soon.

Mr. McNamara proposed the setting up of a Southern Region. Permisison from Council would not be necessary for him to contact members. As with the Northern Region, there should be 50 members in the area of whom two-thirds would wish to form a region.

Apologies were received for non-attendance from: Messrs. Mooney, O Cinneide, McAree and Mulloy.

C. KELLY

Public Business

An address entitled "The Forester and Conservation in the 70's" was given by William Grant, Chief Forester, British Forestry Commission, Grizedale Forest. This was similar in substance to Mr. Grant's contribution, "The Role of Forest Parks in Conservation" to the Fifth Symposium of the British Deer Society on 22 February, 1969, and published in that society's journal, *Deer*, Vol. 1, No. 9, June, 1969.

Speaking after the lecture, **MR. HENRY GRAY**, vice-chairman of the Irish National Committee for Conservation Year, said that the arrangement of the lecture was one of the contributions of the Society of Irish Foresters to the programme for Conservation Year, and continued: Conversation Year has provided such tremendous and widespread interest that it is no longer necessary, in a gathering such as this, to explain what it is all about.

My brief comments now may, nonetheless, help you, having listened to this most interesting and valuable lecture, to put the subject of "The Forester and Conservation in the '70s" firmly in the context of the objectives of Conservation Year.

Not too long ago, nature conservation was generally understood to be concerned almost exclusively with the protection of the rarer species of animals and plants. In recent years, the increasing pressures and threats to environmental values from so many diverse sources has led to a growing awareness that conservation must be concerned with the totality of the natural environment—with the interplay of all its elements of soil, air, water, plant and animal life—and with mankind's role as a central and active factor in his environment.

Today, a sound conservation policy is recognised as being one which, based on ecological principles, provides for the wise long-term use and management of natural resources to the best advantage of mankind. The criteria of advantage must reflect the physical, mental and spiritual requirements of the human race, including economic and social needs, now and in the future.

Well-planned land use is a fundamental part of such a conservation policy. Both the agriculturalist and the forester are, therefore, deeply involved, for better or worse, in conservation—the forester to an even

greater extent perhaps than the agriculturalist because of the long-life cycle of tree species and the great environmental significance of the forest.

Today's foresters must then examine all their policies and practices against a broad spectrum of environmental values, *with* a full realisation that their decisions in 1970 will affect many decades to come, *and* with a firm determination that the forests for which they are responsible must be managed against the criteria of long-term human advantage to which I have referred.

This brings us straight into the field of multiple use of the forest in which it is certain that tonight's lecturer has done much to stimulate even further the wide and effective interest already evident in Ireland.

May I then, on behalf of the Irish National Committee for Conservation Year, thank the Society for having arranged this very timely lecture. To Mr. Grant may I say that he has made it a most rewarding evening.

Proposing a vote of thanks to Mr. Grant, **Mr. C. S. KILPATRICK,** Deputy Chief Forest Officer, Forestry Division, Belfast, said :

Mr. Grant has given us some very interesting and inspiring insights into the problems of conservation in the forests and National Parks of North America. They have led the world in this field for a century and more and are likely to continue to do so for another century.

They are now tackling the problems of the fourth wave. I am not quite sure of the sequence of the waves, though I read about them in Dr. Frazer Darling and Noel Eckhorn's book, "Man and Nature in the National Parks."

Many countries have gone through these phases. Firstly, man lives in harmony with his environment amid great natural resources. Then follows ruthless commercial exploitation of timber for short-term commercial gain and the destruction of resources and habitats. Then comes timber conservation without regard to the other resources and with gates kept tightly locked. This is followed by an open gate policy to allow the people to enjoy their forests but with such success that the wildlife and game resources are endangered.

I hope that the last state will be back to the first idealic balance, at least that must be our aim.

Mr. Grant has certainly been a pioneer in this field in Great Britain and speaks with authority not only on recreation and deer management but also on fishing resources. He has not told us what we should be doing in Ireland and I suppose that is the main subject left to Mr. McEvoy and myself.

