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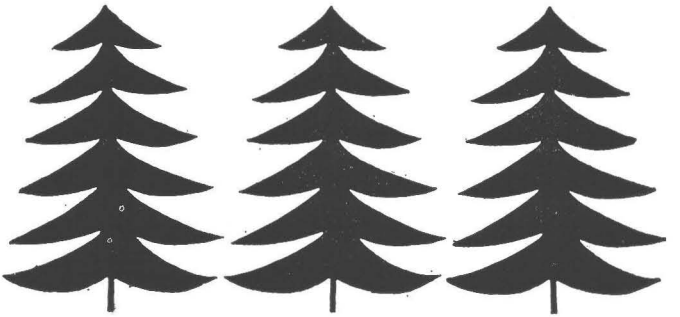

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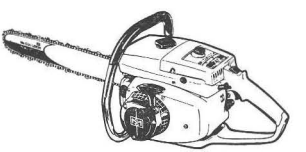

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IRISH FORESTRY

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Editorial

Whereto we pass

Where America leads, we usually, like it or like it not, follow. Let us examine then our future.

At present in the southeastern states they are planting the "third forest." The first was the primeval; the second was regrowth, now almost cut out. The third will, they hope, provide more timber on less land. For this they will depend heavily on genetically improved stock. Everything is mechanised: site preparation (90-ton tree crushers); planting (1000 seedlings per hour); and logging, with a lone man in an air-conditioned cab doing the work of dozens of labourers with simpler machines.

In the Douglas fir region of the Pacific Northwest the Weyerhaeuser Company has laid cold-blooded plans to increase productivity on 5.6 million acres of woodland. Every stage will be monitored, even the weather conditions under which nursery stock may be lifted will be specified. Spacing control, fertilisation with nitrogen (from helicopters), thinning, all will be scheduled and varied according to site class, which is being intensively mapped.

Sentiment, clearly, is out. Would advocates of the "alternative species" please note.

Then there is the other pressure, from the effects of industry. During the 1860s sulphur dioxide from a smelting plant killed nearly 20,000 acres of trees in Tennessee. In the 1920s trees were killed up to 40 miles from a copper smelter in British Columbia. In 1949 fouride poisoning damaged trees within 50 miles of an aluminium ore plant in Washington. Other serious cases led to control measures. We are at the very beginning of this phase. We have had damage; we have few if any effective control measures; we plan more industries.

Planned and dragooned from one side, poisoned and polluted from the other, our future may look bleak. One thing is sure, though; it will be bleaker still unless we ourselves get vigorously involved in its planning and management.

Aspects of Forest Management in the Austrian Tirol

P. M. JOYCE[1]

The Austrian Tirol, one of the nine provinces of the Austrian Federal Republic. has an area of 12,647 sq. km. and a population of 500,000 people. Its capital, Innsbruck, was founded on the old Roman road through the Alps which still serves as the main route between Italy and Germany. Topography is typically Alpine with snow capped mountains alternating with fertile green valleys or *tals*. Its forests, which account for 37% of the land surface are located mainly on the mountain slopes and ridges.

FOREST OWNERSHIP AND ORGANISATION

Forest ownership is divided into 22% Federal Forest, 42% Community Forest, *(Agrigemeinschaft)*, 34% Small Private Woods, and 2% Large Private Woods. The Federal Forest is the responsbiility of the Ministry for Lands and Forests based in Vienna. In the Tirol the forest area which it controls is divided into 16 districts of 5,000 to 10,000 ha each. The District Officer who incidentlly is employed on a contract basis and is not a civil servant, has complete responsibility for the management of his district and according to law the Federal Forest must be managed by the same basic business principles which apply for private enterprise.

Management of the community and private forests is the responsibility of the Tirol Province Forest Service, which operates within the framework of the forest legislative code laid down by the Federal Forest Service for all of Austria. There are 19 Provincial forest districts in the Tirol, each in the charge of an academically trained forester. Districts vary in size from 12,000 to 30,000 ha and are divided into a number of *revieres* controlled by *reviere* foresters who are assisted by forest supervisors *(Waldaufseher)*. (A *Waldaufseher* has had a six months training in forestry and on average there is one in every medium sized village). Since the Province does not own the forest the role of the forestry personnel is somewhat analogous to that of the Agricultural Advisory Service in this country, but in a forestry context. There are, however, Provincial forest laws governing the management of both community and private forests which ensure that

1. Department of Forestry, University College, Dublin.

owners comply with the precepts of the management plan prepared by the Tirol Provincial Forest Service.

SILVICULTURAL PRACTICES

The Austrian Tirol is the meeting place of two of Europe's major climatic zones, an Atlantic type of climate north of the Inn river and a Continental climate to the south.

From a silvicultural point of view the two have important differences. Frequently, both zones occur on opposite sides of the same valley as illustrated by the Atlantic climate of the Hafelekar mountains overlooking Innsbruck from the north and the Continental climate of Patscherkofel to the south. The essential difference is due to aspect and rainfall. Slopes with a southern aspect have a significantly higher rainfall than north facing slopes. The Atlantic climate favours species such as Norway spruce *(Picea abies)*, silver fir *(Abies alba)* and beech while, in the Continental zone, the silver fir and beech are replaced by *Pinus cembra* which needs cold winters for germination. European larch is also present in mixture with the spruce. The silvicultural system most widely practised is the *Saumschlag* (strip system) which involves cutting a 20 m strip every 5 to 10 years after a preliminary regeneration felling. (Essentially this is closer to the *Shirmsaumschlag* or shelter-wood strip system). In the Continental climatic zone every effort is made to obtain a mixture of larch or pine with the spruce as a precaution against wind-throw. If the strip is too narrow there is insufficient light for larch to regenerate; too wide a strip will allow grass to develop and natural regeneration may be impossible. Failure to regenerate naturally is silviculturally undesirable because it means planting with a sub-species or provenance which may be completely unsuited to the site. This is more readily appreciated when it is considered that four sub-species of spruce are recognised; these with pendulous branchlets for the valleys and lower slopes, these with flat branches for the middle slopes, the brush type *(burste)* for the higher slopes and the narrow crown pinnacle type *("spitz")* spruce for the highest regions. Since the different sub-species are indistinguishable in the transplant stage the importance of natural regeneration becomes apparent. Planting of the pendulous branch type on a *"spitz"* spruce site would be disastrous. Similar sub-species exist for pine.

In the Atlantic climate zone the strip system is also the most widely recognised method of regeneration. In theory regeneration with Norway spruce, silver fir and beech should present no problem. In practice, however, regeneration is often impossible to achieve where cattle are allowed to graze. In Achental, for example, 5,300 head of cattle grazed on 6,000 ha of woodland and natural regeneration was non-existent except where fencing was

erected. In ungrazed areas natural regeneration in the proportion; beech 2, silver fir 3, norway spruce 5, is the objective. The proportion of the stand to be removed in the regeneration felling will vary depending on aspect and amount of light reaching the forest floor. In one instance 60% removal on a northern aspect failed to achieve natural regeneration. Then the remaining 40% was removed and regeneration came into profusion.

PRODUCTION AND HARVESTING

The forests of the Tirol are sub-divided into two broad categories, production forest and protection forest. The property of the Federal Forest Service at Achental contains 4,630 ha of production forest and 1,703 ha protection forest with an average standing volume of 221 cubic metres per ha for the production forest and 163 cubic metres per ha for protection forest. The weighted average is 206 metres per ha. Length of rotation ranges from 100 to 120 years. Mean annual increment in Achental varies with species and district from a minimum of 2 cubic metres per ha per annum to a maximum of almost 6 cubic metres per ha per annum. In more fertile districts the mean annual increment can range from 6 to 10 cubic metres per ha per annum, but this is above average for the Tirol. Growing stock is determined at 20 year intervals by systematic sampling on a line plot basis. The allowable cut is determined by Von Mantel's and similar formulae and is currently 800,000 cubic metres per annum for the Tirol.

Topography makes the extraction of timber a difficult and costly operation. In former times chutes and sleds were used to bring logs to the lower slopes where they were loaded on horse-drawn vehicles or stream driven if there was a stream with sufficient water. Occasionally forest railways and aerial ropeways were used. In general, however, the erection of an aerial ropeway of the Wyssen type as used in Switzerland is ecomically unattractive because of the cost of erection and the requirements in regard to total volume and quality of material to be extracted. Good quality roads are considered to be the solution in the long term.

Where short-haul extraction to roads is feasible, as in Achental, the following procedure has evolved. Four men fell with chain saws; six to eight men operate Garret Tree Farmer vehicles to drag the logs to a central depot within the forest where they are put through a debarking machine. A forester and his assistant supervise the operation, one co-ordinating at the logging point and one measuring and segregating material into assortments at the depot. The group has a mechanic available in case of breakdown and the total number in the group is twenty. Using this approach the total cost per cubic metre has been reduced from 158 Sh by the conventional method to 115 Sh (from 9½p./cu. ft. to 7p./cu. ft.).

Roads are constructed to a high standard to cater for truck and trailer loaded to a gross weight of 38 tons—the legal limit. Construction is carried out in winter by bulldozing a road foundation of approximately $\frac{2}{3}$ cut and $\frac{1}{3}$ fill depending on the underlying material. In Achental district the cost of roading ranged from 240 to 270 Sh/mt. (Approximately £7,000/mile). The high cost was attributed to a soft subsoil and the fact that the rough and fine surfacing material has to be transported 4 km and 8 km respectively. Road density it 30 m per ha.

Felling and sort-haul extraction is done by forest labour. Material is sold on roadside at 750 Sh per cubic metre (41p/cu. ft.) for sawlog material and 350 Sh per cubic metre (19p./cu. ft.) for pulpwood. The method of sale, by auction, sealed tender or private treaty, is left to the discretion of the district officer who has responsibility for all matters that relate to his district. This includes road alignment and construction, wildlife management and protection, and the determination of when, where and what to cut as well as sale of the produce. Since Federal Forests operate under the same criteria which apply in private enterprise, management proposals submitted by the District Officers to Headquarters in Vienna come under close scrutiny and only those which indicate a reasonable return on investment will be sanctioned. This practice can sometimes lead to considerable reward. Up to seven years ago the Achental district was losing money, at which time the District Officer submitted a proposal for a roading programme which was underwritten by the Vienna headquarters. Now the district has an operating surplus of 3 to 4 million Sh per year and this is expected to continue.

