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COVER: A simple knapsack fertiliser spreader. This model with a gravity feed to a flexible delivery tube, developed and used operationally in Finland, was recently tested for use under Irish conditions. (*Photograph: P. J. O'Hare*)

Society of Irish Foresters

IRISH FORESTRY

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Editorial

THE NEED FOR COMMITMENT

"THERE'S some who're singin' and some who're not", was the immortal classification made by a dissatisfied provincial choirmaster. If singing can be taken as a metaphor for having a sense of commitment, then there are many of the second class involved today in all aspects and functions of forestry in this country, and at many levels.

This is partly due to the present organisation of the State forestry services. Being part of the Government administrations they share an organisational development based on army structures, which were themselves designed to cope with a rarely occurring situation, that of war. This gives rise to a steeply pyramidal arrangement with a high and increasing number of levels, resulting in a blurring of the limits of individual responsibilities and a growing sense of remoteness from important decisions among the employees.

So we get the "them and us" attitude. How often do you not hear references among its staff, to *"The Department"*, as if that were a remote, strange and unknowable organism? If you work for the Department *you are* the Department,[1] as much as is a chief inspector or an assistant secretary; as much, even, as is your pet aversion, whether he be a regional inspector or a headquarters executive. Your efforts have their part to play in the overall achievement, and they are just as important as anyone else's, even when they are not always as obvious.

1. This may not, in the Republic, be in acordance with the letter of the Ministers and Secretaries Act of 1924, but it should be unnecessary to point out that 1924 was more than half a century ago, and that attitudes then would be different from those of 1975.

Fundamental Options in Silvicultural Management and their Importance[1]

M. VAN MIEGROET[2]

THE general aims of silviculture are forest conservation and forest restoration, but especially the promotion and maintenance of a state of good health and well-balanced structural equilibrium in the forest. The practice of silviculture is a logical consequence of forest utility. It must create appropriate conditions for forest utilisation and produce lasting benefits at a high level for the greatest number. Departing from a pluralistic view on the relationship between Man and Forest it promotes future developments.

The continuity of forest utilisation is to be guaranteed by stabilisation of the individual forest, eventual expansion of forest space and safeguarding of an optimal level of productivity in each subdivision of the area under consideration. The creation of a state of structural and bio-ecological stability is a way to promote actual variability in forest utilisation, not closing the road to unpredictable future developments.

Silvicultural management must realise a compromise between scientific experience, technical ability and human ambitions, all of which are direct objects of interest, research and study. The definition of the immediate aims of silviculture requires therefore a keen perception of the relativity of values leading to

— an open-minded evaluation of the situation of departure;
— the elaboration of alternative solutions to parallel or alternative developments in human society;
— a most careful choice of methods, not to impair possible development by the use of exclusive techniques.

Restrictive partiality in the definition of aims and the choice of techniques must be avoided under present circumstances, characterised by the relative shortage of forest space, increasing consumption of wood products all over the world and quick changes in aspect, importance and quality of forest utilisation. For this reason silvicultural activity must be integrated in a co-

1. Paper delivered at the Society of Irish Foresters Annual General Meeting, Dublin, 22nd March, 1975.
2. State University Ghent, Belgium.

herent policy directed at the protection of natural resources and the care for environmental stability.

The acceptance of a bio-ecological foundation to silviculture must not imply the neglect of economic production. On the other hand public reaction in densely populated industrial countries, where absolute safeguarding of industrial interests at the expense of social functions and general well-being is no longer acceptable, will be provoked by the unilateral orientation of forestry management toward material production and direct financial results.

The forester as a public servant, who administrates public property and helps promoting general welfare, is in an excellent position to mediate between conflicting interests, provided he is able to evaluate correctly the relative value of each forest function and is willing to maintain a functional equilibrium, giving satisfaction to various demands. He has to reconcile socio-cultural ambitions and economic-financial objectives, that quite often correspond with different political options. He must think and plan on a continually expanding scale of time and space, be conscious of the relativity of silvicultural truth and recognise the dynamics of modern society and of perpetual change, caused by industrial expansion on a world scale, population explosion, technological progress, increasing consumption, environmental degradation and a profound change of socio-political relations.

Responsible silvicultural management must go out from the variability of the forest functions and from the constant modification of their relative value in time and space.

However, a critical approach to actual silviculture is necessary because of the great opportunity for choice at different levels of decision, where the future should be considered more important than the present. It is also advisable to accept the possibility of alternative future situations, that can be made more or less probable by present interventions. Each option is in fact related to a sequence of interdependent phenomena and decisions and each individual choice can help to further desirable evolutions or to weaken unfavourable tendencies. The use of the opportunity for choice is important because it expresses the will to choose the future, not to undergo it.

The Forest

The definition of the forest as a vegetative formation dominated by the presence of trees and woody plants covering the soil more or less completely and producing a desirable raw material, is adequate and creates misunderstandings. It applies well to certain forest types created or strongly influenced by man, but does not express clearly enough the fundamental characteristics of the forest as an intricate form of life, a natural phenomen and a product of evolution. By origin and within reasonable limits of human impact, the forest is a complex ecosystem with multilateral links between its compounding elements. It is the result of total integration of a multiform biological entity in its physical surroundings, leading to a close relationship of reciprocal influences between the living world and the site on which it develops. Interdependent physical, chemical and biochemical phenomena occur in a closed association of ecological relations and nutritional chains. Trees and shrubs dominate the ecosystem by appearance and volume, by their overwhelming share in total biomass, but especially by their importance for primary production as the real starting point for nearly all nutrition chains existing on the site.

The total space actually covered by untouched forest with a high degree of eco-systematic complexity has been severely reduced. Therefore all remnants of natural forests, as well as the semi-natural formations at a high level of stability must be protected against unilateral exploitation and destruction, because of their value as objects for study and analysis. They provide more complete information on evolution dynamics and energy exchanges, which are the real basis for silvicultural practice, even in its application to the economic forest and to the simplified tree formations of human invention.

It is indeed rather unsatisfactory that forestry practice and research have been inspired for such a long time nearly exclusively by immediate financial returns and by the efficiency of human interventions in their relation to fixed economic objectives. Most often practice and research do not leave the restricted area of well-intended empiricism, paying more attention to forest utilisation than to the forest itself. This approach to the relationship between action and immediate result, with little interest in the mechanics of influence by silvicultural intervention, has caused losses in material production and neglected the exploration of new roads to growth control, dismissed beforehand as having no practical use. This conclusion applies, among others, to the lack of interest by forest research in the basic phenomenon of photosynthesis, the real point of departure for each type of production in the forest, for all kinds of forest utilisation and for the practice of forestry and silviculture as well. However, the analysis of growth and production, the study of methods and techniques in relation to energy exchange, can create opportunities for increased production, and lead to new concepts on forest treatment by a better understanding of the underlying phenomena.

The low energetic efficiency of the forest is a rather puzzling fact, subject to many speculations. As an average only 1% of the available solar radiations (0.5% in boreal zones, 1% in regions with a moderate climate and 1.5% in the tropics) is absorbed by the forest and partly transformed into dry matter at a rate of 0.5 g to 5 g/m²/day. Burger and Weck were among the first to give particular attention to the possibilities of increased photosynthetic efficiency by cutting transpiration and respiration losses, modifying the absorption equilibrium in favour of photosynthesis and production of dry matter. This is not a utopian enterprise needing big investments or specialised knowledge. The increase of photosynthetic efficiency can be obtained in the forest by directed selection, by preservating forest continuity and by the maintenance of a sufficient degree of structural complexity. A realistic basis for selection is the variation in energetic efficiency between individual trees and between species.

Analysis of the bio-ecological system on the other hand shows, that actual or potential losses, caused by debatable techniques and methods, are quite often more important than the production increase obtained by costly artificial interventions (e.g. soil preparation, use of fertilizers, weed control). Wiedemann demonstrated that repeated clear-cutting in Germany lead to a loss in annual increment of 0.6 — 1 m^3/ha in each consecutive generation. Clear-cutting not only destroys the ecosystem, but profoundly damages the apparatus for energy absorption at the same time. The recycling of biogene elements is disrupted. In the period between forest destruction and stand renewal, energy exchanges proceed at an extremely low level. Many years after reforestation have to pass before energy absorption is satisfactory again. The total period of reduced energetic efficiency, loss of dry matter production and factual loss of growing space gets relatively longer as the rotation between clear-cutting is shortened.

Fundamental options and silvicultural systems need a realistic analysis. It is the only way to find out the merits and disadvantages of repeated clear-cutting or forest continuity, of shorter or longer rotations, of the optimalisation of technical or ecological circumstances in forest management. Notwithstanding the ultimate choice, it can not be denied that the interpretation of forest growth and of silvicultural practice in terms of energy exchanges is of fundamental importance. These exchanges are affected by each intervention in forest development. Although energetic efficiency will probably never become a way of direct approach to forest treatment, it nevertheless is closely related to the type of forest, which undoubtedly is an object of choice.

The Forest Types

Forest types are engendered by a double series of influences

- — The given phytogeographical, climatological and ecological conditions.
- — The character, volume and frequency of human intervention as a measure for forest utilisation.

The forest type is, in some way, the reflection of the basic relationship between man and the forest. It often expresses clear intentions concerning the use of the forest and the kind of management needed to that end.

From a silvicultural point of view it is possible to distinguish forest types, corresponding with different forms and degrees of human impact.

In the *natural forest*, established and perpetuated by spontaneous natural regeneration, no trace of human influence is detectable.

Human intervention causing a decrease in standing volume, a reduction of the number of tree species, a modification of structure and patterns of mixture but without introducing non native or exotic species, have the development of the *semi-natural forest* as a consequence. Natural regeneration is often spontaneous, but it can be controlled and even be induced by man. In some cases the semi-natural forest remains close to the original natural situation. It can also be in a state of reversible or irreversible degradation or develop into a valuable economic forest with a potential for sustained yield at a high level.

The purposeful combination of native with introduced species and of natural with artificial regeneration in a changing pattern of time and space is the distinguishing mark of the *transition forest.*

The principal role of the native species, notwithstanding their eventual economic value, resides in the stabilisation of bio-ecological conditions; exotic species are mainly introduced to increase the level of wood production in direct response to local or temporary demands.

In the *artificial forest,* created by man by afforestation and reforestation with native or introduced species, the nearly exclusive objective is wood production.

This is also very often the case in the *naturalized forest,* resulting from the transition to natural regeneration in a forest with an artificial origin.

A last group consists of the *marginal forest types,* that do not possess the basis characteristics of the real forest and mostly take the aspect of simplified, artificial ecosystems. They can represent an important economic value, although their continuity is not always guaranteed and their sustained yield not assured. Coppice forests, tree farms, plantations, poplar cultures can be considered as marginal types.

The forest types under consideration show a variable level of bio-ecological stability, a gradual modification of principal functions and important differences in value production, (volume and quality).

Approaching the unmodified natural situation more and more, a sequence of interrelated characteristics and phenomena is detectable which circumscribe the substantial value of natural oriented forest types, their functional significance and the set of silvicultural consequences:

— Increase of bio-ecological stability.
— Growing structural complexity.
— Higher potential for multiple utilisation.
— Stabilisation of material production, although quite often at a level of sustained increment appreciably lower than that which can eventually be obtained over a short period by concentration of means and effort.
— Intensification of stand treatment, especially in the economic forest, not necessarily requiring higher levels of investment.

More artificial forest types have qualities, willfully induced or the unavoidable consequence of human intervention:

— Highly simplified forest structures, posing less treatment problems and possessing a higher degree of surveyability.
— Reduction of biological substance and genetic reserve, eventually leading to an apparent or potential loss of productivity to be restored by artifical intervention.
— A clear limitation of functions, as most artificial forest types are conceived as a response to demand for quick financial results and the appeasement of acute, temporary and local needs.
— A lower degree of treatment intensity as interventions are projected against their immediate financial consequences in

order to cut down on management expenses and to meet the rising costs of reforestation.

Even in the field of material production the choice of type is to be understood as a potential choice between mass production of an industrial raw material and the promotion of better tree quality, between the satisfaction of temporary local needs and the stabilisation of production, between functional specialisation and functional plurality, between maximal return over a short period and sustained yield with no time limit.

The choice of forest types and their dispersion illustrate in last analysis the present state of society and the visions on future social development, on the evolution of forest utilisation and on the modifications directly linked to changing needs and demands.

Forest Utilisation

Till the end of the 18th century the european forest fulfilled a predominantly social function. Its economic value was low on account of the restricted possibilities of wood transformation, the lack of general prosperity and the regional importance of markets for raw material and processed products.

Forest utilisation, based on customary law, tried to provide local populations with wood for direct consumption (fuel wood, manufacture of tools, construction materials), with vegetable food and with animal proteins to be obtained by collecting, hunting or the organisation of forest grazing.

The industrial revolution of the 19th century ended this situation by recognising the economic importance of the forest and its most obvious product, wood, as a material for industrial transformation.

Systematic exploitation rapidly increased the human impact on the forest and changed its structure and composition profoundly. Growing tension between production and exploitation lead to silvicultural management considered as a set of rules, techniques and patterns of intervention, aiming at the systematic organisation of human utilisation of the forest. The principal goal at the moment was to secure and guarantee the supply of an expanding industry with a maximal quantity of raw material.

In the 20th century the situation underwent new modifications provoked by three groups of influences:

1. Technological explosion and accelerated industrialisation on a world scale, producing an immediate rise of the level of consumption and prosperity in the regions directly affected.
2. The profound modification of the pattern of living, due to

the increase, the concentration and the growing mobility of populations with an accelerated loss of space and the urbanisation of agrarian regions as side effects.
3. Environmental degradation and manifestation of an ecological crisis situation, causing forest destruction and forest restoration at the same time and bringing about fundamental changes in forest utilisation.

For this reason silviculture and forestry seem to find themselves to-day confronted by the need for choice between social and economic utilisation of the forest, especially in densely populated industrial countries.

Generalisation of the multiple-use system is in fact no solution in all cases, because of the unequal utilisation-value of the forest and the differences in population pressure and regional needs.

A way to harmonise conflicting aspirations and to develop several forest functions to an acceptable level, is the attachment of as many simultaneous functions as possible to suitable forests, and to recognise the necessity for functional specialisation in less polyvalent forest areas at the same time.

The acceptance of a strictly limited number of simultaneous functions, eventually of a single function leads to the concept of functional forest types and their suitable dispersion.

It reduces fundamental silvicultural options to functional organisation of space in general and of forest space in particular.

The following functional forest types are considered for practical purposes in Belgium:

Well-being

1. The park: Exclusive social function inside the agglomeration.
2. The forest park: Predominant or exclusive social function at the periphery of agglomerations.
3. The recreation forest: Dominant social function and limited economic function within reach of the agglomeration.

Production

4. The multiple-use forest: Variable proportion of social and economic function.
5. The production forest: Dominant or exclusive function.

Protection and conservation

6. The forest reserve: Exclusive internal or external protection.

Functional zoning of forest space creates its own problems, but it does not provoke profound modifications, nor does it restrict any function in a dangerous way, if put through or considered over sufficiently large area.

This can be illustrated by a practical model for Belgium with nearly 10 million people living on a little more than 30,000 km^2, with a forest area of 625,000 ha, annually producing 2.5 million m^3 of wood.

Forest type	*Optimal available surface*	*Production repercussions*	
Forest reserve	25,000 ha	− 400,000 m^3	
Recreation forest	100,000 ha	− 400,000 m^3	
Production forest	500,000 ha		+ 700,000 m^3

A good organisation of the actual forest area of Belgium, could allow a theoretical gain in annual wood production of at least 200,000 m^3 because of the possibility for unhindered concentration of production on 500,000 ha. For the calculations a total loss of useful increment in the forest reserves and of 50% in the recreation or multiple-use forest is accepted. Of the remaining 500,000 ha of forest to be used exclusively for production, nearly 200,000 ha are now in a state of relative degradation, easily permitting an annual increase of 2 m^3/ha.

On the rest of the production forest area a total annual increase of 300.000 m^3 is not excluded.

The importance given to functional division of available space is in direct relationship to the importance of produced value, composed of material production and of the social services rendered.

The Value Production

Under all circumstances where wood production is the dominant or exclusive objective of forest management, it is normal to express the profitability of the enterprise, the effect of interventions, the volume of capital investments and labour input in relation to the money-value of the produced raw material.

The analysis gets complicated when management aims simultaneously at material production and at rendering of services, especially as no common evaluation norm can be found for both forms of forest utilisation. It seems in fact difficult to express in terms of direct financial profit the value of recreation, pure water and clean air, prevention of erosion and protection against avalanches, floods and landslides although their value is very real.

Moreover, the financial evaluation norm does not always permit the fundamental distinction between material production and the provision of services, as wood production in some industrial countries is also developing into a public service with an evident negative financial return.

Between 1950 and 1975 the selling price for standing timber was affected by a tendency to drop all over Europe and its stabilisation was an exception. During the same period however costs and investments (wages, materials, social provisions etc. rose to an index-level of 240 to 280. Notwithstanding steadily increasing wood consumption, the divergent evolution of prices and costs caused a serious diminution of the financial return on the forest enterprise to far below the normal level for attractive investments if not to become clearly negative.

Ertl and Hasel calculated, that in West Germany the net financial product of the state forests increased from 54 D.M./ha in 1951 to 108 D.M./ha in 1956 to decrease regularly from there on to reach a level of -55 D.M./ha in 1968. This evolution represents a quick change from a net profit of nearly 26 D.M./m^3 in 1956 to a net financial loss of 12 D.M./m^3 in 1968. (Table 1).

TABLE 1: Evolution of financial profitability in the state forests of West Germany (Ert, 1970, Hasel, 1971).