In Northern Ireland we have long ago given up the closed gate attitude and have gone out of our way to provide facilities for the public, not only in our five forest parks but in virtually every forest. We have also given a lot of thought to game and fish management and yet European Conservation Year has brought home to us the realisation that we have still not given serious consideration to the conservation of wildlife habitats in the true sense of the word.

At one time it was comforting to know that we had declared no less than 10 Forest Nature Reserves in conjunction with the Ministry of Development, 2 Forest Nature Reserves in co-operation with the RSPB, and 2 Bird Sanctuaries in conjunction with the Ministry of Home Affairs, yet these are only a few small corners and in themselves can never make a major impact on the wildlife of our country.

I am not even in a position to state our policy on conservation but we must use this ECY 70 to think this matter out and come to definite conclusions. The best contribution that we can make will be to manage our own land and other resources wisely.

A forester is by nature thrifty; he resents the loss of even small areas

of plantable land. This may be partly due to our small areas, and difficulty of acquiring good land. In this the forester is perhaps no different from others interested in one single resource.

The agriculturist, the sportsman, the fisherman, and the naturalist can be even more single minded. The solution is for the forester to cease being purely a timber grower and to become a wise manager of all the resources under his control for the benefit of present and future generations.

To start the ball rolling and to see ourselves as others see us the Forestry Division in the North recently wrote to the Nature Reserves Branch of the Ministry of Development and invited their comments on the effects of our large scale afforestation on conservation.

The committee which considered the matter consisted of Professor P. J. Newbould of the New University of Ulster, Mr. R. E. Parker of Queen's University, and a member of this society, Dr. H. G. Heal, a chemistry lecturer at Queen's and a noted lepidopterist, and Mr. J. C. L. Phillips, our Divisional Forest Officer, based on Omagh.

Naturally and predictably after expressing sympathy with afforestation and our policy on recreation, sport and tourism they called for more research into vegetation and animal population changes brought about by drainage, fertilisers, pesticides, and the monoculture of Sitka spruce. They understandably asked to be consulted about plans for afforestation in areas delineated as areas of scientific interest under the Amenity Lands Act (Northern Ireland). They then made a *cri-de-coeur* for greater diversity. Which of us have not echoed that cry many times and committed many economic sins in its name.

In their own words:

"We therefore recommend diversification wherever possible. This might include:

(a) the use or retention of indigenous species especially on margins, or as firebreaks. In old estate woodlands blocks of deciduous trees should be retained.

(b) The use of reasonably wide rides or firebreaks, or grazing corridors.

(c) the creation of clearings by not planting certain areas.

(d) variation of initial spacing.

(e) the use of mixtures of species, e.g. Sitka and Lodgepole.

(f) avoidance of planting on some habitats such as areas of scrub, mature deciduous woodland and the areas close to mountain streams and small loughs.

(g) the manipulation of planting and felling programmes so that at any time there are some young plantations in each locality.

The advantages of such diversification may include:

(a) the conservation of a variety of fauna, flora and habitats, and

(b) the creation of ecological stability thereby, including biological control of forest pests.

(c) beneficial long-term effect on such factors as fertility and depth of rooting, especially from species such as alder.

(d) beneficial effects on the use of the forest for education, recreation and as an element of the landscape. In the long run these could become as valuable as its timber production.

In the long run we feel therefore that to set aside some part of an afforestation scheme for so-called non-profitable uses may in fact prove profitable. But even if it does not, it would seem desirable that there

should be some clause in the White Paper on Forest Policy encouraging the Forestry Division to have regard to wildlife conservation in their afforestation plans."

The committee rightly felt that if the habitat is right the forest animals, birds and fish will be able to look after themselves. Already one of our Forest Officers has been given the task of reporting on the possibility of growing considerable areas of alder on heavy clay sites. We have to get our own policy straight in these important matters. We can then go out and give talks to school children and the public with a clearer conscience.

It should be a stimulating and rewarding year.

MR. T. McEVOY, Inspector General, Forest Service, Dublin, in seconding the vote of thanks, joined with Mr. Kilpatrick in thanking Mr. Grant for his very comprehensive, all-embracing talk with its fresh, imaginative approach especially creditable in one who admits to being trained in the older, narrower concept of the forester as a mere grower of trees.