WILDLIFE MANAGEMENT

In the Tirol the management of deer is considered an integral part of Forest Management. The forest is rented in hunting *revieres* and the following table illustrates the size of *reviere* and rental perha per annum in the Achental.

Name	*Area in Ha*	*Rental—Sh/Ha*
Bachental	6,568	23
Klammbach	1,456	25
Hechenberg	1,067	43
Dollsmannsbach	867	30
Seekarspitz	1,126	30
Pitz	1,186	30

In addition to the rental per ha there is a charge to cover the cost of foddering deer during the winter months. In Klammbach this

is currently 162 Sh per ha to give a total charge of 187 Sh per ha. Here fifty-two red deer were fed last winter on silage, hay and concentrates which included vitamins A and D. The amount of foddering depends on the weather. When the snow is heavy the deer find it difficult to move through the mountain ranges. Generally foddering lasts approximately 170 days from October to May and the daily ration per head is 6 kg silage, 2 kg of hay and 0.6 kg concentrates.

In addition to foddering, wet areas are reclaimed for grass and meadow is rented from local farmers to give 1% to 2% of the total area as "deer lawns." Regenerated areas in the 1 to 20 years age class are also counted as grassland and areas over 100 years are given as $\frac{2}{3}$ of their actual acreage. The objective is to prevent damage to natural regeneration by deer where there are 6 head per 100 ha as in Klammbach. The normal stocking is 1 to $1\frac{1}{2}$ per 100 ha. In areas where natural regeneration is prolific a stocking of 2 to 3 red deer and 5—6 roe deer per 100 ha is possible. A stocking of 10 red deer per 100 ha generally leads to the disappearance of the silver fir which is eaten in the seedling stage. In natural woodland the silver fir occurs in mixture with Norway spruce in the proportion 40%—40%. With high stocking of red deer the proportion becomes silver fir 10%and norway spruce 80%. Many foresters have claimed that the disappearance of silver fir is a natural phenomenon because there is no apparent regeneration of silver fir. They are not aware that it is eaten in the seedling stage. This can be proved by shooting the deer and examining the contents of the rumen. Generally, where the stocking is high the deer are usually young animals. This is a bad situation as hunters prefer to shoot older deer and the young have no teachers to show them what to do.

In winter the herds are counted and the shooting plan is drawn up in May by the district staff. In Klammbach the 1970-71 count showed 154 red deer, 57 roe and 70 chamois. The shoot of red deer in 1971 will be 3 stags over 10 years of age, 15 younger ones and 35 calves and hinds. The general recommendation of the shooting guide is to remove 50% of the calves, 25% of 1 to 5 year old and none of the 5 to 10 year old. The aim is to have 50% of the red deer stags more than 5 years old. Red and roe deer are shot in the ratio 1 male to 1 female and chamois 1 male to 1.2 female. The following table outlines the shooting season for red and roe deer and chamois.

Red Deer:

Hinds, 1 year calves	1st July—31st Dec.
Young stags IIb	1st Aug.—31st Dec.
Young stags	31st Aug.—31st Dec.
Old Stags Ia, Ib	16th Aug.—31st Dec.

Roe Deer:

Roebuck	16th June—31st Oct.
Female Roe and kids	16th June—31st Dec.

Chamois: 1st Aug.—15th Dec.

Hunters are rarely allowed to go into the hunting *revieres* alone unless they are very experienced. They are allowed to keep the meat of the kill and there is no extra charge for the trophy. Renting of a hunting *reviere* by a syndicate is frowned upon and in the Achental only two persons are allowed to combine in the renting of a hunting *reviere*. In addition to red and roe deer and chamois hunting *revieres* have good numbers of capercaillzie *(Auerwild)* and Black Grouse *(Birkwild)*. In 1958 an experiment was launched to establish a colony of *Ibex (Steinwild)* in Bachental. Today they number 29 after the loss of three in an avalanche in the winter of 1969/70. The Red Deer Preservation Association, *"Karwendel"*, was established in 1962 to improve the structure and raise the quality of the herds. To date, the results achieved have been extremely good. In Achental, since the Spring of 1970 a programme of wildlife research is being conducted under the well-known game biologist, Dr. Bubenik. The objective is to investigate the movement of deer in relation to time and area and determine the dependence on infrastructure and environmental factors.

PROTECTION FOREST

In former times the people of the valleys cleared trees from the timber line first to provide summer grazing for their animals. As the population increased people moved up the slopes and the timber line moved down. The grazing sequence for cattle is a movement to the higher elevations (2000 m) in the summer, to the middle slopes in autumn, to the lower slopes in the late autumn and back up to the middle slopes where they are fed and housed for the winter months. Grazing of the woodland areas and the constant cutting of vegetation and branches for animal bedding has resulted in degradation of both the alpine meadows and the forest.

The formula; Precipitation = Evapo-transpiration + Run-Off + Percolation expresses the water balance between the atmosphere and the ground. It is well known that closed woodland reduces or may even eliminate run-off and thereby reduce erosion and by delaying the flow to water courses checks or prevents floods. Furthermore, snow melts more slowly under trees and the melt-water is unlikely to exceed the absorptive capacity of the litter on the forest floor and the soil beneath (1). The forest is therefore an important factor in the Tirol in the effort to prevent

avalanches in the winter and spring and combat torrents in the late summer and autumn.

Avalanches are of two kinds; the wet avalanche is caused by the movement of wet snow down a slope and trees can play a signifiant part in preventing its occurence or checking the movement. Dry avalanches occur after a heavy fall of dry snow on sloping ground. The force holding the molecules of snow together is overcome by the force acting down the slope. As the snow breaks away to form the avalanche there is a tremendous release of energy giving off an explosive sound and the avalanche hurtles down the slope creating an air cushion in front which uproots or breaks trees. The force which it exerts on an object in its path is reckoned at 100 tons per square metre. This type of avalanche usually forms above the timber line and when it strikes it leaves a swathe through the forest on the lower slope. Since little can be done to stop it the objective is to prevent it. This is done by using rockets or explosives to bring down the snow before it can build up to avalanche proportions. In the long term the raising of the timber line will provide a more adequate and less costly form of protection against avalanches than the existing steel barriers and nets. This work is the responsibility of the Tirol Forest Service and the current work being done in the Zillertal demonstrates the approach adopted.

The Ziller river rises in the glaciers of the Zillertal Alps on the Austrian-Italian border and flows north into the Inn through the Ziller Valley for the greater part of its course. The "*integralmelioration*" project being conducted for the 197 sq. km. on the left side of the Ziller Valley has to date cost about 128 million Sh. The Federal Government provides 70% of the cost and of the remainder 20% is provided by the State of Tyrol and 10% by the community. A large proportion of the fund is spent on controlling the small tributaries which flow down the valley side into the Ziller. In the past the small towns and villages were erected on those tributaries as they provided the only source of power. During periods of heavy rainfall those small tributaries can become raging torrents which transport thousands of tons of debris and deposit it in the valley. These torrents consist of 40% water and 60% material ranging from fine silt to boulders weighing more than a ton. The deposition of the material interferes with the flow with the result that it spreads out from the stream bed causing extensive damage to property and sometimes resulting in deaths in the villages and towns. Initially, dams were erected to create small lakes where the material could settle and be removed later. These dams were, however, only adequate for the control of small torrents and in some instances the settling area filled up in less than 15 minutes so that the remainder of the torrent went over the dam. More recently, the trend has been towards the erec-

tion of barriers consisting of horizontal steel girders bridging the stream and set in concrete and stone piers. A three barrier battery of this type protects the town of Fugen in the Zillertal. The first barrier has the girders 1 m. apart so that anything exceeding 1 m. in diameter is held. The next barrier has girders 60 cm. apart and the third has girders 30 cm apart so that each in turn will trap material larger than 60 cm and 30 cm respectively. The 30 cm spacing of girders in the third barrier is conditioned by the fact that the Ziller can move material up to 30 cm in diameter.

In addition to the erection of barriers much work is being done to reduce the speed of the water flow in the streams and consequently its potential for erosion. This is achieved by constructing a series of steps along the steeper stretches.

The contribution of the Forest Service *(Forstinspektion)* in the drive to re-afforest the high alpine meadows is illustrated on a 200 ha commonage near Fugen. Altogether there are 30 to 40 owners who have agreed to the re-afforestation of 160 ha of the 200 ha in return for amelioration of 40 ha. The results have been striking; the total milk yield formerly obtained on the 200 ha has been doubled and the quality has improved. In addition a new road network has improved communications and marketing arrangements for milk and milk products are better. Stock has been excluded from the 160 ha and the area has been planted with *Pinus cembra,* European larch and Norway spruce at a stocking of 5,000 plants per ha costing 15,000 Sh per ha. The objective is to raise the timber line from 1600 m to 2100 m and abolish grazing by cattle in the existing production forest. This is expected to increase increment from 1 to $1\frac{1}{2}$ cubic metres per ha to 2—$2\frac{1}{2}$ cubic metres per ha. The Forest Service is very pleased with the success of this project and now has data to prove that amelioration of part of the area can free the remainer for re-afforestation. Convincing the owners of the feasibility of such projects will be less difficult.

The re-afforestation of the high alpine meadows is a task of great difficulties, not the least of which is the heavy failure rate due to extreme exposure. In an attempt to overcome this problem a small nursery has been established in the Zillertal at 1700 m to produce plants for high altitude afforestation. Larch and *Pinus cembra* seedlings, 1 year and 2 year old respectively, are brought up here for transplanting and remain for a two year acclimatisation period before being planted. In the Sellraintal there is a further problem of too much or too little snow to contend with. Too much snow results from movement of the snow by wind into drifts, the location of which depends on the configuration of the ground. Other areas are stripped bare of snow in the process and the plants suffer from frost damage. A great depth of snow creates ideal conditions for the snow fungus, *Phacidium infestans*

and when the slope is steep the snow has a tendency to creep down the slope ripping out plants in the process. In an attempt to prevent this ripping out of plants, snow-bridges have been erected over the plants or the ground has been stepped to create a flat location for the plants. The major problem of uneven snow distribution has been overcome by the erection of screens at strategic points to control the wind speed. A screen with 50% open space will give a flattish distribution of snow to leeward while a screen with only 25% open space gives a much more peaked distribution closer to the screen. Screens of iron, aluminium and plastic have been tried and to date the best results have been obtained with the plastic type 50% open. The Sellraintal was at one time a continuous closed forest but was deforested 1,000 years ago for the purpose of obtaining pasture. The cost of re-afforestation is borne by the State (80%) and the owners (20%). *Pinus cembra* and larch are the species used at a density of 6,000 plants per ha on good sites and 10,000 to 15,000 plants per ha on poor sites.