Year	*Gross product* DM/ha	*Management expenses* DM/ha	*Net product* DM/ha	*Net product* DM/m^3
1951	189	135	54	14
1956	316	208	108	25.5
1961	307	267	40	9.3
1966	334	321	13	2.8
1967	271	310	–39	–8.4
1968	265	320	–55	–12

Under such conditions it is understandable that owners lose interest in their forests, the more so as they are confronted with chronic labour shortages and a high level of investments for eventual mechanisation. The ultimate consequence of such a development toward low financial return from the forest enterprise as soon as general prosperity reaches a certain level is, that wood production becomes a public service, to be rendered by the executive branch, eventually at a direct financial loss. It develops into a measure to promote economic expansion and social stability. It is to be judged by the same value-norms as are used to assess the expenditure on road construction, the organisation of public education and the creation of infrastructural facilities.

These recent changes in conditions and approach modify the significance of the forest and affect the position taken by society towards forestry. The conservation of certain forest areas for their cultural or scientific value, for their scarcity or their irreplacability has become acceptable. The development of the social forest function is justified by actual necessity, as well as by the volume and character of predictable future demands. The level of investment for material production and social well-being is the expression of the intentions of human society and of the degree of financial sacrifice it is willing to make in both cases.

The gathering of information on requirements and needs outside the field of material production is therefore necessary.

As far as forest recreation is concerned ample information already exists. In the "Stadtwald Frankfurt" 20,000 to 30,000 persons visit daily a forest area of 5,000 ha and Ruppert even observed 100,000 visitors on peak-days in 1960. The Cantareiro-forest near San Paolo received 1.3 million visitors a year over 179 ha, corresponding to 20 daily visitors per ha (Mello & Lima).

In the U.S.A. the number of forest visitors increased by 52% between 1960 and 1965. During that same period the federal authorities augmented forest space available for recreation by 72% and up to 130 million ha or 0.6 ha recreation forest area per inhabitant against only 0.06 ha total forest area and 0.3 ha total space per inhabitant in Belgium.

In Belgium 771,354 persons visit recreation areas on peak days. They represent 20% of a population of 3,856,670 living in towns with more than 15,000 inhabitants, where environmental pressure is well felt and the need for recuperation and open-air recreation evident. They travel an average of 60 km (grand total 1,152,000 km) with 192,000 motorcars needing 100,000 l of fuel for the trip.

The care for well-being through the development of social forest utilisation is a just and necessary measure of compensation for increased environmental pressure following quick industrialisation. It prevents ultimate economic loss and loss of prosperity.

Such a conclusion results at any case from the thorough analysis in Germany by Buchwald. He found that in 1939 about 2% of the active population was not at work on account of illness.

In 1950 the level of 3.8% was attained and it rose to 7.3% in 1967. In the same year (1967) 12% of the active population ended productive activity at an average of 12 years before the normal age for retirement. Health control in schools indicated that 50% of all children were suffering from chronic diseases.

Equally important are the results of the analysis of the relative value of forest recreation and material production undertaken by Bichlmaier in a forest area of 68,000 ha near Munich.

Attributing to each controlled forest visit a value of 2 D.M., he concluded that the total benefit represented by recreation reached 22.8 million D.M. a year as against 5.6 million D.M. for wood production or 335 D.M./ha for recreation against 82 D.M./ha for material production.

The development of the social forest function corresponds to a direct social need and an indirect economic requirement. Its contribution to general well-being and social stability deserves attention and a reasonable level of investment. Such a thesis is more easily accepted by public authorities and political decision makers than by foresters, who are often reluctant to accept the idea of multifunctional management and polyvalent forestry. They do not so rapidly agree with the conclusion of Ertl and Hasel, confirmed in a way by Abetz and Speidel, that from an economic point of view, the forest enterprise passes through an extremely difficult period in industrialised countries on account of full-employment, high wage levels and rising management costs. It is therefore necessary to analyse silvicultural ways and means in a realistic and non-prejudiced state of mind to assess correctly the value of alternative solutions and to interpret the actual situation in terms of general human interests.

The Practice of Silviculture

Options regarding the fundamental characteristics of the forest, forest types and their dispersion, forest utilisation and value production, influence silvicultural concepts and lead to modifications of silvicultural practice. Alternative silvicultural solutions concur in fact with alternative types of forest utilisation and with alternative definitions of the objectives of forestry. The choice of silvicultural methods and techniques is clearly co-determined by socio-economic circumstances and by the general line of thought on forest policy. It reflects in a way the actual state of mind in human society and expresses its vision of the long-range future.

The choice of species

In many european countries the choice between native and exotic species, between hardwoods and conifers still has a real importance.

This choice is closely related to options between the priority accorded to bio-ecological forest stability or to supplying material products to a prosperous and demanding human society.

Between 1960 and 1975 total wood consumption on a world scale increased by 28%; but consumption of paper and cardboard increased by 118%, and in Europe by 139%. The situation is growing critical in Europe where a timber surplus of about 5 million m^3 in 1960 developed into a general deficit of 66 million m^3 in 1975 and into a deficit of 139 million m^3 in the E.E.C. countries alone. Under such pressure, there is no doubt about the necessity for conservation and even for extension of the coniferous area. It is equally clear that the introduction of conifers in natural hardwood regions is unavoidable, especially to reafforest new sites.

This however is not the heart of the problem. From an silvicultural point of view it is more important to question the way in which conifers are used and to postulate that the introduction of conifers must not provoke a loss of soil fertility or site productivity, nor should it endanger the continuity of forest presence and forest utilisation.

Therefore a position is taken, not so much against the exaggerated use of conifers, as against the automatic sequence of decisions and phenomena that often start with the introduction of conifers following the line:

Artificial regeneration	Homogenous stand
Systematic clear-cutting	Uniformity of forests
Short rotations	Decreasing resistance
Extensive treatment	Loss of ecological stability
Dominance of technicality	Loss of biological substance
Restricted management objectives	Modest genetic reserve.

This sequence results from a definite pattern of behaviour starting with the choice of species, that can easily be changed to reduce consequences. In extreme cases it mortgages the future, does not pay attention to past experiences and reveals an optimistic attitude toward the technical ability to prevent production losses and forest destruction.

Catastrophic forest destruction in Europe was always linked in the past, not so much with the introduction of conifers in natural hardwood regions in itself, as with the ensuing homogenisation of the forest, the lack of interest in forest treatment, repeated clear-cutting, shortened rotations and artificial forest renewal as a system.

Lemmel relates the increase of the area completely defoliated by caterpillars from an average of 1771 ha a year for the period 1800-1870 to 7,538 ha a year for 1870-1935 with the expansion of the coniferous area and the progressive forest homogenisation in Germany.

In the homogenized coniferous stands of the German Mittelgebirge, wind damage amounted to 62% of total wood production in 1941 and to 72% in 1942 (Heger). Calculations by Weck prove that in the German state forest insect damage in the homogenous conifer-stands reached a level of 20% of total production between 1900 and 1939. Control of growth and growing stock over 180,000 ha of Saxon state forest indicates that, parallel to progressive homogenisation, yearly increment dropped from an over-all average of 6.1 m^3/ha for a growing stock of 189 m^3/ha in the period 1875-1883 to 2.5 m^3/ha for a growing stock of 170 m^3/ha for the period 1924-1929 (Tab. 2).

TABLE 2: Evolution of growing stock and incremen tin the Saxon State Forest (Weck).

Period	*Growing stock* m^3/ha	*Annual increment* m^3/ha	*Increment %*
1800-1830	152	4.7	3.09
1847-1853	177	6.1	3.45
1875-1883	189	6.1	3.23
1904-1913	185	4.6	2.49
1924-1929	170	2.5	1.44

Recent wind and storm damage over thousands of hectares in the Luneburgerheide tends to prove the limited stability of homogenous coniferous stands of artificial origin and the higher degree of resistance of the native hardwood forest.

Analogous phenomena are found all over Europe.

In the Belgian Ardennes a severe hoarfrost in 1938 caused a loss of 10 to 60 m^3/ha in homogenous spruce stands. In 1953 snow damage amounted to 250,000 m^3 in the same area, equivalent to about 13% of total annual wood production in Belgium. It lead to a direct financial loss of 180 million B.F. and important accessory and subsequent losses through stand degradation, drop of increment, insect damage, disturbance of markets, management plans and cutting schemes.

These and other calamities, the quick spreading of forest fires, damage by *Fomes annosus* in homogenous spruce stands, undeniable site degradation and loss of productivity, disrupting of recycling chains following homogenisation and clear-cutting, direct and indirect material losses, the high cost of later conversions, sanitary interventions and reforestations explain a certain degree of scepticism about the uncontrolled use of conifers and the inappripriate extension of even-aged, homogenous stands in Europe. There is apprehension, not directed against the choice of conifers in itself, but against the absence of precautions in their use and the chain reaction the original choice can provoke. Conifers are needed. They can and should be used, but with care, preferably in mixture and exceptionally in homogenous stands.

Restricted use of conifers can lead to a potential restriction of production in the immediate future that is acceptable if it ultimately helps to promote the continuity of forest presence and the realisation of sustained yield.

It further should be realized that many roads to the introduction of conifers and the creation of mixtures exist:

— Planting of conifers in a pioneer vegetation of native hardwoods.
— Simultaneous planting of hardwoods and softwoods in afforestations.
— Conversion of poor hardwood stands, by the introduction of conifers in coppice stands and in forests with coppice and standards.
— Conversion of homogenous conifer-stands by group regeneration or/and underplanting with hardwoods.

The choice of treatment

A broad vision on forest functions and their relative importance influences the concept of forest treatment, as the displacement of functional points of gravity leads to alternative management aims and to modification and adjustment of techniques.

The one-sided orientation of forest management toward mass production, exclusive economic utility and maximal financial profit, nearly always leads to the abolition of silvicultural interventions with no direct financial benefit. A state of mind develops to consider silvicultural interventions, especially thinnings, in the first place as harvesting measures with some kind of an accessory treatment effect only as far as the development of growing stock and the regulation of yield and increment are concerned.

The option for exclusive economic-financial rentability permits far reaching simplification of treatment, often considered as a rationalisation of forestry and silviculture. The rationalisation applies in fact but to the choice of management aims and is therefore only accaptable as far as the aims of management are acceptable and unchanging. Treatment has a broader basis in the polyfunctional forest.

The main objective of silvicultural interventions is here the maintenance of the forest in a state of structural stability and optimal productivity so as to guarantee forest presence, permanent material production and continual rendering of various services. The acceptance of functional versatility implies a less absolutistic approach to forestry. The admission of the relativity of values and the possible shifting of functions in time and space however creates also obligations:

1. Treatment must realise or perpetuate a functional equilibrium that in many cases leads to severe restrictions in the choice of methods and techniques (e.g. no clear-cutting in recreation forests, ecological stability is furthered by mixture and structural complexity, recreation is served by maximal border lines).
2. The plurality of actual and future forest functions and the possibility of their continual shifting, stress the primary importance of ecologically stabilised forests, suitable to alternative utilisation types and fit to absorb, quickly and easily, all modifications in requirements and aspirations.
3. In the polyfunctional forest, economic production is not to be neglected and is not necessarily of secondary importance. It takes a specific aspect and is more directed toward tree quality and the conservation of valuable and eventually slowly growing species.
4. The acceptance of the possible variation of functions makes short-time economic realisations nearly impossible and leads to the almost automatic exclusion of short rotations and the abolition of clear-cutting as a system.
5. More attention is given to permanent production as preferable to temporary maximal production. The stabilisation of value production is realised by making the higher inherent quality of the product compensate for a decrease in volume output.

A new approach to the fundamental aims of silviculture in the industrialised countries of Europe leads to consider wood production more and more as a phenomenon that accompanies forest treatment, but is not its sole nor its main objective.

The choice of regeneration

The question of forest renewal has been passionately debated by generations of foresters in constant argumentation over natural and artificial regeneration. To-day this question has lost part of its reality, because the choice of regeneration method is induced and even dictated to a certain degree by socio-economic conditions and specific management circumstances, that leave silvicultural management no great opportunities for choice. Artificial regeneration is the rule when new sites are taken over by forestry and in the case of homogenous stands of exotics, which can not be retained to full maturity, corresponding with maximal reproductive capability, for biological, economic or technical reasons.

The obligation to make use of artificial regeneration may even be generated by the chosen silvicultural treatment as short rotations, high stand density, homogeneity, low thinnings, restricted treatment intensity are a bad preparation for natural regeneration.

Also illustrating the relationship between the type of forest regeneration and socio-economic conditions, is the fact, that renewed interest in natural regeneration is a direct outcome of labour shortage and the increase of reforestation costs above the level where even a modest degree of direct financial profitability can be expected. This recent evolution, purely socio-economic in origin, gains momentum, because the preference for natural regeneration is well received by ecologically-minded groups and by conservationists, who interpret is as a manifestation of good-will on the part of forestry. These reactions in turn help to improve conditions for better silvicultural management and reinforce the merits of the original choice that brought about this change in mind and mentality. The choice between the two types of regeneration should remain open because of their respective advantages. It should however be kept in mind, that, where the choice can be made freely, it implies a series of options with far-reaching consequences, that illustrate the view of the role of forestry and of the forest in modern society: -

Artificial regeneration

Homogenous, even-aged stands of conifers.
Low intensity of early stand treatment.
Preference for low thinnings.
Short production period.
Functional specialisation and predominance of economic function
Forest replaced by plantation or tree farm.
Principal management aim is the realisation of economic equilibrium.

Natural regeneration

Uneven-aged, mixed stands.
Dominance of autochtonous (native) species and systematic con-

servation of local races, of biological substance and of genetic reserve.

Individualisation of individual tree of stand and treatment at an early stage.

Long and even uninterrupted production periods.

Polyfunctional forest utilisation.

Dominating interest for continuity of multilateral value production.

Principal management aim is the realisation and maintenance of bio-ecological equilibrium.

Even a superficial analysis of the problem proves that the choice of the regeneration method or the purposeful creation of conditions directly leading to one type of regeneration and excluding all others, correspond with fundamental options concerning the destination of the forest and the organisation of its use.

Conclusions

Industrialisation and general prosperity, increasing density and progressive concentration of the population, continual loss of space and growing complexity of social structures provoke fundamental changes in forest utilisation and modify the demands and requirements of human society on forestry. Silviculture as a scientific discipline and as a practical activity must recognise this situation and conceive measures to guarantee permanent and polyvalent utilisation of the forest by a growing number of interested groups and individuals.

To realise its objectives, silvicultural management can fallow different roads that are not always an object of free choice. It can proceed to the systematic establishment of several simultaneous functions on every sub-division of the forest area or try to realise functional zoning or division of available space, assigning to each forest function an area of dominant development related to its actual or future importance.

The choice between these two possibilities is influenced by available forest space and dispersion of the forest. In regions with a permanent lack of space functional zoning is nearly impossible; it is more indicated where great reserves still exist or can be created. Both alternatives do not exclude each other as a matter of principle. They can be realised simultaneously in a restricted number of cases.

Moreover, it is not the choice of alternative which is most important, but the correct evaluation of its consequences. Polyvalent forest utilisation, meaning the simultaneous practice of different and possibly conflicting activities, requires the stabilisation of the forest and its structuring, even if the modification of functions is a phenomen to reckon with. A realistic approach toward functional plurality accepts the possibility of mutual hindrance, because maximal development of a desirable function is not always possible without restriction of other, less important ones.

The multiple-use system creates specific conditions for material production, as it requires the stabilisation of the forest, of yield and of growing stock. The restriction in space of cutting practices furthers early individualisation of treatment and growing interest in stand and tree quality. Multiple-use helps to promote mixture and structural complexity, rejects clear-cutting as a system and directs treatment toward simultaneous care for tree, forest and site.

Functional division of forest space results in the development of specialised forest types, some extreme or exclusive in character.

Zoning is realistic where big reserves of forest and space exist. It allows the development of certain forest functions without limitations of any kind, as in the case of accelerated production of a maximal amount of fibre in the shortest possible possible time in artificial stands of conifers. Functional specialisation furthers simplification of silvicultural management, increases the opportunity for rationalisation and mechanisation and eventually permits reaching maximal financial profitability for a short time. The evaluation of its characteristics, advantages and drawbacks is related to the vision on future development of human society and on the services and goods to be expected from forestry and silviculture.

Strict functional zoning of forest space can have an important impact and seriously jeopardize future:

— It leads to a clear distinction between silviculture and tree growing as separate forms of human activity.
— It implies the eventual creation of different executive branches for the administration of economic forests and for those with a predominantly social, cultural or scientific function.
— It leads to financial losses on an integrated level, because functional exclusively provokes the disappearance of valuable secondary functions to be developed as exclusivities in their own right and at great expense on other sites.

Society imposes permanently growing demands on both wood production and on social forest utilisation.

The care for public well-being is already a co-dominant line of forestry policy in industrialised countries in full evolution toward a post-industrial situation and a society of leisure, dominated by the need for mutual services. The economic function of the forest is well developed or prevails in countries, where the wood industry takes command because of the economic and political force it represents, and also in less-industrialised or non-industrialised countries with a low consumption level, a great reserve of cheap labour and a growing population, considered as a potential market for wood products. The perpetuation of such a dualistic and ambivalent situation on world level can only accentuate existing inequalities for a long time to come.

To soften tensions and to reduce insecurity about the future it is advisable, in each field of human activity, to create diverging situations, allowing alternative future situations to be reached by reinforcing favourable influences and keeping less profitable evolutionary tendencies in control. A secure initial position for sound silvicultural activity and future forest management consists in the creation and the promotion of polyvalent forests, the acceptance of pluralistic management objectives and the rejection of dogmatism and schematic procedure in the organisation of forest utilisation.