It is interesting that the continental forester never suffered from this narrow view of his function but remained the guardian of the total environment of the forest — game, wildlife, recreation, nature as well as timber. Indeed, it is possible that at times his interest in deer, and his privileged position in the matter of shooting rights, caused him to neglect his timber, or at least to tolerate very considerable losses, for the sake of his hunting prestige.

Perhaps the situation in Britain and Ireland reflects the difference in forest history. Most forests here are man-made, not primeval, and very many were created by landlords to provide privacy and game with timber only as an incidental by-product. This priority of objectives was reflected in the hierarchy of management — estate owner — agent — farm manager — game keeper — forester. The forester at the tail end was not even allowed into his woods when the game-keeper decided the birds must not be disturbed! This division of responsibility between game-keeper and forester may well have been responsible for the confinement of forester education to the narrow field of timber production. It was against this background that formal forest education at forester school and university level began and developed in these islands in this century.

In these difficult circumstances it is fortunate that the broad ecological basis of sylvicultural education survived — thanks to the influence of continental foresters who could look back on several centuries of management of the environment of their forests — especially in Germany. In fact it is hardly an exaggeration to say that the forester is the first example of the practical habitat manager — he was doing it and aware of some of the complex inter-relationships of the habitat before ecology came to be recognised as a separate branch of science. This broad basis of training, together with his daily contact with nature and the necessity for long-term thinking when one is dealing with forest rotations, enables the forester to adapt easily to the new demands now being made on his ability by the change from single-purpose timber management to multi-purpose use.

This brings me to the difficult question of what will be the appropriate 'mix' of uses in the 70's and beyond. We can accept the principle laid down by Mr.Grant — that which yields the best total output — but this rather begs the question of measurement — how does one find a common yardstick for such diverse elements as the cubic foot (metre) of timber, the lb. of venison, the pleasures of the chase, the

satisfaction of the nature photographer, the simple pleasure of the picnic or of just lazing about in natural surroundings. A difficult question — but studies such as the pioneer work in Britain by Dr. Mutch do indicate that the public puts a high value on the imponderables and is in fact prepared to pay hard cash for them (if they have to). Many of them even put their money in conscience boxes without anyone looking over their shoulder!

This new outlook — and it is new — is of course a development of the affluent society. The mediaeval multi-use forest in Europe on the other hand was a product of the privileged class society. It is, I think, axiomatic that affluence determines the hierarchy of forest values. In a subsistence economy timber is at the top (for shelter, for housing, for fuel, indeed for survival). On the other hand in the affluent U.S. enormous areas — one-tenth the size of Ireland — can be devoted to recreation with commercial timber production ruled out completely. In Europe the Netherlands is perhaps the most interesting case. There a dull, flat landscape lacking in vertical scale plus an immense pressure of industrial urban population has placed landscape and recreational values above timber production. In Britain we have seen these recreational and other secondary values steadily climbing the scale and indeed it is obvious from the prices paid for wooded estates in the "home counties" near London that in some areas they already exceed the primary timber production value.

Where do we in Ireland stand? We have a very low population density by European standards, especially in terms of people living in crowded, urban environments, oppressed by the tensions of megalopolis and demanding a change to rural peace and quiet; we have a standard of living in money terms well below that of our industrial neighbours. We have a rather short tourist season. In sum, the pressures on our rural areas are much less. On the other hand compared with Europe we have the capacity for very high yields of timber — £20 per acre per annum — due to soil and climate.

In these circumstances I see the timber production function continuing to be of prime importance in most of our forests, at least in the foreseeable future. But this certainly does not preclude the proper consideration of all the secondary values mentioned by Mr. Grant. In fact I find one point in his paper particularly encouraging and *apropos*. He emphasised that rich, varied and profitable wild life and flora can be provided by special attention to less than 1% of the forest area. He painted indeed a most attractive and persuasive picture of a forest with open glades, varied canopy and a rich understorey. This is so different from the usual allegations of tedious monotony against the coniferous mono-culture. In this matter I think we foresters suffer unduly because so many plantations are now in the thicket or early thinning stage where the canopy is at its densest and the forest floor bare of vegetation. If only the critics could wait to see the normal forest with its proportion of older, more open stands in which the ground flora has re-entered.