It is now recognised that a large proportion of avalanches and torrents can be attributed to the lowering of the tree line in former times to provide alpine meadows for grazing. While protection against avalanches and torrents can be effected by technological methods such as nets and barriers, this a very expensive approach and is limited in practice to strategic areas. In the long term the solution lies in restoring the tree limit to its former position, but this is a very difficult undertaking without scientific research. The *"Klimahaus"* on Patscherkofel mountain south of Innsbruck is one centre of the Alpine Forest Research Institute investigating the problems involved.

At Patscherkofel, Professor Tranquillini of the University of Innsbruck and a staff of twenty conduct research into aspects of climatology, plant physiology, soil science etc. associated with the survival and growth of plants at high altitudes. Young plants are examined to investigate their resistance to varying climatic conditions such as freezing temperatures, heat, desiccation, etc. Since the weather is very extreme at the centre many plants fail to survive. On the open mountain it is impossible to determine the cause of death or, indeed, to say when the plant died. In the *"Klimahaus"* it is possible to take one factor at a time, e.g. there is a room where freezing temperatures can be simulated.

Working with with different species, such as *Pinus cembra, Larix* and *Picea,* their response to various factors can be determined. For example, fertilization with nitrogen gives big plants with very poor resistance to freezing temperatures. These will die on the tree line. The second research objective in the *"Klimahaus"* is to determine the material production of plants: they must not alone survive, they must grow to be of use. The relationship between growth and climate is important so it is essential to grow

plants and measure the rate of growth. Since this would take years to accomplish, an alternative method has been evolved in the form of measurement of carbon dioxide uptake. This method is expensive in practice, but it is exact. After a few minutes it is possible to say how much material the plant will produce.

The relationship between production and temperature for *Pinus cembra, Larix* and *Picea* is also being investigated. The production surve for Patscherkofel, at 2000 m above sea level, shows an optimum at 12°C and differs markedly from that at Innsbruck 1,500 m below it in the valley.

Wind is another important factor which influences production. With tree species, greater production is obtained with low wind speed which gives a higher carbon dioxide gradient than zero wind speed. With greater wind speed the stomata close and production decreases. The sensitivity of Rhododendron to even moderate wind speed is apparent from the abrupt decrease in production with increasing wind speed.

—Experiments with shoot and root anti-transpirants have shown considerable success and results have been put into practice in the field. In particular, the application of an alginate (agricole) to plant roots after lifting has given good results. Planting check is diminished and survival is much improved. In the *"Klimahaus"* research is in progress to determine the relationship between root respiration and photosynthesis of shoot and next year fifteen different provenances of spruce will be tested to establish this relationship for each one. The relationship between respiration and photosynthesis of shoot can be established for varying intensities of temperature, humidity and light in an intricate home-made apparatus. Essentially, it is a question of measuring the carbon dioxide content of the controlled atmosphere at different levels of these factors. Professor Tranquillini considers that the best pioneer species is larch but at the tree line the only species worth considering is *Pinus cembra.* A New Zealand research worker at Patscherkofel had no success with *Pinus contorta* from New Zealand.

RECREATION

The Tirol is well known as one of the leading ski-centres in Europe and the demand is such that forestry loses 50 ha per year to ski-runs. An equivalent area is, however, planted elsewhere to maintain the balance.

In the vicinity of Innsbruck there is a network of paths through the forest to facilitate hiking or mountain climbing. Most of those paths have been formed over the years by people seeking recreation. On the outskirts of Innsbruck a forest walk of 2.5 km long has been created in the "Hottinger Hofbannwald" at the foot

of the "Nordkette" and more recently a "Forest meile" has been created at Gotzens which includes a series of exercises in the recreational facilities offered.

The role of the forest in contributing to amenity is very important in the Tirol because of tourism and it is fortunate that the silvicultural system adopted by choice (the strip system) causes a minimum of disturbance of the landscape. Whether this can continue in the future remains to be seen. Rising costs and economies of scale may force the logging of larger areas in the interest of economic forestry. Amenity will then act as a constraint and may indeed limit any development in that direction. Since many of the private forest owners are also involved with tourism in that they provide accommodation, they may willingly decide to forego revenue from the forest in order to maintain the unique amenities which now exist.

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Microbial utilization of Cellulosic materials as a commercial venture

AIDEN J. McLOUGHLIN[1]

Wood has held for many centuries a significant place in the human requirement. It has served man as a structural material for building, furnishing, tools, weapons, transport and until recently was his only readily available fuel. Other parts of the tree such as fruit, flowers, bark, seeds and needles have been used as food, clothing, medicine and for decoration.

The possibility of using hydrolyzed wood as a source of fermentable carbohydrate has been recognised for many years. This fermentable carbohydrate or "wood sugar" as such hydrolyzates are usually called may be utilized by a microbial process. In 1943 the Forest Products Laboratory undertook the hydrolyzes of various woods on a pilot scale for the production of ethyl alcohol and fodder yeast. The interest at that time stemmed from war-time conditions.

With the increased interest in microbial fermentation of the last fifteen years and with renewed interest in national resources our interest once again turns towards "wood sugar."

Wood sugar is obtained from the hydrolysis of cellulose and hemicellulose found in plant material. Forest products are part of this pool which also embraces agriculture residues and peatlands. Utilization of these resources will mean that new frontiers in hydrolysis and fermentation must be crossed.

Forests are a unique resource. They are inexhaustible compared with oil and coal etc. They may be sited, with planning, where required. In addition forests have great ecological significance. It is estimated that one fourth of the earth's land mass is covered with forest thus making this resource one of the most widespread.

Conversion of cellulosic material to "wood sugar" involves the breakdown of high polymer carbohydrates present and the hydrolysis of the bonds between them and other compounds.

There are now several processes for obtaining wood sugar. The following methods are reviewed by Prescott and Dunn (1959).

1. The Bergius—Rheinau process: This is based on the fact that 40% HCl will hydrolyze cellulose at room temperature. In this process the wood is shredded and then dried in revolving

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drums to a water content of 0.5%. The dried wood is transferred to a battery of dicusers where HCl acts on it and produces water soluble sugars.

2. The Scholler-Tornesch Process: this method employs dilute acid, elevated temperatures and steam under pressure.
3. The Giondani-Leone Process: uses sulphuric acid.
4. The Madison Process: in this process wood is percolated with dilute sulphuric acid (150°—180°C).
5. Another process which liberates wood sugar is the sulphite process used in mills in Europe and North America. In this process wood is digested in an aqueous solution of bisulphites with an excess of sulphur dioxide, this solubilizes the lignin, leaving the wood cellulose intact whereas the less resistant hemicelluloses are hydrolyzed to sugars. Virtually all sulphite pulp mills are faced with spent sulphite liquor disposal problems.

These processes yield not only wood sugar but also chemicals of importance. Although the author is interested in the biological utilization of cellulosic material one cannot ignore the chemical significance. The following is a short account of some of the chemicals obtained using the above processes.

The main chemical product of wood is cellulose—this has many and diverse uses which are too numerous to discuss here.

Hydrogenation of hexoses and pentoses, found in wood sugars, in the presence of a nickel catalyst under pressure and at elevated temperatures yield the corresponding polyhydric alcohols, hexitols and pentitols which are important in industry. Sorbitol, a polyhydric alcohol obtained on reducing glucose is important in resin manufacture, paint manufacture and in the confectionery industry. Dulcitol, a polyhydric alcohol related to galactose has industrial significance.

Dehydration of pentoses in an acid medium yields the heterocyclic aldehyde furfural which is of significance in the manufacture of plastics, synthetic fibres, resins etc.

Hydrogenation of furfural yields furfuryl alcohol used as a raw material for resin synthesis and tetra hydrofuryl alcohol used as a solvent for cellulose esters.

Oxidation of furfural yields maleic anhydride and maleic acid which is important in resin manufacture. Furfural based compounds are significant as chemotherapeutic agents in medicine.

Lignins also yield chemicals of some industrial significance. These products include activated carbon, nitrolignin, chlorolignin, oxalic acid and protocatechuric acid. Vanillin, a product obtained from lignin is of importance in the confectionery industry.

Fermentation based on wood is known for many decades now. Originally wood sugar was used for the manufacture of ethanol and protein. The ethanol based industry could not compete with similar industries based on petroleum thus after the war this pro-

cess became less popular and at the moment is carried out only in Russia.

The protein based industry found its impetus in the shortage of animal protein during World War II when countries such as Germany and Sweden replaced much of their protein requirements with protein obtained from yeast. This industry played a less significant role after the war and gradually was linked to the sulphite process.

With the awakening of interest in protein obtained from microorganisms at the moment the wood industry is sadly trailing the petroleum industry. B.P., Esso and Shell have invested many millions of pounds in factories built for the production of yeast protein on hydrocarbons. Their process is costly and toxicologically has not ben proven. Table I compares the cost of protein from different sources.

TABLE I

Comparable prices of protein-rich foods (US$)

Food	Protein content %	Price/lb. protein
Beef	15.2	4.6
Pork	11.6	4.3
Non-fat dry milk solids	36.0	0.6
Soy-flour	52.0	0.13
Yeast grown on sulphite liquor	50 (approx.)	0.27
Yeast grown on hydrocarbon	50 (approx.)	0.35

The main weakness in the production of war-time protein was that enough research was not carried out to make the product more palatable. Recent research has shown that with various treatments the protein may be made to take on certain desirable flavours and textures.

Yeasts in addition to yielding protein are also rich sources of biochemicals. There are at least one hundred enzymes listed that are produced by yeasts. Many of these enzymes are at present of purely academic interest, for instance in connection with research or intracellular metabolic pathways. Enzymes of commercial importance obtained from yeasts include alcohol dehydrogenase, glucose-6-phosphate dehydrogenase, gluthathionine reductase, hexokinase and uricase.

Another group of important cell components includes the coenzymes which in contrast to the complex protein structure of the enzymes themselves are usually relatively small molecules which act as carriers of simple molecular groups or elements such

as hydrogen, hydroxyl, acetyl and phosphate. These compounds are important in biochemical research.