A pluralistic concept of silviculture recognises three basic aims, to be reckoned with at every stage of development:

The perpetuation of the forest requiring interventions for protection and conservation that are of direct importance for environmental stability and represent an indirect economic value.

The organisation of social forest utilisation aiming at the production of a direct social value, that is of indirect economic importance and promotes ecological and social stability as well.

The safeguarding of material production at the highest level of sustained yield, both in volume and value, in response to direct economic demands and indirectly serving a social purpose.

The positive evolution of modern society must be favoured and in conditioned by an equilibrium between prosperity and well-being, a just distribution of power and wealth, the acceptance, the promotion and the harmonisation of a broad variety of human ambitions and aspirations.

Each field of human activity must collaborate to produce generalised prosperity and well-being. This is also the case for forest management and silvicultural practice as protectors and administrators of an extremely rich and constantly renewable natural resource.

To enjoy this valuable good in an optimal way, to maximize its beneficient effects to present society, to assure its polyvalent utilisation by future generations is a mission, a moral obligation and a big challenge that no forester can refuse to accept.

A Visit to the Giant Sequoias

By B. J. Collins[1]

Introduction

Recently I had the pleasant and rewarding experience of visiting Sequoia National Park in California to see at first hand and in their national habitat the wonder and splendour of the Giant Sequoias (*Sequoiadendron giganteum*) or better known in these islands as the Wellingtonias. The park is situated in central California on the western slopes of the Sierra Nevada mountains and covers 156,000 ha (386,000 acres). It is a vast region of forest, mountain, canyons, rivers, lakes and meadows. It is administered by the National Park Services of the Department of the Interior of the U.S.A. The principal reason for establishing it in 1890 was to preserve the Giant Sequoias which were subjected to heavy exploitation during the period 1862 to 1900. Two factors saved the giant trees which survive here to-day, firstly, their inaccessibility at that time and secondly, their vast size which presented logging difficulties over rough terrain.

Picturesque Setting

The park is approached from the south through fertile country. Due to its low rainfall this area is irrigated by water from the Sierra Nevadas and consequently extensive vineyards, orange groves and cherry orchards are quite common. The scene gradually changes to grassy hills studded with oaks. Beyond the confluence of three rivers is a large deer reserve where a little party of mule deer browsed contendly as if conscious of their protection. At the entrance to the park the wooden carving of the head of an Indian Chieftain reminds one of the origin of the name "Sequoia". To the right lies the Kaweah river in a deep canyon which carries a dense thicket of broadleaf scrub while across and above loom the bare and barren Sierra Nevada mountains rising 4,420 m (14,500 ft.) and which were snowcapped at the time. On the left are limestone cliffs from which the roadway was hewn. This roadway is known as the General's Highway and winds for 46 miles through the Sequoia belt.

1. Forest and Wildlife Service, Portlaoise, Co. Laois.

Giant Forest Grove

After passing a camping and picnicing area the hard climbing begins, turning and twisting over the next five to six miles and rising to an elevation of 1500 m (5,000 ft.) before getting the first glimpse of the "Big Trees".

Here you meet Giant Forest Grove which is one of sixteen Sequoia groves within the park. It lies astride the highway and extends over 1,000 ha (2,400 acres) and is at an elevation of between 1,500 and 2,000 m (5,000-7,000 ft). It is considered the largest and finest forest of giant Sequoias in the world. As the highway goes through the grove, visitors are afforded a magnificent view of the trees even while driving. First impression of the trees is one of awesome wonder, even disbelief of their size and grandeur. Their towering majesty is difficult to comprehend, and the Douglas firs which are growing in association with them, though large by Irish standards (25-27 m high, 50-60 cm dbh) are mere dwarfs in comparison. The beautiful red-brown bark which may be over 30 cm thick on the older trees is fluted in long vertical plates which gives the tree a columnar appearance. They seem to show very little taper from above the large buttresses to the first branches which may be 30 m or more above ground. Indeed it is little wonder that some confusion arose when their size was reported by the "Forty-niners" who came across this mountain range, when it was thought that inches were meant instead of feet. Three years later, however, in 1852 when miner A. T. Dowd reported on the stupendous trees in Calaveras Grove botanists and plant-collectors pursued his findings.[2]

Composition of the Grove

Within the grove the Sequoias are more closely spaced and the deep shade cast by them excludes their earlier associates of Douglas fir, sugar pine and white fir (*Abies concolor*) and suppresses natural regeneration which may occur. One circular group of four trees stood virtually adjacent to each other. It is surely amazing that such massive trees had lived so harmoniously as near neighbours for up to 3,000 years.

A notable feature is the big number of trees bearing fire scars which vary from basal burns to longitudinal streaks for 15 or 20 m up the trunks and which reach deep into the heartwood in some cases. Most of the larger scars are at the base and frequently on opposing faces of two trees standing close together, presumably, the deep forest litter and reflected heat from one to the other sustained the fire. Despite the destruction of large areas of the Cambium layer and resultant retardation, the trees exhibit extraordinary recuperative powers because the scars are slowly closing over.

Stability of Trees

While the trees have withstood gales and storms over the centuries those that have succumbed may have been weakened by either fire, soil erosion or waterlogging. Mitchell has shown how wind firm the tree is in these islands insofar as it has never been known to blow down.[3] Over the years it is inevitable that changes occur in the local physiographic conditions. Streams from melting snows may gradually erode the supporting soil with the result that the trees fall or lean. This can create a dam which can cause waterlogging up-stream, thus leaving the trees vulnerable to windthrow. For some unknown reason but probably due to internal stresses large trees fall with a great roar on still days during late summer or in winter.[1]

Fallen trees, some of which have lain for centuries, illustrate the disease resistance of the trees. The good condition of the logs testifies to the ability of the species to resist both fungal decay and insect attack. Sequoiadendion wood is durable with a high tannin content.

Root System

The Giant Sequoia tree has a relatively small root system in proportion to its trunk size. It has no permanent tap root but a closely matted adventitious root system which lies close to the soil surface. Single roots are known to grow 60 to 90 m towards a water supply.[1] On fallen trees the roots appear to break off close to the base of the tree.

General Sherman

Mid-way in the grove and a short distance from the road stands the well known General Sherman tree, which is the largest (though not the tallest) and perhaps the oldest living thing. Some vital statistics of both this tree and the General Grant tree (second largest) which occurs in the adjoining Kings Canyon National Park convey some idea of their size. (Table 1).

A ring count on felled neighbouring trees estimates the age of the Sherman to be 4,000 years.[2] The enormous size of the tree

TABLE 1

Name of tree	Height	Basal	Mean diameter in ft. at 60 ft.	at 120 ft.	Volume Hoppus ft.
Sherman General	272 ft. (83m)	30.7	17.5	17.0	40,000 (1,444 m^3)
Grant General	267 ft. (82m)	33.3	16.3	15.0	34,500 (1,242 m^3)

is illustrated by a branch which arises from the trunk at 130 ft. above ground, having a diameter of 6.75 ft. and growing upwards for 150 ft. It is larger than most Irish trees yet it is an inconspicuous part of the tree. Some die-back of the crown is evident in both the Sherman tree and some of the older trees. It is suggested that a number of factors may give rise to this phenomenon e.g. fire damage, lightning, lack of water or nutrients, increased root competition or the inability of the older roots to function normally.

Dimensions of other notable trees also to be found within this grove are given in Table 2.

TABLE 2

Name of tree	*Height*	*Basal Diameter*
The Lincoln	78.9 m (259 ft.)	9.4 m (31 ft.)
The President	76.2 m (250 ft.)	8.8 m (29 ft.)
The McKinley	88.7 m (291 ft.)	8.5 m (28 ft.)

Animal Ecology and Forest Management

As a result of the strict protective policy applied by management over the years, some problems have arisen. With the elimination of the grizzly bear and the suppression of the cougar or mountain lion there has been a build up of mule deer. They have caused the depletion in some areas of some plants such as the snowbush and bitter cherry. Extermination of the rattle-snake has in turn increased the ground squirrel population. Control of forest fires has brought about the accumulation of deep forest litter which is hindering the regeneration of the Sequoias while, outside the grove, dense impenetrable thickets of pines, fir and incense cedar have been established. It is against this background that ecologists and managers are researching with the aim of finding the corrective measures to apply.

Facilities in the Park

The park offers hundreds of miles of trails, including self-guided nature trails, to the visitor. There are log-cabins, lodges and motel type rooms available for renting. Areas are designated for camping. There are food stores and rental equipment is available for ski-ing, pony trekking and fishing. Guided walks and campfire programmes are conducted during the summer months. Ranger stations are located at strategic points throughout the park.

Departure

As the road climbs and winds its way to almost 2,500 m (8,000 ft.) O.D. before turning west for the great expanse of the rich San Joaquin Valley below, there is a great sense of peace and tranquility. With snow to a depth of 60 cm in the forest, the panorama was reminiscent of Christmas card scenes. The Sequoias, Douglas-fir and White fir give way to interior type sugar pine (*Pinus lambertiana*), pondorosa pine, dogwood, alder and willow. Lower down small groves of Sequoias were passed and to the right lies Kings Canyon National Park which is famous for mountain wilderness, deep canyons and cedar groves, finally departing through Big Stump grove which has a remnant of one of the largest trees ever felled. With such abiding memories of these mammoth trees, it is easy to understand why they are one of the seven wonders of the modern world.

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2. Edlin, H. L. Quarterly Journal of Forestry. Vol. LX, No. 2.
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The Influence of Fertilisers upon Microbial Activity in Peat

II. CALCIUM AND NITROGEN[1]

J. J. GARDINER[2]

Introduction

A LARGE proportion of some of the nutrients, especially nitrogen and phosphorus in certain peat types are unavailable to most crops. Peats are also characterised by having a low pH (Gorham, 1953), a high moisture content (Burke, 1967), a high carbon to nitrogen ratio and a relatively inert microbial population (Dickinson and Dooley, 1967). These features cause or lead to an extremely slow peat to plant nutrient cycling system.

The object of the present studies was to determine whether calcium and nitrogen had an effect on the microbial population in peat and, if so, whether this would increase the rate of peat decomposition and nutrient recycling.

Experimental Details

The peat used and the experimental methods were as previously outlined (Gardiner and Geoghegan, 1975). Calcium carbonate ($CaCO_3$) was added to the peat at rates equivalent to, 0 (Ca_0), 1500 (Ca_1), 3000 (Ca_2), 6000 (Ca_3), 7500 (Ca_4) and 10,000 (Ca_5) kilograms per hectare. After mixing with the $CaCO_3$ the peat was stored in jars in the laboratory and microbial activity was examined at intervals over an 80 day incubation period.

Results

1. *Effects of $CaCO_3$ addition on Peat Characteristics*

(a) Peat pH

The effect of added $CaCO_3$ on the acidity of the peat is shown in Table 1.

At all levels of added $CaCO_3$ the pH of the peat samples increased steadily over the first 4 weeks of incubation, but in most cases it dropped slightly thereafter. The highest pH of 7.50 was recorded

1. Part I: *Superphosphate and Ground Mineral Phosphate,* by J. J. Gardiner and M. J. Geoghegan, was published in *Irish Forestry,* Vol. 32, No. 1 (1975), pp. 50-59.
2. Forestry Department, University College, Dublin.

TABLE 1

THE INFLUENCE OF $CaCO_3$ APPLIED AT VARIOUS RATES UPON THE pH (H_2O) OF CUT-OVER PEAT

Treatment	Days after Incubation							Mean
	1	7	14	28	39	52	70	
Ca_0	4.40	4.35	4.35	4.40	4.40	4.35	4.35	4.37
Ca_1	4.45	4.55	4.55	4.55	4.50	4.47	4.47	4.50
Ca_2	4.65	5.20	5.55	5.50	5.25	5.35	5.20	5.24
Ca_3	5.50	5.75	5.90	5.85	5.65	5.60	5.55	5.68
Ca_4	5.90	6.50	6.75	6.75	6.45	6.35	6.30	6.43
Ca_5	6.45	6.95	7.25	7.50	7.40	7.25	7.15	7.13
Mean	5.22	5.55	5.72	5.75	5.60	5.56	5.50	

L.S.D. (5%)=0.087

on the 28th day of incubation in the highest $CaCO_3$ treatment. After 70 days pH ranged from 4.35 in the untreated peat to 7.15 in the highest treatment.

(b) Concentration of NH_4–N

As shown in Figure 1 the addition of $CaCO_3$ to the peat led to a

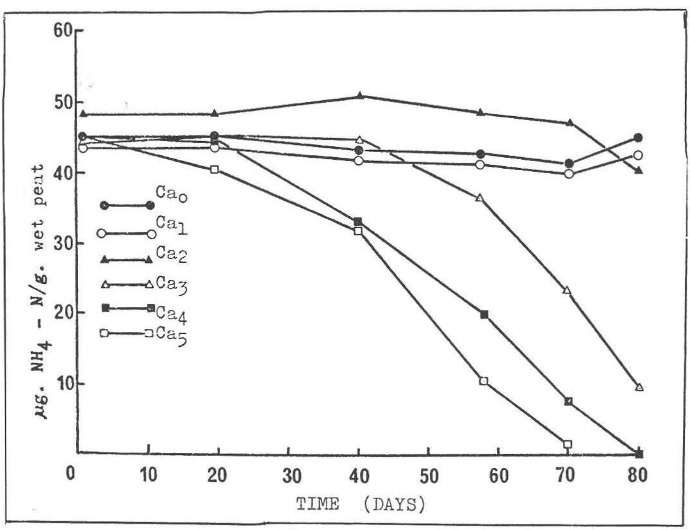

Figure 1
Amounts of NH_4–N in cut-over peat treated with various levels of $CaCO_3$.

decrease in the amount of NH_4–N in the peat at the three higher levels of application.

At the two highest rates of $CaCO_3$ addition the measured quantities of NH_4–N had reached zero by the 70th and 80th days after incubation compared with 45 microgram per gram wet peat in the untreated peat. However, at the three lower levels there was relatively no change in the concentration of NH_4–N over the period.

(c) Nitrification of NH_4–N

Figure 2 illustrates that nitrification of NH_4–N became evident in some of the treated peat samples after approximately 40 days. This would account for some of the loss of NH_4–N in Figure 1.

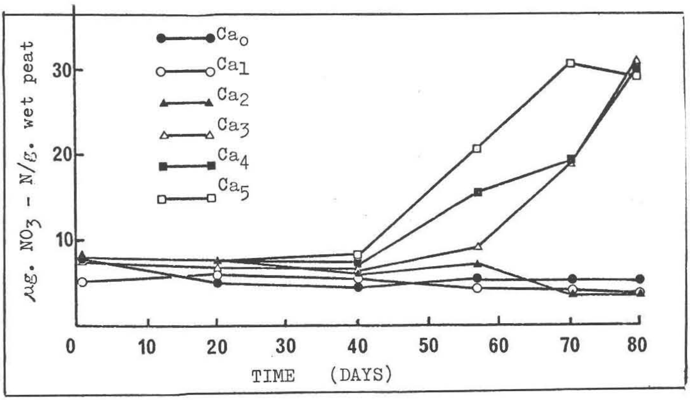

Figure 2

The effect of $CaCO_3$ on nitrification of native NH_4–N in peat.

(d) Total Mineral Nitrogen

A net decrease in total mineral nitrogen was apparent in most of the treated samples at the end of the incubation period. Table 2 shows that, while the total nitrogen concentration in the untreated peat was the same at the beginning and end of incubation, at the highest rate of $CaCO_3$ added, it had decreased from 52 to 29 microgram per g;am wet peat over the same period. This decrease was statistically significant at the three higher levels of $CaCO_3$ application.

(e) Bacterial and Fungal Population

Total bacteria were counted after 80 days incubation. Substantial increases were found in bacterial numbers but no such increases

TABLE 2

THE EFFECT OF $CaCO_3$ ON THE TOTAL K_2SO_4—EXTRACTABLE—NITROGEN IN PEAT. (NH_4-N+NO_3-N MICROGRAM PER GRAM WET PEAT)

Treatment	Time (Days) 1	20	40	57	70	80	
Cao	51	50	49	50	49	51	50.00
Ca_1	49	51	48	47	45	46	47.70
Ca_2	55	55	56	54	51	45	52.60
Ca_3	53	52	53	44	44	39	47.50
Ca_4	52	52	40	37	35	30	41.00
Ca_5	52	47	37	31	30	29	37.70
Mean	52.00	51.17	47.17	43.83	42.30	40.00	

L.S.D. (5%)=2.42

could be demonstrated in fungal numbers as is shown in Figure 3. The Ca_3, Ca_4 and Ca_5 treated peat samples had a significantly higher population of bacteria than the control peat.

Table 3 shows that nitrifying organisms were not present at detectable concentrations in untreated, cut-over peat or in the Ca_1

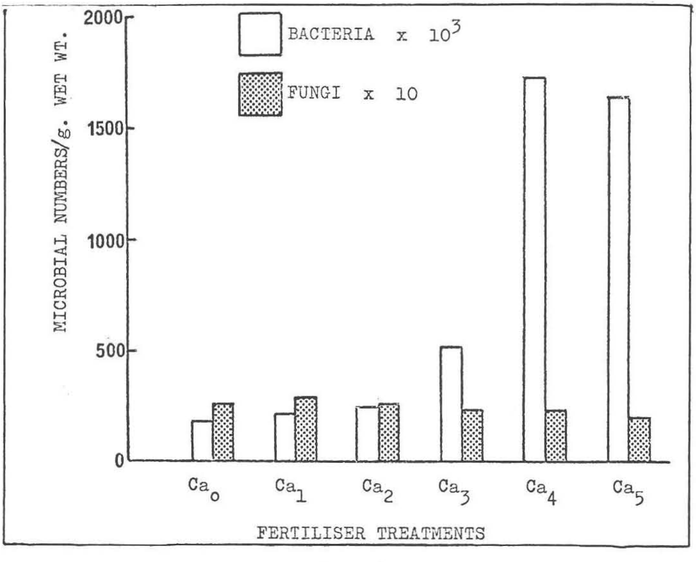

Figure 3
The influence of $CaCO_3$ upon microbial numbers in cut-over peat.