In his suggestion for forest capability classification, Mr. Grant was on the right lines in taking the inherent advantages of the site but he might have added location in relation to the consumer — the centres of larger population. In our case we are fortunate that we have at Dublin's backdoor the 60,000 acres of Wicklow forest, rich in geological and topographical diversity and reflecting that diversity in a forest rich in tree species, age classes and ground flora. Advantage is being taken of this fortunate combination of circumstances to develop the recreational and scenic values of the Wicklow forests to the full and the public is

responding avidly to the opportunity. Gougane Barra, in Co. Cork was a pioneer effort in opening forests for public enjoyment and is remarkably successful. Rockingham on Lough Key will soon follow. But the policy is to encourage public access to all forests wherever this is consistent with the safety of the forest itself — fire especially being the danger. Nature trails play a useful rôle in introducing the general public to the riches of nature. Three of these will be established in forests this year and many more will follow. The visitor is taken metaphorically by the hand and the wonders of nature are pointed out.

If I may turn to a conservation aspect in the stricter scientific sense of the term. It is well known that Ireland's primeval forests of oak, birch, ash, elm etc. were almost completely eliminated in the course of our chequered history. Now only a few thousand acres of recognisable remnants remain — and these considerably altered by human exploitation in recent centuries. While the man-made forests are important and welcome additions to our biological environment, these indigenous remnants have a special scientific and historical value transcending their commercial value. In this Conservation Year '70, the Forest Service has begun a detailed mapping and assessment of all such woods in its possession so that they may be dedicated permanently to scientific use and managed in accordance with ecological requirements. Some people may be shocked by the term 'managed' — they distrust the human in his effect on the natural. But Mr. Grant has shown clearly that even a two million acre wilderness of a National Park is not immune from environmental changes originating outside its boundaries, the destruction of vermin etc. Management with the proper objectives is therefore necessary. The aim will be to bring these native woods closer to natural conditions and to learn all we can of the balance of nature in the process.

To revert to the paper — for me the supreme lesson to be learned from it is the danger of too narrow a view of the rôle of the forester. We have seen the dangers which arose when he became subject to the game-keeper and retreated into the narrow role of tree grower. It is clear to me that the forester should be trained and employed for the job of forest habitat management with ecology as his basic science.

It is quite out of date to think of the forester only as a grower of trees and even more so as a producer of commercial timber. At the same time it is clear that he must be assisted by many more specialised scientists, botanists, zoologists, soil scientists and others. He must be in a position to co-ordinate and apply the expertise of many scientists in forest habitat management. His special knowledge is concerned with the largest and dominant feature of the forest habitat, the tree itself, without which the whole dependent community fails. He is therefore the key to its conservation and must remain the manager.

"Down in the Forest . . . ."

Under this general title a series of guided forest walks was organised by the Society in co-operation with the State Forest Services on the weekend the 12th and 13th September, 1970. This was a contribution towards European Conservation Year, and was intended to provide the public with an opportunity to

visit the forests and learn something about them. Walks were organised in the following forests:

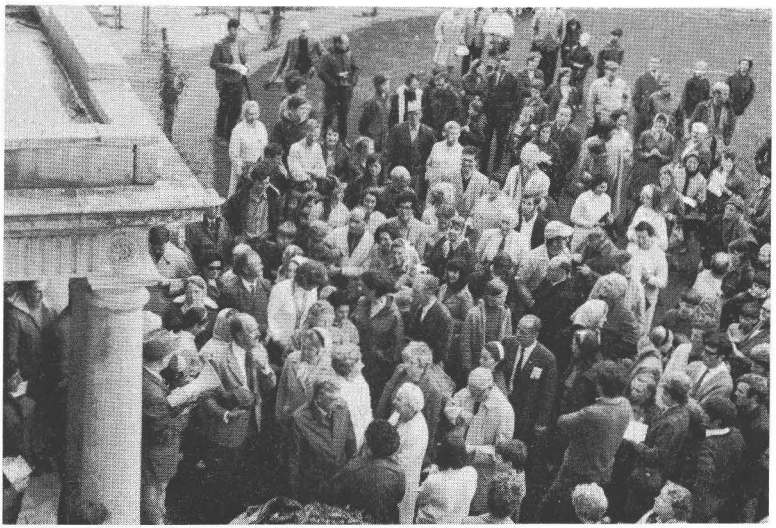
Forest	Leader
Avondale, Co. Wicklow.	H. M. Fitzpatrick, (Saturday). O. V. Mooney (Sunday).
Ballymahon, Co. Longford.	Wm. Breslin.
Binevenagh, Co. Derry.	R. Lamb.
Carnagh, Co. Armagh.	H. Conn.
Castlecaldwell, Co. Fermanagh.	C. N. Parker.
Curraghchase, Adare, Co. Limerick.	J. Horgan.
Dunaree, Kingscourt, Co. Cavan.	A. McGinley.
Foxford, Co. Mayo.	T. de Gruineil.
Glendav, Macroom, Co. Cork.	Wm. Shine.
Gortin Glen, Omagh, Co. Tyrone.	J. W. R. Devenney.
Hillsborough, Co. Down.	R. T. Sherwood.
Iniscarn, Co. Tyrone.	G. Jones.
Killavullen, Co. Cork.	J. Ryan.
Killygordon, Co. Donegal.	M. O'Donovan.
Knockmany, Co. Tyrone.	C. N. Parker.
Lough Gill, Co. Sligo.	J. E. Johnston.
Mount Bellew, Co. Galway.	E. McGuinness.
Pomeroy, Co. Tyrone.	G. Jones.
Randalstown, Co. Antrim.	J. McCurdy.
Rockingham, Co. Roscommon.	J. Duane.
Woodstock, Co. Kilkenny.	T. J. McCarthy.

The leaflet advertising the walks drew attention to the fact that our forests "are essentially vast cellulose factories but they pollute no air and contaminate no water." The walks were well covered in advance in press and on radio, and were reported on television. At each centre copies of a leaflet were distributed in which the President, Mr. H. M. FitzPatrick, had condensed the basic principles of forestry into about 2,000 words of layman's language. The attendance was variable, but generally higher than anticipated, averaging 120 over all the walks.

The success of this series was the result of a great deal of hard work by Mr. Fergal Mulloy (Convener) and Miss Lily Furlong of the Meetings Committee.

On Sunday at **Avondale,** the President, Mr. H. M. Fitz-Patrick, opened with a welcome from the door of Avondale House and a word of thanks to the Minister for Lands for the co-operation of his Department. He then outlined the history of

the house and its occupants. Because of the large number of people present it was necessary to divide them into two groups for the walk, the second group, led by Mr. A. M. S. Hanan, covering the same ground as the first. At the first stop at the end of the Big Ride, Mr. FitzPatrick explained how the original plots were used to test the potential of newly introduced and untried species. A little further on he explained the use of nurse species, spoke about the native Irish tree species and explained



Part of the crowd at Avondale on September 12th being addressed by the President.

how to distinguish between pedunculate and sessile oaks. Carrying on he spoke of the silver firs and at a young plot of *Pinus contorta* he explained how Ireland had come to pioneer the use of that species. He demonstrated the natural regeneration of *Tsuga heterophylla* and spoke about the giant redwoods. Finally he pointed out a smallish specimen of *Tsuga canadensis* to exemplify the difference in growth between species such as this from eastern North America, and those such as *Tsuga heterophylla* from the west.

All the participants were clearly intrigued by what they saw and heard, and many expressed pleased surprise on learning that the grounds of Avondale, and indeed other State plantations, are open to careful walkers.