Amino acids, nucleotides and nucleic acids in addition to vitamins may also be obtained from yeast grown on wool hydrolyzates and in fact are produced commercially from yeast grown on the waste sulphite liquor of the pulp industry.

Among the more recent fermentations carried out on wood sugar, by yeasts, are the production of citric, gluconic and pyruvic acids.

Examples of other chemicals obtained from yeast include the production of ephedrine, which is of medical significance, by the conversion of benzaldehyde.

Fermentation is the conversion of sugar by microrganisms to form various products. Thus by varying the types of microorganisms it is possible to obtain such commercial products as fumaric, kojic, lactic and propionic acids. It is also possible to obtain solvents such as acetone, butanol etc., but in this field it is more enconomic to obtain these products from the petroleum industry.

Some of these processes (solvent production, ethanol and protein production) were used during the war years but were not viable economic process in the post-war years. The reasons for economic failure was probably due to low yields, high processing costs and low quality low priced products. In general, reliance was placed on a single product to carry the economic burden and little or no attention was directed towards fractionation of the major wood components, with subsequent processing of the separated fractions for high yields of high quality products. Another reason for the failure of some of the biological processes was due to the failure of the fermentation process for example, the production of ethanol, acetone or butanol. It was only incidental that the substrate used was "wood sugar."

Thus in any future development of projects for the utilization of cellulose it must be seen that forests are a pool of raw material. The wood consuming industries will take only what they need from this reservoir. For efficient utilization of this reservoir it will be necessary for each industry to return its waste for some other use. It is envisaged that conversion of cellulose waste to wood sugar is one of these subsidiary industries.

Much research has been carried out in an effort to develop this industry. Much of this research has been product orientated—the emphasis being laid on the conversion of a substance to some end-product—without enough basic research into the structure of the cellulose and lignin molecule. Suggested areas of research in this field include the effects of cathode rays and also the effect of amines on the crystalline structure of cellulose, Enzymic degradation of cellulose may prove a fruitful field.

The economics of wood sugar utilization is very difficult to assess. Kobayashi (1971) calculates that reducing sugar at a concentration raging from 3—4% can be obtained at a cost of approximately .67p per pound of reducing sugar excluding the cost of wood waste, by the use of the Scholler process.

Table I outlines the cost of protein produced on sulphite liquor and compares it with other proteins.

Thus it appears that the future of wood hydrolysis lies in the modification of existing wood hydrolysis processes such as pulping. However, there is still a potential for wood hydrolysis processes to be developed further. One way of achieving this is to integrate it with other industrial processes e.g. the sulphuric acid methods could be linked to the fertiliser industry.

In summary it may be said that the wood hydrolysis process is a difficult process to develop, the reasons are as follows:

1. It is associated with war-time conditions. Many who object to the process claim that if it was viable why was there not greater strides after the second World War. This argument fails to recognize the developments in fermentation technology since the forties.

2. The structure and decomposition of cellulose is not sufficiently known.

3. There is necessity for more pilot scale studies especially on a large scale.

4. The possibility of new biochemicals for microorganisms grown on wood sugar must be examined further.

5. There must be a greater integration of the wood processing industries and subsidiary industries.

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Chemical weed control and its effect on the response to potassium fertilisation

BY N. O'CARROLL[1]

INTRODUCTION

Growth check of Norway spruce *(Picea abies (L.) Karst)* and Scots pine *(Pinus sylvestris L)* on reedswamp peat in Moanvane, Emo forest, Co. Laois, appeared, on investigation, to be due to potassium deficiency (O'Carroll, 1966).

Pottassium fertiliser was applied on an experimental basis to the crops involved in early June 1964, the crops being then aged 20-22 years, and having a mean height in the worst affected areas of from 1.3—3.8m. By August of that year there was a marked upsurge in the vigour of the ground vegetation in the plots treated with potassium, and by late Autumn the visual symptoms of deficiency had disappeared from the trees in those plots. At the same time the foliar potassium levels had been significantly increased from a mean of 0.36% of dry matter in control plots to 0.64% in plots treated with potassium. No significant increase in height growth was obtained however until 1966, and then the increase was slight. This was disappointing in view of the rapid and spectacular responses to phosphate fertiliser obtainable in Sitka spruce *(Picea sitchensis* Bong. Carr*)* growing on western blanket bog peats where the limiting factor was phosphate deficiency. One possible cause of the slow development of the response, and its small size, was competition from the more vigorous ground vegetation which had resulted from the fertiliser treatment.

At this time it was becoming apparent that potassium deficiency was likely to be a fairly widespread problem on certain peat soils in the east midlands. It was therefore necessary to investigate whether a simple top dressing of potassium fertiliser would be adequate, or whether intensive vegetation control methods would also be needed.

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EXPERIMENTS

Three experiments were begun in the summer of 1967 to test the hypothesis that ground vegetation was in competition with the trees and was reducing the effeciency of applied potassium fertiliser as reflected in tree growth.

The experiments were located in existing young plantations at Clonavoe and Derrycricket, both in Edenderry forest, Co. Offaly, and at Boherbaun in Athy forest, Co. Kildare.

These sites were chosen on the basis of the presence in the crops of the distinctive symptoms of potassium deficiency. These symptoms have often been described and illustrated (e.g. van Goor 1970) but may briefly be described as follows: A partial or gradating chlorosis of the needles in which the points of the needles are yellower than the bases, and with a gradual decrease in yellowness in the needle from the point to the base. In addition in Norway spruce the needles nearer the bud are usually more severely affected than those further back on the same twig. These symptoms were strongly developed at Clonavoe and Derrycricket, and present, though not well developed, at Boherbaun.

Soils

The soil at Clonavoe and Derrycricket consists of over 2m of woody fen peat (Barry 1969) overlying limestone glacial drift. The Boherbaun site, with over 1m of peat underlain by shell marl, represents the organic component of the Finnery soil complex (Conry *et al* 1970).

Crops

The crops at all three sites consisted of a mixture of three lines of Norway spruce alternating with one line of Scots pine, a common mixture on sites in the midlands with a high risk of late spring frosts.

Clonavoe was planted in 1966 with Norway spruce of Bodenseegebiet and Oberschwaben origin, and Scots pine of Scottish origin. Derrycricket and Boherbaun were both planted in 1959 using Norway spruce probably of Danish origin and Scots pine of Scottish origin.

All sites were ploughed before planting using the double mouldboard Cuthbertson plough (for description of plough see Taylor, 1970). Clonavoe was treated after planting with ground rock phosphate at the rate of 3 oz. (85g) per plant (365 kg/ha). Derrycricket was similarly treated in 1963, and Boherbaun was probably treated at the same rate with either basic slag or ground rock phosphate after planting.

The mean heights of the crops at the beginning of the 1967 growing season are given in Table 1.

TABLE 1

MEAN HEIGHT (METRES) OF EXPERIMENTAL CROPS AT START OF 1967 GROWING SEASON

Site	Age (years)	Mean height (metres)	
		Norway Spruce	Scots pine
Clonavoe	2	0·36	0·34
Derrycricket	8	0·64	0·91
Boherbaun	8	0·85	1·44

Vegetation

The vegetation at Clonavoe and Derrycricket was characterised by a mixture of the grasses creeping red fescue (*Festuca rubra,* L.), sweet vernal *(Anthoxanthum odoratum L.) and Agrostis canina* L., with the common rush (*Juncus effusus* L.) colonising the plough furrows. The other species differed at the two sites, consisting of, at Clonavoe, marsh cinquefoil (*Potentilla palustris* Scop.) and *Cirsium palustre* Scop., and, at Derrycricket, meadow-sweet) (*Filipendula ulmaria* Maxim.) and *Epilobium palustre* L.

At Boherbaun the predominant grasses were *Molinia caerulea* Moench. and creeping red fescue, accompanied by wild valerian (*Valeriana officinalis* L.), purple loosestrife (*Lythrum salicaria* L.), meadow-rue (*Thalictrum flavum* L.), meadow-sweet and others of minor occurrence.

Experimental treatments and design

Two factors, potassium fertiliser and herbicide, each at two levels, one of which in each case was zero, were tested. Combined in a 2 x 2 factorial design these give four treatment combinations viz.—

O Control. No potassium or herbicide.

K Potassium as 3cwt potassium chloride per acre (376 kg/ha) supplying 188 kg K per ha.

H Gramoxone W (Paraquat) at 6 pints in 100 gallons of water per acre (8.4 l in 1,123 l/ha).

KH Treatments K and H combined.

All treatments were applied during the first half of July 1967 and regrowth in all herbicide-treated plots was sprayed in November and each subsequent Autumn. The aim was to keep those plots as free as possible from all vegetation other than the trees.

Plot size was .037 ha (.09 acre) at Clonavoe and Derrycricket, and 0.40 ha (.10 acre) at Boherbaun.

The four treatment combinations were replicated four times at each site, in randomised blocks at Clonavoe and Boherbaun, and in a latin square at Derrycricket.

ASSESSMENTS

Annual leader growths of both species for 1967, 1968, 1969 and 1970 were measured. In addition, mean height was assessed at the end of the 1969 growing season.

Foliage of Norway spruce (from the top whorl) was collected at Derrycricket and Boherbaun in January 1969 for chemical analysis. Two replications at each site were sampled. The foliage was analysed for N, P, K and Mg.

Some frost damage was observed on the spruce at Clonavoe and Derrycricket in the Summer of 1969, and this was assessed by means of a scoring system, each tree being scored as a unit. No damage was scored O, damage to lateral buds confined to the lower parts of the tree was scored 1, and damage to buds over all parts of the tree was scored 2. The final score for each plot was expressed as a percentage of the maximum possible score for that plot (2 $\times$ number of live trees).

All data were subjected to standard variance analysis, the percentage data from the frost damage assessment having first been transformed to angles by the arcsin transformation.

RESULTS AND DISCUSSION

Leader growth

Average leader growths for all treatment combinations for each of the four years after treatment (1967-1970) on each of the three sites are given with their standard errors in tables 2-4. Each is the mean of four replications. Where there were no significant effects of treatments this is indicated by the letters N.S. Where there was a significant interaction between the two factors, potassium and herbicide, the least significant difference at the 5% probability level is given. (L.S.D. 5%) and this is used to compare all four means. Where one or both of the main effects was significant, without significant interaction, the means for both levels of

the significant factor or factors are given (K_0 and K_1 indicate without and with potassium fertiliser respectively, and H_0 and H_1 indicate without and with herbicide).