TABLE 3

THE M.P.N. OF *NITROSOMONAS* AND *NITROBACTER* (PER g. WET WEIGHT) PRESENT IN CUT-OVER PEAT 80 DAYS AFTER ADDITION OF $CaCO_3$ TO THE PEAT AT VARIOUS LEVELS

Treatment	Nitrosomonas spp.	95% Confidence Limits		Nitrobacter spp.	95% Confidence Limits	
		Upper	Lower		Upper	Lower
Ca_0	0	—	—	0	—	—
Ca_1	0	—	—	0	—	—
Ca_2	0	—	—	0	—	—
Ca_3	0	—	—	45	149	14
Ca_4	230	759	70	1300	4290	394
Ca_5	230	759	70	1300	4290	394

The factor for the 95% confidence limits is 3.3 (Cochran, 1950).

or Ca_2 treated peat samples. However, their presence in the other peat samples could be shown by the "Most Probable Numbers" method. (Cochran 1950) Nitrogen fixation by non-symbiotic nitrogen fixing micro-organisms could not be demonstrated under aerobic or anaerobicconditions.

(f) Rate of Oxygen Uptake

The rate of oxygen uptake by the peat samples was in all cases highest at the beginning of the experiment and as can be seen from Figure 4 the peat which had received the highest $CaCO_3$ application had the greatest rate of oxygen uptake at all times of testing.

Statistical analyses showed that there were significant differences between all of the peat samples in respect of rate of oxygen uptake at all times of testing. This indicates that microbial activity in peat is enhanced by even small additions of $CaCO_3$. Although some of

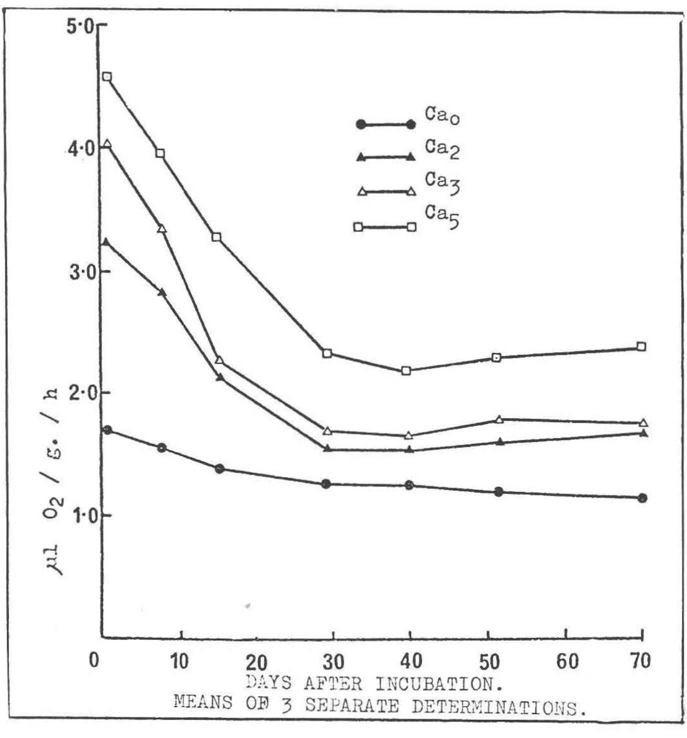

Figure 4
The effect of $CaCO_3$ on the rate of oxygen uptake by peat.

this oxygen may be used initially for non-biological reactions, Jackman (1960) has shown that carbon becomes more available when the peat pH is raised and Hu *et al* (1968) have found a good correlation in forest soils between the rate of soil respiration and the amount of water soluble carbon present.

In summary, these experiments show that the addition of $CaCO_3$ to peat leads to:

1. A decrease in the concentrations of NH_4–N and total mineral nitrogen in the peat.
2. An increase in the bacterial flora of the peat, but no corresponding increase in fungal numbers.
3. An increase in the rate of oxygen uptake by the peat.

These results indicate an increase in the rate of assimilation of carbon and nitrogen from the peat. However, it should be noted that this increase in the rate of decomposition of the peat has led to a net assimilation of available nitrogen.

2. *Effects of $CaCO_3$ and Mineral Nitrogen on Peat Characteristics*

In a second series of experiments ammonium sulphate $(NH_4)_2SO_4$ was applied to peat in combination with $CaCO_3$. The rates of

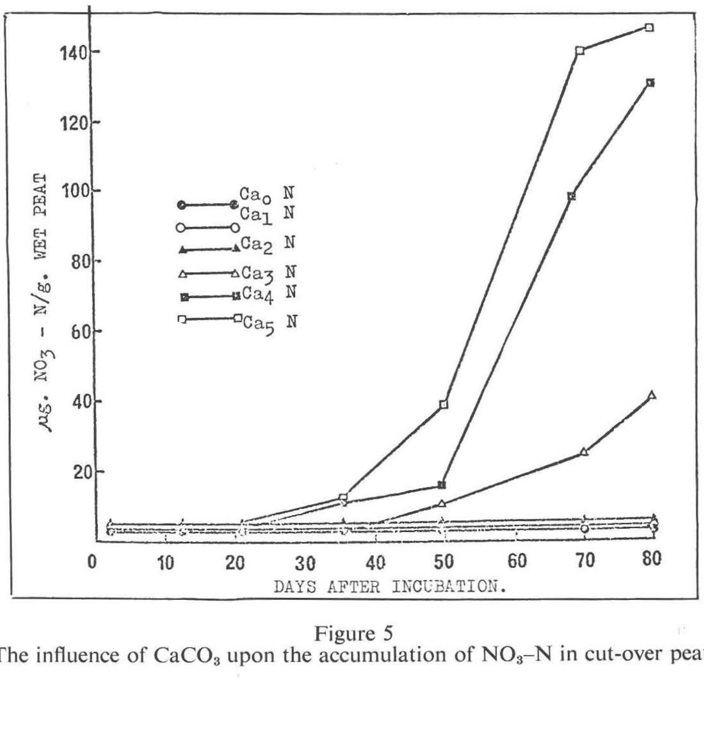

Figure 5
The influence of $CaCO_3$ upon the accumulation of NO_3–N in cut-over peat.

application of lime were as used in the previous experiment and nitrogen was applied at a rate of 200 micrograms per gram wet peat in each case. This is approximately equivalent to 730 kilograms of sulphate of ammonia per hectare.

3. *Effect of Calcium plus Nitrogen on Peat Characteristics*

(a) Peat pH

The pH of these peat samples followed much the same pattern as observed in the previous experiment, but the final pH levels were lower. This lowering of the pH was probably due to the more inten e nitrification of NH_4–N found in these samples.

(b) Concentrations of NH_4–N and NO_3–N

The variations in NH_4–N concentration and NO_3–N accumulation were similar to those already observed. As shown in Figure 5 there was little or no oxidation of NH_4–N prior to the 35th day of incubation but thereafter values for NO_3–N were much higher than where only $CaCO_3$ was added.

(c) Total Mineral Nitrogen

Again a decrease was observed in the total mineral nitrogen content of the incubated peat samples (Table 4). These losses of mineral nitrogen were in most cases significant at the 5% level.

TABLE 4

THE EFFECT OF $CaCO_3$ UPTON TOTAL K_2 SO_4—AVAILA'LE NITROGEN (NATIVE+ADDED) IN PEAT. (MICROGRAMS PER GRAM WET PEAT

Peat Treatment	Time (Days)							Mean
	1	14	21	35	49	69	80	
Ca_0 N	246	246	240	241	233	237	232	239.3
Ca_1 N	254	234	212	216	201	195	200	216.0
Ca_2 N	251	232	227	199	177	182	162	204.3
Ca_3 N	249	223	196	190	184	188	172	200.3
Ca_4 N	250	224	202	186	165	144	138	187.0
Ca_5 N	258	202	162	157	144	145	149	173.9
Mean	251.3	226.8	206.5	198.2	184.0	181.8	175.5	

L.S.D. (5%)=8.09

(d) Bacterial and Fungal Population

The decreases in mineral nitrogen were accompanied by large increases in the bacterial population as shown in Figure 6. However,

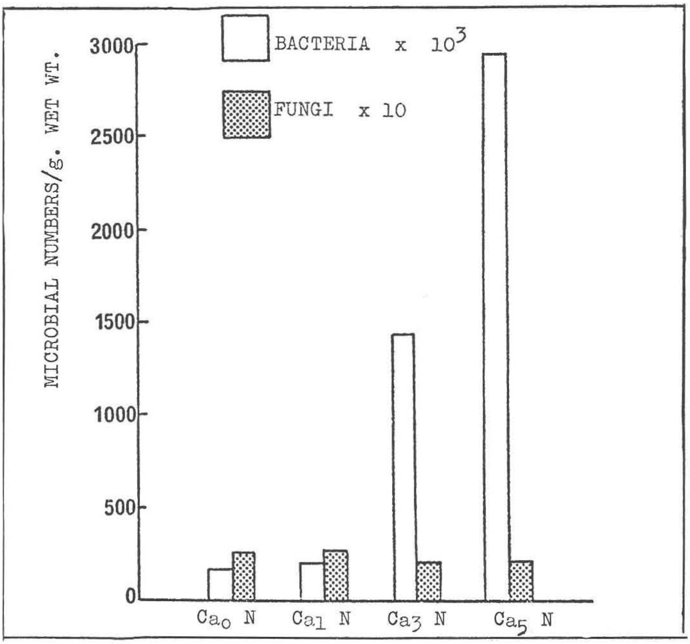

Figure 6
The influence of $CaCO_3$ plus added nitrogen upon microbial numbers in cut-over peat 80 days after treatment.

no statistically significant multiplication by the fungal flora could be shown. Table 5 shows that the concentrations of nitrifying organisms was very similar to that observed in the previous experiment. From these two experiments (Tables 3 and 5) it appears that *Nitrobacter* spp. are always more abundant in peat than *Nitrosomonas* spp.

This may account for the fact that nitrite nitrogen (NO_2–N) did not accumulate in any of the limed peat samples. The presence of active nitrogen fixing organisms could not be demonstrated by the Acetylene reduction technique.

(e) The Rate of Oxygen Uptake

The pattern of oxygen uptake by the treated peat samples as shown in Figure 7 was very similar to that already shown for the $CaCO_3$ treated peat. Statistical analysis of the results showed that the addition of nitrogen alone (i.e. the Ca_0 N treated sample) significantly depressed the rate of oxygen uptake from the 40th day of incubation to the termination of the experiment.

TABLE 5

THE EFFECT OF $CaCO_3$ PLUS ADDED NITROGEN UPON THE M.P.N. (PER g. WET WEIGHT) OF *NITROSOMONAS* AND *NITROBACTER* IN CUT-OVER PEAT 80 DAYS AFTER TREATMENT

Treatment	Nitrosomonas M.P.N.	95% Confidence Limits		Nitrobacter M.P.N.	95% Confidence Limits	
		Upper	Lower		Upper	Lower
Ca_0 N	0	—	—	0	—	—
Ca_1 N	0	—	—	0	—	—
Ca_2 N	0	—	—	0	—	—
Ca_3 N	40	12	132	78	23	257
Ca_4 N	1100	333	3630	3500	1061	11550
Ca_5 N	2800	848	9240	4300	1303	14190

The factor for the 95% confidence limits is 3.3 (Cochran, 1950).

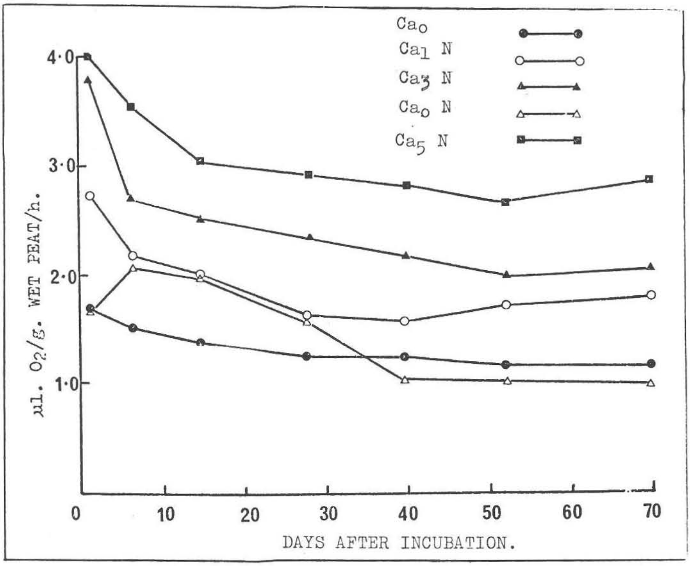

Figure 7
The influence of $CaCO_3$ plus nitrogen upon the rate of oxygen uptake by cut-over peat.

Comparisons also showed that the rate of oxygen uptake by the samples treated with lime plus nitrogen was significantly greater than that of the corresponding lime treatment, i.e. O_2 uptake by the Ca_3–N treated peat was greater than that of the Ca_3 treated peat and Ca_4 N > Ca_4, Ca_5 N > Ca_5.

These experiments again showed a stimulation of the microflora of peat following the addition of lime plus nitrogen to the peat. This stimulation resulted in the assimilation of mineral nitrogen from the peat.

However, this increased activity of microbial population took place only following liming of the peat. Fertilising of the peat with nitrogen alone, in the form of ammonium sulphate, significantly depressed the rate of oxygen uptake. It is doubtful if this depressed rate of activity was due to pH, since the difference in pH between the untreated and the nitrogen treated peat samples was very slight.

Discussion

It has frequently been proposed that the liming of organic residues, such as peat, would result in the release of mineral nitrogen (Kaila *et al,* 1953). This may apply to materials rich in available nitrogen (Waksman, 1929) but it appears from these studies that, an expanding microbial population must, initially at least, assimilate any mineral nitrogen available. This also seems to apply in field experiments. Dickson (1972) has reported that the addition of lime at planting to a Sitka spruce crop growing on peat resulted in a depression of leader growth and a decrease in nitrogen uptake by the trees lasting at least six years. It would, therefore, seem that tree roots cannot compete with an expanding microbial population for available nitrogen. Adams and Cornforth (1972) have also shown that the liming of Sitka spruce litter resulted in a decrease in nitrogen uptake by the crop. They conclude: "It is probable that the initial effect of lime in the field is to increase the rate of litter breakdown, cause assimilation of mineral nitrogen and decrease the uptake of nitrogen by the trees." Williams (1972) also found that lime in the absence of fertiliser nitrogen markedly stimulated the level of microbial activity and yet depressed the net production of mineral nitrogen. His experiments were carried out on pine humus.

Thus, results presented here, which are in accord with those of other laboratory and field trials, show that liming effectively promotes breakdown of peat and other acidic organic residues with a wide C : N ratio.

Nevertheless, it appears that the addition of lime to peat does not, in the short term, promote the rapid cycling of nutrients, particularly nitrogen, to trees growing on the peat. Nutrients become available to tree crops only after the needs of the microbial population are satisfied. These studies also indicate that, despite the provision adequate phosphorus and potassium, tree growth on peats may become limited by deficiency of available nitrogen, because phosphorus does not appear to stimulate microbial decomposition of the peat (Gardiner and Geoghegan, 1975). However, data available from laboratory and field experiments lead to the belief that if the acidity of peat is reduced by liming, and the initial nutrient requirements of the microbial population satisfied, then peat soils can be converted into productive forest soils, with regular recycling of nutrients to the tree crops.

In the absence of research data, one can only guess how long this conversion process will take or what fertiliser imputs will be necessary to promote this development. However, Dickson (1973) has reported that lime applied to peat in 1958, without addition of nitrogen, was beginning to influence uptake of nitrogen by Sitka spruce trees in 1972. With nitrogen addition this 15 year waiting period would surely have been shorter. In addition, O'Toole (1971) has shown that we can expect considerable release of nitrogen from cut-over peat after a period of cropping varying from 2–3 years on newly exposed fen peats, to a considerably longer period on

TABLE 7

FERTILISER USE/ACRE AT LULLYMORE

(Ref.: Lullymore; A Guide to Experiments, 1970)

Type of Bay	LIME (Ground Limestone)	PHOSPHORUS (Superphosphate)	POTASSIUM (Muriate of Potash)	NITROGEN (Calcium Ammonium) Nitrate 23% N.
New	2–10 tons†	15 cwts.	8 cwts.	6–20 cwts.*
2nd Year	—	8 cwts.	6 cwts.	2–20 cwts.*
"Old" Bays ... (maintenance rates)	—	4–8 cwts.*	3–6 cwts.*	2–20 cwts.*

†Based on pH determination.
*Varies according to the nutrient requirements of the crop.

Sphagnum peats. Three years after reclamation the latter investigator obtained a yield of 17 tons of onions per acre without addition of mineral nitrogen. The fact that this crop did not respond to dressings of mineral nitrogen indicates that its total nitrogen requirements were supplied by the peat. However, the fertiliser imputs necessary to bring about this enhanced nitrogen supply were extremely heavy by forestry standards (Table 7).

The results outlined show that addition of lime with or without nitrogen to samples of cut-over peat incubated in the laboratory brings about changes in some chemical and biological properties of the peat samples. If these changes occurred under field conditions they might result in rapid recycling of nutrients in coniferous forest ecosystems, especially those developed on peat.