N. O'CARROLL

Annual Study Tour

The Study Tour in 1970 was held in the Wexford region, and led by Mr. T. Enright, District Inspector, Enniscorthy. Thirty-four members stayed at the Castle Hotel, Ferrycarrig, Wexford, and nine other members also took part.

The first day, Tuesday, 19th May, started with a brief stop at Deerpark property of Bunclody forest, followed by a drive to the top of Mount Leinster (2610 ft.), site of the television transmitter, and a view of one of the most extensive prospects in Ireland, covering on a fine day six counties.

Lunch was taken *al fresco* at the John F. Kennedy Memorial Park, and was followed by a tour of the arboretum, the forest garden, the phenological garden and the buildings conducted by Messrs. A. M. S. Hanan and B. J. O'Reilly, Director and Forester in charge, respectively. One of the most striking plots in the forest garden was one of red alder *(Alnus rubra)* averaging about 10 ft. in height after 4 growing seasons. The visit ended with a walk through a small section of old woodland with blue-bells and other wildflowers in full bloom. Here were seen nesting boxes provided for tits. Other birds of interest which nest here or in the neighbourhood are kestrel, long-eared owl and hen-harrier.

In conclusion it was pointed out that the Park contributes much more to the local economy than a farm enterprise of similar area. Apart from direct employment there is a growing business in farm-house guest accommodation as a result of the increasing number of tourists visiting the Park.

Wednesday, 20th May, began with a visit to Forth forest (Mr. J. McKnight, Forester in Charge; Mr. J. P. Mulkern, Assistant) with just over 2,400 acres planted. Soils here are extremely infertile podsols and gleys derived from cambrian quartzite. Crops seen demonstrated the importance of cultivation and fertilization, and in particular of agricultural reclamation, resulting in good growth of Sitka spruce on former agricultural fields. A seed stand of contorta pine was visited and N. O'Carroll (Research Branch, Forest Service) explained the methods and results of an NPK factorial experiment on a range of contorta provenances.

In the afternoon the group went to Johnstown Castle, headquarters of the Soils Division of the Agricultural Institute (An Foras Taluntais), and visited the laboratories of the National Soil Survey and the soil testing laboratories. This was followed by a tour of the nature trail laid out in the grounds of Johnstown Castle by Dr. Austin O'Sullivan. The day ended with a visit to the grass growing and drying enterprise at the South Sloblands covering 2,500 acres of reclaimed alluvium.

The first stop on Thursday was in a 51 year old stand of *Abies grandis*, Yield Class 300, in Camolin forest (Forester in Charge: Mr. P. J. Kerrigan; Assistants Messrs. M. Donoher and J. O'Driscoll). Also of interest in Camolin forest were the 51 acre nursery, opened in 1959, a 55 year old stand of Norway spruce and a 43 year old stand of *Cupressus macrocarpa.*

In the afternoon the group went to the Raven, an area of sand dunes formerly Curracloe forest, now a property of Bree forest (Forester in charge: Mr. S. Ua Cearnig; Assistant: Mr. J. F. Fee). The discussion was opened by the President, Mr. H. M. FitzPatrick, who recounted his memories of the beginnings of Curracloe forest in 1931. To start with, 20 lb. of maritime pine seed was sent by post,

addressed, according to custom to "Curracloe Forest". The postman arrived with it saying, not without an edge of sarcasm: "I am looking for Curracloe Forest", to which the forester, Mr. O'Brien, replied: "Sure you have it there on the front of your bicycle."

Mr. O. V. Mooney outlined the development of sand dune afforestation in the Landes region of France, on the Culbin sands in Scotland, and on the Raven itself. He concluded that the effort had been successful technically, but not economically when judged by normal forest standards.

Mrs. Ann Quinn of the Institute for Physical Planning and Research *(An Foras Forbartha)* spoke on sand dune ecology and pointed out examples of dune formation, mature dunes, and dune erosion.

Mr. Oscar J. Merne, of the Irish Wildbird Conservancy spoke about the North Slob, reclaimed from the sea in 1848, and particularly about its bird population. One half of the total world population of the White-fronted Goose now spends the winter on the Wexford Slobs. There are about 170 species of birds of which about 80 breed in the neighbourhood. Shooting is strictly controlled, less than 10% of the goose population being shot each year.