TABLE 2

CLONAVOE
MEAN LEADER GROWTH (CM) DURING FOUR YEARS AFTER TREATMENT

	Norway Spruce				Scots Pine			
	1967	1968	1969	1970	1967	1968	1969	1970
O (Control) ...	2·8	6	9	12	7·1	9	16	18
K	2·7	12	22	36	5·7	16	32	35
H	2·7	9	9	14	6·6	12	18	20
KH	3·3	11	16	32	5·9	14	31	34
Standard error ...	0·28	0·37	0·62	1·2	0·65	1·08	2·3	2·5
L.S.D. 5%* ...	N.S.*	1	2	4	N.S.	—	—	—
K_0	—	—	—	—	—	10	17	19
K_1	—	—	—	—	—	15	31	34

*L.S.D. 5%=Least significant difference at the 5% level of probability.
N.S.=not significant.

TABLE 3

DERRYCRICKET
MEAN LEADER GROWTH (CM) DURING FOUR YEARS AFTER TREATMENT

	Norway Spruce				Scots Pine			
	1967	1968	1969	1970	1967	1968	1969	1970
O (Control) ...	7·9	8	10	12	15	13	16	22
K	8·1	15	32	36	16	22	40	50
H	8·4	11	18	24	14	17	32	39
KH	8·4	15	30	44	14	18	36	43
Standard error ...	0·45	0·63	1·65	3·0	1·42	1·57	2·2	1·41
L.S.D. 5% ...	N.S.	2	6	—	N.S.	—	8	5
K_0	—	—	—	18	—	15	—	—
K_1	—	—	—	40	—	20	—	—
H_0	—	—	—	24	—	—	—	—
H_1	—	—	—	34	—	—	—	—

TABLE 4

BOHERBAUN
MEAN LEADER GROWTH (CM) DURING FOUR YEARS AFTER TREATMENT

	Norway Spruce				Scots Pine			
	1967	1968	1969	1970	1967	1968	1969	1970
O (Control ...	21	26	35	40	34	38	52	56
K	21	30	35	43	31	37	51	57
H	21	29	34	38	32	37	51	55
KH	21	30	40	52	30	37	53	57
Standard error ...	1·58	1·90	2·2	2·1	1·40	1·68	1·9	2·1
L.S.D. 5% ...	N.S.	N.S.	N.S.	7	N.S.	N.S.	N.S.	N.S.

There were no significant effects on growth on any site in 1967. Presumably the time of application of the treatments was too late for any effect on leader elongation to develop during that growing season.

In Clonavoe the effects, differing in the two species, were fairly consistent in each of the following years. In Norway spruce, potassium applied without herbicide significantly increased leader growth each year, but when potassium fertiliser was combined with vegetation control the result each year was a significant reduction in growth compared with potassium alone. In 1968 the herbicide treatment without potassium gave a significant increase in growth compared with control, but this effect was no longer significant in 1969 and 1970.

In the Scots pine, leader growth was significantly increased by the potassium whether the vegetation was controlled or not. There was no significant effect of herbicide.

It is suggested that the effects on Norway spruce may be explained by assuming that the initial kill of the vegetation released sufficient potassium to allow a measurable growth increase in the trees; that where potassium was added as a fertilizer, portion was stored in the ground vegetation when that was allowed to remain, but when the vegetation was suppressed by spraying with herbicide a considerable portion of the applied potassium was lost from the rooting zone. Of interest in this connection are the results of Bjorkman *et al* (1967) who investigated the retention of applied nitrogen on plots with sparse and with dense ground cover. On the plots with denser cover they found that after one

growing season 33% of the applied nitrogen was retained in the total vegetation (trees, ground cover, and all roots) compared with only 21% on plots with sparse vegetation.

The absence of any significant effect of herbicide treatment on Scots pine growth on this site requires comment. Ingestad (1962) working with seedlings in nutrient solutions found that Scots pine was more tolerant of potassium deficiency than was Norway spruce, although the difference was relatively less with potassium than with other major nutrients. If this greater tolerance of Scots pine is taken as applying here also, it could follow that the relatively small changes in potassium supply brought about by the herbicide treatment may have resulted in effects on growth too small to be detected in this experiment. It is also possible that the deeper rooting habit of the Scots pine rendered it less sensitive to changes in nutrient supply near the soil surface where the influence of the ground vegetation would be greatest.

In Derrycricket (Table 3) the effects on Norway spruce in 1968 and 1969 were similar to those at Clonavoe, except that the use of herbicide did not significantly reduce growth when it was combined with potassium fertiliser. In 1970 the interaction was no longer significant statistically, but it may be seen that the effect of herbicide appears to be very much less in the presence of potassium than in its absence. In Scots pine, only potassium had a significant effect in 1968. In both 1969 and 1970 there was a significant interaction between the two factors. In 1969 the effects were the same as those on Norway spruce on this site. In 1970 the effects were the same as those on Norway spruce at Clonavoe, i.e. herbicide with potassium resulted in significantly reduced growth compared with potassium alone. These results may appear to be in conflict with the explanations offered for the lack of effect of herbicide on Scots pine in Clonavoe, but they are not in fact. If we advert to the low rate of uncontrolled variation in the 1970 assessment of Scots pine in Derrycricket, as reflected in the standard error of the means in relation to their magnitude, it is clearly possible that effects not detected in the Clonavoe assessments might be detected in the more sensitive Derrycricket assessment. These results are quite consistent with the hypothesis that the effects of treatments on species differed in degree rather than in kind.

At Boherbaun there were no effects at all in Scots pine, while in Norway spruce there were none in 1967, 1968 or 1969. In 1970 there was a significant interaction between the factors. On examining the means (Table 4) we can see that potassium alone and herbicide alone did not have any significant effect while both together significantly increased growth. As stated already the potassium deficiency symptoms were less pronounced at Boherbaun than at Clonavoe or Derrycricket, thus indicating a less in-

tense deficiency. This is supported by the foliar analysis (see below). The fact that herbicide at Boherbaun significantly increased the foliar concentration of nitrogen, accompanied by an increase in phosphorus concentration which nearly, but not quite, reaches significance, suggests that there may be simultaneous mild deficiencies here of nitrogen, phosphorus and potassium, and that the potassium fertilization is effective only when the supply of nitrogen and/or phosphorus is increased by controlling the vegetation. If this is so, it is probable that these deficiencies could be corrected more cheaply and more effectively by fertilization than by herbicide treatment, as in the case of potassium at Clonavoe and Derrycricket.

Mean height

While leader growth may be taken as the simplest measure of treatment effect on growth in any particular year, the mean height reached after a number of years may be a better index of the effects of the treatments in terms of practical forestry. Mean heights at the end of the 1969 growing season are set out in Table 5. At Clonavoe in spruce we have a significant increase due to potassium, and a significant reduction due to herbicide when

TABLE 5

MEAN HEIGHT (M) AT END OF 1969 GROWING SEASON

	Clonavoe		Derrycricket		Boherbaun	
	Spruce	Pine	Spruce	Pine	Spruce	Pine
O (Control) ...	0·54	0·68	0·96	1·43	1·80	2·80
K	0·74	0·84	1·26	1·75	1·76	2·72
H	0·57	0·70	1·08	1·56	1·67	2·70
KH	0·65	0·87	1·26	1·68	1·78	2·71
Standard error ...	0·012	0·049	0·050	0·095	0·084	0·120
L.S.D. 5% ...	0·04	—	—	N.S.	N.S.	N.S.
K_0	—	0·69	1·02	—	—	—
K_1	—	0·85	1·26	—	—	—

this was combined with potassium. At Clonavoe in pine and at Derrycricket in spruce we have significant increases due to potassium with no significant effect of herbicide. At Derrycricket in pine, and in both species at Boherbaun there are no significant effects of treatments.

Foliar nutrient content

The results of foliar analyses carried out on the spruce at Derrycricket and Boherbaun in January 1969 are given in Table 6. These appear to confirm the impression gained from the relative intensity of the development of potassium deficiency symptoms at the two sites that Derrycricket was more deficient in potassium than Boherbaun.

TABLE 6

FOLIAR NUTRIENT CONTENT (% DRY MATTER) IN JANUARY 1969 (TWO REPLICATES AT EACH OF TWO SITES)

	Derrycricket				Boherbaun			
	N	P	K	Mg	N	P	K	Mg
O (Control) ...	1·86	·36	·30	·14	1·58	·20	·60	·12
K	2·11	·27	·70	·12	1·40	·20	·75	·11
H	2·12	·34	·50	·12	2·02	·24	·80	·11
KH	1·98	·28	·68	·10	2·02	·22	·65	·11
Standard error ...	·134	·017	·047	·0029	·109	·012	·065	·0048
L.S.D. 5% ...	N.S.	—	—	—	—	N.S.	N.S.	N.S.
K_0	—	·35	·40	·26	—	—	—	—
K_1	—	·28	·69	·23	—	—	—	—
H_0	—	—	—	·26	1·49	—	—	—
H_1	—	—	—	·22	2·02	—	—	—

The effect of herbicide on nitrogen and phosphorus contents at Boherbaun have already been referred to. It has been suggested (e.g. Conner and White, 1970) that triazine herbicides may directly increase nitrogen concentration in conifer tissue, but no such mechanism is postulated in this case.

At Derrycricket the phosphorus and magnesium levels were significantly decreased by the potassium application, possibly a dilution effect due to the greatly stimulated growth.

Frost damage

The results of the assessment of late frost damage carried out in Clonavoe and Derrycricket in 1969 are given in Table 7. In both analyses the interaction between potassium fertilization and herbicide was signifcant. At Clonavoe the amount of frost damage was significantly increased by potassium alone and significantly decreased by herbicide alone when compared with control. At

TABLE 7

FROST DAMAGE TO NORWAY SPRUCE AT TWO SITES IN 1969

	Degrees (transformed)		% (back-transformed)	
	Clonavoe	Derrycricket	Clonavoe	Derrycricket
O (Control) ...	20·4	34·3	12	30
K	36·9	45·5	36	51
H	16·6	40·7	8	42
KH	23·7	40·6	16	42
Standard error ...	1·19	0·70	—	—
L.S.D. 5% ...	3·8	2·4	—	—

Derrycricket the amount of damage was significantly greater in all three other treatment combinations compared with control, but herbicide alone, and potassium and herbicide combined, were both significantly less damaged than potassium alone.