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Notes on Afforestation of Open-cast Mining Site at Rossmore Forest (Co. Carlow)

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AN area of 9.5 ha of an open-cast coal mining site at Slatt (near Crettyard, Castlecomer) was recently acquired. In view of probable increase in the development of such sites for forestry purposes an investigation into the difficulties and problems of afforestation thereon was deemed desirable.

A joint Management/Research project was initiated in June 1973, following which the area was planted in the spring of 1974. The following is the brief account of the undertaking.

Description of Site

The area forms part of the Castlecomer Plateau which is characterised by heavy gley soils derived from upper Carboniferous shales. Peat accumulation which is often associated with the type was not present. Elevation of the site is 700′. Exposure is moderate. Aspect N.E. to E but not pronounced.

When first inspected the area consisted of a shattered shaley rock distributed after mining in an irregular "hill & dale" pattern carrying virtually no vegetation. The former top-soil was accumulated towards one end (to the north) and also along the eastern edge. The site had been lying undisturbed for 2 or 3 years and only occasional patches of coltsfoot had become established.

It was decided to cultivate the area by ripper and modify the worst of the hill & dale effect by cut and fill with dozer blade. A D7 machine was used and was most effective in obtaining a deep rupturing of what had become a very compacted medium. The power available was invaluable in effecting modification of the hill and dale because of the amount of earth-moving involved.

Preliminary pH readings were taken and these showed a wide variation. Two from the general area gave values of 3.4 and 3.7. One from the top-soil area gave a value of 7.0 and another from a coltsfoot patch gave 7.8.

These results indicated the need for a more intensive survey of pH values. This was done on a 50m × 50m grid. Sampling points and pH values were mapped.

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2. Research Branch, Forest and Wildlife Service, Bray.

On the basis of this survey it was possible to divide the area into two site-types. Site A consisted of topsoil of medium to high pH. Site B consisted of acid to very acid broken shale rock.

The former was treated with an application of superphosphate at 12.5 cwt. per ha (5 cwt per acre) (experimental work at Glanamoy indicated that higher levels of P as superhphosphate were not effective).

The latter site B was treated with 12.5 cwt per ha of rock phosphate. Both were applied broadcast, before planting by manure distributor mounted on wheeled tractor. Potassium fertiliser was not considered necessary at this stage.

Selection of Species

Site A was planted with *Abies grandis*. Experience at Clonsast had shown that this species can root in soil material of very high pH and there is no species of comparable productivity can do this.

Because of the nature of the soil in site B, mainly its complete lack of organic matter, it was thought that only two species, coastal lodgepole pine (*Pinus contorta*) and alder (*Alnus glutinosa*) would have any real chance of establishment. The major proportion of the area was planted with these two species.

Because of the possibility that the lodgepole pine would suffer from early damage from windsway in the stony scil, this was planted on the eastern portion where elevation was somewhat lower and shelter a little better, with the alder in the more exposed western part.

Other species which might be deemed as having some potential for success on these sites were Japanese larch and Sycamore. Trial plots of .2 ha ($\frac{1}{2}$ ac) each were tried with these species.

As a feature of interest it was also decided to try small plots of Sitka spruce and Douglas fir (approx. 0.1 ha) on a part of site B where the soil appears to contain more fine material than elsewhere.

Progress Report (*after one growing season*)

Following inspection at the start of the second growing season the following is a brief report on the results of the project to date.

The area is general still appears virtually vegetation free. Closer examination however reveals the presence of a number of grasses (mainly *Agrostis tenuis*) in the area treated with superphosphate. Patches of clover are frequent.

In the high pH area where *Abies grandis* was the major species, survival rate of the species had been satisfactory. Appearance and vigour however is not encouraging. The plants are very yellow and rather sickly looking especially in the more shaly areas.

Lodgepole pine on the high pH area had a somewhat lower survival rate but the plants are healthy and while not yet showing the vigour associated with the species, promises to do well. Beating up of first season failures has taken place.

On the lower pH site alder had done well. Survival rate is high and the plants are vigorous and healthy. Lodgepole pine on this site has also done well. Survival rate is satisfactory and plants are again vigorous and healthy. Japanese larch has given equally promising results. Survival rate is good and the plants have a good appearance and look happy.

Both Douglas fir and Sitka spruce have not performed very well. Survival rates are low and plants look sickly and debilitated.

The other species of a particular interest on this site is sycamore. Survival rate is satisfactory. Flushing is not yet complete but plants are healthy looking, but as yet not displaying any significant degree of vigour after one growing season.

Progress Report (*end of second growing season*)

The following account was written following inspection in April 1975. This further paragraph was added following further inspection in October 1975.

The invasion of the site with grassy vegetation has proceeded steadily.

It will be recalled that the driest summer recorded for 30 years has ensued in the interim. The drought conditions which prevailed as a result would constitute a very severe test for growth in the conditions of friable rocky soil with sparse vegetation which obtained at Slatt.

In the event remarks relative to performance as recorded above are still valid with one perhaps notable exception. Great hopes had been placed in the potential of sycamore for such sites. The performance as recorded above reflects a mood of guarded optimism. Such optimism proved to be deceptive. The sycamore has virtually been wiped out during the current growing season. Whether this is due to the inherent soil conditions or due to the unusually dry conditions of the season is an issue which will only be resolved by further trials.

Further observations will be necessary in respect of all species before reliable conclusions can be reached.

Fomes Annosus—A Forest Pathogen[1]

DIARMUID T. MCAREE[2]

Summary

Fomes annosus (Fries) Cooke is a pathogenic fungus that decays roots and heartwood of living trees. The fungus is one of the most destructive of all the parasites encountered in coniferous plantations. Its distribution is widespread. Modern silvicultural practices have enhanced its spread and development.

The pathogen has a life cycle typical of most wood-inhabiting Hymenomycetes. Inoculation occurs when basidiospores of the fungus come in contact with freshly cut stump surfaces or other wounds. If environmental conditions are favourable, such as temperature and relative humidity, germination penetration and colonisation occurs and eventually the sexual stage, a perennial basidiocarp, develops on the stump or root surface. Basidiospores released from these fructifications are disseminated by wind and are eventually deposited by impaction or gravity. The disease cycle may be renewed by viable spores which alight on a suitable substrate, such as an exposed stump. Secondary disease cycles have not been studied in great detail but it has been shown that the conidial state, *Oedocephalum lineatum* Bakshi, is also capable of stump infection.

Disease losses occur as the fungus grows, via root contacts from colonised stumps to living trees, where it causes a root and butt decay. The merchantable volume of timber, therefore, is greatly reduced and the infected trees are liable to be wind-blown. An intensive research programme has been initiated to study the complexity and diversity of this ubiquitous pathogen. Chemical treatment of stumps has been the chief method of control used although biological control by stump inoculation with antagonistic micro-organisms has also been suggested. However, as with many diseases of forest trees, there is need for an economically feasible silvicultural control.

Name and Classification

Fomes annosus (Fries) Cooke is the fungus that causes a root and butt-rot of conifers throughout the temperate regions of the world.

1. This literature review was prepared in early 1973 while the author was a post graduate student at the University of Florida, U.S.A. Many of the references are of American origin but the general principles apply universally.
2. Research Branch, Forest and Wildlife Service, Bray.

It is a facultative parasite. In Europe, the disease is commonly called Conifer Heart Rot. Because of its ability to decay lignin material, it is classified as a white rot fungus. Other synonyms used are Annosus root rot, Fomes decay and Fomes heartrot.

Susceptible Plants

Probably all conifers and most dicotyledonous trees are in varying degree subject to infection (7). Koenigs (27) records that spruce, larch, cedar and hemlock are the most susceptible genera. Since 1960, in the U.S., the pathogen has been found associated with most species of pine, spruce, larch, fir, Douglas fir, hemlock, juniper, cedar, elm, ash, Rhododendron and mountain laurel (11, 12, 36). Moderately resistant pines are the red, Virginia and longleaf species. The most susceptible pines are shortleaf, loblolly and eastern white pine (34). In European forests both Norway spruce and European larch are highly suceptible species (7). Trees are predisposed to infection by drought, by insect defoliation, by thinning or by any other adverse climatic, edaphic or biotic factor (13). Though infection can occur on healthy vigorously growing trees, colonisation usually does not take place except when such trees are wounded during their dormant season. Antagonistic fungi such as *Trichoderma viride* and *Peniophora gigantea* can more readily colonise these trees and exclude *Fomes annosus* (8).

F. annosus more easily colonises suppressed and weakened trees. It has been suggested by several authors (9, 10, 29, 33) that these trees prove more susceptible because of their lower resin content. Large reserves of carbohydrates in the root are conducive to rapid colonisation by the fungus (34). Suppressed tree roots are rich in carbohydrate reserves and are more amenable to infection (30). A major site factor affecting susceptibility of trees to infection is the afforestation of arable soils. These sites are normally calcium enriched with a pH value greater than 5.0. It is agreed that such sites increase the susceptibility of trees to infection by *Fomes annosus* (5, 13, 17, 18, 20, 32, 48). In Western Ireland where most of the afforestation programme is concentrated in the acid oligotrophic peatlands, the incidence of *Fomes annosus* there is unknown. However, in the fertile valleys of the Southeast, *Fomes annosus* is the major forest pathogen and is responsible for most of the decay in susceptible conifers. In general, trees planted on sites of low organic matter where the soil is light and sandy are more likely to be infected (17, 18, 32). Resistance to infection increases in stands over 30 years old (32). The fact that so many different tree species are susceptible to attack by the fungus suggests that its physiological tolerance spectrum is very broad.

History and Geographical Distribution

Robert Hartig first described the pathogen in 1874 and later thoroughly investigated the disease in 1878 (22). Because it is now considered to be the cause of one of our most important diseases of conifers, research on the fungus and on the disease it causes has been increasing at a rapid rate during the past decade. In the U.S., *Fomes annosus* was first recognised as a potentially dangerous pathogen in 1954 when large areas of southern pine plantations in South Carolina and Georgia were attacked (35). Since then, numerous surveys have demonstrated how extensive and widespread the disease has become. Naturally regenerated forests are not adversely affected. It seems that the problem is man-made and a consequence of plantation-type forestry practice. The natural forest had its own inbuilt system of checks that counteracted the detrimental effects of potential pathogens such as *Fomes annosus*. However, economic practice dictated the planting of extensive areas of pure plantations. These forest monocultures, regularly thinned and mechanically harvested, provided ideal material for the spread and development of the formerly unimportant parasite.

Fomes annosus is worldwide in distribution but is more damaging and widespread in the temperate climatic zones with as yet only sporadic and minor occurrence in the subtropical and tropical climatic zones (7). On the American continent the pathogen is present throughout the softwood forests from Canada to the Gulf of Mexico and from Nova Scotia to the Pacific Coast (C.M.I. Map 271, ed. 2, 1968). The disease has reached epidemic proportions in sections of the South and is expected to increase in the Northwest as thinnings or other forms of selective cutting become more common in the second-growth stands.

Economic Importance

Financial data available about the economic impact of the pathogen are scarce and when available, are very subjective. In Sweden, for example, it is estimated that the annual loss due to stem decay in Norway spruce is $10m. In Denmark an investigation on the same species showed an annual reduction in profits of 32% and a reduction in capital value of 47%. In Germany it is estimated that a reduction in timber yield due to *Fomes annosus* amounts to 10–15% annually. In East Anglia, in England, losses due to the disease were calculated to be in the region of $3.50 per acre per annum. A pilot survey recently carried out in Ireland showed a loss of timber due to stem decay of 5%. It is conservatively estimated that the disease destroys a quarter million cubic metres of timber annually in the United States (1). Any true appraisal of the economic importance of this disease is further complicated by the fact that *Fomes annosus* sometimes causes outright mortality, sometimes slows tree growth, and at other times acts as a heart rot leading to actual loss, of, or degrading of, merchantable volume. Suffice to say that the fungus causes very serious economic losses, some of which cannot even be quantified.

Symptoms

Foliar symptoms are not always evident although some species show thin and chlorotic crowns. In most conifers the earliest symptom of infection is a red or purple discolouration of the stem wood (4). The colour varies with the host. In the incipient stage, decayed wood is generally indicated by very small white pockets of rot. Minute black specks are visible as the decay progresses. The final state of the decayed wood varies from fibrous to slimy, according to the amount of moisture present. Resin flow may occur from the butt (4) and occasionally distress coning is obvious. Root decay is characterised by a yellow stringy rot. Trees with severe root rot are susceptible to windblow. Infection groups of trees or "*Fomes annosus* pockets" occur. These are dead trees where the pathogen has acted as a killing agent. Hodges (24) observed that tap roots and main vertical roots became infected more frequently than laterals. His observations indicate that tree species with long tap roots are more liable to be killed by *Fomes annosus* than to be subjected to stem decay. Other symptoms of the disease include reduction in growth increment and a degrade of wood quality.

Morphology, Taxonomy and Nomenclature of the Pathogen

The basidiocarp, sometimes called a carpophore or conk, is a perennial fructification. It is very irregular in shape. Often imbricate and confluent, it is sessile with a broad basal attachment and is at times resupinate. The upper surface is grey-brown to bay and it darkens with age. This surface is glabrescent and zonate and has a tuberculate rugose crust. The actively growing margin is white, thin and acute. The context is up to 1 cm thick, whitish and firm, corky to woody. The pore surface is white to yellowish and the irregular pores are circular to labyrinthoid. The basidiospores are ovoid to broadly ellipsoid. They are hyaline and thin-walled. Four basidiospores are borne on each short clavate basidium. Cystidia are absent. The hyphal system of *Fomes annosus* is dimitic, non-agglutinated with generative and skeletal hyphae. The former type are thin-walled, freely branching and simple septate whilst the latter are unbranched, are of unlimited growth are thick walled and have a narrow lumen. They are non-septate. Conidiophores produced in culture are oedocephaloid and vertical. The conidia are unicellular, hyaline, ellipsoid to piriform and thick walled.

The pathogen is a Basidiomycete and is a member of the Polyporaceae. *Fomes annosus* is sometimes known as *Polyporus annosus* (Fr.) or as *Trametes radiciperda* (Hart.). Another synonym, *Fomitopsis annosus* (Fr.) Karst., is commonly used in Australia and New Zealand. The imperfect stage of the fungus is referred to as *Heterobasidion annosum* (Fr.) Bref. and as *Oedocephalum lineatum* Bakshi. (Fungi Imperfecti, Moniliales).

Proof of Pathogenicity

The ability of basidiospores to establish root disease fungi such as *Fomes annosus* or mycorrhizal fungi was shown to be possible (29, 37, 40). This was achieved by finding favourable substrates and using natural inoculation methods. Hüppel (25) reported in 1968 that he successfully inoculated both pine and spruce seedlings with conidia of *Fomes annosus* or *Heterobasidion annosum* and reproduced the disease syndrome. Thus the postulates demanded by Koch (in Garrett (19)) to complete a disease investigation were realised.

Life Cycle of the Pathogen

The life cycle of *Fomes annosus* is comparatively simple. It is generally accepted now that spores produced by the fungus are the primary source of inoculum for initial infection. Of the two spore types produced, basidiospores and conidia, the former are thought to be of much greater significance. It has been demonstrated that the inoculum potential of basidiospores is 60 times more effective than that of conidia (23). Conidial production is infrequently observed in nature (3). Basidiospores, however, are frequently and abundantly produced in the fructifications that are formed on the trunks of infected trees, normally at ground level (31).

These spores are very light and are quite effectively transported and disseminated by air movements. Viable spores have been found airborne 70 miles from the nearest possible source of production (38). Basidiospores can be leached through a sand column 40 cm. thick and still infect susceptible root tissue (24). In view of the vicissitudes these spores encounter in the soil and the thin nature of their cell wall, this evidence is remarkable. Jorgensen (26) showed that basidiospores isolated from soil were still viable after 2 months. Several investigations (42, 43, 44, 45, 46, 49) have attempted to correlate basidiospore release with season of the year, time of day and various other environmental parameters. Much of the evidence which has been presented is somewhat conflicting or inconclusive. It does appear, however, that basidiospores are produced in all seasons and are released in largest numbers, in many areas, primarily in the spring and autumn.

Since *Fomes annosus* is not a vigorous microbial competitor (8, 37), the basidiospores are most efficient in initiating infection when they directly intercept interior root tissue or the heartwood of the lower stem of susceptible hosts. In coniferous plantations, stump surfaces of recently cut trees are excellent infection courts. Because these stump surfaces are also colonised by other microbes, several of which are more vigorous competitors than *Fomes annosus,* the length of susceptibility of these stumps is quite short. In the case of most species, susceptibility estimates have been less than 1 month. Cobb and Schmidt (10) have suggested that the susceptibility of eastern white pine stump surfaces may be only 1–3 days after felling. The significance of other wounds such as those resulting from pruning, extraction damage or animal feeding is generally thought to be less important than that of stump surfaces.

Following basidiospore germination on the stump, the haploid mycelium of the fungus grows through the heartwood into the root system. It grows at a variable rate which may approximate 20–40 centimetres per week (12, 21). Following anastomosis, the diploid mycelium grows between the bark and wood and eventually gives rise to the perennial basidiocarp. The mycelium grows down the colonised root causing death, disease and decay as it spreads. It transfers to live healthy roots of adjoining trees by root contact or grafting. It is incapable of growing freely in the forest soil (37). Viable conidia or basidiospores, however, may be leached to susceptible roots. These spores may be stimulated by the ninhydrin-positive root exudates of the rhizosphere and they then germinate, penetrate and colonise the suscept. The cycle is repeated.

Infection Biology and Physiology

The literature abounds with conflicting evidence about the interaction of the host/parasite relationship. Perhaps the greatest obstacle in evaluating the role of this pathogen or its suscept is the difficulty of experimentation under natural conditions. Most studies, therefore, have been and are made under artificial conditions of controlled laboratory experimentation, with emphasis on single reactions. It appears that in many cases, the experimental methods of the investigator have determined the outcome of the host/parasite relationship.