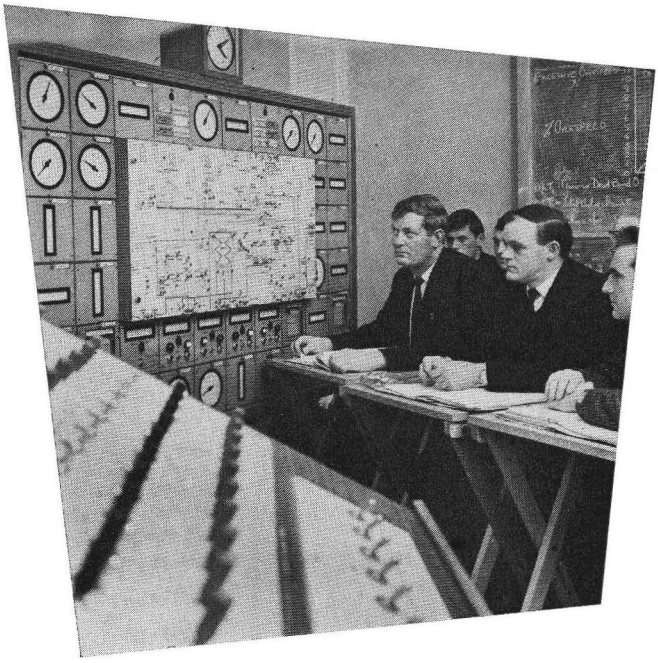
The Study Tour as a whole was a very good example of the way in which foresters are broadening their horizons so as to include the various aspects of land use other than commercial timber production.

N. O'CARROLL.

Meeting at Dundalk Forest

An outdoor meeting took place in Dundalk forest on Sunday, 25th April, 1970. The leader was Mr. M. O'Brien, then Assistant District Inspector, Cavan, who introduced the Forester in Charge, Mr. P. Giblin, and his Assistant, Mr. M. Ward. Crops seen and discussed included an intimate mixture of Norway and Sitka spruces planted in 1927, groups of Norway spruce, beech and Scots pine which had been planted in 1957 to replace Douglas fir attacked by honey fungus, pure Lawson's cypress planted in 1932 (yield class 160, 4,000 H. feet per acre) and pure *Cupressus macrocarpa* planted in 1948 (yield class 180) which appeared to be well able to withstand exposure. Some impressive views were also seen, bringing to mind the great amenity potential of the area.

J. A. McGINLEY



TOMORROW—
they'll be working for you

Right now there are almost 1,000 E.S.B. personnel undergoing special training — to make certain that the E.S.B. can meet your needs tomorrow — and in the years ahead. It's part of the E.S.B's. policy to ensure that all have the opportunity to develop with this vital industry and to progress in their chosen professions.

As your use of electricity becomes greater, the E.S.B. must plan ahead to have the men and the machines geared to meet your needs.

This is just one aspect of the "forward look" which the E.S.B. must maintain as its contribution to the community to which it belongs and serves.

ESB

POWER FOR PROGRESS — PROSPERITY FOR PEOPLE

The combination of Viking half-tracks and Igland multi-drum winches is a low cost way of increasing output from timber operations. The easily fitted tracks increase traction, enabling you to haul bigger loads and work previously inaccessible sites. With hydraulic tracks, ground pressure can be altered for crossing ditches or other obstacles.

Robust Igland winches give faster gathering, they have a long trouble-free life and are simply mounted onto most tractors. One to eight ton pulling capacities are available at distances up to 400 yards. For increased timber output at low cost get the powerful combination of Viking half-tracks and Igland winches.

Also suppliers of Highland Unimog forest tractors, Highland County skidders, Highland Bear hydraulic grapple loaders and cross country trailers.

James Jones and Sons Ltd.

Forest Equipment Sales
P.O. Box 35, Larbert,
Stirlingshire
Tel: Larbert: 2241

a powerful combination
Viking half tracks and Igland winches