The general tendency of the potassium fertilizer has been to increase frost damage. It is believed that this is due to earlier flushing in the potassium-treated plots rather than to an increase in frost susceptibility as it is usually understood, although no quantitative evidence can be put forward in support of this.

The results for herbicide are contradictory. At Clonavoe, herbicide treatment significantly decreased frost damage. At Derrycricket the effect was significantly positive in the absence of potash and significantly negative in its presence. No simple explanation can be offered to account for this interaction.

General

The results of these experiments do not support the hypothesis on which they were based: that ground vegetation interferes with the utilization of applied potassium. In fact the opposite appears to be the case under some circumstances at least. The main difference between the crop at Moanvane (mentioned earlier) where growth responses to applied potassium were slow and small, and these crops where responses were satisfactory, is one of age. The Moanvane crop was 20-22-years-old when treated, while the crops treated in these experiments were 2-8 years old. The difference in establishment (Moanvane was not ploughed) is thought less likely to account for the difference in response, since there is no indication of a soil aeration problem at any of the sites.

CONCLUSIONS

Ground vegetation does not interfere with the uptake or utilization of potassium applied as a fertilizer on peats strongly deficient in potassium. Under such conditions, if the vegetation is regularly killed by spraying, some extra potassium is made available to the trees with some improvement in growth, but this effect can be obtained more efficiently by the application of a potassium fertilizer. On the other hand, when potassium is applied as a fertilizer, the ground vegetation may be important in the retention of the added potassium in the site.

The question of vegetation control in young forest plantations needs to be carefully reviewed, and the practice possibly confined to the level required for the prevention of physical competition, for e.g. light.

It is possible that earlier flushing induced by the potassium fertilizer may slightly increase the risk of damage due to late frost, but this risk is of little practical importance when measured against the beneficial effects of the fertilizer. The benefit is even greater since the accelerated height growth results in earlier emergence of the tree crowns from the zone near the ground where the danger of damage by late frosts is greatest.

The relative intensity of potassium deficiency on various sites appears to be indicated by the relative intensity of the development of deficiency symptoms in trees already growing on those sites.

SUMMARY

Slow and small responses to applied potassium in a potassium deficient 20-22-year-old crop of Norway spruce and Scots pine suggested the possibility that ground vegetation may prevent the efficient utilization of applied potassium. Three experiments were established in which potassium fertilizer and vegetation control by annual spraying with herbicide were tested factorially in 2-8 year old crops. Growth data for four years after treatment, and data on foliar nutrient contents and frost damage are given. On two of the experimental sites where the potassium deficiency was severe, vegetation control by itself lead to a small growth increase compared with potassium alone, but tended to decrease growth or be ineffective when the treatments were combined. It is suggested that the ground vegetation may play an important part in retaining applied potassium in the site. On the third site where the potassium deficiency was milder there were some indications that a nitrogen and/or phosphorus deficiency, alleviated to some extent by vegetation control. may also have been limiting growth.

Potassium fertilization significantly increased late frost damage

on the spruce, indirectly, it is believed, by causing an advancement in the time of flushing.

ACKNOWLEDGMENTS

The field work involved in these experiments was carried out mainly by Messrs. W. F. Collins, J. Fennessy, J. Freeman and T. Horgan.

The chemical analyses were carried out at the Agricultural Institute's Soil Laboratory at Johnstown Castle, Wexford.

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Research Note

Cocoon size and sex in the European Pine Sawfly

Recent very severe epidemics of the European pine sawfly (*Neodiprion sertifer* Geoff. Hymenoptera, Diprionidae) in Ireland have given cause for concern. During recent investigations which were concerned with damage quantification and host susceptibility, the opportunity was taken to confirm quantitatively the known relationship between cocoon size and sex. Adult females have larger cocoons than adult males. A sample of 300 cocoons was collected in the field, and these were divided into large and small cocoons. Adult emergence by sex was recorded. 98% were classified correctly. The lengths and diameters of 25 large and 25 small cocoons were measured. The means and standard errors are given below.

	COCOON SIZE	
	Large	Small
Length (cm)	1.01 ± 0.013	0.74 ± 0.013
Diameter (cm)	0.45 ± 0.010	0.31 ± 0.007

It is concluded that an error as low as 2% would be quite acceptable for most conditions. However it should be recognised that the method is subject to error albeit a small one.

G. de Brit,
Research Branch, Forest and Wildlife Service, Dublin.

Trees, Woods and Literature—6

For indeed, instead of retiring along the shortest line, and gaining the shore of Lake Maggiore, where his boat was awaiting him, he made an enormous circuit to go and visit his tree. *The reader may perhaps remember the love that Fabrizio bore for a chestnut tree planted by his mother twenty-three years earlier. "It would be quite worthy of my brother," he said to himself, "to have had the tree cut down; but those creatures are incapable of delicate shades of feeling; he will never have thought of it. And besides, that would not be a bad augury," he added with firmness. Two hours later he was shocked by what he saw; mischief-makers or a storm had broken one of the main branches of the young tree which hung down withered; Frabrizio cut it off reverently, using his dagger, and smoothed the cut carefully, so that the rain should not get inside the trunk. Then, although time was highly precious to him, for day was about to break, he spent a good hour in turning the soil round his dear tree. All these acts of folly accomplished, he went rapidly on his way towards Lake Maggiore. All things considered, he was not at all sad; the tree was coming on well, was more vigourous than ever, and in five years had almost doubled in height. The branch was only an accident of no consequence; once it had been cut off, it did no harm to the tree, which would grow all the better if its spread began higher from the ground*

From *The Charterhouse of Parma (La Chartreuse de Parme)* by Stendhal, translated by C. K. Scott Moncrieff. Reprinted by permission of Mr. George Scott Moncrieff and Messrs. Chatto and Windus.

Henri Beyle was born in Grenoble, in the south-east of France, on 23 January 1783. He passionately hated his father, and this may have been the cause of his use later of scores of noms-de-plume, one of them Stendhal, the name by which he is now universally known. As a young man he obtained a commission in Napoleon's army, and was involved in the retreat from Moskow. His middle years were spent in journalism and art criticism and general hack work, until in 1831 he was appointed French Consul at Civita Vecchia, near Rome. His sudden death in March 1842 has been ascribed to veneral disease contracted in 1808.

Stendhal is now remembered mainly for his two great novels, *Le Rouge et le Noir* (1831) and *La Chartreuse de Parme* (1839). He has been claimed to be the originator of the modern psychological novel.

C. K. Scott Moncrieff (1889-1930) is best known as the translator of Proust.

Notes and News

NEW HEAD OF FOREST AND WILDLIFE SERVICE

Mr. A. W. (Billy) Duggan has succeeded the late Henry Gray as Assistant Secretary in charge of the Forest and Wildlife Service of the Department of Lands in Dublin. A native of Waterford, Mr. Duggan entered the Civil Service in 1937 and has been in Forestry since 1942. He became a member of the Society of Irish Foresters in 1955. All members will wish him well in his arduous task.

INTERNATIONAL SPACING AND THINNING EXPERIMENT

Resulting from a meeting of a Working Group of the International Union of Forest Research Organisations held in Freiburg in 1969 an international series of experiments was suggested to test the implications of mechanical harvesting of thinnings. Participating countries include Austria, Belgium, Czechoslovakia, Denmark, France, Finland, Germany (the Federal Republic). Great Britain, Hungary, Ireland (both the Republic and Northern Ireland), Netherlands, Norway, Sweden, and Yugoslavia. To date 10 experiments have been established. The Irish experiments are at Granard and Lisnaskea. The work is being undertaken by research officers of the Dublin Forest and Wildlife Service and the Belfast Forestry Division.

CONSERVATION OFFICER

Mr. Bill Dallas has been appointed conservation manager by Tara Mines, the Irish subsidiary of a Canadian company, for its zinc/lead development near Navan, Co. Meath. Mr. Dallas, who qualified in Forestry in Dublin in 1954, was formerly employed by the Forestry Division of the Northern Ireland Ministry of Agriculture.

REVIEW REVIEWED

In the course of a review of Eileen McCracken's *The Irish Woods since Tudor times, Their distribution and exploitation,* in the Jesuit-run quarterly, *Studies,* Mr. T. McEvoy give some consideration to her estimate of 12% as the proportion of Ireland under forest in the seventeenth century, and suggests that it may be too high. He also highlights the importance of iron smelting as a destroyer of woodland; to produce one ton of iron required the equivalent of a year's growth on 20 acres of coppice oakwood. This important book has already been reviewed in *Irish Forestry* by Mr. C. S. Kilpatrick.

NOTABLE TREES AT CASTLEWELLAN

The following height measurements of outstanding trees in Castlewellan Arboretum in Co. Down have been supplied Mr. R. T. Sherwood, District Forest Officer in Newcastle. Heights are in metres, converted from feet.

Abies amabilis 27.3, A. cephalonica 27.1, A. delavayi 12.8, A. delavayi faxoniana 13.7, A. fraseri 9.8, A. koreana 8.2, Arbutus menziesii 14.3, Athrotaxis laxifolia 12.5, Betula jacquemontii 12.2, Chamaecyparis obtusa "Tetragona aurea" 8.2, Cunninghamia konishii 7.0, Cupressus cashmeriana 7.3, C. lusitanica "Glauca Pendula" 14.9, C. macrocarpa "Aurea" 28.3, Dacrydium franklinii 7.6, Eucalyptus perriniana 17.7, E. urnigera 34.1, Juniperus cedrus 10.1, J. wallichiana 8.2, Metasequoia glyptostroboides 8.5, Nothofagus fusca 18.0, N. menziesii 10.7, Picea breweriana 10.7, P. orientalis 24.7, P. spinulosa 25.0, Pinus sylvestris "Aurea" 14.3, Podocarpus acutifolius 6.1, P. salignus 15.2, Pseudotsuga macrocarpa 11.6, Pseudowintera (Drimys) colorata 3.0, Sorbus rehderiana 9.8, Thujopsis dolabrata 19.5 & 14.9, Torreya californica 16.2, Tsuga mertensiana 16.2.

SLOGAN FOR FORESTERS

W. G. Burch in his President's Report (of 1970-1971) to the Canadian Institute of Forestry, suggests that foresters should regard themselves as "Statesmen of the environment—not simple fibre farmers." He points out the need, however, for foresters to continue to explain to the public what they are doing and why, so that the public may not ultimately fail to understand the compatibility of harvesting and conservation in both wildlife and forest management.