Rishbeth's work (37, 38, 39) has clarified many misconceptions about the infection biology of *Fomes annosus.* He also found that superficial growth of the pathogen was abundant on roots in alkaline soils but absent or feeble on more acid soils. Roots in the latter soils were colonised by *Trichoderma viride* which was demonstrated to have a marked *in vitro* antibiotic effect on *Fomes annosus*. These observations and others formed the basis for studies on the biological control of the pathogen.

Physiologic specialisation of the fungus is unknown. No evidence for the existence of races nor for host-specific variation in decay ability has been found. Growth rates of 45 isolates from different parts of the world showed no significant difference (12). Optimum growth of the mycelium *in vitro* and on pine discs has been found to be as much as 6.8 mm/day at 24 °C (12, 21, 45, 47). Maximum infection by the fungus occurs when the mean monthly temperature is around 21 °C (14). Thermal inactivation period for conidia is $1\frac{1}{2}$–2 hours at 45 °C (24). Basidiospores are inactivated at 40 °C for 2 hours (8, 41).

Infection of stump-tops occurs most frequently in the autumn. Spring is the second most vulnerable period. Where the climate in Summer is warmer, successful infection of most stumps by *Fomes annosus* does not occur because of the high stump-top temperatures (6, 8, 14, 15, 16, 41, 50). Once the pathogen is established it can survive for a relatively long period during the decomposition of woody material in the soil (28). Rishbeth found that *Fomes annosus* could survive in infected root systems for as long as 30 years (37).

Fomes annosus is classified as a white rot fungus; movement through the stump and in the roots involves decay of both lignin and cellulose. The mechanism of decay by the pathogen is thought to be via production of typical extracellular enzymes of the white rot group. Studies of the fungus *in vitro* by Bassett et al. (2) have revealed, however, the presence of fomannosin. This compound is a sesquiterpene which when applied artificially to host roots will produce symptoms similar to those in natural infections. Demonstration of this material in diseased tissue would support the suggestion that it is a fungal toxin.

Control of the Disease

Control measures are aimed at prevention rather than cure, as diseased stumps may remain as sources of infection for up to 30 years. Prompt treatment of thinned stumps by painting with a substance inhibitory to *Fomes annosus* has been the practice in most countries since 1950. The original stump protectant used was creosote but in field use this was variable in performance and liable to breakdown. Since then various chemicals such as sodium nitrite, urea, powdered borax, ammonium sulphamate and others have been used with greater success (38). The rationale behind this stump treatment policy was advanced by Rishbeth and his associates (28, 37, 38). They had shown that the still-living tissues of the stumps were strongly selective for the pathogen *Fomes annosus,* and for a small number of harmless saprophytes such as *Peniophora gigantea.* Rishbeth, therefore, sought for chemical treatments that would destroy this dangerous selectivity of the stump tissues for *Fomes annosus* and permit colonisation by harmless saprophytes instead. Any treatment that kills the living host tissues is likely to promote this result, but the most promising chemicals were found to be disodium octaborate, ammonium sulphamate and urea. All three treatments favoured colonisation of the stump surface by mould fungi in place of the Basidiomycetes colonising untreated stumps. Ammonium sulphamate and urea encouraged a particularly vigorous growth of moulds, partly perhaps through their nitrogen content.

Biological control of the pathogen by stump inoculation with spores of *Peniophora gigantea* has been successful with pine species (39). This saprophyte—the candle-wax fungus—is an indigenous species in Britain and Ireland. It is the most effective natural competitor of *Fomes annosus* in pine stump colonisation in East Anglian plantations (37, 38, 39). Rishbeth has perfected a technique for producing lyophilised suspensions of *P. gigantea* oidia. These suspensions are placed in water and the resultant liquid is then applied to the freshly cut pine stumps. Chemical treatment of stumps other than pine is still practiced in Britain and Ireland. Sodium nitrite is commonly used except in water-catchment areas where urea is substituted.

Silvicultural means of control include (a) the avoidance of thinning—especially in high hazard sites. Trees may be planted at wider spacings to avoid thinning and to reduce root contact. (b) If thinning is necessary it should be done at a time unfavourable to the fungus—i.e., in warm seasons when stump-top temperatures may inactive the pathogen (8, 14, 26, 41). (c) Stump removal has been resorted to in an effort to decrease the amount of inoculum available. This method, is occasionally used on high value amenity sites. (d) The use of mixed stands with a variety of species and the planting of resistant species such as some hardwoods are other control measures often employed. (e) Phytosanitary controls involve the avoidance of intercontinental and inter-regional spread by excluding shipments of logs and unseasoned wood containing incipient decay.

It is obvious from the above review that further studies on the biology of the fungus and the etiology of the disease are necessary. This is especially true of studies on factors affecting host predisposition, fungal antagonism and physiology. Such studies could lead to some form of control by imparting resistance to the host. This could be accomplished either by plant breeding or by culturally modifying the environment the tree is growing in so as to take advantage of the pathogen's natural antagonists.

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Trees, Woods and Literature—13

Week followed week without so much as a drop of rain. Bernard lived in constant fear of fire. He was suffering from his heart again. More than a thousand acres had been burned over at Louchats. "If the wind had been from the north I should have lost my Balisac pines." Therese was in a state of waiting for she knew not what to fall from the immutable sky. It would never rain again. One day the whole surrounding forest would crackle into flame, even the town itself would not be spared. Why was it that the heath villages never caught fire? It seemed to her unjust that it should always be the trees that the flames chose, never the human beings. In the family circle there was a never-ending discussion about what caused these disasters. Was it a discarded cigarette, or was it deliberate mischief? Therese liked to imagine that one of these nights she would get up, leave the house, reach the most inflammable part of the forest, throw away her cigarette, and watch the great column of smoke stain the dawn sky . . . But she drove the thought from her, for the love of pine-trees was in her blood. It was not them that she hated.

From *Therese Desqueyroux* by Francois Mauriac, translated by Gerard Hopkins. Reprinted by kind permission of Messrs. Eyre and Spottiswoode, Ltd.

Francois Mauriac was born in Bordeaux, in south west France, in 1885, and his many novels are concerned with the lives of the bourgeois inhabitants of that region of vineyards, *landes* and pine forests. They deal with intense human emotions, family entanglements, religious hypocrisy, and greedy manoeuvring for rights over property.

Therese Desqueroux is driven by circumstances to attempt the murder of her husband, but the family withhold incriminating evidence at the hearing of charges, and she is subsequently kept a prisoner behind a facade of normal family behaviour. "Family honour" must be preserved.

Mauriac died in 1970. Despite his achievements, and the award of a Nobel Prize for literature in 1952, he does not appear to be highly regarded among English critics.

Letter to the Editor

The Editor,
Irish Forestry.

Dear Sir,

The article by Savill and Dickson[2] in the last issue of Irish Forestry (Vol. 32, No. 1, 1975) raises a number of interesting points some of which we feel may be misinterpreted by your readers.

It is noted with much interest that the authors have been successful in relating site vegetation to fertilizer needs on both deep peat and gley soils. That they have been able to do so is encouraging to say the least particularly as vegetation type is a site parameter easily read by the discerning forester on the ground.

Notwithstanding these findings our first concern would be that one must bear in mind the severe limitations imposed by the use of vegetation analysis alone to evaluate sites. Its main limitations are (i) that roots of ground vegetation do not normally permeate the soil to as great a depth as tree roots so it does not reflect conditions in the deeper regions of the soil profile and (ii) that changes in ground vegetation may be a reflection not of site but rather of the influence of man or of animals.

Our second concern arises as a result of their comments in relation to the use of other site parameters, specifically soil, for predicting growth potential and fertilizer requirements. Although it is stated that "tree growth is obviously being influenced by soil conditions" it is strongly suggested that soil parameters are not useful for this purpose. The background for this philosophy appears to be a paper by Adams *et al*[1] who failed to find a relationship between tree growth and soil type. This is not surprising when one considers that the analytical methods dsed by the latter were designed specifically for agricultural crops and bear no relationship to forest trees.

Too many reports are to be found in the literature where scientists have failed to relate tree growth and/or fertilizer requirements to soil characteristics in which agricultural methods of soil analysis were used. Once again it must be stated that there is no reason whatsoever why a particular analytical method should work for Sitka spruce or lodgepole pine simply because it happens to

1. Adams, S. N., Jack, W. H., and Dickson, D. A., 1970. The growth of Sitka spruce on poorly drained soils in Northern Ireland. Forestry *43*, 125-33.
2. Savill, P. S., and Dickson, D. A., 1975. Early growth of Sitka spruce on gleyed soils in Northern Ireland. Irish Forestry *32* (1).

be useful for potatoes or sugar cane. Foresters must strive to develop their own analytical procedures which are of relevance to tree growth and fertilizer response instead of reverting to an era when sites were evaluated solely by vegetation type, a system long recognised to be unsatisfactory. In this way statements like: "The present classification of gleyed soils is therefore of limited use to forest management . . .", page 35, are likely to become less common.

M. L. Carey
R. McCarthy

Notes and News

by Wood Kerne

TRENDS AND THINKING ABROAD

North America. George Weyerhaeuser, President of the giant Weyerhaeuser Company, has said that, given sufficient investment now, the U.S.A. and Canada could, by the turn of the century, hold a place in the world trade in forest products similar to that now held by the Persian Gulf in the oil trade. This was assuming that the other major untapped source, the U.S.S.R., would not decide to upgrade quickly the priority attached to the development of its timber resources and transportation system.

Mr. Weyerhaeuser predicted a doubling of the world demand for industrial wood by the year 2000, with a tripling of the demand for industrial paperboard. The biggest increase would be in North America, Japan and western Europe. He thought that North America could increase its exportable surplus by a factor of about seven.

U.S.S.R. A Soviet government planner has put forward a 25 year programme to develop the country's timber industry into a major exporting industry. There would be two aims: to attract Western investment and equipment to be paid for in forest produce, and as an alternative foreign exchange earner to oil, which needs to be conserved for domestic demand.

Sweden. A Swedish Commission studying the natural forest resources says that if cutting continues at its present level, a reduction of 20% wil be necessary from 1980 if a sustained long term yield is to be achieved. But the Swedish Pulp and Paper Association argues that this takes no account of the effects of fertilisation, better silviculture and a higher degree of utilisation.

(Information from *World Wood*)

GERMAN FORESTS IN THE RED

Forests in West Germany are no longer as profitable as they used to be. This is ascribed to a trebling of forest upkeep costs since 1950, compared with a 1% per annum increase in the cost of wood. Natural disasters such as the 1972 storms have also contributed. Members wil be interested to know that one exception is the municipal forest of Baden-Baden, which the Society visited during its 1956 Annual Study Tour. This forest of 7,500 ha costs 4 million DM per year to run. It employs thirteen officials, six skilled and 68 semi-skilled workers. Although half the woodland is less than forty years old, in 1973 the forest netted a profit of 224,000 DM.

(Information from *The German Tribune*, No. 698)

PLANTS BY HELOCOPTER

In Scotland a helicopter has been used by a private forestry company to deliver plants to 200 ha of inaccessible planting sites in Porthshire. The helicopter carried 8,000 trees per load and cost £90 per hour of flying time. The total cost of the delivery operation was £425 compared with an estimated cost of £675 by land-based vehicle and walking.

Reviews

The potential of Western Hemlock, Western Red Cedar, Grand Fir and Noble Fir in Britain. By J. R. Aldhous and A. S. Low. Forestry Commission Bulletin 49, HMSO. £1.50.

Bulletin 49 reports the findings of a survey carried out in 1967-'68 on the potential of four minor species, western hemlock, western red cedar, grand fir and noble fir as an alternative to the recognised major species in British forestry. Crops surveyed were planted prior to 1950 and chosen to represent the different site types and the different climatic regions of Britain. The findings are presented in seven chapters dealing with the different aspects of an afforestation programme covering both techniques and costs. Comparisons are made with the major species for each aspect the results being summarised in tabular form.

It was found that establishment costs, based on 1968 data, are higher for the minor species due to greater seed cost and poorer survival rate. An added factor was late spring frost which tended to be a limiting factor on those sites where these species might form a possible alternative.

Growth comparisons are presented in chapter 3 in graphical form. Each graph is based on from 2 to 20 comparisons per species. Correlation coefficients are presented for each set of data On suitable sites grand fir outgrew the major species, western hemlock was as productive while western red cedar and noble fir were generally poorer. First thinnings occurred later even on the most productive sites and the produce was smaller in size than for similarly aged Sitka spruce.

The species represented in the survey are known to be subject to stem defects. The survey of pole stage crops showed that drought cracks were most serious in the Abies. These were also present in Sitka stands but were less severe. Fluting was found to be quite prevalent in western hemlock and western red cedar while buttressing was confined to western red cedar. Fomes was considered a serious problem only for western hemlock. Grand fir though it appeared resistant to decay in earlier studies was found to be considerably attacked in subsequent investigations. Other fungal diseases did not present a serious problem. Insect attacks were confined to Adelges infestations of grand fir where attack if severe could lead to rotholz (abnormal wood formation similar to compression wood) and possible death of young trees.

Utilisation of the end product is covered under five headings, weight and strength properties, sawing, appearance of wood, pulping properties and marketing. Of the four species only western hemlock had a higher specific gravity than Sitka, while in all instances their moisture content far exceeded both Sitka and Douglas fir. Both their sawing and wood working properties were considered to be more than adequate. All of the species were considered suitable for pulping with the exception of western red cedar though data for noble fir was based on U.S. experience. Marketability was closely related to pulping suitability.

The penultimate chapter deals with the revenue that may be expected from the species. In all instances at Yield Class 18 the minor species have a lower return than Sitka spruce while at Yield Class 14 grand fir is the only one to have a higher return. These differences are attributable in the main to the effects of early growth on timing of thinnings.

The potential of the four species for British forestry are summarised in the final chapter. Grand fir will depend on its being more widely planted before it is of importance. Western hemlock offers little hope as it is outproduced by all the major species. Western red cedar grows well only in the southern half of Britain and is therefore of limited use while noble fir appears to have no future.

This publication achieves its aims in gathering together all the relevant data about the species concerned. In its presentation it is up to the usual high standards set by the British Forestry Commission. It contains a wealth of graphs and tables which clearly illustrate the points in the text. Its main fault lies in the limited number of areas and age classes surveyed casting some doubt on the validity of the graphs in Chapter 3, a point conceded by the authors. In the section on natural distribution of the species the northern extension of the Sitka spruce range is somewhat foreshortened. In addition its association with noble fir is somewhat of a surprise.

The conclusions drawn by the authors of the species usefulness come as an anticlimax. At £1.50 the bulletin will serve as a useful reference on the species performance in Britain outside of which it may be less relevant.

J. O'DRISCOLL

Fertilisers in the establishment of conifers in Wales and Southern England. Forestry Commission Booklet 41. J. E. Everard. HMSO, 1974. £1.25.

A feature of forestry in Britain and Ireland in recent years has been the establishment of large areas of coniferous plantations on what are frequently impoverished, nutrient deficient soils. This has resulted in a considerable amount of research into the fertiliser requirements of the more important tree species across a range of site types. The purpose of this colourfully produced Booklet, which summarizes the results of about fifty such experiments, is to answer some of the questions commonly asked about the use of fertilisers in young forest crops in Southern Britain.

The Booklet discusses in brief such basic questions as to why fertilisers should be used in the first place and if so where, when, how, and in what quantity they should be applied. The fertiliser requirements of a number of different species and the question of heather control and its relationship to the nitrogen nutrition of Sitka spruce are also considered in brief. Phosphorus is the most commonly deficient nutrient in the region to which the Booklet refers. It is usually applied as unground phosphate rock at a rate varying between 50 and 75 Kg P/ha.

Although nutrient levels may be low and even limiting growth, the use of fertilisers is only justified when the expected response exceeds the cost involved in monetary terms. In deciding whether or not to use fertilisers, therefore, an estimate of the expected response must be initially made. This is done by comparing the production of fertilised and unfertilised trees growing under similar climatic conditions. The number of years crop revenues are likely to be advanced by fertiliser application are then estimated by reference to the results of experiments on similar site types. This enables the calculation of net discounted revenue figures for both the fertilised and unfertilised crop and the expenditure that is justified on fertilisation is thus obtainable.

In theory the approach is sound, in practice it is likely to suffer from a paucity of data, over generalisation, a questionable and highly subjective system of site classification and an over emphasis on the value of foliage analysis as a diagnostic tool.

Most of the publication is taken up by diagrams and tables. The ten colour plates included could have been better positioned and more informative. Despite its limitations the Booklet is of much value to forest managers in Southern Britain and Wales. Its usefulness in Ireland is limited due to different soils and environmental circumstances.

M. L. CAREY

Forest site yield guide to Upland Britain. By R. J. N. Busby. Forestry Commission Forest Record 97. HMSO. 40p.

This is a 13-page booklet which attempts to solve in Britain the foresters' ubiquitous problem of how to evaluate tree growth potential. The author uses soil groups and elevation zones as broad criteria in the formulation of guides to yield class for each of the nine Conservancies embracing Upland Britain. The guides are presented in tabular form in which the soil groups within each Conservancy are listed and the yield classes are given for the tree species chosen at two or three elevation zones. Species selection is determined by the moisture and vegetation status of the site and the time(s) when fertilizers should be applied in order to achieve the predicted yield class are also indicated.