FORESTRY AT OXFORD

In the late spring of 1970 the Department of Forestry, University of Oxford issued a Note about the new Honour School of Agricultural and Forest Sciences. (See Irish Forestry, Vol. 27, No. 1 1970, p. 40). In this Note reference was made to the fourth year post-graduate course in the more special and technical aspects of forestry leading to the Diploma in Forestry and its relation to Land Management.

In keeping with the new policy of the University regarding diplomas this diploma has now been upgraded to a Master of Science degree *by special study;* this is still a taught course lasting three terms and includes a written study and an examination at the end.

At the same time the Bachelor of Science degree has been replaced by a Master of Science degree *by research* with a normal period of about six terms, but with a minimum of three terms.

Candidates for either M.Sc. must have obtained at least the equivalent of an upper second class in an honours degree at a university recognised by Oxford for Senior Status.

In special circumstances other candidates with considerable experience in certain special aspects of forestry, or a related subject, may be considered by the Board of the Faculty of Biological Sciences for admission "as otherwise suitably qualified" for either M.Sc. degree.

It is possible for the most promising candidates for the M.Sc. degrees to apply, at a later stage, through their colleges, to the Faculty Board for admission as Advanced Students (if suitably qualified) to submit these for the degree of Doctor of Philosophy.

The M.Sc. *by special study* is designed primarily for,

(a) candidates who have taken a good honours degree in Agricultural and Forest Sciences at Oxford and who wish to follow forestry as a career, and

(b) candidates who have taken a good honours degree in a pure or applied biological subject including forestery, or, in special cases, economics, and wish to continue their studies in forestry at a post-graduate level.

In addition, it is also intended for suitably qualified forest officers in service (usually from developing countries) who want a more advanced course in Policy and Planning, Forest Management and Utilization, and in applied biological sciences such as Genetics, Pathology and Ecology.

The course it pitched at a high academic level and requires a considerable amount of specialised reading and critical and con-

structive thought and writing; it is not meant merely for acquiring advanced factual knowledge.

Further details can be obtained from the Department of Forestry, South Parks Road, Oxford. Enquirers should give full particulars of their previous degrees and experiences, if any.

Formal application however must be made through the Oxford Admissions Office, 18, Banbury Road, Oxford.

REARING MALLARD

An account of a successful attempt to rear mallard has been sent to us by Mr. P. J. Morrissey, formerly of Castlepollard, Co. Westmeath. He purchased 93 eggs, and, after 28 days in an incubator 76 ducklings emerged. These were placed in a shed within an open pen. They had access to water and gravel and were fed chick crumbs for the first four weeks, then, for the next four they were given yellow meal and boiled potatoes together with an assortment of greens. A larger pen was then erected across a stream and they were placed in this at the seven week stage. From here on they ate all kinds of food and for the greater part were fed with offal from combine harvesters. Towards the beginning of September the flight feathers were all clipped off one wing of each bird, which kept them from flying out of the pen. This operation had to be repeated every six weeks. Any reader who would like to have further information on this project should get in touch with Mr. Morrissey who is at Mount Anglesby, Clogheen, Co. Tipperary.

A FORESTER'S SOIL?

The latest of the National Soil Survey's county series to be published is *Soils of Co. Kildare,* by M. J. Conry, R. F. Hammond and T. O'Shea. (An Foras Taluntais, Dublin. £1.50). Members will be interested to know that one of the new soil series recognised and mapped in that county is the *Kilpatrick series,* but may be disappointed to learn that it is named after a farm at Lullymore rather than after our illustrious Past-President. Appropriately enough, though, the series, which comprises podsolic gleys derived from glacial till composed mainly of limestone, is placed in soil suitability class B2, which is "suitable for Forestry."

IVY WHINES

Silly-season subjects are less common in the newspapers now than they were some years ago, but last summer our esteemed contemporary *The Irish Times* permitted the hoary old chestnut (if we may be allowed to mix our metaphors) of ivy on trees "of

every race and denomination" to be raised in its columns. It all started with a letter calling for an Ivy Destruction Crusade or even a Tree Solidarity Movement. This was supported by a thundering editorial calling for "some noted dendrologist or other expert" to "give the final, emphatic word." Unfortunately, he didn't. But letters began to appear. First the redoubtable Tom Nisbet threatening a counter campaign with the motto "Ivy is good for Yew." Then, in more sober vein, a forestry student, Geoffrey Michael, who pointed out the greater damage caused by honeysuckle and wild Clematis, and listed some points in defence of ivy. A final letter, on the other side, referred to "the Forestry Division, who should know their job" clearing the ivy off trees in their plantations as a routine task. This letter was right up to date in its call for an approach to the Minister for Lands to do something about this "arborial pollution."

HONOURABLE MENTION

Not everyone craves mention in that other esteemed contemporary, *Private Eye*. A recent issue carried an article about a gunsmith who operated for some time in an Irish midland town. Various considerations would render it imprudent for us to go into the details, but at one stage the gunsmith is supposed to have been visited by "a senior police officer and an Irish Forestry Commission civil servant" (*sic*). The story is in the issue for 11 February 1972. (No. 265).

Obituary

HENRY J. GRAY
1918—1971

Henry Gray, Assistant Secretary in the Department of Lands with responsibility for the Forest and Wildlife Service, died suddenly on 19th November last in Portumna. He was on a tour of inspection with particular emphasis on multiple use of forest land, the integration of timber production with wildlife management, recreation and environmental improvement, a development with which his name will always be associated.

He entered the department of Lands in Dublin in 1936 and as an executive Officer and later as a Higher Executive Officer in the combined Land Commission/Forestry Establishment Branch, he came in contact with Forestry problems, policies and personalities. But his forestry career began in earnest with his promotion to Assistant Principal Officer in charge of the newly formed Forestry Establishment Branch in 1951. In 1954 he was appointed Principal Officer with administrative responsibilities and in 1967 he became Assistant Secretary in charge of the Forestry Division.

These are the bare bones of his official life. However, through his determination, his dedication to his work, a rare ability assisted by a phenomonal memory, he invariably succeeded in exerting an influence on events far beyond what might be inferred from his rank. While he may have appeared on superficial acquaintance to have been a "typical Civil Servant" his constant search for new approaches to problems and his refusal to accept the conventional restraints and precedents belied the outward appearance.

He came to the Forestry Division at a time when it was recovering from wartime restrictions and when afforestation policy was being reviewed. In 1951 the FAO Cameron Report recommended a planting programme of 25,000 acres per annum at a time when the forest area was only 150,000 acres. Its implementation involved enormous expenditure and led to an administrative reorganisation to bring forestry more closely into line with Irish Civil Service practice, a change which was not easily achieved. As the new structure evolved he became more closely identified with and more deeply committed to forestry as something far more than just the arm of the public service in which he happened to serve. He fought hard and successfully for the funds, the staff and the conditions of service which he considered necessary for fully efficient working. He introduced or supported many innovations and saw them through their teething troubles. An outstanding example was the introduction of work study and incentive bonus payment for the labour staff at a time (1957) when industry generally was only cautiously feeling its way in this field. In 1958 he was responsible for an economic analysis and forecast for state forestry which was a remarkably able assessment of the contribution of forestry to the national economy and which formed the basis for the forestry sector of the Government's First Programme for Economic Expansion.

An event which turned out to have far reaching repercussions for himself and for forestry was his appointment as Irish delegate to the European Committee for the Conservation of Nature and Natural Resources of the Council of Europe in 1963. His chairmanship of this Committee (1965-7) was a recognition on an

international scale of his abilities but it also alerted him to the growing importance of multiple land use and of scientific and recreational values which was to become the dominant preoccupation of his later work in the Forestry Division. He was a natural choice to become the administrative director of the National Committee for European Conservation Year 1970 to which he made such a dynamic contribution as Vice-Chairman under the Minister for Lands. These events, followed by the transfer of wildlife activities into his area of responsibility ensured a radical change in the outlook and activities of the Forestry Division in accordance with modern trends. The shift of emphasis was epitomised in the change of title to Forest and Wildlife Service in 1971.

One tends to emphasise these, as it were, external stimuli which he brought to bear on a service founded to provide a national timber supply. But his contribution to the original goal was also considerable. In particular his part in freeing land acquisition in 1967 from "ceiling price" limitations and in the adoption of a realistic land price structure deserves mention as a most significant development in forest policy.

His concentration on the development of the Forest Service was such as to appear to leave little time or energy for other activities. Yet he was extremely active in the Catholic Social Welfare Bureau of the Dublin Diocese of which he was Honorary Secretary from 1942 until his death. His knowledge of emigrant problems gained in the Bureau led to his appointment in 1969 by the Minister for Labour to the Committee on Emigrants, where his experience and advice were greatly valued. He still found time for a happy family life which included skilled woodwork and the creation of a remarkably fine rock garden.

What kind of man lay behind all these activities? Essentially he was a man who fulfilled himself in creative action, one who did not relax easily who had little time for small talk and social trivia who was less interested in the study of people *qua* people than in action for their betterment. He had exceptional self-confidence which, combined with his all-round ability, ensured success in many diverse fields. He was not wont to accept readily the views of others but subjected every proposal to close analysis, made up his mind and, having done so, pursued his objective unrelentingly. He was, of course, a perfectionist and found delegation difficult. Yet he pioneered assignment of ultimate responsibility to technical staff, for instance, in important aspects of land acquisition and he recognised the necessity for further delegation in the field of forest management, especially at Divisional level.

In the end the unremitting pressure took its toll. But he had seen forestry through a critical period of expansion to acceptance as an important and permanent element in our pattern of land use. Forestry and in particular the Forest and Wildlife Service will for ever be in his debt. May he rest in peace.

T. McEVOY

A. M. S. HANAN

We regret to announce the death of Tony Hanan, which occurred while this issue was in press. A full obituary notice will appear in our next issue.

Review

The Public Park

BY HERBERT L. EDLIN

The Local Search Series. Routledge & Kegan, Paul Ltd. 1971. £1.40

This small book is aimed at a limited public, being one in the Local Search Series of handbooks designed to help school-children carry out 'projects'. This particular one on Public parks is very relevant to modern life as the need for public outdoor recreation becomes increasingly important. The student is asked to do a vast amount of fact-finding for himself, thus gaining an intimate knowledge of how parks are designed and maintained. Perhaps more important will be the student's ultimate realisation of the value of these open spaces however large or small, simple or sophisticated, to the health and well-being of the whole community.