The text of the booklet is confined to a very short introduction which outlines the main features of the system used to determine the guides and includes a brief explanation of the term yield class. A discussion section dealing with the background to formulating the guides would have been informative. For instance, the use of elevation as one of the two major criteria in the guides is bound to puzzle many, since investigators elsewhere have found elevation-tree growth relationships to be very variable. Also, the somewhat arbitrary selection of elevation zones does not inspire confidence in their usage. The absence of any reference to soil and foliar analyses leads one to believe that the Forestry Commission feel such analyses to be unimportant in predicting yield class, or perhaps it is a reflection of a lack of confidence in laboratory methods. References to fertilisers were limited to the element only; footnotes denoting type and quantity of fertilisers recommended would have been desirable.

To judge the merit of these guides and their relevance to Irish forestry one looked in vain for experimental evidence of the presumed relationships between soil groups and elevation zones to yield classes. There is no doubt that accurate yield class prediction is needed for more efficient forest management. What is in doubt however are the criteria upon which we predict yield class.

Finally, it is noted that the maximum production recorded in this publication is yield class 18. Thus, our drumlin soils, bearing stands of yield class 28, take on added significance, not to mention reports of yield class 40-plus in Co. Clare (Irish Forestry, pp. 30-33, Vol. 32 (1) 1975.

R. McCARTHY

Fifty Years of Forestry Research by R. F. Wood will be reviewed in our next issue by Dr. W. H. Jack.

Other Publications Received

FORESTRY COMMISSION PUBLICATIONS

Forest products in the United Kingdom Economy, by B. G. Jackson. Bulletin 52. £1.35.

Influence on spacing on crop characteristics and yield, by G. J. Hamilton and J. M. Christie. Bulletin 52. 80p.

Production and use of tubed seedlings, by A. J. Low. Bulletin 53. £1.00.

Field recognition of British elms, by J. Jobling and A. F. Mitchell. Booklet 42. 85p.

FOREST RECORDS

93 *Cross country vehicles in Forestry*, by D. H. Wallace. 40p.

94 *Biology of Dutch elm disease*, by J. N. Gibbs. 23p.

95 *Wood resources and demands. A statistical review*, by A. J. Grayson. 25p.

96 *Beech bark disease*, by E. J. Parker. 25p.

100 *Dutch elm disease survey* 1972-73, by J. N. Gibbs and R. S. Howell. 30p.

LEAFLETS

58 *The large pine weevil and black pine beetles*, by T. M. Scott and C. J. King. 23p.

59 *Hydrostatic skidder*, by W. O. Wittering. 27p.

60 *Selection of conifer seed for British Forestry*, by J. N. Kennedy. 8p.

Society Activities

ANNUAL STUDY TOUR, 1975

TUESDAY 10th JUNE

A heavy haze shrouded the landscape as the members assembled at Ennis on the morning of 10th June for the 33rd Annual Study Tour and we wondered if the recent dry and sunny weather was nearing an end. Fortuitously, perhaps, our journey to Lough Graney Forest took us by Biddy Early's cottage and as the haze dispersed to let the sun through we knew, intuitively, that the fine weather would continue.

In the shadow of the T.V. mast at Maghera the President, Mr. D. McGlynn, welcomed the members and expressed the hope that the disastrous storms which followed previous visits to Clare by the Society would not be repeated. Our tour leaders, Messrs. M. O'Donovan and E. Larkin, forester in charge Mr. Quinlan and assistant forester Mr. Joyce were introduced. Mr. O'Donovan then treated us to a historical outline of the development of the previous crop and the establishment of the current crop on this rather wet podsolised Old Red Sandstone site.

Originally planted in 1932 on shallow peat at 600 to 900 ft. elevation, the Sitka spruce crop was the show-piece of the Clare coniferous forests with a potential yield class of 280 (Hoppus) over much of the area. Windblow commenced in February 1957 at the lower elevation and was completed by hurricane Debbie in October 1961.

Replanting of the area presented a major problem. Studies indicated a cost of £100.00 per acre for manual draining and mounding because of the wetness of the site and the tangle of lop and top. Mr. O'Donovan paid tribute to his predecessor, the late Brendan Gibbons, who had recognised the difficulty and devised a method of ground preparation with a J.C.B. Operating time was 8 hours per acre at a cost of £3 per hour. At 700 to 800 plants per acre the number was one third less than the then recommendation, but is now very much in line with present day thinking on espacement. Indeed, Mr. E. Johnston was heard to remark that the low stocking would avoid many management problems later on. The crop of Sitka is growing very satisfactorily. At eight years it is, according to Mr. T. Purcell, potentially yield class 24 (metric) over most of the area. The question of future stability of the crop was raised in regard to the method of planting each plant on a 'bucketful' of soil. Mr. P. Verling wondered how the trees would behave on these mounds. Mr. T. O'Keefe queried the adequacy of drainage. Mr. O'Donovan, however, felt confident that the crop would be stable at this espacement. In view of the general agreement on wider spacing the President was of the opinion that our present policy on espacement should be reconsidered. Mr. Mooney, with memories of a stroll in 1938 through the newly planted previous crop still fresh in his mind, obviously felt that wide spacing was not the full answer. He would advocate stabilising zones of hardwoods around the crop perimeter, coupled with wide spacing.

At a higher elevation in the vicinity of the T.V. mast, Mr. O'Donovan drew attention to Sitka growing somewhat unhappily in heather. It was, said Dr. N. O'Carroll, a case of nitrogen deficiency and the remedy was neither simple nor inexpensive. If you kill the heather with 2,4-D you get a temporary response which will disappear when the heather re-invades. His prescription would be based on current thinking and practice in Northern Ireland; nitrogen at 3 cwt. per ac. at fairly frequent intervals: a costly cure.

Following a most pleasant picnic lunch on the shore of Lough Atorick the Society journeyed to Mountshannon Forest, where Dr. N. O'Carroll explained the philosophy and experimental design underlying current fertiliser experiments. Traditionally, said Dr. O'Carroll, fertiliser experiments concentrated mainly on detecting whether or not a crop responded to a particular treatment, and to a lesser extent in measuring the size of the response. The kind of information obtained is of most value in extreme situations, but is of little value to the forest manager dealing with average crops. Now forestry is much more complicated. The forest manager wants to know the consequences of a range of possible treatments over all possible situations. He wants to know the return from specific inputs, or conversely, the inputs required to give a certain output.

To obtain this information a series of 30 experiments have been established in pole-stage Sitka spruce. The one located in Bohatch Property dates from 1972 and is located in a stand planted in 1928. The particular feature of these experiments which will enable them to achieve the objective is the experimental design used. This is known as the Central Composite Rotatable design and it allows a range of levels of three different factors (in this case N, P and K) to be tested simultaneously. Five actual levels of each factor are used to give fifteen treatment combinations. The initial aim is to derive a predictive regression equation for each site with basal area increment as the dependent variable and the three factors and their first order interactions as independent variables. The next step, Dr. O'Carroll continued, will be to establish correlations between the equation co-efficients and some site factors such as yield class, available N.P.K. etc. This will allow the application of the predictive equation to sites where factors are highly correlated with the equation co-efficients. Using the relationship of volume increment to m^2 basal area increment appropriate to the particular yield class and age, Dr. O'Carroll and Mr. J. Dillon calculated the predicted profit on an input of fertiliser costing £80. Prof. Clear commented that the effect of fertiliser application was often undervalued in the pole-stage crop. One should take cogniscance of the price-size gradient. In another context, he felt that this kind of cost benefit analysis could show that it may be much more profitable to plant the "green" land rather than apply fertiliser on poor sites. In reply to a question by the President as to the role of research in this regard, Dr. O'Carrol salid that he saw research as a service to management in this the management procedure of the future.

The Society expressed its thanks to Dr. O'Carroll for a lucid explanation of what at first seemed a rather complicated experimental procedure. Some reservations were expressed as to the facility with which correlations between co-officients and site factors could be established but he deserved to be complimented on his approach to the problem. He had, indeed, introduced a fourth dimension into forestry in this country.

A brief visit to the Scariff Chipboard factory showed how sawmill waste and dimension timber can be processed into high quality chipboard. Following some welcome refreshment at the "local' the party returned to Ennis.

P. M. JOYCE

WEDNESDAY, 11th JUNE 1975

Cooler breezes prevailed as we travelled to Mt. Callan estate where Messrs. Robert and Charles Tottenham showed us their extensive Sitka spruce plantations. The President Mr. McGlynn spoke briefly before handing over to Mr. Robert Tottenham who stated that there were two land use options, grass or forestry. A soil pit showed a pretty sticky gley with an unusually friable surface horizon, but Mr. Tottenham emphasised that it would cost well over £200 an acre to drain, lime, fertilise and reseed this type of land. Local letting values were only £25 per acre — which would not repay overdraft interest, thus their interest in Sitka at the growth rates prevalent here.

Mr. Tottenham laid on a demonstration of his ploughing unit — Massey Ferguson twin rear wheel tractor with a modified Ferguson deep digger plough that turned over a very acceptable sod. The planting method demonstrated was removal of a round plug by means of a stabber (a modified daffodil planting tool) and insertion of a Sitka seedling before replacing the plug. Fertilisation rate was 4 cwt. of Gafsa (North African) phosphate per acre before planting with a boost of 10.10.20 around plant at planting time (boost less than $\frac{1}{2}$ cwt./acre).

At the second stop the grass/forestry options were again aired — Mr. Tottenham explaining how Professor Clear gave them the rather revolutionary advice of planting the best land in their 1,400 acre estate first; this they followed, planting 40 to 50 acres per annum. A young plantation at this stop had three lines of Sitka to one line of coastal lodgepole pine. The policy was to remove the latter species at first thinning, or earlier if damaging the spruce.

Stop three was an eleven year old Sitka spruce crop being mechanically thinned. Mr. Tottenham considered early thinning essential and used a straight forward two lines in six system, which made standing sale possible and also enhanced woodcock shooting. It was here that the *raison d'etre* of our visit became apparent (apart from the barrel of stout at lunch) when the subject of yield class of this stand was broached. Estimates were asked for and both Mr. Purcell and your diarist gave a guess estimate of 340 (Hoppus). The thinning of such stands was discussed; Messrs Johnson and Moloney of Sligo preferred single lines while Professor Clear stated very forcibly that thinning should have been two years earlier, whether stems were saleable or not, and quoted New Zealand practice. Mr. Mangan voiced reservations about quality due to ring width but Professor Clear countered that two rings to the inch were quite acceptable.

The logical consequence of growing timber is saleable raw material and Mr. O'Donovan spoke of the difficulties experienced in selling standing timber in Co. Clare, despite the geographical proximity to both Scarriff and Limerick city.

The final stop at Mt. Callan was a small plot of Sitka spruce planted in 1961 and reputed to be the fastest growing example of the species in Ireland. This stand was very impressive and we were told that every second line was removed at nine years and 25% of remaining trees thinned in 1974. This plot has already been written up in the Spring 1975 issue of this journal so details are unnecessary — suffice to say that if large areas of similar land could be afforested we would be an important timber producing country in twenty years.

Lunch, pleasantly washed down by a barrel of stout "on the house" was followed by a visit to the Burren country, where we met Jenny and Michael Neff at Poill na Sallagh. Mr. Neff gave a brief description of the history and flora before we all went botanizing. One could appreciate why genteel young ladies took up this subject at the turn of the century as the combination of sun, sea, rock and flowers was pretty, in the best sense of that word. Near the sea shore we found the common wild thyme, sea pink and kidney vetch all in flower, while slightly inland, *Geranium sanguineum,* one of the special burren species was in bloom. The maiden-hair fern and wood sage were also in evidence and our guides found the blue gentian and mountain avens, *Dryas octopetala* still flowering in a shady hollow.

The final stop was near Grogan's Castle, where we visited the megalithic tombs, and presumably the carolina rose we saw near the tombs has been there for some time.

The President, Mr. McGlynn thanked the leaders and closed the proceedings at the end of one of the more interesting days of the tour.

L. P. O'FLANAGAN

THURSDAY, 12th JUNE

Ennis Forest. Foresters: Messrs. L. Cawley (in charge), P. J. O'Reilly and C. O'Shea.

The first stop may have been designed as a test of our physical condition when we were led across a 12 foot high causeway without handrail to see a square tower, one of the last of its type, built about 1600 as a fortified residence for one of the O'Briens of Thomond. In usually good repair, the exhilirating effect of the top parapet was ample reward for those intrepid enough to climb the stairs.

One of the features of this property is the presence of the rare pine marten, for years in danger of extinction but now to be protected under the new Wildlife Bill. Mr. P. J. O'Sullivan, wildlife forester, described some of his observations on the animal's habits. It eats wild berries and nuts, also small mammals and birds, including their eggs, ("a gastronomic opportunist"). Almost all reports of damage to fowl could be ascribed to foxes, and there was no evidence of damage to lambs by pine martens. He showed us a captive specimen, which obviously did not think much of the company, a feeling reciprocated by any of those who got down-wind of him.

Tulla Forest. Foresters: Messrs. Joe Stapleton (in charge) and M. J. Lynch.

At Monanoe property we saw a species comparison experiment managed by the Genetics Section of the F.W.S. Research Branch. Mr. Michael Forde (Research Forester) gave us some indicated yield classes for these species planted in 1963 on this site with its shallow soil and outcropping limestone. These were: Sitka spruce 24 (Metric), Douglas fir 22, Norway spruce 20, Corsican pine 14, Japanese larch 12 and Scots pine 12. Unfortunately, because of their high value for winter grazing, these sites are no longer becoming available for forestery.

Craggaunowen Project. This project, when completed, will consist of a restored castle, replicas of a crannog (lake dwelling) and a ring fort, and a museum. The crannog is completed, and the work on the ring fort, now under construction complete with souterrain, was described to us by

Mr. Jim Bourke of the Shannon Free Airport Development Association. These reconstructions, while no doubt highly valuable from the tourism development point of view, and perhaps also educationally, are sadly lacking in that unique but distinctive "atmosphere" associated with genuine antiquities, no matter how dilapidated. They bear the same relationship to the genuine article as do the modern office blocks with fake facades to the Georgian houses they have replaced in Dublin. You can take them or you can leave them. I prefer the latter course.

Lunch was taken in the grounds of the former Cullaun House, built 1799-1802. In 1828 Daniel O'Connell spent some time here to obtain a residential qualification for election to Parliament. The last inhabitant died in 1954 and three years later the Land Commission acquired the estate. In 1960 the house and some land passed to the Forestry Division, and now the shell of the house is open to inspection.

Cratloe Forest. Foresters: Messrs. Donal Keohane (in charge), and John O'Shea.

The main block, now mostly conifers, was formerly covered by the famous Cratloe oakwoods, some of whose timber, it is said, was used for panelling in Westminster Abbey.

The discussion centred on a block of Japanese larch, of low productivity, and the problems of replacing it. Clear-felling would be objectionable to amenity fanatics because of its position above the main Limerick-Shannon road. It must be stated that much of the ensuing discussion was inaudible due to the size of the group, the lack of any firm chairing of the proceedings and the absence of amplifying equipment. Once again the discussion turned to the marketing difficulties encountered in the region. At least some of the blame was ascribed to our centralised marketing system and its virtual exclusion of the small local buyer.

Following the closing addresses the group returned to the West County Hotel, Ennis, for the Annual Dinner, the quality of which was well up to the standard to which we had become accustomed during our stay at this hotel.

N. O'CARROLL

PARTICIPANTS

"A". Dan McGlynn (President), Michael O'Donovan and Eamonn Larkin (Tour Leaders), Lily Furlong and Fergal Mulloy (Meetings Committee), Professor Thomas Clear, Maureen and Myles Cosgrave, Michael Costello, Peter Crowe, Charlie Crowley, Jim Crowley, Jim Dillon, Frank Drea, Martin Duggan, Donald Eastwood, Gerry Farragher, John Fennessy, Mick Forde, Seamus Galvin, Dr. Padraig Joyce, Ernest Johnston, Harry Kerr, Tommy Luddy, Ted Lynch, Bob McConnell, Andy McClean, Michael MacNamara, Dermot Mangan, Tony Mannion, Benny Moloney, Emma and Owen Mooney, Brid Morrissey, Michael O'Brien, Dr. Niall O'Carroll, Liam O'Flanagan, Paddy O'Malley, Martin O Neachtain, Tom Purcell, Jim Quinlivan, John Ryan, John Twomey, Dan Walsh, Con Warren, Harry van der Wel.

"B". Dan Brassil, Arthur Buckley, Seamus Carew, Larry Cawley, Joe Corbett, Tony Crehan, Noel Cullinan, Anthony Daly, Mick Davoren, Andy Duffy, Michael Flannery, Pat Flynn, Paddy Giblin, Mick Hennessy, Joe Kilbride, Sean MacNamara, Noel Manning, Matt Moroney, P. J. Murray, Tony O'Keefe, Bill Quirke, Dan Scannell, Joe Stapleton, Alicia and Charles Tottenham, Geoffry Tottenham, Jane and Robert Tottenham, Jim Vaughan, Paddy Verling.

SOCIETY ACTIVITIES

KNOCKDRIN AND TULLYNALLY ESTATES. 25th JULY 1975

The party assembled at Knockdrin Estate near Mullingar. The President, Mr. McGlynn introduced members to the hosts. Mr. Prondzynski, son of the owner, Baron Prondzynski had arranged excellent transport facilities and conducted the members on a guided tour of the woodland area. Mr. Schmidt, the estate manager, Mr. L. O'Flanagan, Divisional Inspector, and Mr. J. Quinlivan, District Inspector, Forest and Wildlife Service commented on aspects of woodland management.

The estate comprises 206 ha grassland, 226 ha woodland and 93 ha, water, gardens and buildings. Of the woodland 37% is conifer, mainly Sitka and Norway spruce, 33% hardwood, mainly Oak and Ash and 30% is scrub. Stops included very high yielding Sitka and Norway spruce, Grand fir and Douglas fir. The Yield class of the Sitka ranged from 26 to 30. Discussions concerned thinning and spacing. The general consensus was that early systematic thinning should be practised and that future plantations might be established at 2.5 to 3.0m spacing.

At Tullynally, formerly known as Pakenham Hall, the owner Mr. Thomas Pakenham led the party. The estate, comprising 223 ha grassland 162 ha tillage, 172 ha woodland, and 50 ha bogs, gardens and buildings has belonged to the Pakenhams since the 17th century.

Of the woodland area 61% is conifer, mainly Sitka and Norway spruce and Scots pine, 35% hardwoods, mainly oak and beech and 4% scrub.

Stops included high yielding Norway and Sitka spruce stands. Also seen were Norway spruce stands of poor growth, associated probably with a marl layer near the soil surface, row thinning of Norway spruce and over-mature Scots pine and European larch.

Discussion centred on silvicultural treatments for the young spruces and how to deal with the old larch and Scots pine. With regard to the latter, pathogenic causes of death were discussed and Mr. De Brit demonstrated the Shigometer, an instrument which measures woodrot in standing trees.

G. J. GALLAGHER

ANNUAL GENERAL MEETING 1975

COUNCIL REPORT FOR 1974

COUNCIL MEETINGS:

During the year six Council meetings were held. Attendance was as follows:- Messrs. O. V. Mooney, F. Mulloy, J. Prior and J. Dillon: 6 meetings; Miss E. Furlong, Dr. N. O'Carroll, Messrs. D. McGlynn, M. O'Donovan and C. Tottenham, 5 meetings; Mr. E. Joyce, 4 meetings; Messrs. P. Savill and J. O'Driscoll, 3 meetings; Mr. M. Sharkey, 2 meetings; Messrs. J. Mackin and A. Duffy, 1 meeting; Dr. D. Dickson, Nil.

Mr. A. Duffy resigned during the year and Mr. J. O'Driscoll was co-opted to the vacancy.

SOCIETY MEETINGS:

Three indoor and three outdoor meetings were held during the year. The mid-week meeting in the Northern Region which was held in Lettercran and Kesh Forests was particularly well attended when up to 80 members attended. The Society are grateful to those who gave indoor talks and led outdoor meetings: Prof. F. Convery, Dr. J. Gardiner, Messrs. S. Caulfield, P. Hand, P. Savill, M. O'Donovan and M. Carey.

GUIDED FOREST WALKS:

Guided Forest Walks were held at thirty-three centres in September and while bad weather kept attendance low on the opening Saturday, between 4.500-5,000 people turned up on the following day. The Society appreciate the assistance given by Forest and Wildlife Service, Dublin and Forestry Division, Belfast in the organisation of the Walks and is also grateful to those members who acted as Walk Leaders at the various centres.

ANNUAL STUDY TOUR:

The Annual Study Tour was held in May in the Castlebar District with headquarters in Westport. A summary of tour events is reported in Vol. 31 No. 2 of "Irish Forestry". Our thanks are due to Mr. T. de Gruineil, tour leader, and his staff who assisted with the organisation in conjunction with the Meetings Sub-committee.

ANNUAL GENERAL MEETING:

The 32nd Annual General Meeting was held on Saturday, 23rd March, 1974, at the Shelbourne Hotel, Dublin, the minutes of which are available in "Irish Forestry", Vol. 31 No. 2. Dr. W. H. Jack delivered a very interesting paper entitled "The Changing Patterns in Forestry".

SOCIETY PUBLICATIONS:

Two issues of "Irish Forestry" were published in 1974. A new and revised edition of 'Why Forests' was released in conjunction with the publicity drive for the Guided Forest Walks.

A special sub-committee was set up to investigate the possibility of producing a booklet-type publication on forestry in Ireland. The booklet is intended to have wide appeal.

An up-dated map showing the present forest estate in Ireland is being prepared with the co-operation of the two Forest Services.

The Society is indebted to Dr. Eileen McCracken who has completed an index to Vols. 26-30 of "Irish Forestry". This index will be published as soon as possible.

HONORARY MEMBERSHIP:

The motion "that Mr. Duncan Craig be elected an honorary member of the Society" was unanimously carried at the meeting of 14th February, 1975, at the R.D.S.

NEW MEMBERS:

The Council is pleased to report that 31 new members were elected to the Society during the year.

EXAMINATIONS:

The two candidates who sat for the Preliminary Certificates (formerly Woodman's) were both successful. There were no applicants for the Forester's Certificate. The Council regrets the lack of interest shown by members in connection with both of these examinations.

ELECTIONS:

Three positions of Technical Councillor for the 1975-1977, period were filled by election.

MISCELLANEOUS:

The Society presently enjoys a membership in excess of 550 persons and has a satisfactory financial position. However, the Council regrets that attendances at meetings has been disappointingly low.

Signed: JAMES DILLON,
Hon. Secretary.

MINUTES OF THE 33rd ANNUAL GENERAL MEETING, SATURDAY, 23rd MARCH, 1975, IN THE SHELBOURNE HOTEL, DUBLIN

Due to the unavoidable absence of the President, Mr. O. V. Mooney, the Vice-President, Mr. D. McGlynn opened the proceedings and welcomed those present. The attendance included Miss E. Furlong, Messrs F. Mulloy, D. Craig, D. Mangan, M. Sharkey, W. H. Jack, J. Durand, L. O'Flanagan, S. Galvin, C. B. Tottenham, T. McEvoy, M. Swan, M. Cassidy, J. O'Driscoll, P. M. Joyce, M. O'Brien, T. A. Barry and J. Dillon. Apologies were received from Prof. T. Clear and Messrs. J. Prior and N. O'Carroll.

Secretary's Business

The minutes of the 32nd Annual General Meeting having been published in Irish Forestry, Vol. 31 No. 2 were taken as read and were duly signed. The Council Report for 1974 was read to the Meeting and its approval was proposed by Mr. T. McEvoy and seconded by Mr. D. Mangan.

In the discussion that followed on the proposed forest 'Booklet', the meeting was told that enquiries had been made as regards cost of producing a 20,000 word publication. £400 was quoted for 2,000 copies but there was general feeting that this number might be inadequate. On the proposal of Mr. McEvoy and seconded by Dr. Jack, it was agreed that authority be given to spend not more than £1,500 on the booklet. The editing would be carried out by Dr. N. O'Carroll.

Forest Walks

Miss E. Furlong reported on the difficulty of finding volunteers to lead Forest Walks and she suggested the formation of a special sub-committee outside Council to assist with the organisation. The preparations which must go into these Walks places a heavy burden on the meetings committee and she asked if it was worth continuing on the same scale as in previous years. Mr. McEvoy felt, without interfering with Council business, that perhaps 8-10 walk centres might be adequate. The Vice-President suggested that this matter could be left until the first Council meeting when a decision could be taken. Mr. Mulloy stated that we owed thanks to the Forest and Wildlife Service for the clerical services provided for the distribution of literature.

Duncan Craig Presentation

In presenting a watch to our former Honorary Auditor, Mr. McGlynn said that the Society owed a great debt to Mr. Craig. He had been with the Society since its inauguration and had attended to its financial affairs ever since.

Replying, Mr. Craig thanked the Society and felt that honorary membership in itself was quite sufficient. He said there were only seven honorary members before him but that he was now the first non-technical honorary member.

Abstract of Accounts

The Treasurer presented the financial statement for year ending 31st December, 1974. It was proposed by Mr. L. O'Flanagan and seconded by Mr. M. Swan. On the question of increases in membership subscriptions the Treasurer stated that no increases would be necessary for 1975 at least. The last increase was made in 1971.

Elections

The 1975 Council Elections were confirmed as follows: President, D. McGlynn; Vice-President, P. M. Joyce; Secretary, J. Dillon; Treasurer, F. Mulloy; Editor, N. O'Carroll; Business Editor, M. O'Brien; Hon. Auditor, W. H. Jack; Councillors Technical, Prof. T. Clear, J. Mackin, W. B. Luddy; Councillors Associate, C. B. Tottenham.

Any Other Business

Mr. Tottenham reported that the proposed Wealth Tax Bill 1975 should be viewed with anxiety by the Society. In his opinion it contained passages which, if not amended, would be detrimental to private forestry. He instanced one anomaly where bloodstock is exempt but no such exemption existed for a crop of standing trees. He urged the Society to make representation to the Minister for Lands on behalf of private forestry. On the point that if this proposed Bill was a real deterrent to private forestry interests, Dr. Jack felt it is the duty of the Society to speak out on the matter.

The Annual Study Tour 1975 was stated by Miss Furlong to have been fixed for Co. Clare on 10-12th June with headquarters at West County Hotel, Ennis.

On the question of mid-week meetings, she reported that three such outings are planned for the coming year. As the Sunday meetings in recent times have been poorly attended, these midweek outings offered members a worthwhile outing. Participation will be confined to members and both Forest Services have agreed to allow time off to their staffs, who are members of the Society, to attend.

As a mark of respect to deceased members, M. W. Breslin and Mr. F. Moorehead, a minute's silence was observed.

In closing the meeting Mr. McGlynn thanked the Council for their efforts in the past year and asked members to help the Society by their participation in future events.

FORESTRY WALKS 1975

As in every year since 1970, the guided forest walks, organised by the Society for the benefit of the general public, and led by members of the Society, were held on Sunday 14th September. The walks again proved very popular, with generally high numbers attending. The Avondale walk, which was also held on Saturday 13th, was attended by the President of the Republic of Ireland, Cearbhall O Dalaigh.

The following were the areas visited and the leaders:
Abbeyleix Demesne, Co. Laois: S. R. Fyfer.
Adare, Co. Limerick: E. Larkin, M. O'Donovan.
Ards, Co. Donegal: D. Connolly.
Avondale, Co. Wicklow: D. MacAree, P. MacOscair, P. O'Malley.
Ballyhooley, Co. Cork: P. Verling.
Ballygar, Co. Galway: J. Desmond, P. McArdle.
Camolin, Co. Wexford: P. J. Cotter, G. Murphy, J. J. O'Reilly.
Cappamore, Co. Limerick: D. Dinneen, P. White.
Castlepollard, Co. Westmeath: J. Martin, P. J. Morrissey, M. Sheridan.
Clonmel, Co. Tipperary: S. Gavigan, E. Ryan.
Donadea, Co. Kildare: P. Crowe, E. Fitzpatrick.
Dromore, Co. Clare: L. Cawley, P. J. O'Sullivan.
Drumsna, Co. Leitrim: J. F. Duane, J. E. Ryan.
Emo, Co. Laois: J. Prior.
Farren, Co. Cork: D. McMahon, W. Shine.
Forth Mountain, Co. Wexford: T. Enright, M. T. Ryan.
Foxford, Co. Mayo: T. de Gruineil, D. Murphy.
Galtee, Co. Limerick: J. Moloney.
Killeshandra, Co. Cavan: B. Friel, F. Kelly.
Glencree, Co. Wicklow: S. Hayes, A. Higgins.
Glenealy, Co. Wicklow: H. M. FitzPatrick.
Glen of Imaal, Co. Wicklow: T. Donohue, F. Fahy.
Gort, Co. Galway: C. Hanley, J. Lillis.
Granard, Co. Longford: L. Diffley, J. Quinlivan.
Hazelwood, Co. Sligo: C. Crowley, T. Gallen, T. Hunt.
John F. Kennedy Park, Co. Wexford: J. Durand, C. Kelly, B. T. O'Reilly.
Killakee, Co. Dublin: J. Deasy, J. Fennessy, M. O'Brien.
Kilfinane, Co. Limerick: L. O'Connor.
Killorglin, Co. Kerry: J. Costello, D. Walsh.
Knocktopher, Co. Kilkenny: P. Crowley, D. Hayes, G. McCarthy.
Lisgoold, Co. Cork: M. McNamara.
Lough Eske, Co. Donegal: A. Connolly.
Lough Talt, Co. Sligo: M. Cassidy.
Mullaghareirk, Co. Limerick: M. Doyle, J. O'Mahony.
Portumna, Co. Galway: P. Keane, E. McGuinness.
Randalstown, Co. Antrim: W. J. Crawford.
Ravensdale, Co. Louth: T. J. McCarthy.
Townley Hall, Co. Louth: J. A. McGinley.

SOCIETY OF IRISH FORESTERS

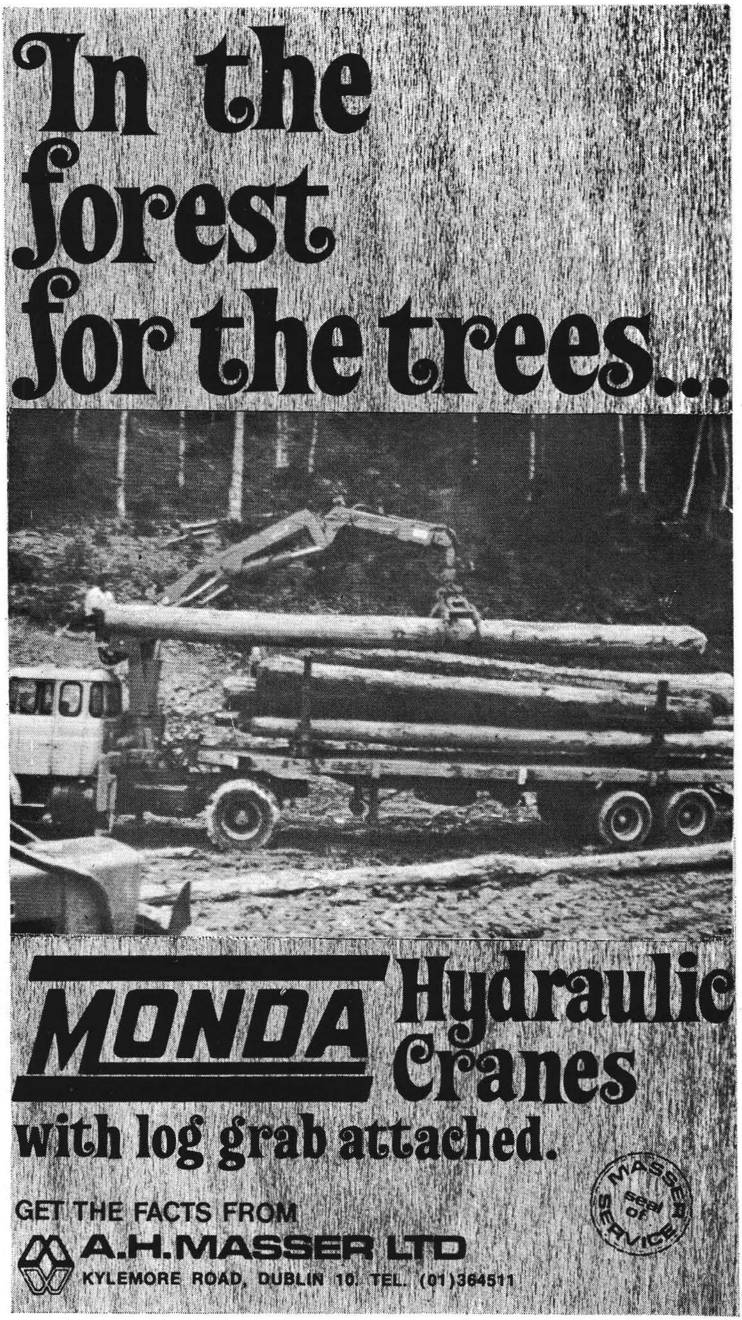
STATEMENT OF ACCOUNTS FOR YEAR ENDING 31st DECEMBER, 1974

1973	RECEIPTS			
650.18	To Balance from last Account			1,899.95
	” Subscriptions Received			
	379 Technical	1974	939.22	
	7 Technical	1973	12.50	
	116 Associate	1974	232.91	
	4 Associate	1973	3.00	
	13 Student	1974	19.50	
	Other Arrears		1.00	
	Advance Payments		32.50	
1,157.43	Other Subscriptions		9.50	1,250.13
	” Interest on Investments			
	” Dublin Corporation $9\frac{3}{4}\%$ Stock		20.10	
86.92	” Savings Account		189.99	210.09
	” Journal			
	Sales		118.87	
793.21	Advertising		919.46	1,038.33
	” Contribution ex Department—Forest Walks			
	” Contribution from Forest & Wildlife Service			
	Promotion of Forest Walks		**547.64**	
	Publication of *Why Forests*?		**363.88**	**911.52**
4.00	” Examination Fees			—
20.82	” Book Sales			7.64
10.00	” Donations			—
2,722.56				5,317.66

1973	PAYMENTS		
23.49	By Stationery and Printing		16.43
258.41	” Printing of Journal & Reprints		910.29
202.36	” Postages		297.70
26.32	” Expenses re Meetings		11.81
21.20	” Bank Charges		7.50
182.55	” Secretarial Expenses		220.91
3.00	” Examination Expenses		—
32.78	” Value Added Tax		43.03
22.50	” Refunds		—
	” Honoraria		
	Secretary	12.50	
	Treasurer	12.50	
	Editor	12.50	
50.00	Business Editor	12.50	50.00
	” Forest Walks Expenses		
	Promotion of Forest Walks	547.89	
	Publication of *Why Forests*?	300.00	847.89
	” Balance		
	In Bank, Current & No. 2 A/c	133.49	
1,899.95	Savings Bank	2,778.61	2,912.10
2,722.56			5,317.66

I have examined the above account, have compared it with vouchers and certify same to be correct, the balance to credit being £2,912.10, which is on Current and Savings accounts at the Ulster Bank Ltd. This includes £1.00 credit due from Bank and not shown on Bank Statement. There is also a holding of £206.19, Dublin Corporation $9\frac{3}{4}\%$ Stock. The above statement does not take account of a bill outstanding of £63.88 for publication “Why Forests?”.

Dated 8th February, 1975. W. H. JACK, Hon. Auditor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