The author's excellent range of photographs and Colin Gilson's useful line drawings give life to this text-book and I particularly liked the well explained double page 25-inch plan of a town park.

Any park manager could spend some useful and salutory minutes considering replies to some of the questions which Mr. Edlin suggests the students should pose.

A. M. S. Hanan.

Other Publications Received

FORESTRY COMMISSION PUBLICATIONS

Windblow of Scottish forests in January 1968, Edited by B. W. Holtam. Forestry Commission Bulletin No. 45. 1971. 45p

Wildlife Conservation in woodlands, by R. C. Steele. Forestry Commission Booklet No. 29. 1972. 40p

Fifty-first annual report and accounts of the Forestry Commission for the year ended 31st March, 1971. 75p

Forest management tables (metric), revised by G. J. Hamilton and J. M. Christie. Booklet No. 34. 1971. £1.60

CANADIAN FOREST SERVICE PUBLICATIONS

Forest gene resources: Their conservation and utilization with speical reference to the Canadian spruces, by Laurence Roche. Forest Research Laboratory, Quebec Region, Quebec. Information Report Q-X-16. JJanuary 1970. n.p.

Variation, selection and breeding coniferous tree species: An introduction, by Laurence Roche. Laurentian Forest Research Centre, Quebec Region, Quebec. Information Report Q-X-22. June 1971. n.p. (Aims "to provide a coherent and easily read introduction to the important aspects of forest genetics and tree improvement research and practice.")

Correction

In Fig. 1 of O. V. Mooney's "The Augustine Henry Memorial Grove—a record" in *Irish Forestry* Vol. 27, No. 2, 1970, p. 83, specimen No. 44 should be 1.7m high and not 21.0m as shown.

Society Activities

DAY MEETINGS

Drumhierny Plantations, Co. Leitrim. 20th June 1971. **Leader :** Prof. T. Clear.

Glenealy Forest, Co. Wicklow. 11th July 1971. **Leader :** Mr. L. Condon.

Ballyhoura Forest, Co. Cork. 29th August 1971. **Leader :** Mr. D. Walsh.

FOREST WALKS

A further series of public forest walks was organised by the Society with the co-operation of the Forest and Wildlife Service on 12th and 13th September 1971. The locations and leaders are given below :

Ballygar, Co.Galway (Mr. E. McGuiness), Collooney, Co. Sligo (Mr. J. E. Johnston), Emo, Co. Laois (Mr. J. O'Connell), Forth, Co. Wexford (Mr. R. Enright), Foxford, Co. Mayo (Mr. D. Murphy), Glenealy, Co. Wicklow (Mr. H. M. Fitzpatrick) Glengarra, Co. Tipperary (Mr. M. Mac GiollaCoda) Lough, Eske, Co. Donegal (Mr. A. Connolly), Woodstock, Co. Kilkenny (Mr. T. J. McCarthy), John F. Kennedy Park and Arboretum, Campile, Co. Wexford (Mr. A. M. S. Hanan).

LECTURES

Forestry in the Austrian Tirol, by Dr. P. M. Joyce, Mullingar, 15th October, 1971.

Impressions of American Forestry, by Messrs. G. Gallagher, T. McEvoy, O. V. Mooney and N. O'Carroll. R.D.S. Dublin, 19th November, 1971.

Whither Irish Forestry, by Dr. J. F. Durand, Mr. R. Harrington, Dr. W. H. Jack and Mr. D. McGlynn. R.D.S: Dublin, 10th December, 1971.

Forestry in South Africa, by Mr. M. McNamara. Portglenone, 15th January, 1972 and Mallow, 22nd January, 1972.

Work Study in the Republic of Ireland, by Mr. B. Moloney. Ballybofey, 5th February, 1972.

Forest Fertilization, by Dr. D. A. Dickson. Moy, Co. Tyrone, 26th February, 1972.

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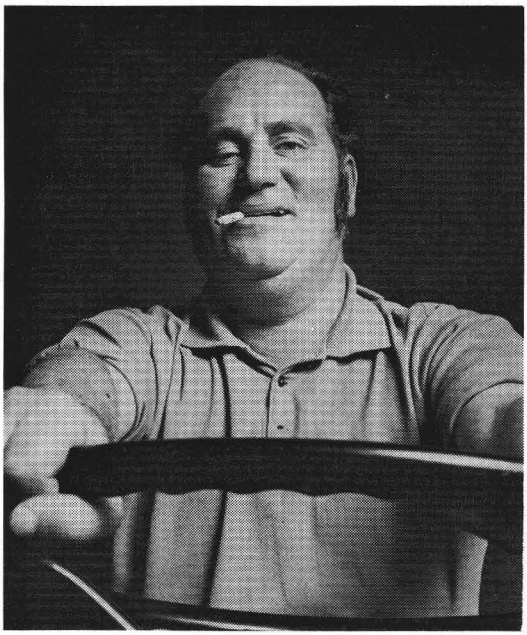

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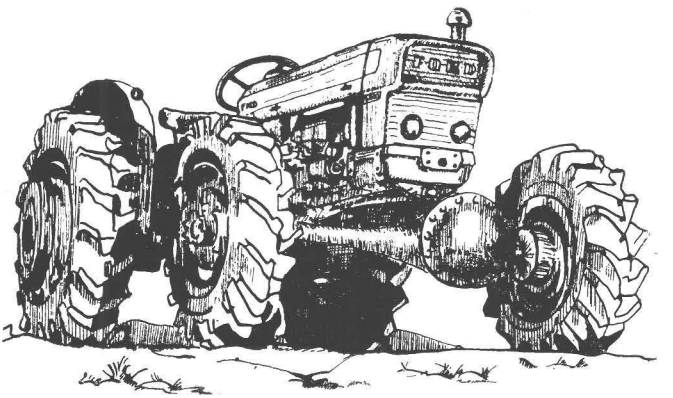

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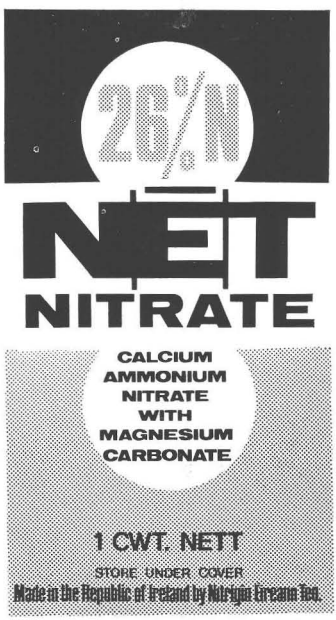

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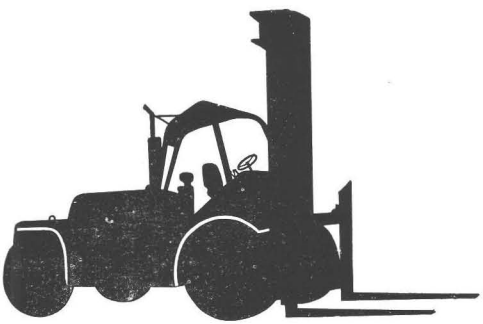

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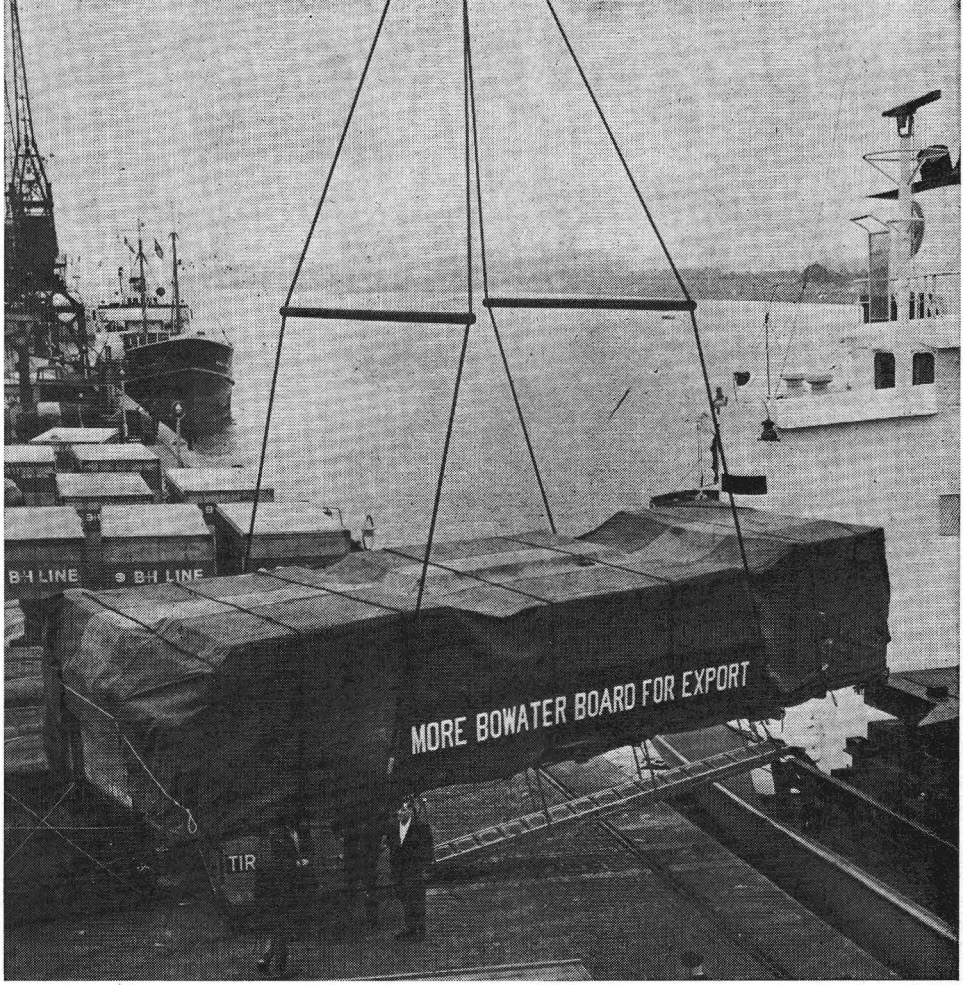

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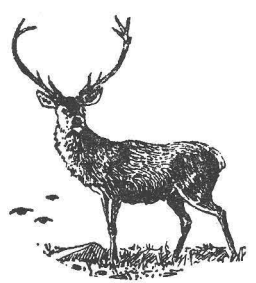

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